



Human Performance, Training & Education Quad Charts: Warrior Resilience

Dr. Peter Squire
ONR Code 30
HPT&E Thrust Manager

Distribution Statement D. Distribution authorized to DoD and U.S. DoD contractors only (Administrative Use) (31 July 2016).



Warrior Resilience Portfolio Framework

Sense

Body

Automated Functional Movement Screening (FMS)

Naval Surface Warfare Center – Dahlgren

Body Worn Sensors for Monitoring Warrior Physical and Mental State

Cognionics

STARwatch

Pulsar Informatics

AID-Medic

Perceptronics, Inc.

Self-Contained Performance Monitors

PhaseSpace

Medical Informatics Decision Assistance and Support (MIDAS)

Milcord

Markerless Motion Capture

USC

24/7 Combat Fitness Center

Air Force Research Lab

FitRisk

Naval Health Research Center

Assess

Body

Mitigation of Heat Strain Through the USMC Training Continuum

University of Montana

Malum Terminus: A US Marine Corps Simulation System for Injury Avoidance

University of Iowa

Rapid Assessment of Mind & Body Optimization (RAMBO) Performance

Naval Health Research Center

Precision High Intensity Training through Epigenetics (PHITE)

Wright State University

Mind

Glymphatic Modulation

Harvard University

Address

Body

Individualized Fatigue Countermeasure Training Tool

Pulsar Informatics

Optimal Training Intervals for Marine Corps Martial Arts Program

University of Kansas

Neurocognitive Patterns

Aptima, Inc.

Connecting STEM Outreach Now Using VIE Education for Youth (CONVEY)

Johns Hopkins University (JHU)
Applied Physics Laboratory (APL)

Mind

Post-Stress Glucose & Resilience to Trauma

UCLA

Strengthening Health & Improving Emotional Defenses (SHIELD)

Charles River Analytics

Key:

--- Future Award

MURI

Exploitation & Deployment

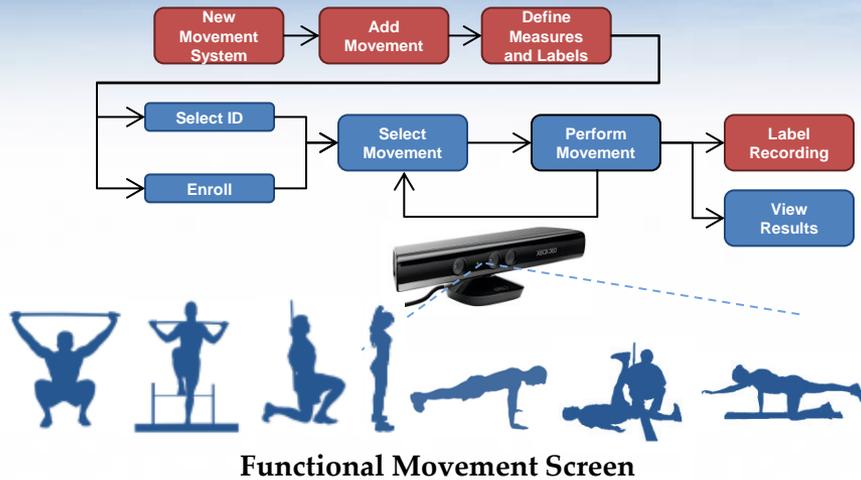
SBIR

Discovery and Invention

STEM



Automated Functional Movement Screening (AFMS)



OBJECTIVE:

- The objective is to evaluate the feasibility of automating the functional movement screening using a low-cost markerless motion capture systems.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Musculoskeletal injury is a leading cause of lost duty time and morbidity among deployed populations.
- Once injured, Warfighters have to be rehabilitated and evaluated to ensure they are fit-for-duty
- The system will provide low-cost accurate solution for fit-for-duty fitness evaluations and injury prevention training

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- Training & Education: Warrior Resilience (T&E STO-3)

TECHNICAL APPROACH:

- Task 1:** Develop the user software and analytic tools to evaluate the Warfighter Functional Movement Screening and integrated the second-generation Kinect.
- Task 2:** Manual feature selection using anthropometric models using inverse kinematics, quaternions, and state base modeling techniques
- Task 3:** Develop FMS scoring models for the seven functional movements
- Task 4:** Develop dictionary learning algorithms in order to automated feature extraction.
- Task 5:** Capture FMS performances: Study at Dahlgren and planned event at Cannon AFB in October.
- Task 6:** Final T&E with AFSOC

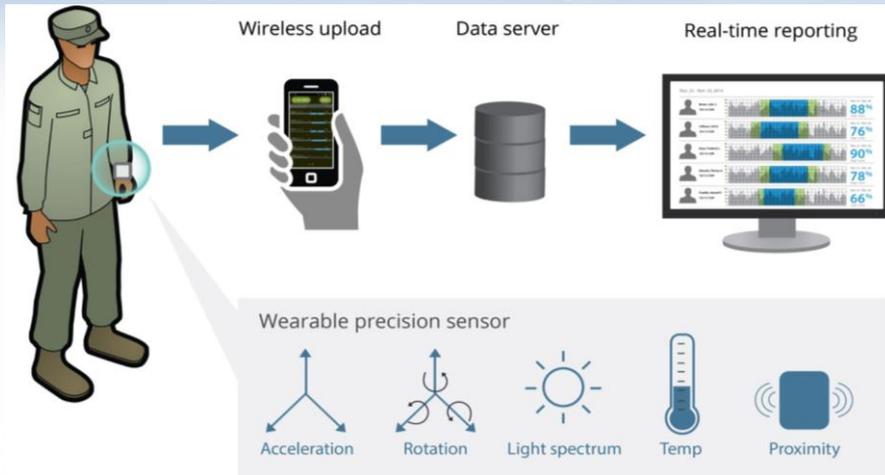
PERFORMER: Naval Surface Warfare Center (Dahlgren)

SCHEDULE:

	FY14	FY15	FY16	FY17
TASK 1: Develop software and evaluate	—◆			
TASK 2: Manual feature selection	—◆	—◆		
TASK 3: Develop FMS scoring models		—◆		
TASK 4: Dictionary learning for feature extraction			—◆	
TASK 5: Collect data for a baseline		—◆	—◆	
TASK 6: Software / Model V&V Testing			—◆	▲

Star Watch Wearable Activity Sensor

Figure 1. Star Watch wearable activity sensor. Sensor data related to sleep and fatigue are uploaded via Bluetooth and displayed on dashboard.



OBJECTIVE: Develop data collection suite for environmental, physiological, physical, and subjective measures associated with physical and cognitive fatigue & sleep.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Increased fatigue resilience training effectiveness
- Enhanced sleep health surveillance capabilities
- Enhanced sleep health intervention capabilities
- Reduced fatigue-related operational errors

NAVAL S&T FOCUS AREAS ADDRESSED:

- Med STO-2: Human performance enhancement
- Med STO-3: Fatigue Management
- Med STO-5: Health surveillance, intelligence, and preventive medicine
- Med STO-7: Warfighter physiology
- T&E STO-1: Warrior decision making
- T&E STO-3: Warrior resilience

TECHNICAL APPROACH:

- Develop Star Watch to meet the following operational requirements: (1) high-resolution motion capture for actigraphy analysis; (2) lightweight, unobtrusive and wearable devices; (3) configurable software for streamlined operation; (4) no-maintenance run time up to 30 days; (5) extensible wireless sensor network; (6) ease of use by subjects; (6) rugged, waterproof; (7) cost-effective for researchers

PERFORMERS:

Pulsar Informatics, Inc.
Naval Surface Warfare Center – Dahlgren Division

PRINCIPAL INVESTIGATOR:

Daniel Mollicone, Ph.D.
Email: daniel@PulsarInformatics.com
Phone: 215.520.2630

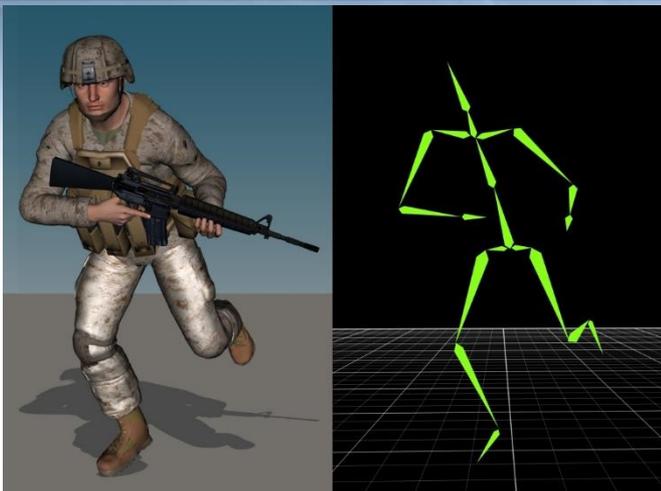
SCHEDULE:

	FY14Q2	FY14Q3	FY14Q4	FY15Q1	FY15Q2	FY15Q3	FY15Q4	FY16Q1	FY16Q2	FY16Q3	FY16Q4	FY17Q1
Program Milestones	[Solid black bar spanning all quarters]											
Device hardware												
Device management software												
Laboratory validation study												
Data acquisition software toolkit												
Laboratory validation study												
Produce wearable device, test, develop algorithms												
Integrate with our platform to address sleep disruption												

Legend: ★ Kickoff — Progress ◆ Milestone ▲ Transition



Self-Contained Performance Monitoring System



Tracking pose over time and throughout the mission

OBJECTIVE:

- Capturing realistic motion data over mission timespans for later evaluation of physical changes over time. Ultimately, tracking other physiological data as well as motion.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Tracking position and physiological data over the course of operations will give insight into effects of fatigue on performance over time

NAVAL S&T FOCUS AREA(S) ADDRESSED:

- T&E STO-3: Warrior Resilience (base period and option periods)
- MED STO-7: Warfighter physiology (option periods)

TECHNICAL APPROACH:

- Precise skeletal and movement information in remote, realistic field conditions over several hours of mission performance
 - IMUs with state-of-the-art accelerometers and gyros
 - Algorithms to filter out noise
 - Low-profile, low power, low weight, including data storage
- Skeletal software to interpret and depict movement data
- Data verified via laboratory tests comparing the IMU data to Optical Motion Tracking data for the same movements
- Option periods: Improve interfaces, streamline data capture/storage and add other physiological data

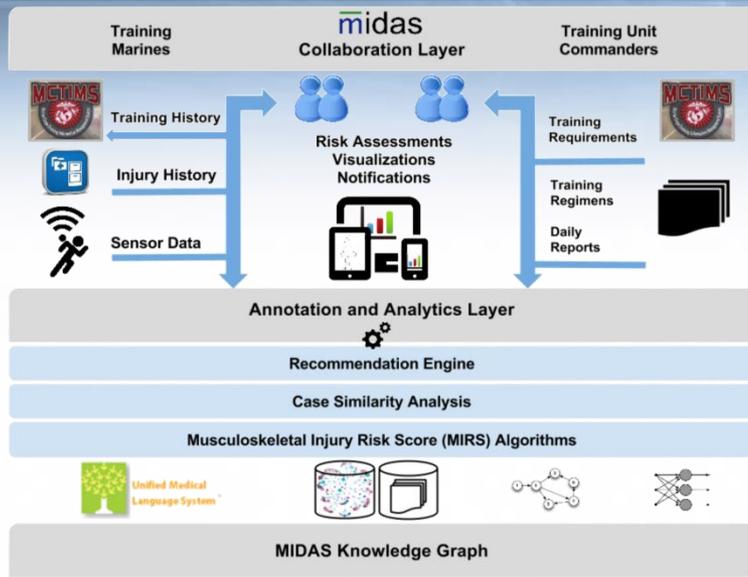
PERFORMER: PhaseSpace, Inc.

SCHEDULE:

	FY16Q1	FY16Q2	FY16 Q3/4	FY17Q1
TASK 1: Kickoff Meeting	◆			
TASK 2: Decide on sensors	▬	◆		
TASK 3: Design sensor boards	▬	◆		
TASK 4: Create skeleton SW Test/Debug		▬	◆	
TASK 5: Interface IMU/LED Location data w/SW		▬	◆	
TASK 6: Demo/Final Report				▬



Medical Informatics Decision Assistance and Support (MIDAS)



OBJECTIVE:

- The objective of the Medical Informatics Decision Assistance and Support (MIDAS) project is to research, develop, and design a capability for sensing, addressing, and acting to combat the musculoskeletal injury epidemic facing Navy and Marine Corps personnel.
- Develop a capability that informs stakeholders about how the current status of a person's condition may help predict the risk of musculoskeletal injury, and how mitigations can be applied to prevent such negative outcomes.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Med STO-5: Health surveillance, intelligence, and preventive medicine capabilities
- Med STO-7: Warfighter physiology
- Med STO-8: Physical readiness conditioning and nutrition monitoring

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- Human Performance/Training & Education
- Warfighter Performance

TECHNICAL APPROACH:

- Make relevant physical training observations and contextual information accessible to humans and machines as a knowledge graph
- Apply machine learning, reasoning, and semantics to assess a Musculoskeletal Injury Risk Score (MIRS) that leverages contextual knowledge, such as personnel activity, demographic data, and unit training requirements
- Enable USMC Force Fitness personnel and trainers to improve individual and unit injury prevention by providing dynamic training injury risk assessments
- Alert and quickly modify user behavior (athletic, active duty assignment, etc.) based on observed metrics ("situational awareness")
- Enhance timely and open communication between military unit personnel through dynamic performance monitoring, messaging, and easy to understand user interfaces.

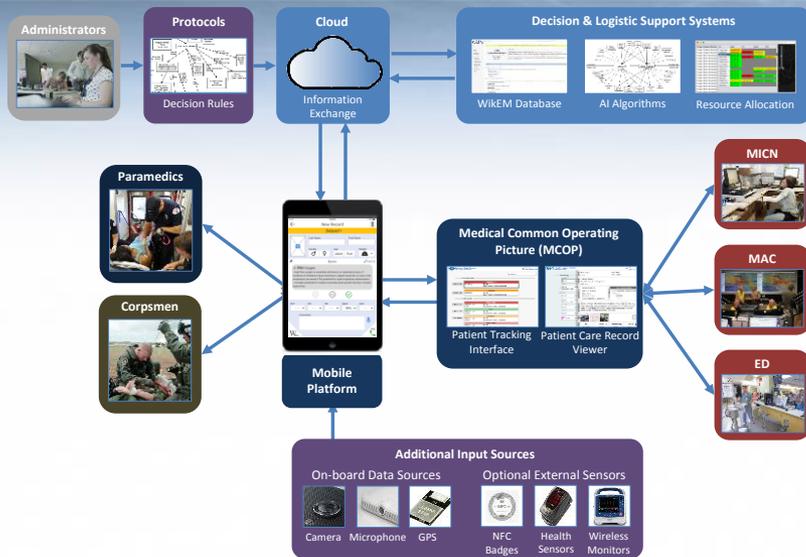
PERFORMERS: Prime: Milcord
Sub: Kno.e.sis (Wright State University)

SCHEDULE:

	FY17	FY18	FY19	FY20
Identify Requirements and Scope	★ —◆			▲
Design/Develop Training Injury Prevention Knowledge Graph	◆ —◆			
Design/Develop algorithms and recommendation engine	◆ —◆			
Design and Prototype MIDAS User Interface	◆ —◆			
Research inputs for augmenting training timeline (e.g. wearables)	◆ —◆			
System integration research and testing		◆ —◆	◆ —◆	◆ —◆
Prototype Integration and Evaluation Testing Events		◆ —◆	◆ —◆	◆ —◆
System accreditation planning and execution		◆ —◆		



Assisted Informatics and Decisions for Medics (AID-Medic)



OBJECTIVE:

Help Navy and civilian corpsmen, paramedics and medical personnel meet the critical needs of field and pre-hospital care

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- First, AID-Medic will be integrated in civilian Mass Casualty Incident and Emergency Care Services in a major city
- Second, AID-Medic will be integrated into Navy initial corpsmen training and Expeditionary Warfare exercises
- Finally, AID-Medic will be part of military and civilian hospital care and continued personnel training and education

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- Expeditionary Medicine
- Hospital Corpsmen Training, Education and Support
- Medical Informatics and Decision Assistance Systems

TECHNICAL APPROACH:

- **Mobile app** for Navy corpsmen and civilian paramedics engaged in pre-hospital care, focusing on Mass Casualty Incidents (MCI)
- **Complementary data management system** that helps solve today's major and universal problems of medical information overload, and in particular the optimal distribution of casualties to facilities and the hand-off from corpsman/paramedics and hospitals
- **Decision support and assistance system** for finger tip accessibility to knowledge and expertise for both training and operations
- **Innovative combination** of several advanced technologies including: Dynamic Agent based resource allocation, WikEM emergency medicine data base, Artificial Intelligence reasoning & prediction, and Human-Centered interface design

PERFORMERS: Prime: Perceptronic Solutions, Inc.
Sub: Charles River Analytics, Inc.

SCHEDULE:

	FY16			FY17			FY18		
TASK 1: Proof of Concept	★	◆							
TASK 2: Prototype Development				◆					
TASK 3: Empirical Evaluation in Civilian EMS operations					◆				
TASK 4: Civilian Pilot Projects									▲
TASK 5: Navy Pilot Projects									▲
TASK 6: Commercial Products									▲



24/7 Combat Fitness System



OBJECTIVE:

- Optimize the Human Performance of the Special Operator through quantified Combat Sports Science.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Personalized recovery prescription based on physiological data
- Optimized training strategies
- Potential for reducing overtraining injuries through physiological monitoring

NAVAL S&T FOCUS AREAS:

- T&E STO-1: Warrior decision-making
- T&E STO-2: Small unit learning and performance assessment
- T&E STO-3: Warrior resilience
- MED STO-2: Human performance enhancement
- MED STO-3: Fatigue management

TECHNICAL APPROACH:

“What can be measured can be managed”

SENSE

1. Assess current SoA of physiological monitoring technologies
2. Validate best technologies for potential use in SOF

ASSESS

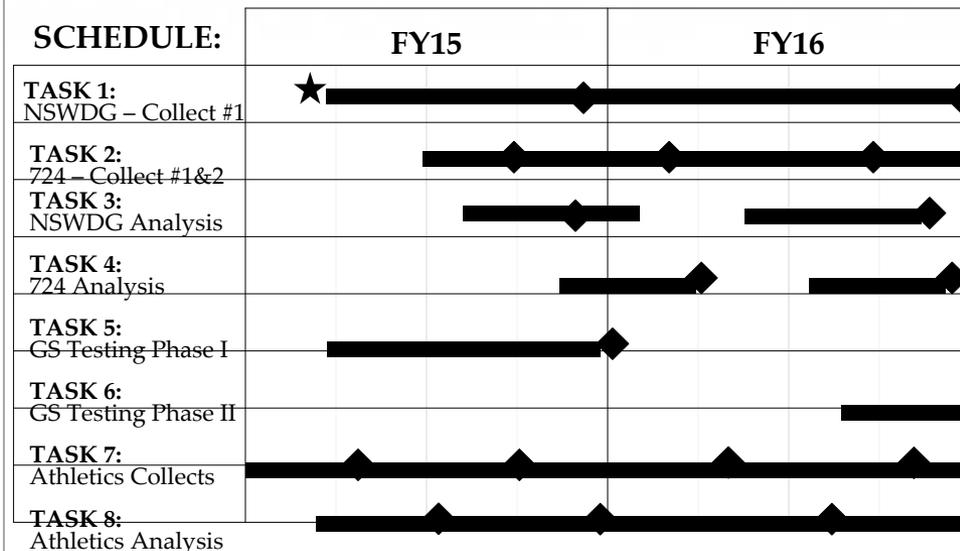
1. Run multiple multi-year data collections in SOF and elite athletics
2. Correlate and model all data

AUGMENT

1. Leverage AFRL research in prescribed recovery to complete SENSE-ASSESS-AUGMENT

PERFORMERS: Prime: Air Force Research Labs

SCHEDULE:



★ Kickoff — Progress ◆ Milestone ▲ Transition



Mitigation of Heat Strain Through the USMC Training Continuum

OBJECTIVE:

Extend the capabilities of the developed HRI risk model to determine associations with critical PT scores and run times associated with increased incidence of HRI.

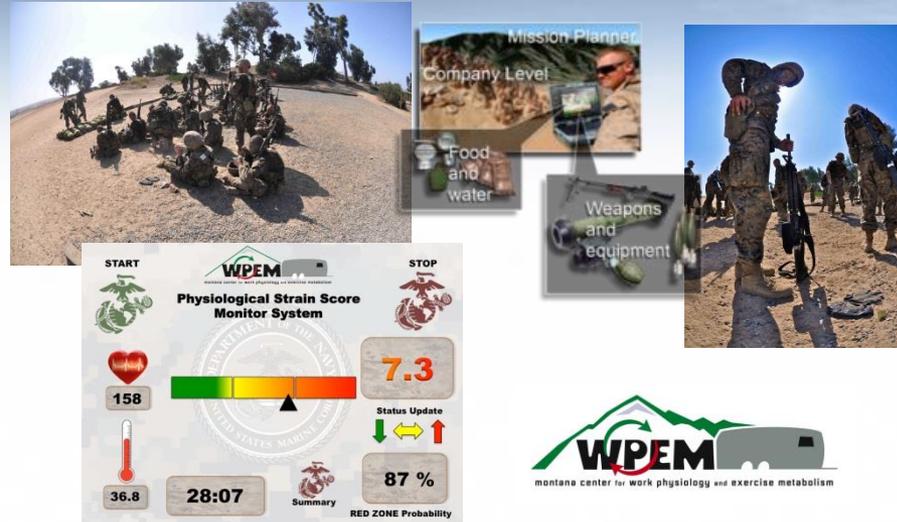
- **Aim 1:** Evaluate existing data from Camp Lejeune to determine HRI incidence relative to PFT biometrics (Mil Med. 178(7):e841-847, 2013).
- **Aim 2:** Demonstrate the effectiveness of the HRI risk model and provide training strategies to reduce HRI risk/incidence.
- **Aim 3:** Establish other metrics and interventions to minimize other injuries (via retention of skeletal muscle mass)

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- This project represents an approach to extend MCO 6200 Heat Injury Prevention Program throughout the USMC training continuum resulting in decreased overall HRI risk and increased training success.

NAVAL S&T FOCUS AREA:

- Med – STO 2, 3, 7, 8, 9
- T&E – STO 1, 2, 3, with potential extension for 4, 5



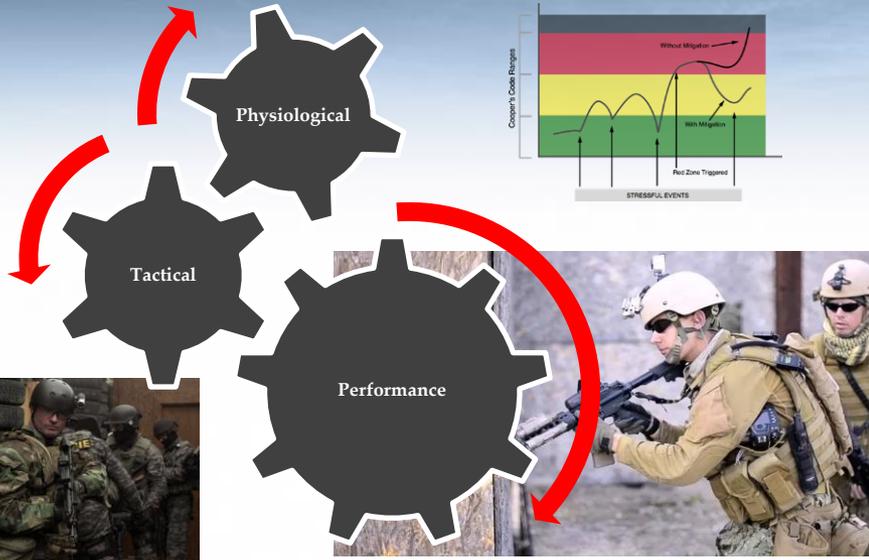
TECHNICAL APPROACH:

- Extend developed HRI risk model (Mil Med paper) to determine its association with PT scores, run times and HRI incidence at Camp Lejeune and Parris Island. **Presently seeking alternative data sets.**
- Implement predictive HRI risk model (initial aerobic fitness and other defined prediction variables) and demonstrate usefulness and reliability. Implement with other data sets as available to further evaluate application.
- Considerations for female candidates. Expand injury risk profile to include skeletal muscle mass retention/loss.

PERFORMER: The University of Montana

SCHEDULE	FY 15	FY 16	FY 17	FY 18
Retrospective HRI study	◆	—	◆	
On site demonstrations			◆—◆—◆	
Female data, Expand injury profiles				◆—◆
UM/Camp Lejeune/Fort Portsmouth IRB approval	◆◆◆			
ONR HRPO approval		◆		

Rapid Assessment of Mind & Body Optimization (RAMBO) Performance Platform



OBJECTIVE:

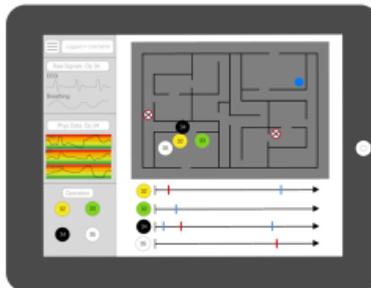
- Deliver a secure, mobile close quarter combat tracking and reporting tool which seamlessly captures training data and delivers actionable and useable information

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Collect data on safety violation and performance during a highly stressful but relevant skill to the Naval Special Warfare Community and expeditionary force communities. Information can be turned over to the community as an advanced training tool.

TECHNICAL APPROACH:

Real-time position tracking with playback for faster and more detailed debriefs



Real-time physio for each Operator

Modifiable for any training block

Integrated performance tracking system with automated debriefs and historical tracking

SCHEDULE:

	FY16	FY17	FY18	FY19
TASK 1: Position System Contract	◆			
TASK 2: Software Develop	◆			
TASK 3: Position System Install	◆			
TASK 4: Pilot test		◆		
TASK 5: CQC testing		◆		
TASK 6: Mobility of platform			◆	◆

PERFORMER: Naval Health Research Center



Precision High Intensity Training through Epigenetics (PHITE)

OBJECTIVES:

PHITE seeks to improve warfighter fitness by determining training elements best suited to individual warfighter genotype, and through the elucidation of epigenetic mechanisms, develop models and diagnostics that can dynamically forecast and assess when peak performance has been obtained.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Inadequate physical fitness contributes to as much as 70% of special operations training washouts. Attrition in training cost the DoD perhaps as much as \$620M per year.

NAVAL S&T FOCUS AREAS:

- T&E STO-3: Warrior resilience
- MED STO-2: Human performance enhancement

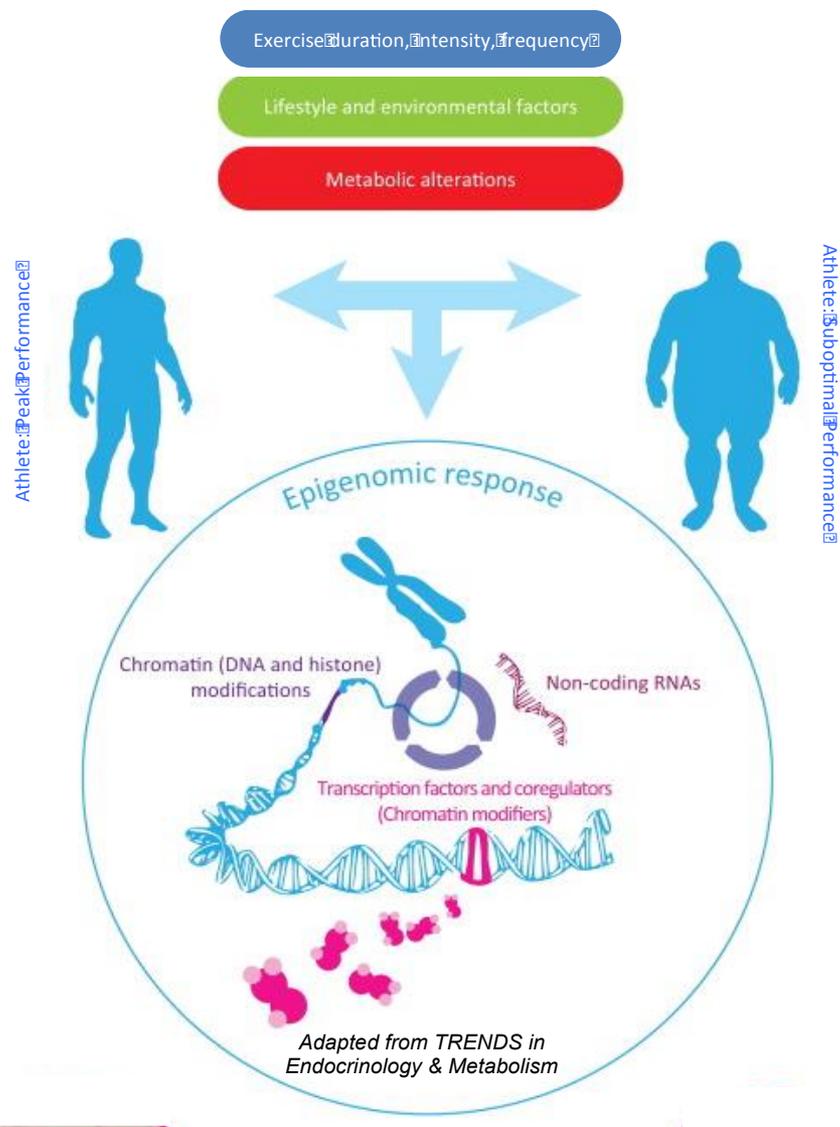
TECHNICAL APPROACH:

PHITE will investigate and mechanistically link changes in DNA methylation, chromatin / histones, miRNA and nuclear transcription factors to changes in performance induced by physical training in 150 military age subjects.

PHITE will explore the link between physical training and epigenetics and will use that understanding to:

- Identify training methodologies that modify epigenetic responses
- Characterize epigenetic regulation of physiological processes, pathways, and mechanisms associated with moderate and high-intensity physical training
- Produce real-time biomarkers of cardiorespiratory and neuromuscular performance that predict physical training outcomes.

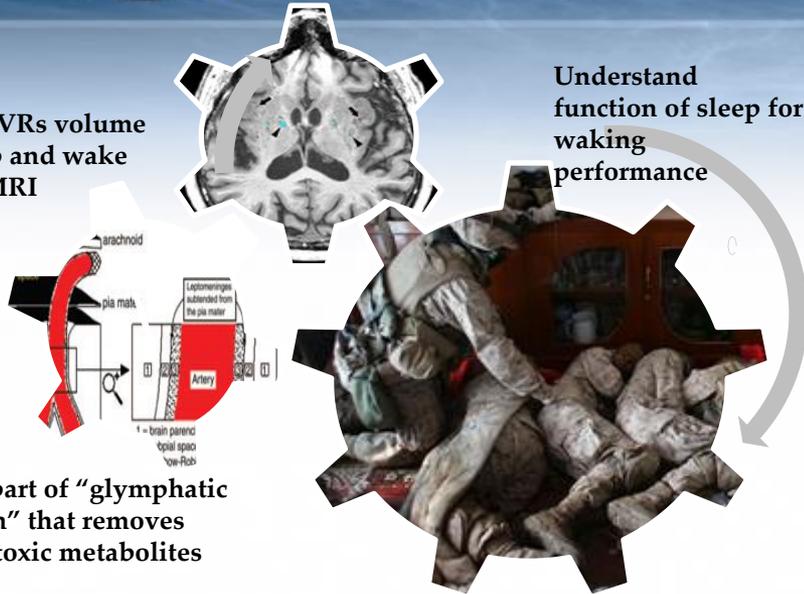
PERFORMERS: Prime: Wright State University



The Impact of Sleep and Sleep Deprivation on the Cerebral Glymphatic System

Assess VRs volume in sleep and wake using MRI

Understand function of sleep for waking performance



VRs: part of "glymphatic system" that removes neurotoxic metabolites

OBJECTIVE:

- Determine if the cerebral glymphatic system shows sleep-wake dynamics in humans

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Promote fundamental knowledge of the restorative functions of sleep for waking performance

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- Warfighter Performance
 - Manpower, Personnel, Training and Education
 - Advanced approaches to personnel recruitment, selection, assignment, retention and professional development
 - Accelerate & enhance training time & impact while reducing costs
 - Develop tools & techniques to achieve ubiquitous, engaging, scenario-based training & automated performance-based readiness assessment
- Warfighter Health and Survivability
 - Enhance warfighter resilience to physical & psychological stressors

TECHNICAL APPROACH:

- Select 15 healthy adults for participation in a 4-d study
- Record a baseline MRI (#1) in the evening of Day 1
- Allow overnight sleep at habitual times
- At waketime, participant begins a 36h controlled wake episode (Days 2-3)
- Waking MRI (#2) in evening of Day 3
- Overnight MRI (#3) during sleep with EEG
- Volume of VRs compared: a) wake vs. sleep; b) nREM vs. REM; c) light nREM vs. deep nREM; d) baseline wake vs. sleep-deprived wake.

PERFORMERS: Harvard University

SCHEDULE:	FY15	FY16	FY17	
Equipment & Training: EEG, MRI	◆			
Pilot Study: Healthy volunteer		◆		
Recruitment and Screening: Study participants		◆	▲	
Data Collection: Record MRI&EEG during sleep and wake		◆	▲	
Data Analysis: Process all recordings from each subject		◆	▲	
Reporting: Interim & Final reports; Manuscript		◆	◆	



Individualized Fatigue Countermeasure Training Tool

Figure 1. Screenshot of Semper SleepFit to provide clinician-in-the-loop support of marines with persistent sleep disruption



TECHNICAL APPROACH:

- Develop Secure, HIPPA compliant, web app to deliver: (1) Sleep health risk assessment; (2) Sleep diary; (3) CBTi program; (4) Clinician dashboard
- Develop fatigue resilience education modules for Marines and clinicians
- Conduct field study

PERFORMERS:

Pulsar Informatics, Inc.
Naval Surface Warfare Center – Dahlgren Division

PRINCIPAL INVESTIGATOR:

Daniel Mollicone, Ph.D.
Email: daniel@PulsarInformatics.com
Phone: 215.520.2630

OBJECTIVE: Develop Semper SleepFit app to enable: (1) Fatigue resilience training for Marines; (2) Dynamic screening assessment for high-risk sleep issues; (3) Self-directed, non-medical, individualized evidence-based programs to address sleep disruption; (4) Sleep health monitoring tools that enhance capacity of existing sleep health providers within the Navy.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Increased fatigue resilience training effectiveness
- Enhanced sleep health surveillance capabilities
- Enhanced sleep health intervention capabilities
- Reduced fatigue-related operational errors

NAVAL S&T FOCUS AREAS ADDRESSED:

- Med STO-2: Human performance enhancement
- Med STO-3: Fatigue Management
- Med STO-5: Health surveillance, intelligence, and preventive medicine
- Med STO-7: Warfighter physiology
- T&E STO-1: Warrior decision making
- T&E STO-3: Warrior resilience

SCHEDULE:

	FY15Q3	FY15Q4	FY16Q1	FY16Q2	FY16Q3	FY16Q4	FY17Q1	FY17Q2	FY17Q3	FY17Q4
Program Milestones	[Progress bar from FY15Q3 to FY17Q1]									
Health assessment application	[Progress bar from FY15Q3 to FY16Q3]									
Fatigue resilience education	[Progress bar from FY15Q3 to FY16Q4]									
Insomnia diagnosis and treatment application	[Progress bar from FY15Q3 to FY16Q4]									
Field Study	[Progress bar from FY16Q3 to FY17Q2]									



Establishing Optimal Training Intervals for the Marine Corps Martial Arts Program (MCMAP) For Improvement in Physical Performance and Warrior Mindset



OBJECTIVE:

- Map the trajectory of endocrine and immune responses to repeated bouts of MCMAP training.
- Quantify variability in anxiety levels and moral/ethical decision making ability in response to MCMAP training.
- Refine the integration of the moral and ethical decision making components based on physiological/psychological trends observed in order to better develop ethical warriors with a combat mindset.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Optimize the integration of the mental and physical training strategies of MCMAP to increase resiliency in warfighters.
- Increasing the effectiveness of MCMAP improves the training for small unit leaders to perform credibly as 'strategic' noncommissioned officers (NCOs), capable of critical thought against hybrid threats in the complex decentralized 21st century operating environment.

NAVAL S&T FOCUS AREA(s) ADDRESSED: Warfighter Performance

TECHNICAL APPROACH:

- Phase 1- (FY14 - FY16)
 - Recruit 36 Male and 18 Female Marines (FY14 10 Marines, FY15 17 Marines)
 - Data collection with existing MCMAP Protocol
 - Analyses and recommend MCMAP training intervals to MACE
- Phase 2- (FY16)
 - Recruit 36 Male and 18 Female Marines (6 9-Marine teams)
 - Data Collection with MACE approved MCMAP training intervals
 - Analysis and Final Report

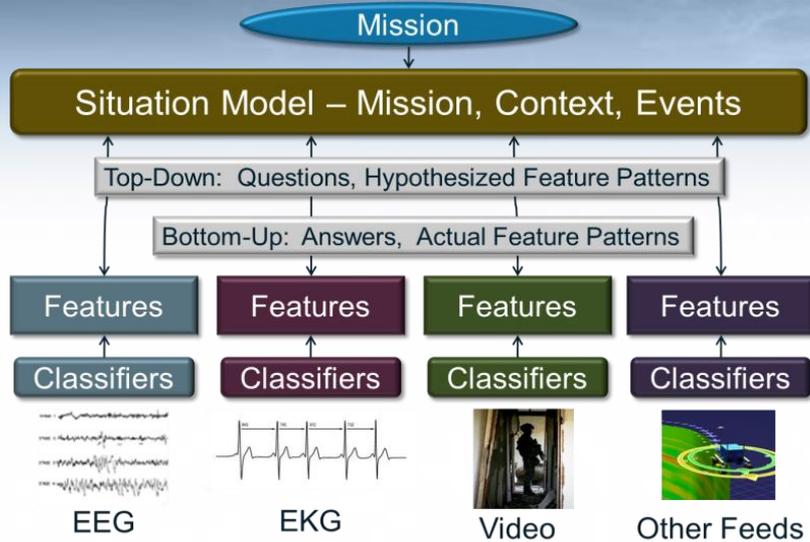
PERFORMERS:

KU Applied Physiology Laboratory, KSU Department of Food Nutrition Dietetic and Health, KU Exercise and Psychology Laboratory, KU Sport Management Laboratory, KU Neuromechanics Laboratory, KU Graduate Military Programs, USMC Martial Arts Center of Excellence (MACE), USMC Detachment Fort Leonard Wood Missouri, USMC Training Command

SCHEDULE:	FY14	FY15	FY16	
TASK 1: Meet MC Det FLW	◆			
TASK 2: Phase I: Data Collection	◆	—	◆	
TASK 3: Analysis & Recommendation			◆▲	
TASK 4: Phase 2: Data Collection			▲◆	
TASK 5: Analysis & Final Report			▲◆	



NeuroCognitive Patterns



OBJECTIVE:

NCP will provide an innovative brain-computer interface (BCI) for a prosthetic arm that combines recent advances in identifying the neural signals of motor intent with technology that exploits video and knowledge to extract contextual information that will help interpret those neural signals. EEG epochs will be informed by a computational event segmentation system that operates on the video signal.

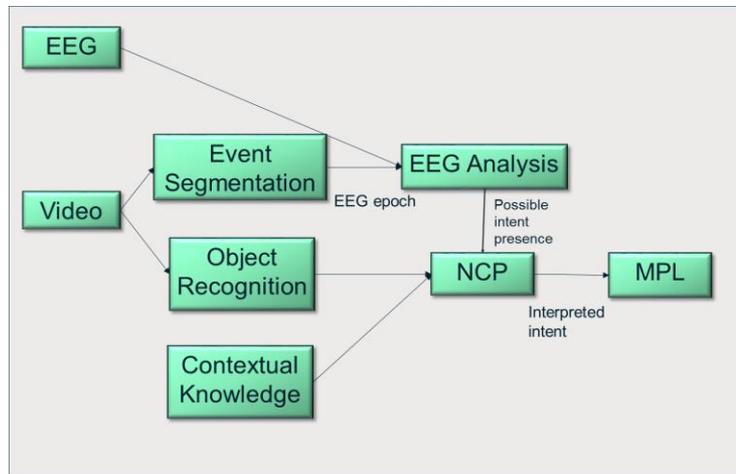
MILITARY RELEVANCE/OPERATIONAL IMPACT:

NCP will result in a new generation of robot control systems that will require dramatically less attention from the operator, freeing operators to attend to other mission-important tasks.

NAVAL S&T FOCUS AREAS ADDRESSED:

- C2 STO-3: Improved situational awareness
- MVR STO-3: Advanced robotic systems

TECHNICAL APPROACH:



PERFORMER: Aptima

Task	Q1	Q2	Q3	Q4
1. Collect EEG data with synced video of events		1		
2. Object recognition system		2		
3. Event Segmentation System			3	
4. Integrate with Simulated MPL				4
5. Integrate and Demonstrate with MPL				5



Connecting STEM Outreach Now using VIE Education for Youth (CONVEY)

OBJECTIVES:

- Increase the exposure of 2nd–12th grade children of wounded warriors to STEM topics related to advanced prosthetics in a fun and interactive way.
- Enhance each child’s understanding of how STEM concepts and products are being used to enable personal independence, mobility, and human interaction.
- Build a foundation of knowledge for students, including fundamentals of musculoskeletal anatomy and physiology, electromyography (EMG) signal acquisition and processing, virtual environment development and implementation – and, for higher-level students, an overview of the neuroscience that is being applied to control the prosthetics.

NAVAL S&T FOCUS AREAS:

- T&E STO-3: Warrior resilience
- MED STO-2: Human performance enhancement

TECHNICAL APPROACH:

- Develop hands-on learning and demo for students in grades 2-12.
- Organize, host, and analyze results of a directed outreach meeting (up to two) with Wounded Warrior organizations at the outset of the program to gather, via survey and discussion, input on participants’ requests for particular outreach activities to aid in program design.
- Host and conduct a pilot to test the system, curriculum, materials, and instructional protocols for – and level of student engagement during – workshops for elementary, middle, and high school groups.
- Develop supplemental follow-on activities/materials for students to participate in/use after the workshop, to be available as take-aways at the end of the workshop and/or available later via email, website, or subsequent STEM events.

PERFORMERS: Johns Hopkins University Applied Physics Lab

Task Name [Milestone]	Start	Finish
PHASE I (Mobilization)	Mon 4/18/16	Wed 5/25/16
[M1] Program Kickoff Meeting	Wed 5/4/16	Wed 5/4/16
PHASE II (Design & Build)	Wed 5/4/16	Fri 2/24/17
[M2] Prelim Design Review	Thu 7/7/16	Thu 7/7/16
[M3] Critical Design Review	Thu 7/14/16	Thu 7/14/16
[M4] MicroVIE Alpha Complete	Fri 11/25/16	Fri 11/25/16
[M5] Final Draft of Curriculum Requirements Document	Fri 7/29/16	Fri 7/29/16
Develop Workshop Framework	Mon 8/1/16	Tue 8/23/16
[M6] Select Format	Tue 8/23/16	Tue 8/23/16
Develop Workshop Content	Wed 8/24/16	Fri 12/23/16
[M7] Finalize Module 1 Content	Wed 10/5/16	Wed 10/5/16
[M8] Finalize Module 2 Content	Wed 10/5/16	Wed 10/5/16
[M9] Finalize Module 3 Content	Wed 10/5/16	Wed 10/5/16
[M10] Finalize Module 4 Content	Fri 12/23/16	Fri 12/23/16
Create Take-Homes and Takeaways	Mon 12/26/16	Fri 1/20/17
[M11] Finalize Takeaway Materials	Fri 1/6/17	Fri 1/6/17
Communication and Networking Tools Development	Mon 12/26/16	Fri 2/3/17
[M12] Finalize Communication and Networking Tools	Fri 2/3/17	Fri 2/3/17
Produce Facilitator’s Manual	Mon 12/26/16	Fri 1/20/17
[M13] Finalize Facilitator’s Manual	Fri 1/20/17	Fri 1/20/17
Competition Development	Mon 12/26/16	Fri 1/6/17
[M14] Finalize Competition Rules	Fri 1/6/17	Fri 1/6/17
Assessment Development	Mon 12/26/16	Fri 2/10/17
[M15] Finalize Assessments	Fri 2/10/17	Fri 2/10/17
[M16] Sponsor Meeting-1st Status Report	Fri 2/24/17	Fri 2/24/17
PHASE III (Pilot Workshop)	Mon 2/27/17	Fri 3/31/17
[M17] Debrief Meeting	Fri 3/24/17	Fri 3/24/17
PHASE IV (Implementation)	Mon 7/11/16	Mon 5/22/17
[M18] Administer Program Surveys	Mon 5/22/17	Mon 5/22/17
PHASE V (Project Closeout)	Tue 5/23/17	Mon 6/12/17
[M19] Final Briefing & Deliver Final Report	Thu 5/25/17	Thu 5/25/17



Effectiveness of post-stress glucose in preventing dissociative amnesia and PTSD in trauma patients



OBJECTIVE:

First of its kind study assessing whether treating trauma patients with glucose within 3-hours following a peritrauma/traumatic incident increases resilience and reduces symptoms of dissociative amnesia and Posttraumatic stress disorder (PTSD).

MILITARY RELEVANCE/OPERATIONAL IMPACT:

Ingestion of oral glucose immediately following a traumatic incident will increase resilience to trauma and will reduce the incidence of PTSD.

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- 1) T&E STO-3: Warrior Resilience;
- 2) Med STO-2: Human Performance Enhancement Capabilities;
- 3) Med STO-9: Stress Resistance, Resilience, and Recovery

Technical Approach: Participants will undergo a battery of assessments at intake (T1), 5-7 days post-trauma (T2) and 2 months post-trauma (T3) ascertaining memory of traumatic event, neurocognitive tests of hippocampal and basal ganglia function, enzyme-linked immunosorbent assay (ELISA) of plasma and salivary samples for neuroendocrine measures of resilience, physiological response to trauma, and self-reported measures of symptoms of PTSD. A monthly progress report will be generated and the final report will be delivered in FY 17 QTR 4.

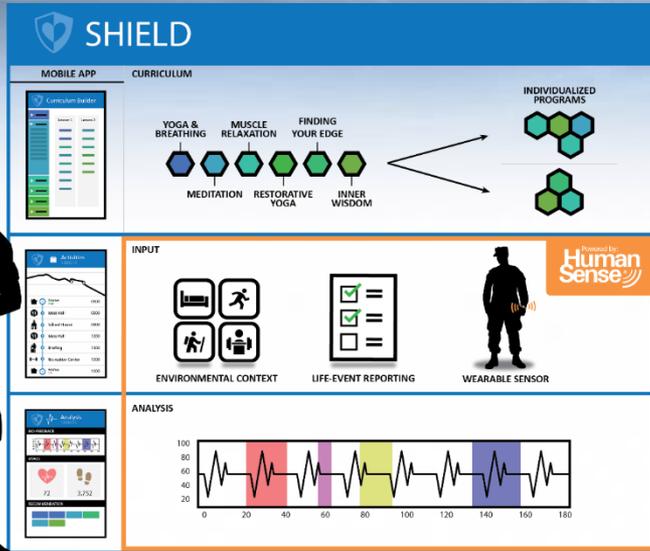
- **Technical Task 1:** IRB & ONR Approvals, Grant Awarded
- **Technical Task 2:** Personnel Staffed & Trained
- **Technical Task 3:** ER & Mobile Field Data Collection Policies & Procedures Implemented
- **Technical Task 4:** Data Collection
- **Technical Task 5:** Data Analysis
- **Technical Task 6:** Final Report

PERFORMER: UCLA

SCHEDULE:	FY14	FY15	FY16	FY17
Task 1 IRB and Grant submitted / approved	◆	◆		
Task 2 RA's Recruited, CITI & HIPPA Certifications Completed & County Badge Received		◆		
Task 3 Dev & Tested Protocols; Purchased Supplies; Coded Software		◆		
Task 4 Data Collection		◆	◆	◆
Task 5 Data Analysis			◆	◆
Task 6 Monitor Progress Each Month; Final Report	◆	◆	◆	◆



Strengthening Health & Improving Emotional Defenses (SHIELD)



OBJECTIVE:

Design a low-cost, flexible, assessment and treatment option for training psychological flexibility and enhancing the resilience and performance of the Marine Corps. To accomplish this goal, we will rely on our expertise in mindfulness training, mobile platform development, data fusion, and biosensor technologies, as well as our familiarity with Marine Corps training, to develop a program that will improve Marines' ability to flexibly adapt and cope with stressors and avoid the negative consequences associated with increased stress. The primary objective of the proposed Phase I work is to design and develop a portable psychological flexibility program for Strengthening Health and Improving Emotional Defenses (SHIELD). Phase II follow-on work will evaluate the efficacy of a full-scope SHIELD prototype.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- To develop psychological flexibility and promote healthy responses to adverse and stressful events.

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- T&E STO-3: Warrior resilience

TECHNICAL APPROACH:

We propose to design and demonstrate a portable psychological flexibility program. SHIELD is a comprehensive approach based on the latest evidence-based strategies from mindfulness-based stress reduction, relaxation response training, and yoga to train Marines to develop psychological flexibility and promote healthy responses to adverse and stressful events. A mobile application using biometric data collected from sensors embedded in smartphones, combined with content delivery and user feedback and evaluation, will build a composite of individual stress-levels to guide personalized training objectives.

PERFORMER: Charles River Analytics

Phase SCHEDULE:	FY15Q3	FY15Q4	FY16Q1		
TASK 1: Requirements Analysis	◆				
TASK 2: Identify Sensors & Design Integration		◆			
TASK 3: Analyze Data & Model Algorithms			◆		
TASK 4: Design Mobile Application			◆		
TASK 5: Demonstrate and Evaluate			◆		
TASK 6: Refine Design Concepts				◆	
TASK 7: Transition & Commercialization					◆
Deliverables:	▲	▲	▲	▲	



Human Performance, Training & Education Quad Charts: Decision Making and Expertise Development

Dr. Peter Squire
ONR Code 30
HPT&E Thrust Manager

Distribution Statement D. Distribution authorized to DoD and U.S. DoD contractors only (Administrative Use) (31 August 2015).



Decision Making and Expertise Development Portfolio Framework

Assess

Measure

Evaluation of Immersive Training Environments

George Mason University

Gender Diversity in Traditionally Male-Dominated Teams

Michigan State University

Measuring & Assessing Maneuver Squad Leader Adaptability

Design Interactive | CPG

Track

Tool for Rapid Assessment of Cognitive Readiness in Teams

Aptima, Inc.

Train and Educate

Quality

Tailored Training

Master Instructor Development (MInD)

CPG

Higher Automated Learning (HAL)

Aptima, Inc.

Adaptive Training Tech For Language & Culture

Aptima, Inc.

Interactive Military Instructor Training & Assessment Tech (IMITATE)

Design Interactive

Accelerating the Development of SUDM

Lockheed + SoarTech

Future Integrated Training Environment

TBD

DM Skills Training

Intuitive Decision Making through Implicit Learning

Northwestern

Synthetic Vision for Ground Forces

Phase I | TBD

Training Intuition

Aptima, Inc.

Immersive Approach to Intuitive Decision Making

Stottler Henke

Quantity

Augmented / Mixed Reality

Wide Area Augmented Reality

Lockheed Martin

Human-Surrogate Interaction

UCF

Augmented Reality Simulation for Design & Evaluation of Training Capabilities

UCSB

Augmented Reality Training Technologies

Phase I | TBD

AI for Infantry Simulation

Phase I | TBD

Simulation Enablers

TBS Technology Evaluation

Lockheed Martin

Rapid Synthetic Environment

Edgewise | Enomalies

Simulated training Exercises with Robust Unmanned Models (SERUM)

Soar Technology

Virtual Human Terrain Scenario Training

Concurrent Technologies Corp

Fast Authoring of Content for Intelligent Tutoring Systems (FACITS)

Soar Technology

Key:

--- Future Award

Exploitation & Deployment

PBD

FNC

SBIR

Other



Evaluation of Immersive Training Environments

Skill Transfer via Training Environment

Simulation



Range (Live)



Group DM



OBJECTIVE:

- Improve upon previous studies that assessed ISMT training effectiveness

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Provide alternative designs, measurement models, and analytic techniques for current research efforts on the impact of training – live and simulated – on skill transfer.

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- Human Performance/Training & Education
 - STO-2: Small unit learning and performance assessment
 - STO-4: Experiential learning technologies and methodologies
 - STO-6: Warrior simulation

TECHNICAL APPROACH:

The first two objectives [Stage 1 & 2] completed a review of past and present literature on the relevant topics prior to compiling a report and list of future recommendations to improve training design, evaluation, and feedback. Further suggestions were made regarding alternative methods based on the review and potential reanalysis of prior findings with alternative techniques.

The current objective [Stage 3] has been to undertake an analysis of simulated and live marksmanship training to assess the mechanisms and degree of skill transfer. Additional connections with marksmanship researchers may result in secondary data analysis of data collected on previous simulation experiments. This reanalysis/study development will serve as an internal review and evaluation of their current program, and so may be considered a quality improvement initiative.

PERFORMERS: George Mason University

SCHEDULE:

	FY14	FY15	FY16	FY17
Task 1: Review past training studies	—			
Task 2: Review present training research		—		
Task 3: Summarize research and recommend future directions		◆		
Task 4: Propose Marksmanship study and review/reanalyze related study findings		—	▲	
Task 5: Run Marksmanship study with TBS			—	



Gender Diversity in Traditionally Male-dominated Teams: The Impact of Alternative Compositional Configurations over Time



OBJECTIVE:

- To extend both theory and empirical evidence of the effects of gender diversity on team outcomes in teams that have traditionally been male-dominated. We seek to clarify prior inconsistencies by (a) taking a configural approach to gender diversity, (b) assessing member contributions in terms of leader emergence, shared leadership, and voice behaviors as explanatory mechanisms linking gender diversity to both proximal outcomes (i.e., leadership over-emergence, group polarization, and premature consensus) as well as distal team outcomes (i.e., team performance, adaptability, and viability).

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- This research holds important implications for organizations seeking to maximize value from gender-diverse teams in terms of (a) team staffing decisions, (b) diversity training and (c) leadership development programs.

NAVAL S&T FOCUS AREA(S) ADDRESSED:

- Human Performance/Training & Education
- Warfighter Performance

TECHNICAL APPROACH:

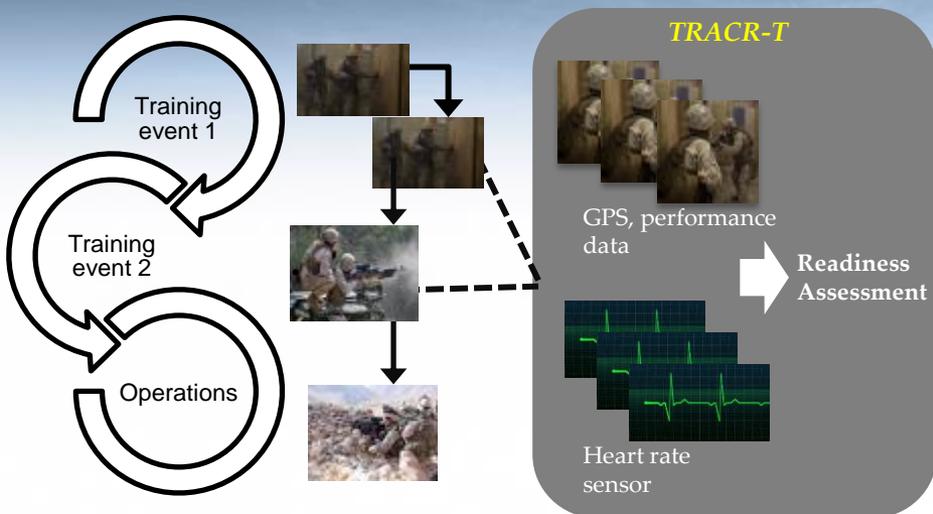
We plan to test a conceptual model of how gender composition affects team performance and processes in a field sample involving male and female individuals recruited from The Marine Corps base at Camp Lejeune, NC. The overarching project timeline will involve four major parts: the initial baseline survey, observer training and team formation, team performance episodes, and a project closure survey. The results will be analyzed at the team and individual level and be used to inform decisions regarding gender integration of USMC infantry units

PERFORMERS: Michigan State University (Hollenbeck)

SCHEDULE:	FY15	FY16	FY17
Design Research Study	◆		
Recruit USMC Research participants	◆		
Collect data at Camp Lejeune		◆	
Preliminary analysis of data for June 18 briefing with MCFIO		◆	
Re-analyze data based on feedback from MCFIO		◆	
Provide new analyses for briefing to Deputy Commandant		◆	



TRACR-T II: Tool for Rapid Assessment of Cognitive Readiness in Teams



OBJECTIVE:

- Predict team readiness based on multimodal measures (e.g., GPS, heart rate).

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Improves assessment of unit readiness using supplemental measures of T&R events
- Enhances AAR fidelity by providing predictive measures of readiness

NAVAL S&T FOCUS AREAS ADDRESSED:

- T&E STO-1: Warrior decision making
- T&E STO-2: Small unit learning and performance assessment

TECHNICAL APPROACH:

- Refine list of measures based on literature review, subject matter experts, sensors used during field exercises
- Train predictive model using previously collected data from the Ground Combat Integrated Task Force Experiments
- Test predictive model using data from live field training exercise

PERFORMER: Aptima, Inc.
Camilla Knott, Ph.D.
Jared Freeman, Ph.D.

SCHEDULE:	FY16	FY17
TASK 1: IRB prep & approval	★ Completed in FY13, Q3	↑ Base period
TASK 2: Refine measures	◆ Completed in FY14, Q2	
TASK 3: Implement measurement instruments	◆ Completed in FY14, Q1	
TASK 4: Define model for computing team readiness	◊	
TASK 5: Modify option 2 evaluations	◆ Completed in FY14, Q3	
TASK 6: System test	◆ Completed in FY14, Q3	↑ Option 1
TASK 7: Conduct evaluations	—	
TASK 8: Demo integration w/ USMC environment		↑ Option 2



Master Instructor Development



CONTINUOUS IMPROVEMENT



Define and measure levels of instructor proficiency

OBJECTIVE: Generate a validated Instructor Assessment Toolkit to support instructor development and track performance trends over time as a result of updated policies and interventions.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Provide a means to objectively assess an instructor’s ability in order to “better educate and train our Marines” – 35th Commandant’s Planning Guidance
- Support implementation of USMC “Train the Trainer Training and Readiness Manual” (NAVMC 3500.37C)
- Support implementation of “Marine Corps Formal School Management Policy Guidance” (NAVMC 1553.2)

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- T&E STO-1: Warrior Decision Making
- T&E STO-2: Small Unit Learning and Performance Assessment
- T&E STO-4: Experiential Learning Technologies and Methodologies

TECHNICAL APPROACH:

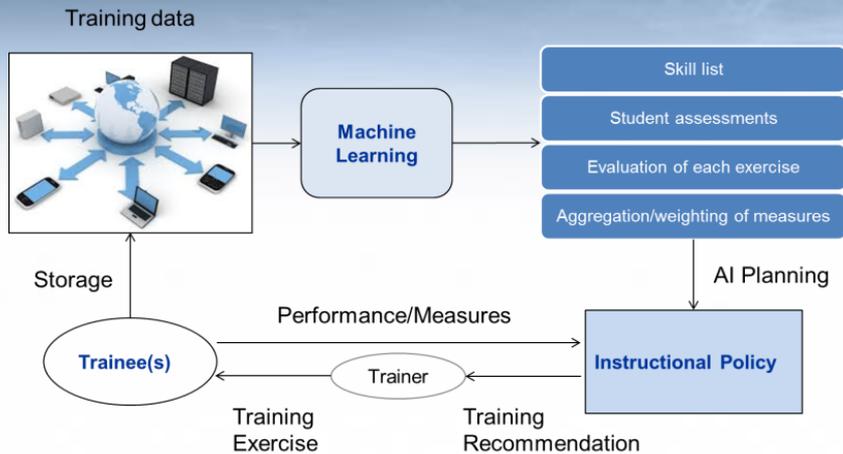
- Build upon existing instructor competency research.
- Conduct knowledge elicitation to develop, validate, and operationalize an instructor developmental model.
- Assess instruments appropriate for inclusion as instructor assessment tools.
- Develop instructor assessment tools and conduct usability testing.
- Conduct field testing and psychometric analysis to examine reliability and validity and support refinement.
- Finalize assessment tools.
- Conduct initial baseline data collection.

PERFORMERS: Ross, PI; Phillips; Vogel-Walcutt (CPG)

SCHEDULE:	FY14	FY15	FY16	FY17
TASK 1: Literature review	▲			
TASK 2: Develop plan; submit IRB	▲			
TASK 3: Mastery Model Development	—◆			
TASK 4: Develop Instruments		—▲		
TASK 5: Field Test Instruments			—▲	
TASK 6: Psycho-metric Analysis			—▲	
TASK 7: Finalize Instruments				—◆
TASK 8: Collect Baseline Data				—▲



Higher Automated Learning



OBJECTIVE:

- Develop a set of complementary mathematical models that facilitate adaptive instruction

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Periscope Training, Language Learning, Marksmanship

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- STO-2: Small unit learning and performance assessment
- STO-4: Experiential learning technologies and methodologies

Technical Approach:

The approach inputs training records; from the training records it identifies relevant skills to the domain, measures of the skills, and effectiveness of each training configuration at increasing performance. From this information it builds an adaptive trainer, which interacts with the student and instructor to assess the student at run-time and to select optimal training configurations.

Technical Task 1: Develop Use Case

Technical Task 2: Design the HAL tool

Technical Task 3: Design the algorithm to discover fundamental skills

Technical Task 4: Automatically generate learning measures of those skills

Technical Task 5: Identify path of progression

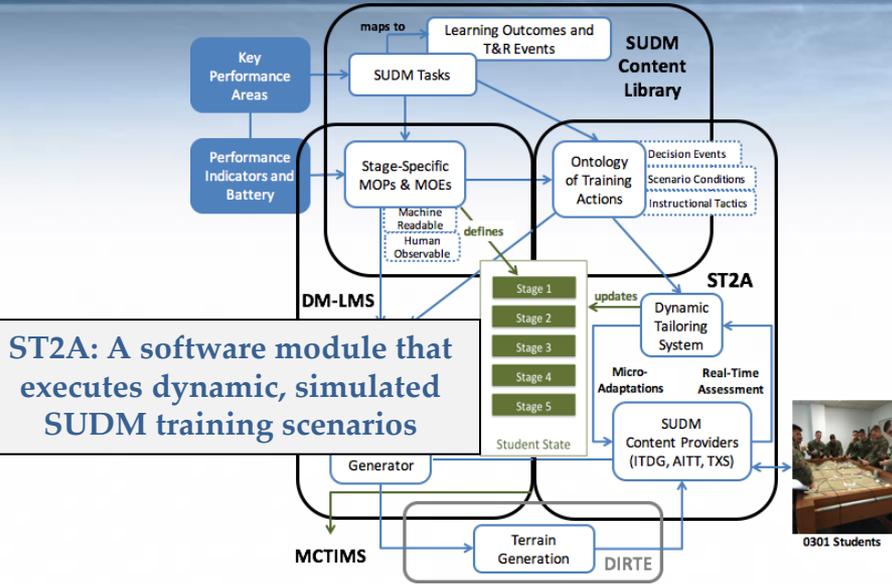
PERFORMER: Aptima, Inc.

SCHEDULE:

	FY14	FY15	FY16	FY17
TASK 1: Develop Use Case	—◆			
TASK 2: Design HAL tool	—◆			
TASK 3: Design algorithm to discover skills	—◆			
TASK 4: Automatically generate measures	—◆			
TASK 5: Identify path of progression	—◆			
TASK 6: Human validation			—▲	



Simulation Tailored Training and Assessment (ST2A)



ST2A: A software module that executes dynamic, simulated SUDM training scenarios

OBJECTIVE:

- Develop a situated, individualized training capability within operationally relevant virtual environments to accelerate the development, training, and assessment of Small Unit Decision Making (SUDM) skills in ground infantry squad leaders

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Improved Marine Corps training capability for SUDM skills
- Reduced time in training pipeline
- Increased repetitions in training pipeline
- Reduced instructor resources

NAVAL S&T FOCUS AREAS ADDRESSED:

- FY15 Gap 43: Small Unit Decision-Making Training Technologies
- FY15 Gap 44: Training Time and Cost Reduction Technologies
- FY15 Gap 48: Immersion Training

TECHNICAL APPROACH:

- Exploit previous development of the Interactive Tactical Decision Game (I-TDG), Augmented Immersive Team Trainer (AITT), and Tactical Execution System (TXS) to develop a software system capable of parsing and adaptively executing dynamically generated SUDM curriculum in a representative setting
- Automate non-invasive, unobtrusive and near real-time training interventions using SoarTech’s Dynamic Tailoring System (DTS)
- Automate pedagogy using SUDM instructional best practices taken from the Maneuver Squad Leader Mastery Model
- Feedback assessment data from ST2A exercises to support instructor-led AAR activities and curricula modifications via the DM-LMS software component

PERFORMERS: Prime: SoarTech
Sub: Aptima, Cognitive Performance Group

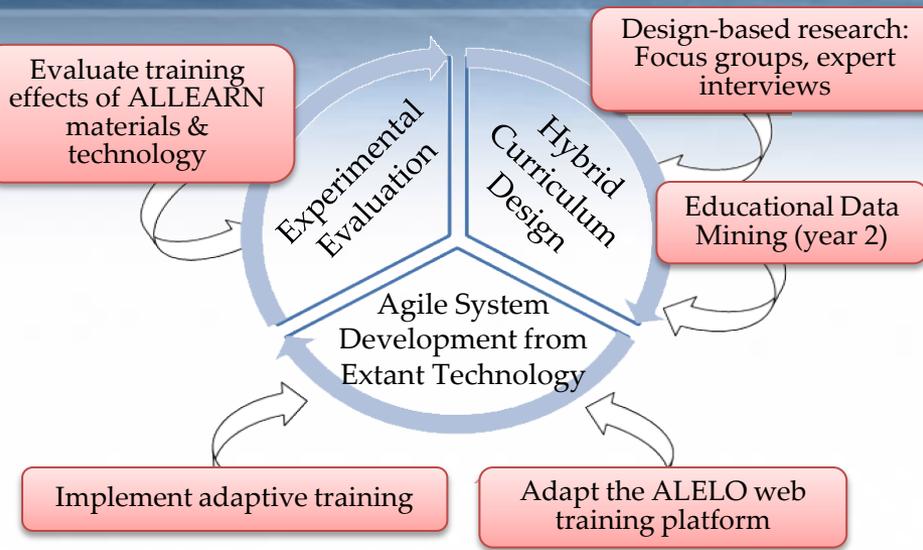
SCHEDULE:	FY16	FY17	FY18	FY19

Major Goals/Schedule by Fiscal year:

- SUDM assessment battery and mastery model analysis (FY16)
- SUDM training content library (FY16)
- ST2A system architecture and proof-of-concept prototype (FY16)
- Initial prototypes and formative evaluations (FY17, FY18)
- User evaluations and ST2A transition to SITE (FY18)



Adaptive Language LEARNing (ALLEARN)



ALLEARN's hybrid development model focuses on learner needs.

OBJECTIVE:

- Help learners quickly master skills in strategic languages to ILR 1/1+ level and beyond.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Helps address gaps in language-qualified billets for personnel across DoD.
- LREC skills are essential for every phase of war, especially for shaping security environments in Phase 0 operations (CNO, 2008).

NAVAL S&T FOCUS AREAS ADDRESSED:

- T&E STO-8: Develop affordable capabilities to facilitate acquisition and application of cross-cultural communication capabilities.
- T&E STO-9: Cultural and language proficiency tools.

TECHNICAL APPROACH:

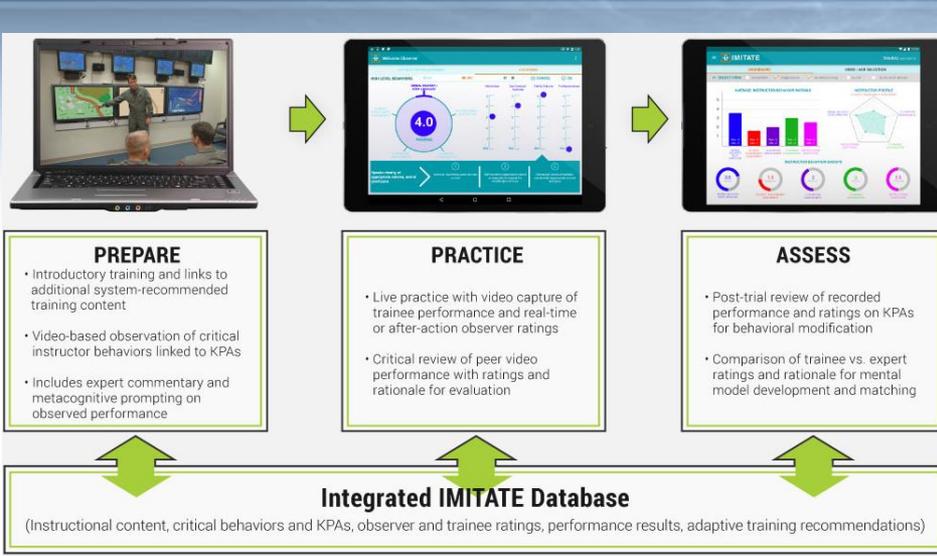
- Design-based research focusing on learners' critical training needs.
- Assess each learner's gaps in communicative competencies, using speech & language technology.
- Optimize training paths to overcome competency gaps, using educational data mining and machine learning.

PERFORMERS: Prime: Aptima
Sub: ALELO

SCHEDULE:	FY16	FY17	FY18	FY19	FY20	FY21
Base: Needs Assessment	◆					
Opt1: Software V1 V2 Valid. Results		◆	◆ ◆			
Opt2: Software V3 Eval. Results				◆ ◆		
Opt3: Software V4 Eval. Results					◆ ◆	
Opt4: Software V5 Eval. Results						◆ ◆



Interactive Military Instructor Training and Assessment Technology (IMITATE)



OBJECTIVE:

- To develop IMITATE, a tablet-based, mobile-computing training technology designed for military instructors at all levels to build, maintain, and remediate instructional skills. IMITATE supports self-guided learning as well as instructor-in-the-loop, real-time assessment of key performance areas (KPAs) associated with military instruction.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Enhanced instructor competence
- Reduction in instructor development costs
- Improved mission readiness at Marine schoolhouses and across the DoD

NAVAL S&T FOCUS AREA:

- T&E STO-4: Experiential learning technologies and methodologies

TECHNICAL APPROACH:

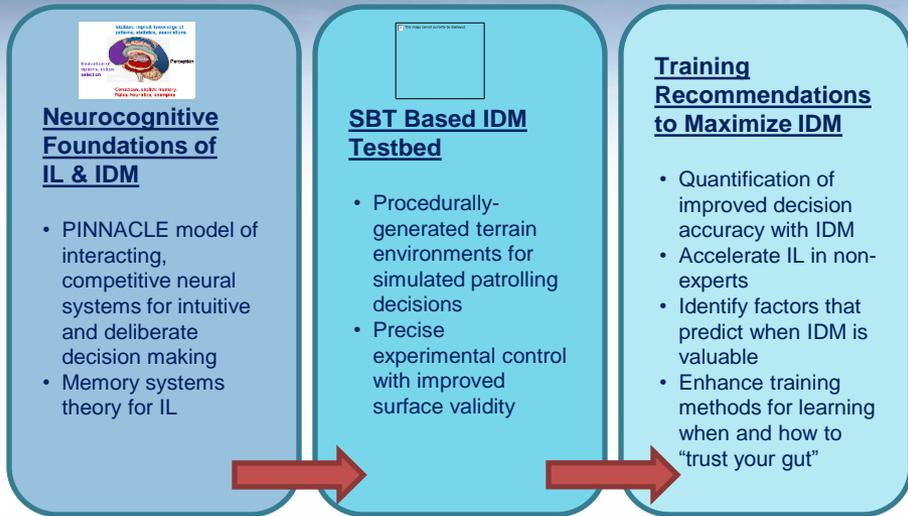
- Focus instructional methods and approaches on the KPAs identified as critical to high quality instruction in the military domain.
- Provide multimedia training content for supporting lesson development on specific instructor KPAs with multiple opportunities for observation-based learning and repeated practice-based learning.
- Strategically integrate multiple training approaches, including video modeling, reflective review and feedback methods, practice, and peer review methods for accelerating instructor mastery of teaching skills.
- Provide support for real-time performance assessment and implementation of measures for assessment of proficiency levels.
- Implement adaptive training by using trainee scores and proficiency levels to automatically suggest training content to meet skill gaps.
- Provide means for ongoing content creation to be utilized by trainees for observing, practicing, reviewing, and reflecting on instructional KPAs.

Performer: Prime: Design Interactive, Inc. (DI)
Sub: Cognitive Performance Group (CPG)

SCHEDULE:	FY16	FY17	FY18	FY19
TASK 1: Conduct Evals, Expand Use Cases, Refine Requirements		PI Option ★	PII ★	◆
TASK 2: Develop Adaptive Training Rules			◆	
TASK 3: Develop Fully Functional System				◆
TASK 4: Develop Training Content, Populate Database			◆	
TASK 5: Finalize Data Collection Plan, Submit IRB Protocol			◆	
TASK 6: Transition and Commercialization				◆



Enhancing Intuitive Decision Making Through Implicit Learning Basic Research Challenge (I²BRC)



Neurocognitive Foundations of IL & IDM

- PINNACLE model of interacting, competitive neural systems for intuitive and deliberate decision making
- Memory systems theory for IL

SBT Based IDM Testbed

- Procedurally-generated terrain environments for simulated patrolling decisions
- Precise experimental control with improved surface validity

Training Recommendations to Maximize IDM

- Quantification of improved decision accuracy with IDM
- Accelerate IL in non-experts
- Identify factors that predict when IDM is valuable
- Enhance training methods for learning when and how to "trust your gut"

OBJECTIVE:

- Develop new or enhanced decision support training through research to characterize and improve Intuitive Decision Making (IDM) abilities, use and validate Implicit Learning (IL)-based techniques within Simulation Based Training (SBT) technology and create training protocols to accelerate effective use of IDM in non-experts.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Every warfighter to exhibit mental flexibility, agile decision-making, and sociocultural acumen
- Optimization of practical exercises and experiential learning across the cognitive, psychomotor, and affective domains.

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- T&E STO-1: Warrior decision-making
- T&E STO-2: Small unit learning and performance assessment
- T&E STO-3: Warrior resilience
- T&E STO-4: Experiential learning technologies and methodologies

TECHNICAL APPROACH:

- ❖ Develop a new SBT-based testbed for quantifying effects of IDM in a more operationally relevant simulated patrolling formation decision task
- ❖ Training and assessment protocols grounded in cognitive neuroscience memory systems theory relating IL and explicit decision processes
- ❖ Experimental hypotheses driven by PINNACLE model of interacting neural systems for IDM and deliberate decision making in the human brain
- ❖ Simulated patrolling decision task blends SBT approach using procedurally-generated environmental conditions with precise experimental control over decision-relevant features
- ❖ Experimentally manipulate cognitive access to environmental features driving IDM to quantify the improvement in decision accuracy from intuition
- ❖ Evaluate methods for increasing the positive impact of IDM on decision accuracy through manipulations of mental state, training instruction
- ❖ Develop training recommendations that maximize IL and strategies for effective use of intuition that provide robust increase in performance measures related to accurate decision making

PERFORMER: Northwestern University

SCHEDULE:	FY16Q12	FY16Q34	FY17Q12	FY17Q34
TASK 1: Initial task protocol development	★ ◆ — — — ◆			
TASK 2: Establish and quantify effects of IL and IDM		◆ — — — ◆		
TASK 3: Strategies for enhancing training of effective IDM			◆ — — — ◆	



Immersive Approach to Intuitive Information Processing & Decision Making



Visual layers that draw attention to “what high-performers would attend to” in like situations. Added visual cues are less explicit than shown here.

OBJECTIVE:

- Develop and validate augmentations to immersive trainers that accelerate the acquisition of effective intuitive decision making skills

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Warfighters exhibiting enhanced anomaly/threat detection capabilities and improved judgment when making decisions under stress and time pressure

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- T&E STO-1: Warrior decision-making
- T&E STO-2: Small unit learning and performance assessment
- T&E STO-4: Experiential learning technologies and methodologies
- Med STO-2: Human performance enhancement capabilities

TECHNICAL APPROACH:

Develop and test new visual cuing strategies display layers within immersive trainers that highlight “what high-performers would attend to” in like situations and thereby accelerate student’s situation recognition capabilities

- Implement systems for capturing, analyzing, and indexing high-performer attention data (e.g., eye gaze)
- Implement and test visual layers that can be displayed within simulated environments to implicitly guide the student’s attention to important features without explicit instruction
- Validate the ability to improve/alter/bias implicit learning by expanding the student’s exposure to key cues, and that the learning is sustained after interventions are removed

PERFORMER: Stottler Henke Associates Inc.

SCHEDULE:	FY14	FY15	FY16	FY17
Pilot studies Implicit learning in games. Stickiness	—◆			
Refine gaze analysis: Clustering, target understanding		—◆		
Test interventions: Auto generated		◆		
Human studies: Test accuracy Implicit vs. explicit			◆—◆	◆
Develop new cueing: Video + stochastic + more implicit			—◆—◆	
Personalize cues: Improve targeting of implicit learning				—◆



Wide Area Augmented Reality



Enhance C2 Tools (e.g. KILSWITCH) with link to Augmented Reality Systems

OBJECTIVE:

- Develop and assess Augmented Reality prototypes capable of working over wide areas for tactical operations and training

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Linking Augmented Reality with small unit C2 systems such as KILSWITCH promises to significantly enhance of small unit fires and CAS capabilities and improve situation awareness.

NAVAL S&T FOCUS AREA(S) ADDRESSED:

- T&E STO-1: Warrior Decision Making
- T&E STO-2: Small Unit Learning & Performance Assessment
- T&E STO-4: Experiential learning technologies and methodologies

TECHNICAL APPROACH:

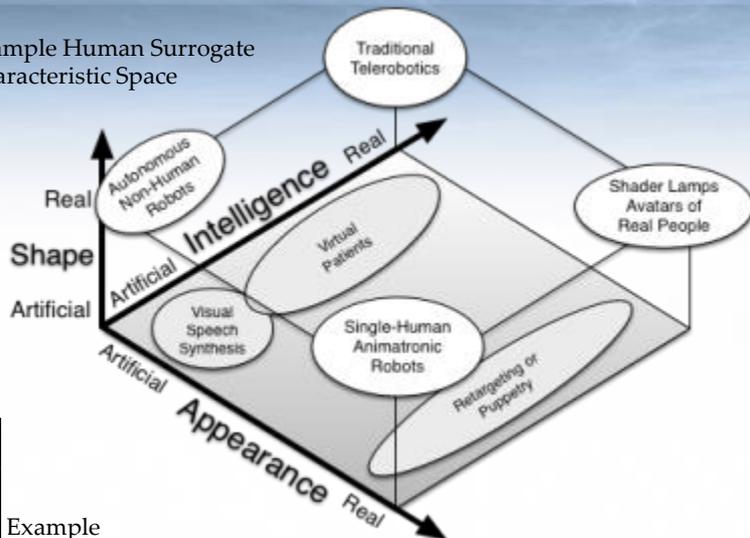
- Develop initial proof of concept linkage between expanded AITT system and KILSWITCH to elicit feedback and demonstrate feasibility
- Collaborate with NAWC Weapons Division - China Lake Digital Precision Strike Suite program
- Associate contractor SRI International to provide tracking and hardware
- Employ 6 month development / demonstration cycle linked to C2 development
- Collect feedback from Marine stakeholders such as TBS Infantry Officer Course, MAWTS-1 Weapons and Tactics Instructor Course, HQMC aviation, and SOIs.
- Explore migration to lower SWaP systems / mobile processors

PERFORMER: Lockheed Martin

SCHEDULE:	FY15	FY16	FY17	FY18
TASK 1: C2/AR Feasibility Prototype		—◆		
TASK 2: Build 1 – C2 Integration			—◆	
TASK 3: Build 2 – Optical see-through, AR HCI				—◆
TASK 4: Build 3 – Wide Area Database Tracking & Tracking				—◆
TASK 5: Build 4 – Student Experimentation				—◆
TASK 6: Build 5 – Operational Experimentation				—◆

Human-Surrogate Interaction

Example Human Surrogate Characteristic Space



Example Human Surrogate

OBJECTIVE:

- A conceptual space/framework for human surrogate characteristics and interactions that encompasses existing manifestations including real, virtual, and physical-virtual humans. Classify literature in this space.
- New knowledge about subsets of this space/framework.
- New knowledge about the impact of context.
- Measurement/estimation framework for subject behavior analysis.
- Guidelines for human surrogate choices (long-term).

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Training for human interactions requires realistic social presence.
- Real human actors involve variability and recurring expense.
- Characteristics/effectiveness of human surrogates are unknown.

NAVAL S&T FOCUS AREAS ADDRESSED:

- T&E STO-1: Warrior decision-making
- T&E STO-2: Small unit learning and performance assessment
- T&E STO-6: Warrior simulation

TECHNICAL APPROACH:

1. Carry out experiments with humans interacting with surrogates.
 - a. Vary characteristics and measure the effects on human subjects in plausible interactions.
 - b. Vary the context (e.g., priming and shared environmental effects) and measure the affects on human subjects.
2. Develop a direct/latent measurement/estimation framework for automated analysis of subject behaviors and apparent state.
3. Develop surrogate technology as needed to support experiments.
 - a. Experimental prototypes (various manifestations).
 - b. Surrogate control (user interface and underlying systems).

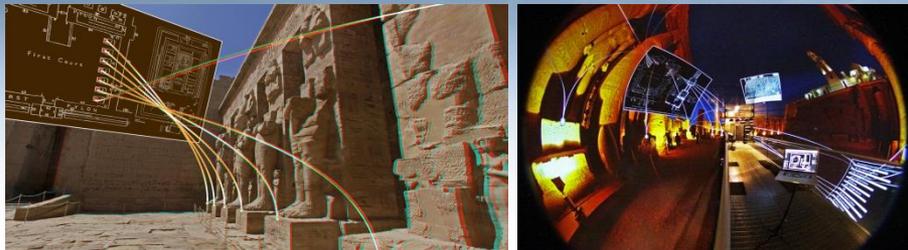
PERFORMERS: Prime: The University of Central Florida
Sub: Stanford University

SCHEDULE:

	FY14	FY15	FY16
Physicality & Gesturing 1 2x2 (gesture) and nx1 (modality) studies	2x2 1xn		
Physicality & Gesturing 2 Design/prep large-scale public study design.		Design/Prep	
Physicality & Gesturing 3 Run large-scale public study		Study	
Behavioral Analysis Develop & test framework for meas./estimation			Develop/Test
Context Studies related to context (e.g., priming & environ)			Design/Study
Technology Development In support of studies	[Bar spanning FY14, FY15, and FY16]		



Augmented Reality Simulation for Design and Evaluation of Training Capabilities



Simulated Wide-field Augmented Reality in the UCSB Allosphere



MR Simulation for Wildfire Emergency Training and for Annotating a City Scene

OBJECTIVE:

- Enable informed design decisions for training facilities involving Augmented Reality (AR) elements

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Improve training transfer for existing training systems by optimizing capability/task match
- Improve effectiveness of new (yet to be built) training systems
- Decrease need for user participation while reliably determining the effectiveness of trainers (freeing up personnel in the future)

NAVAL S&T FOCUS AREAS ADDRESSED:

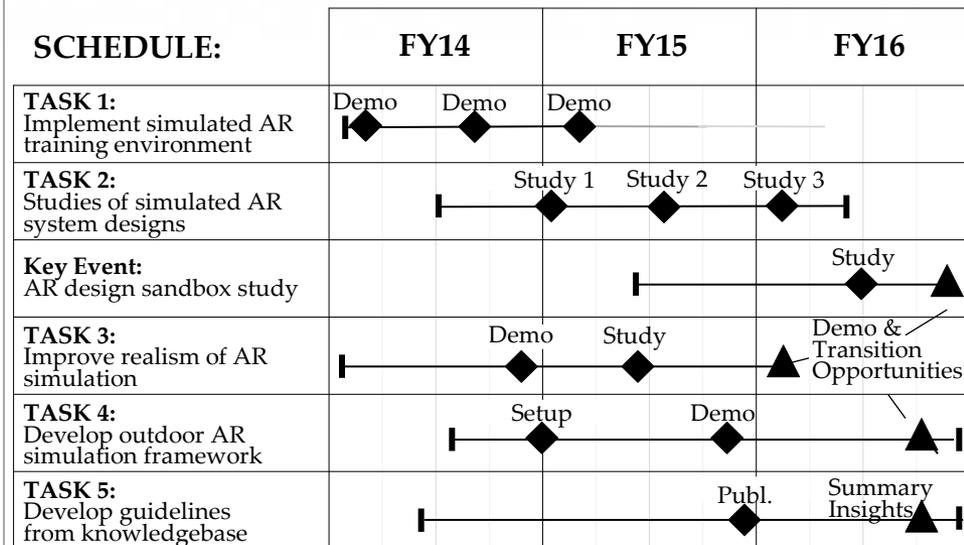
- Human Performance/Training & Education
 - Warrior Simulation
 - Warrior Decision Making
 - High-fidelity Geospatial Synthetic Environment

TECHNICAL APPROACH:

- Using AR simulation, determine the most desirable capabilities for next-generation AR trainers on relevant training tasks
- Identify the most critical need for realism in AR simulators and increase the realism of our MR simulator setups where it is needed most for reliable performance comparisons
- Develop a low-cost outdoor AR setup and methodology to run controlled comparative AR design studies
- Using a knowledgebase of research results, distill guidelines on the use of AR in training systems

PERFORMERS: UCSB (T. Höllerer), Virginia Tech (D. Bowman)

SCHEDULE:





The Basic School Tech Evaluation & ISMT Measurement



OBJECTIVE:

- Develop technology prototypes to enhance TBS instruction.
- Provide an environment and context for code 30 experimentation at TBS.
- Support performance analysis of ISMT training for marksmanship

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- All USMC officers receive training at TBS. Enhancing TBS training would have widespread impact in the Corps through the formative training it provides its graduates.
- BOC and IOC training is challenging and schedules are tight. Technology has the potential to enable more rapid training, allowing time for more in-depth or additional training.
- USMC marksmanship using traditional range training and enhanced with ISMT training evaluates value of ISMT system.

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- Training and Education (T&E) STO-1: Warrior decision-making
- T&E STO-4: Experiential learning technologies and methodologies
- T&E STO-2: Small unit learning and performance assessment

TECHNICAL APPROACH:

- TBS TE Methodology:
 - Instructor-driven requirements development and refinement.
 - Iterative prototype development and feedback.
 - Metric collection during usage trials
- TBS TE focus is Tactical Decision Games
 - Assess opportunities for enhanced instruction
 - Integrated multi-user web-enabled support for student collaboration
 - Implement desired advanced capabilities (e.g., multimedia, layer support, save/restore student session, field-of-fire, simulation integration)
 - Integrate save/restore, instructor scoring for AAR and student evaluation/remediation and SPC support.
- IIT & ISMT Measurement:
 - Support IIT data collection and analysis
 - Compare ISMT and marksmanship range data for analysis of ISMT effectiveness

PERFORMER: Lockheed Martin

SCHEDULE:

	FY14	FY15	FY16
TASK 1: I-TDG Tier 1	—	◆	
TASK 2: I-TDG Tier 2		—	◆
TASK 3: I-TDG Tier 3			—
TASK 4: IIT		—	◆
TASK 5: Transition			▲
TASK 6: Requirements Meeting & Demonstrations	◆◆◆◆	◆◆◆◆	◆◆◆◆



Rapid Synthetic Environment Tool for Virtual Battlespace 2 (VBS)

Bridge Scan



Lab Scan



PIT



Church Scan

OBJECTIVE:

- Rapid Synthetic Environment Tool for Virtual Battlespace 2 (VBS2)

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Training & Education

NAVAL S&T FOCUS AREA(s) ADDRESSED:

- - T&E STO-5: Adaptive simulated entities
- - T&E STO-6: Warrior simulation
- - T&E STO-7: High-fidelity geospatial synthetic environment

TECHNICAL APPROACH:

- The technical objectives are (1) to develop and implement a probabilistic framework to fuse the depth maps from stereo and the kinect sensor, and evaluate its quality to that from structured light scanners in the original
- SBIR proposal; and (2) to develop a hardware/software solution that can capture indoor panoramic video, register them (either automatically or through user-interactions), and provide a light-weight user interface that allows virtual walk-through.
- The expected outcomes are (a) the world's first full-body-capable, high spatial/depth resolution, point-and-shot 3D camera; and (b) a low-cost and easy-to-use system to enable indoor walk-through in a fashion similar to Google Street view. Both have huge commercial potentials.
- Option Phase approved and contract received.

PERFORMERS: Prime: Enomalies

Sub: Stanford University

SCHEDULE:

	FY16	FY17	FY18	FY19
TASK 1: Multi-modal 3D camera prototype	Progress bar with diamond milestone at end of FY17			
TASK 2: Demo of modeling pipeline on PC	Progress bar with diamond milestone at end of FY17			
TASK 3: Demo of Cloud reconstruction System	Progress bar with diamond milestone at end of FY19			
TASK 4: Model import into VBS2 / 3D software	Progress bar with diamond milestone at end of FY17			
TASK 5: Import other modes of scanning,	Progress bar with diamond milestone at end of FY19			
TASK 6: Model import to PIT	Progress bar with diamond milestone at end of FY19			



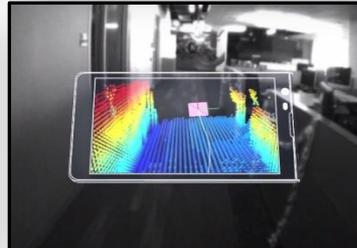
Rapid Synthetic Environment Tool (RSET)



Database Creation



Mobile Terrain Editor



Interior Mapping R&D

OBJECTIVE:

- Enhance train as you fight capabilities through no-cost, easy to use terrain collection, editing, and generation tools

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Ability to create and enhance high-fidelity geospatial synthetic environments with appropriate geographic, topographic, and environmental conditions
- Train and rehearse in physically accurate complex synthetic environments
- Increase effectiveness of simulation training and mission rehearsal
- Improved ease-of-use through coordination and feedback

NAVAL S&T FOCUS AREA(S) ADDRESSED:

- T&E STO-7: High-fidelity geospatial synthetic environment
- T&E STO-6: Warrior Simulation

TECHNICAL APPROACH:

- Coordinate with appropriate organizations to improve existing geospatial synthetic environment capabilities
- Refine tasks and tool development based on feedback
- Develop terrain editing capabilities for mobile devices
- Automate collection and processing of interior spaces using Google's Project Tango device
- Integration of tools and reduction in learning curve
- Incremental demonstration and delivery of capabilities

PERFORMERS:

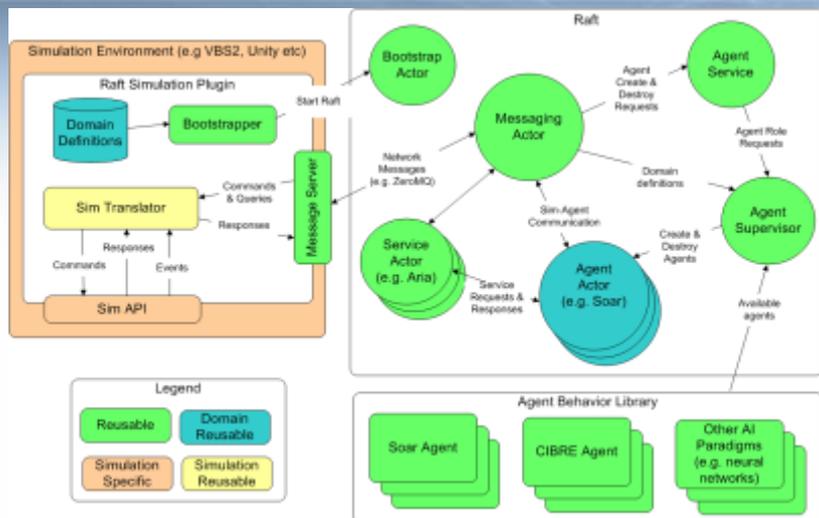
Edgewise Technologies and Applied Research Associates

SCHEDULE:

	FY16	FY17	FY18	FY19				
TASK 1: Coordination / Reqs Gathering	◆	◆	◆	◆				
TASK 2: Terrain Generation Tool (VBS focus)	■	■	■	■				
TASK 3: Mobile Terrain Editor Development	■	◆	■	◆				
TASK 4: Project Tango device R&D	■	◆	■	◆				
TASK 5: Integration of capabilities				■				
TASK 6: Progress, delivery, demonstration	◆	◆	◆	◆	◆	◆	◆	▲



Simulated training Exercises with Robust Unmanned Models (SERUM)



The Raft Framework

OBJECTIVE:

- Develop generalizable AI software to facilitate development of tactically realistic, entity-level behaviors for virtual training environments

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Improved Marine Corps training capability for SUDM skills
- Reduced time in training pipeline
- Increased repetitions in training pipeline
- Reduced instructor resources

NAVAL S&T FOCUS AREAS ADDRESSED:

- T&E STO-1: Warrior decision-making
- T&E STO-5: Adaptive simulated entities
- T&E STO-6: Warrior simulation

TECHNICAL APPROACH:

- Develop software infrastructure (Raft) for integrating AI behaviors and algorithms within a virtual environment
- Develop and integrate small-unit behavior primitives
- Integrate AdCogSys AI paradigm (CIBRE) into SERUM
- Augment AI behaviors with Aptima intent inference

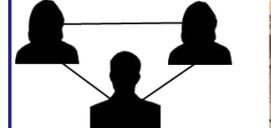
PERFORMERS: Prime: SoarTech
Sub: Aptima, Adaptive Cog. Systems

SCHEDULE:

	FY15	FY16	FY17	
TASK 1: Develop SERUM infrastructure	—◆			
TASK 2: Develop AI primitives		—◆		
TASK 3: CIBRE integration	—◆			
TASK 4: Intent inference	—◆			
TASK 5: Verify infrastructure interoperability		—◆		
TASK 6: SUDM training capability			—◆▲	



Virtual Human Terrain Scenario Training (VHTST)

<p>VHTS-E</p>  <p>RIPPLE</p> <p>VHTS Editors for creating scenarios and Non-Player Characters (NPCs), includes a <u>Dialog Editor</u>, <u>Action Editor</u>, <u>Response Editor</u>, and a <u>Personality Editor</u>.</p>	<p>VHTS-I</p>  <p><Agent Platform></p> <p>VHTS Intelligent Agent platform maintains world facts and individual Player/NPC beliefs. Monitors progress of the individual (single-player) or team (multi-player).</p>	<p>VHTS-S</p>  <p>VBS2</p> <p>VHTS Simulation provides an <u>interface</u> to VBS2 or other simulation platform.</p>
---	--	---

OBJECTIVE:

- Integrate VBS2 with E-CTC RIPPLE, resulting in an affordable, flexible, interoperable training environment. Provide a semantically enhanced content authoring system for realistic training scenarios covering cultural and tactical training areas.

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Enhanced training at reduced cost, integrated cultural and tactical training, semantically authored scenarios, strategic scenario influence.

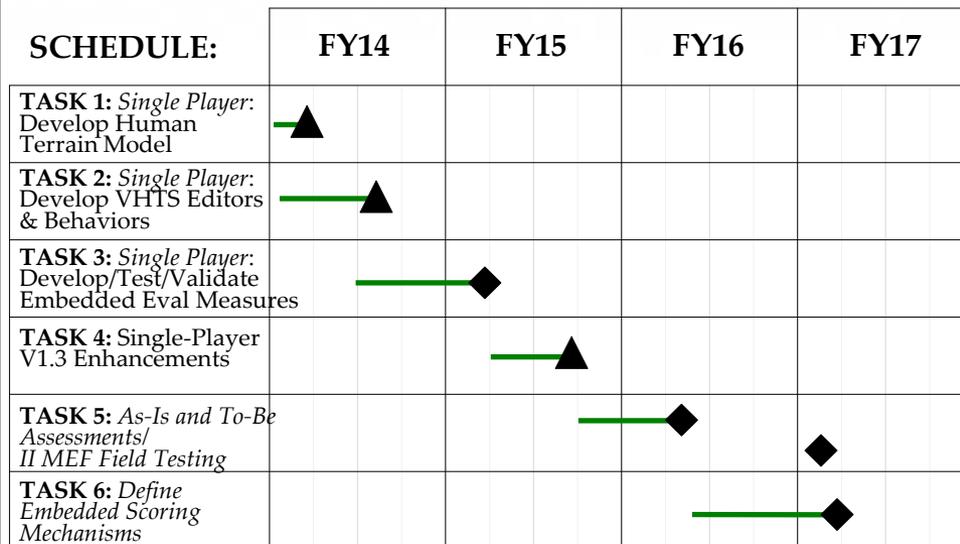
NAVAL S&T FOCUS AREA(s) ADDRESSED:

- Training & Education: Warrior decision making (T&E STO-1).
- Warfighter Performance: Experiential learning technologies & methodologies (T&E STO-4) and Adaptive simulated entities (T&E STO-5).

TECHNICAL APPROACH:

- Identify and model sociological aspects of human network behavior
- Instantiate semantic processing between Exportable E-CTC RIPPLE and core areas of VBS2
- Integrate VBS2 Fusion API with E-CTC RIPPLE
- Demonstrate content authoring scenario system with intelligent agent-based human network software
- Define embedded scoring mechanisms
- Conduct field testing with DVTE suite

PERFORMER: Concurrent Technologies Corporation (CTC)





SUDM Tactical Execution System (TXS)



TXS: A virtual environment and decision-making interface to support SUDM training

OBJECTIVE:

- Implement methodologies for encoding and integrating autonomous, synthetic role players to support virtual SUDM training exercises

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Improved Marine Corps training capability for SUDM skills
- Increased repetitions in training pipeline
- Reduced instructor resources

NAVAL S&T FOCUS AREAS ADDRESSED:

- T&E STO-1: Warrior decision-making
- T&E STO-5: Adaptive simulated entities
- T&E STO-6: Warrior simulation

TECHNICAL APPROACH:

- Develop virtual environment and intuitive interface to support SUDM training
- Develop software infrastructure and framework connecting synthetic role players to the environment
- Develop and integrate SUDM role player (squad team members) and red cell behaviors
- Apply a basic infantry officer use case (squad patrol) to the environment

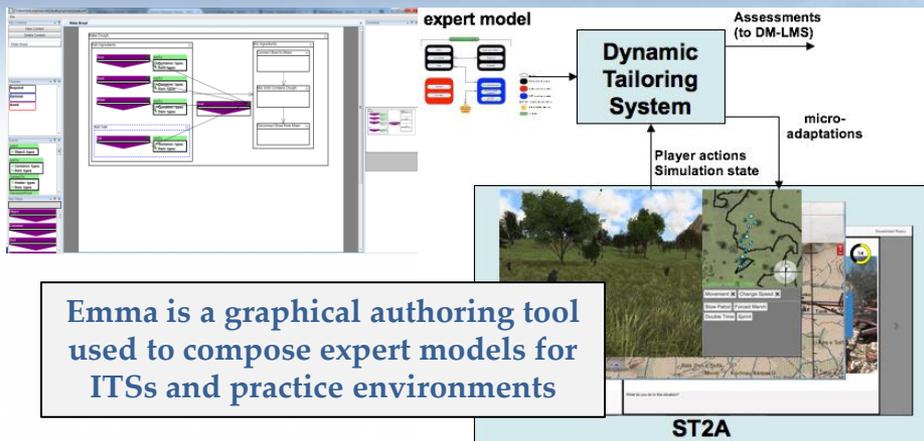
PERFORMERS: Prime: SoarTech
Sub: Cognitive Performance Group

SCHEDULE:

	FY13	FY14	FY15	FY16
TASK 1: Develop behavior language/interpreter		—◆		
TASK 2: Implement SUDM behavior models		—◆	—▲	
TASK 3 (SBIR): Develop robust control interface			—◆	—▲
TASK 4: Develop behavior specification interface			—◆	
TASK 5: micro-adaptation capability			—◆	—▲
TASK 6: Capability Evaluation			—◆	—◆



Fast Authoring of Content for Intelligent Tutoring Systems (FACITS)



Emma is a graphical authoring tool used to compose expert models for ITSs and practice environments

OBJECTIVE:

- Reduce the time and expertise required to compose training content for Intelligent Tutoring Systems (ITSs) and simulated training environments

MILITARY RELEVANCE/OPERATIONAL IMPACT:

- Provide cost savings in terms of the time required to generate ITS content for DoD-relevant training systems.
- Reduce the expertise required to develop new training content, while increasing the quality of that content.
- Quicker adoption of current and future training systems.
- Support for more complex, ill-defined training domains

NAVAL S&T FOCUS AREAS ADDRESSED:

- FY15 Gap 43: Small Unit Decision-Making Training Technologies
- FY15 Gap 44: Training Time and Cost Reduction Technologies

TECHNICAL APPROACH:

- *Emma* is a graphical authoring tool for composing constraint-based expert models (CBEMs) for ITSs and immersive practice environments
- Trainee actions can be compared against CBEM models to identify errors and make other assessments for in-situ scenario tailoring and AAR
- Compose and integrate SUDM expert models and trainee monitoring into TXS system to demonstrate micro-adaptation and real-time student assessment

PERFORMER: SoarTech

SCHEDULE:	FY16	FY17	FY18	FY19
Emma development	★	—		
TXS Integration		◆	◆	◆
SUDM expert modeling	—			
Emma user acceptance testing		—		
ADSUDM/ST2A integration			—	▲