



Integrity ★ Service ★ Excellence

Human System Technologies Strategic Vectors

15th Annual Science & Technology
Engineering Technology/ Defense Tech
Exposition

8 April 2014

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Changing Landscape

New Bio Developments

- Genomics, proteomics
- Neuroscience
- Microbiome

Warfighter Demand

- Cyber, RPA, OE...
- Areas we didn't have 15+ years ago
- Extreme cognitive & physical environments
- A2AD operations



New Tech Development

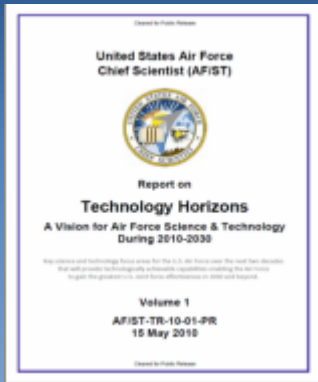
- Human-machine teaming and autonomy
- LVC immersive environments
- Robotics

Affordability & Sustainment (Cost of healthcare, personnel, energy)

- Exponential growth
- Unsustainable

AF S&T Vision Key Documents & Studies

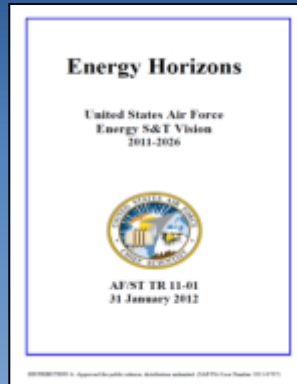
Tech Horizons



Single greatest finding is the need for gaining capability increases, manpower efficiencies, and cost reductions through:

- Far greater use of autonomous systems
- Human performance augmentation

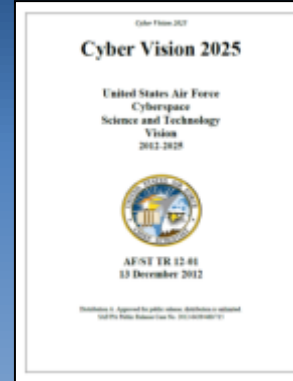
Energy Horizons



Maximizing distributed, interactive flight simulators to:

- Decrease the training costs of live operations
- Enable safe training in contested, congested conditions
- Enhances readiness

Cyber Vision 2025



Assured cyberspace advantage by focusing on:

- Mission assurance
- Resiliency and agility
- Human-machine integration
- Trust

Global Horizons



Key game changers for the AF resulting from significant global trends in technology advancements:

- Personalized health & performance via mobile technologies
- Personalized learning
- Flexible autonomy
- Weapons in Context of Human Environment

AF Human Performance Challenges

RPA Operator



- Low manning
- Long hours, shift work
- Emotional exhaustion
- Asset losses
- Decreased mission effectiveness

Aircrew



- High physical demands
- High cognitive load
- Decreased adaptability to contested environments
- Survivability issues in high-G

ISR Analyst



- Time pressure
- Intel data overload
- Continual transfer of operational SA
- Missed intelligence
- Threat/danger missed
- Manpower efficiency

Special Operator



- High physical demands
- High cognitive load
- Time/lost targets
- Poor decisions
- Loss of life

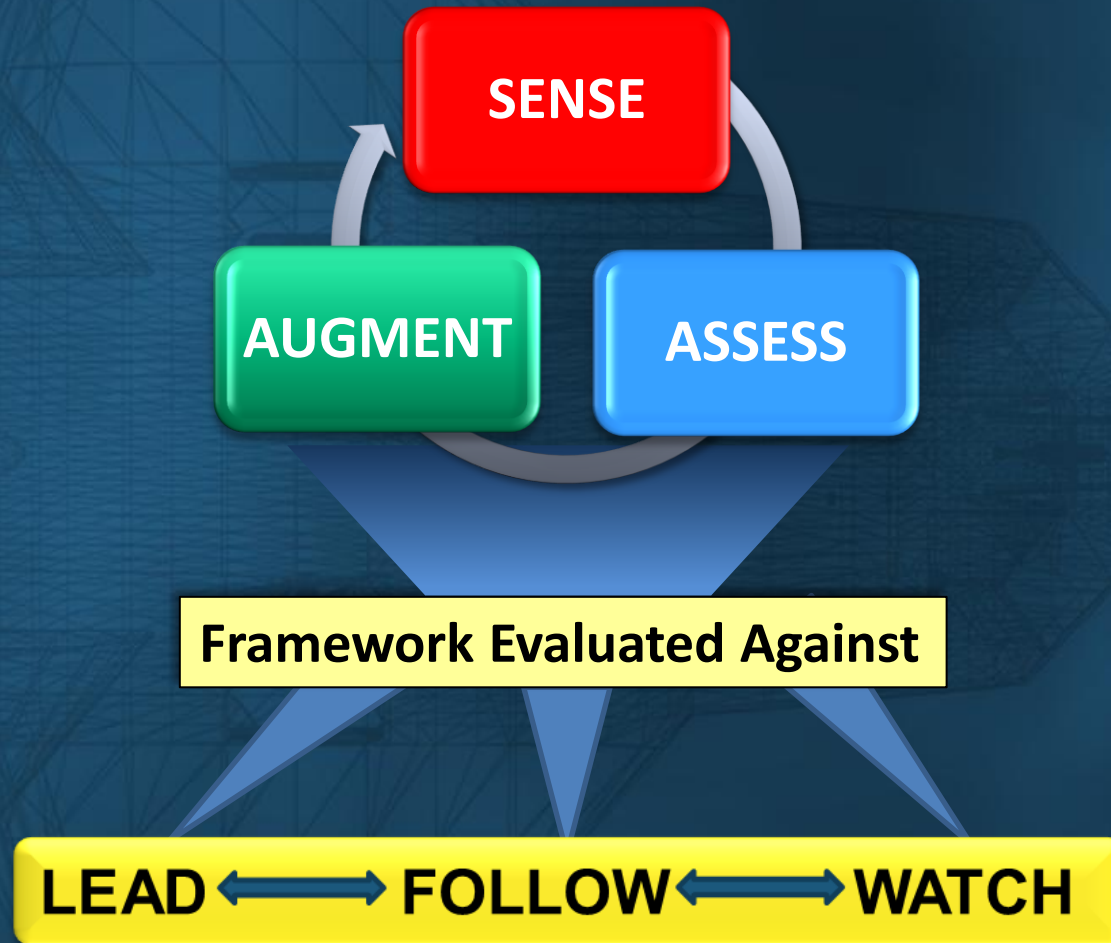
Cyber Operator



- Information overload
- Reduced acuity
- Decreased vigilance
- Missed interventions
- Missed intelligence
- Decreased offensive proactivity

Repetition, Information Overload, Fatigue, Stress

Human Systems Framework



Strategic Vectors

**Personalized
Health &
Performance**



**Human-Machine
Teaming for
Autonomous
Systems**

Protection

Strategic Vectors

**Personalized
Health &
Performance**

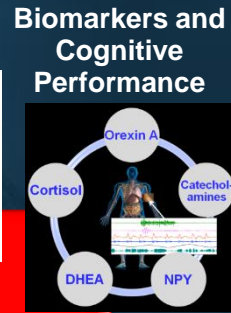
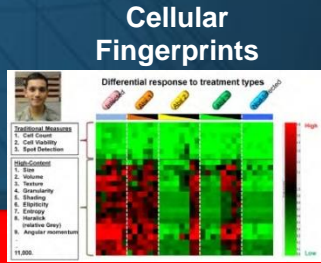


**Human-Machine
Teaming for
Autonomous
Systems**

Protection

Personalized Health & Performance

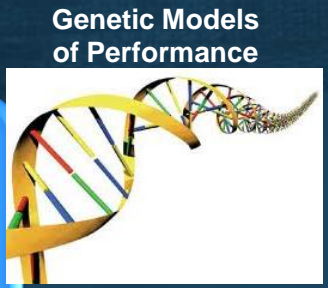
Seamless En Route Care
Precision Care via Genomics
Pharma/nutraceuticals
for Performance



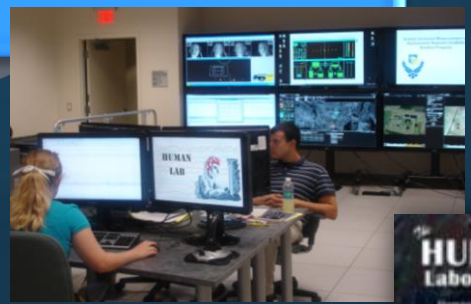
SENSE

AUGMENT

ASSESS



Personalized Learning



Assessment from Integrated Sensors



Personalized Health & Performance



- **Technologies that Provide:**
 - Unprecedented real-time and continuous feedback
 - Quantification at the individual level with complex data resolution across scales from genes to whole body
- **Technologies that Enable:**
 - Assessment of the physical and cognitive state of the operator
 - Optimization of health and performance lifecycle needs of the warfighter
 - Individualized solutions

Strategic Vectors

Personalized
Health &
Performance



Human-Machine
Teaming for
Autonomous
Systems

Protection

Protection



Advanced Hearing Protection

Physiology



Toxicity Assessments and Toxicology Characterization & Profiling of Aircraft Fluids

Toxicology

Cognitive

SENSE



Stress & Resilience Biomarkers

AUGMENT

ASSESS



Laser Eye Protection



Neuropsychological Performance Assessment Tools

Cognitive



Application of Toxicology Exposure Sensors

Toxicology



Centrifuge Testing

Physiology



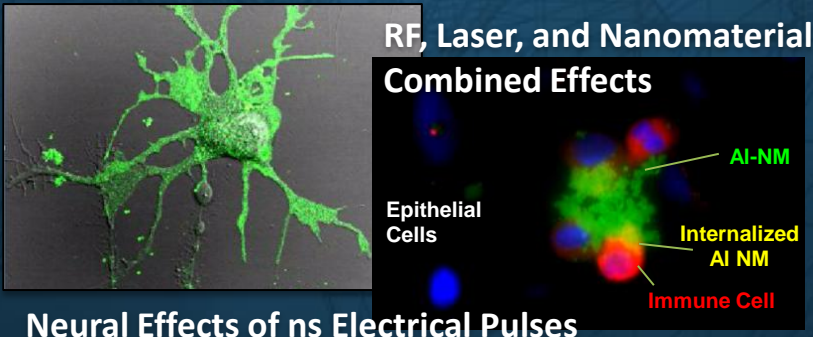
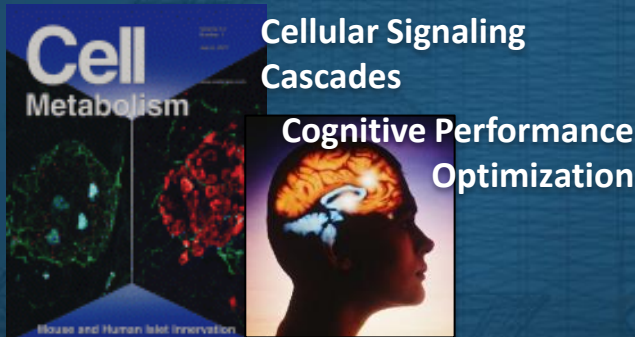
Altitude & Decompression Studies

Protection

Aerospace Fuel and Materials Toxicology



- **Technologies that Provide:**
 - Physiological effects of USAF environmental stressors
 - Fundamental mechanisms for cognitive decrement
 - Emerging fuels and materials toxicology
 - Directed energy system bioeffect protection
 - Data for exposure limit standards
- **Exploitation of Technologies**
 - Novel weapon concepts
 - Optimized concepts of operation and technology blends



Strategic Vectors

Personalized
Health &
Performance



Human-Machine
Teaming for
Autonomous
Systems

Protection

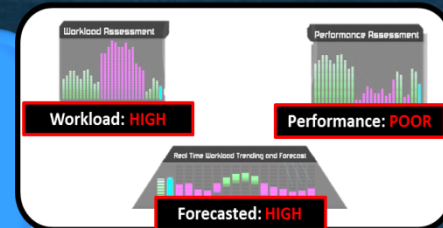
Human-Machine Teaming for Autonomous Systems

Leverage Developments in Personalized Health & Performance

SENSE

AUGMENT

ASSESS



Implement a Controlled Feedback Cycle

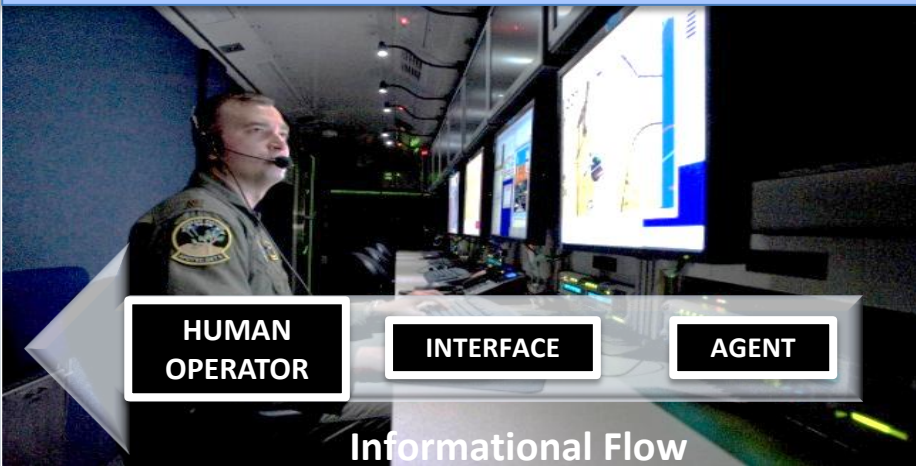
Augment Human Performance with Autonomous Systems



Human-Machine Teaming for Autonomous Systems

**HUMAN DECISIONS
GUIDE MACHINE BEHAVIOR**

**HUMAN AND MACHINE TEAM
TOGETHER TO MAKE DECISIONS**



Current Status

Future Status

Bi-Directional Flow of Information

Human-Machine Teaming for Autonomous Systems



- **Technologies that enable:**
 - Objective measurement and assessment of human's state (physiological, performance, behavioral)
 - Humans and machines to communicate and share information
 - Tasks and function allocation for workload and decision-making balance
 - Adaptive, learning and extended mutual training between H & M
 - Integrated human and machine data (context, time, format) for a shared world model

Partnering Opportunities

- **Personalized Performance Monitoring**
 - **AF Mission-Relevant Human Sensing Technologies (leveraging current personalize performance developments in sports and health)**
 - **Assessment & Augmentation Technologies**
- **Protection**
 - **Physiology, Cognitive & Toxicology Sense & Assessment Technologies**
- **Human-Machine Teaming**
 - **Mission-based Assessment Technologies**
 - **Intelligent Machines to Augment Airman Performance**

Questions