# Department of Defense
# HUMAN SYSTEMS OVERVIEW

## July 2012

# Roadmaps Tuned to Strategic Guidance of January, 2012

- **President**
  - … focus on … Asia Pacific …. deepening partnerships
  - … military is agile, flexible, and ready for the full range of contingencies
- **DepSecDef**
  - … Joint Force of the future that will be smaller and leaner, but will be agile, flexible, ready, and technologically advanced.
  - … led by the highest quality, battle-tested professionals
- **Primary Missions**
  - Counter Terrorism and Irregular Warfare
  - Deter and Defeat Aggression
  - Provide a Stabilizing Presence
  - Conduct Stability and Counterinsurgency Operations
  - Conduct Humanitarian, Disaster Relief, and Other Operations
- **Joint Force**
  - … resist the temptation to sacrifice readiness
  - … limited resources may better tuned to their requirements
  - … encourage innovation in concepts of operation

# Summary – Human Systems

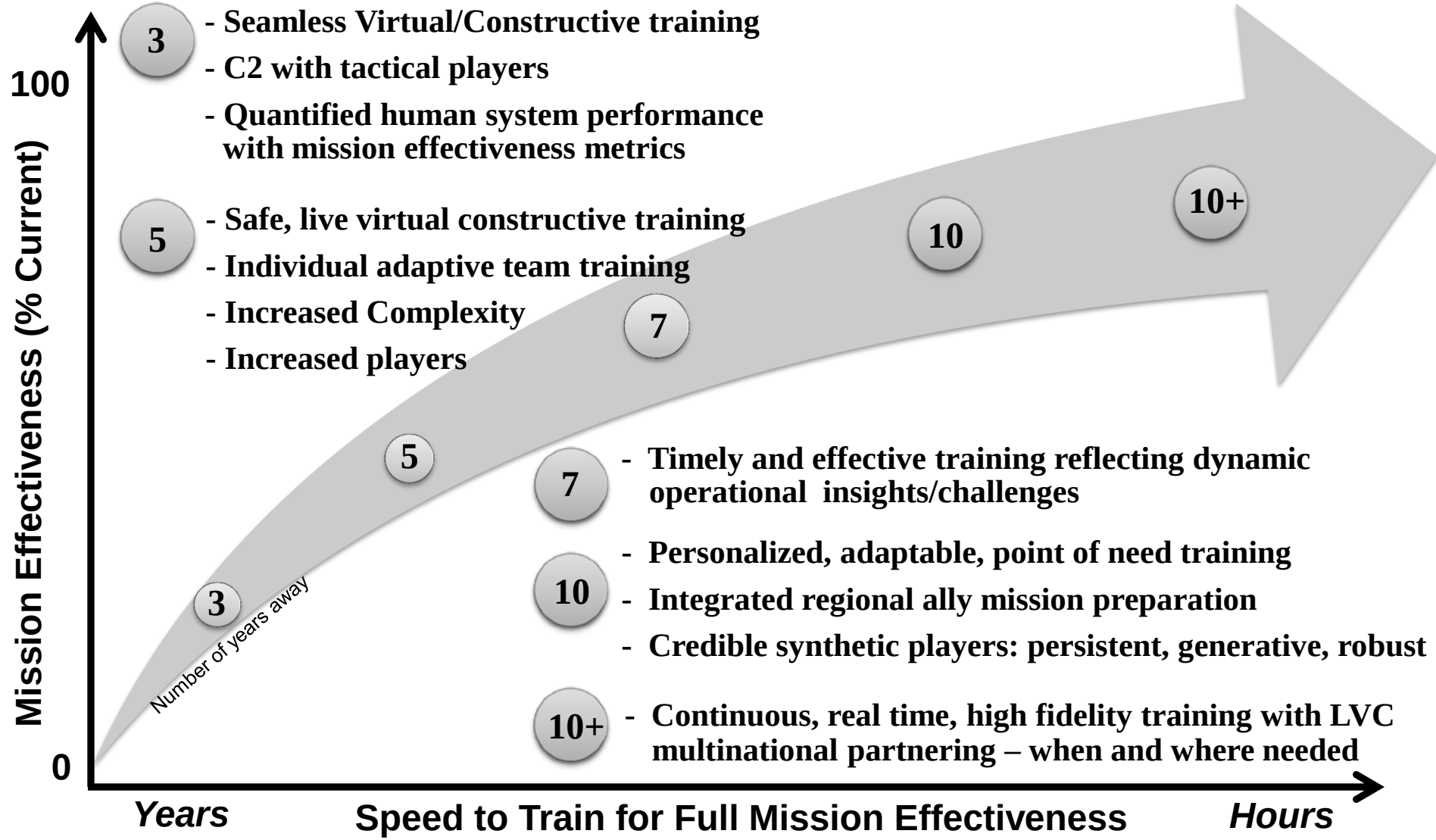
- **Big Ideas**
  - Enable Engineering and Assessment for Joint Mission Effectiveness
    - Baseline Effectiveness Using Realistic Mission Training Scenarios
    - Extend Mission Training Scenarios to Joint Missions
    - Provide Synthetic Environments for Collaboration with Industry, Others
  - Natural interfaces to manage multiple scale multiple role systems
    - Develop common representation schemes for system/data interaction
    - Develop natural language and gestural system interaction
    - Develop operator state monitoring technology

# Human Systems Training for Readiness

## Problem: Complex Evolving Threats Outpace Readiness Training

- Warriors train for tomorrow's fight using yesterday's technology, methods, and strategies
- Current  training scenarios not matched to evolving mission complexity and dynamics
- Warfighters are trained to doctrine -- fight strategically and dynamically to meet new threats
- Training is costly
  - Live systems deplete inventory, consume fuel, require maintenance & wear out
  - Ranges & role players are expensive –  lack fast responsiveness to changing scenarios
  - Training ranges not designed for flexible scenarios and throughput is inadequate

# Training Technology End States



# Human Systems Training Technical Challenges

## Challenge 1: First Principles for Training Design

- Validated tools to optimize training outcomes across individuals and teams
- Characterizing and exploiting the "science of learning" and developing performance measures for effectiveness prediction
- Techniques to automatically capture operationally relevant measures of performance

## Challenge 2: Realistic, Adaptive and Interactive Scenario Based Training

- Persistent integration of real world events and content into scenarios and syllabi
- Demonstrated and validated for the full range of warfighter capabilities reflecting recent lessons learned
- Training that adapts to warfighters' individual needs in near real-time

## Challenge 3: Persistent, Affordable, Integrated Training

- Mission-focused training simulations that enhance individual and collective training
- Seamless, secure integration of training systems across services and coalition partners

# Training Challenges

## #1 – First Principles for Training Design

**Gaps**

- Estimated operational effectiveness via training scenarios
- Verification & Validation of advanced training models
- Measures and assessment of long term (life long) performance

## #2 – Realistic, Adaptive, and Interactive Scenario Based Training

**Gaps**

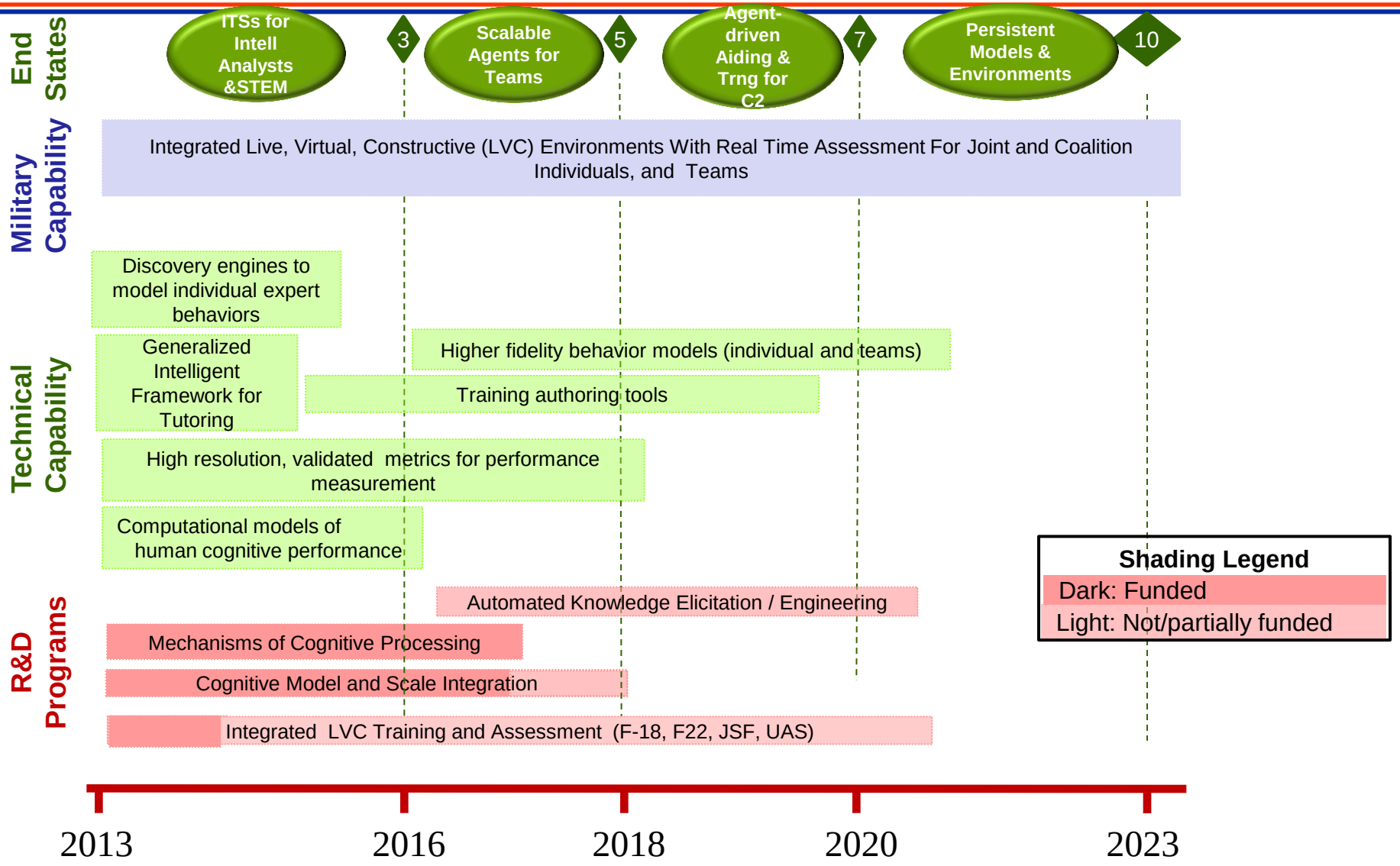
- Automated, adaptive, and individualized tutors
- Automated knowledge elicitation to develop responsive instructional content
- "On the fly" assessment in dynamic environments

## #3 – Persistent, Affordable, Integrated Training

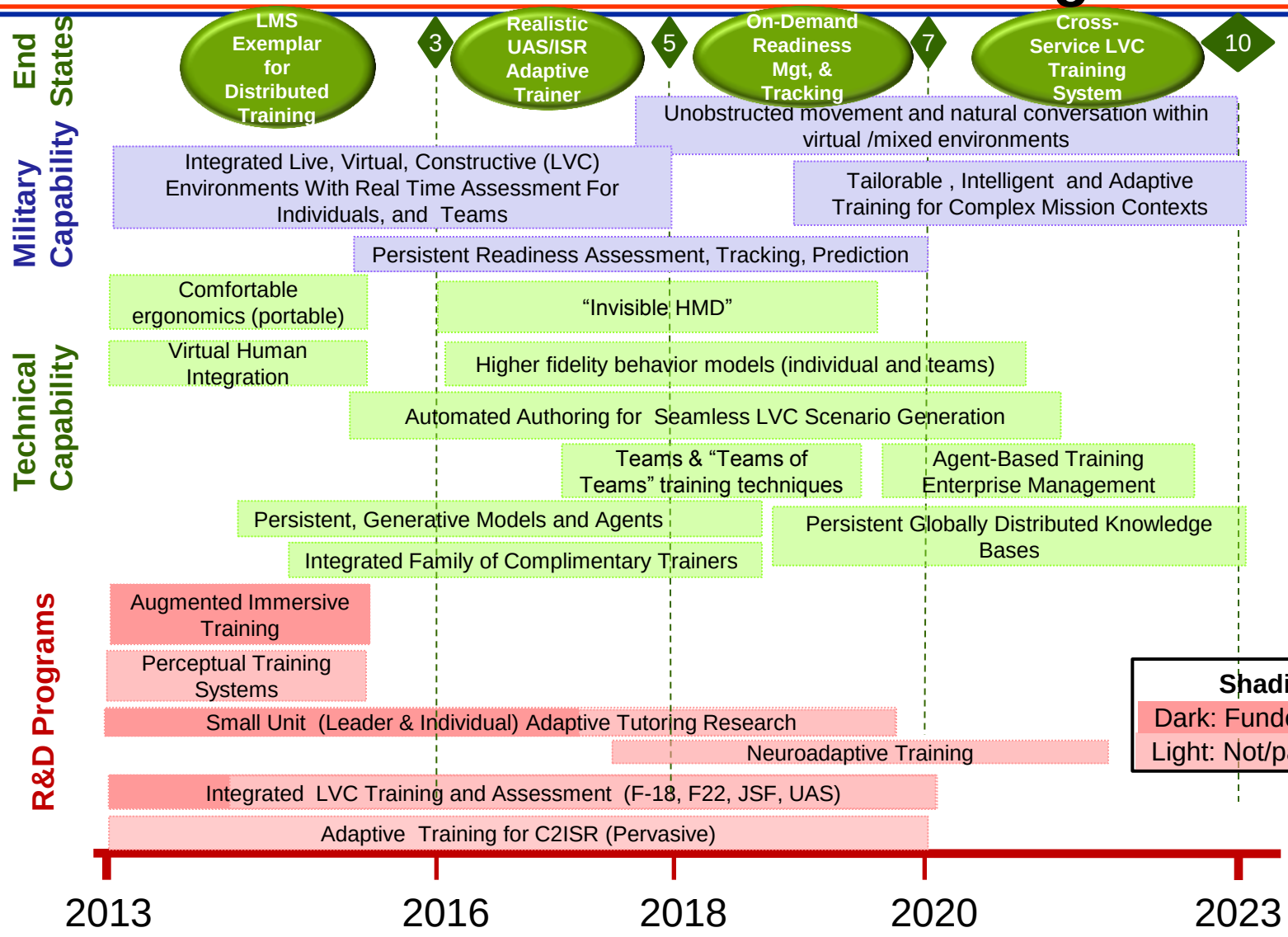
**Gaps**

- Training systems which adapt to individual needs
- Standardized data protocols for operation in multi-level classified environments
- Scalability across increasingly complex domains

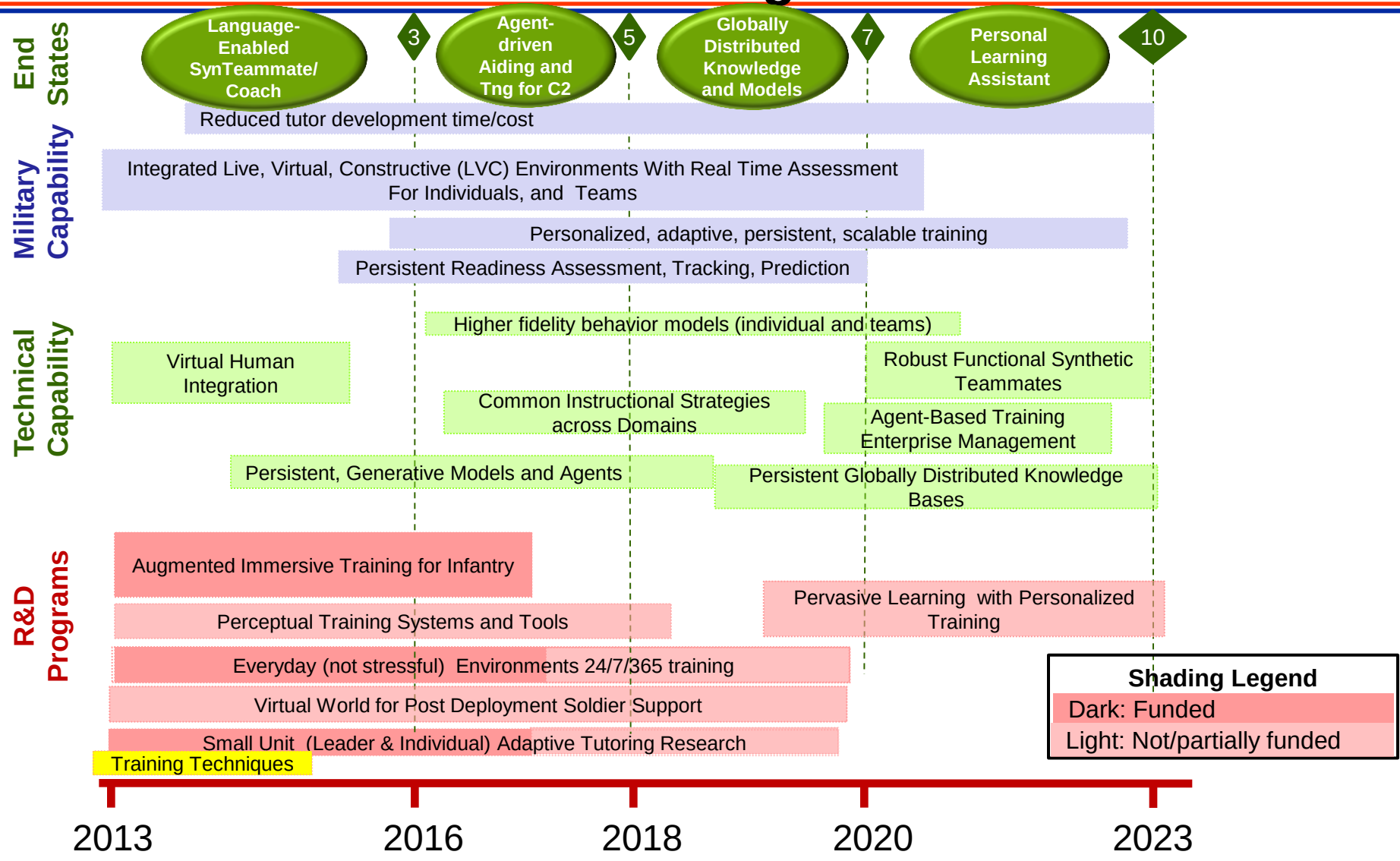
# Training Roadmap – First Principles for Training Design



# Training Roadmap – Realistic, Adaptive and Interactive Scenario Based Training



# Training Roadmap – Persistent, Affordable, Integrated Training

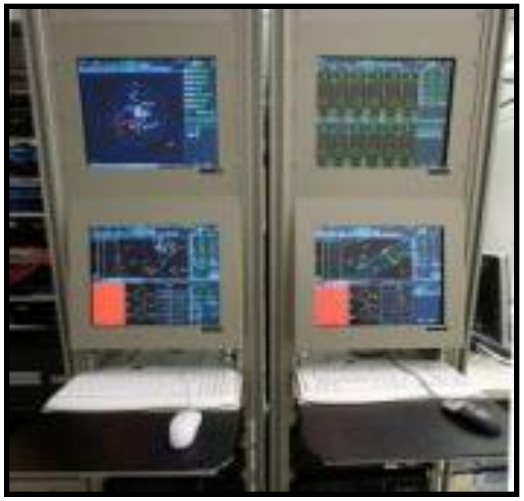


# Human Systems Interface for Effectiveness

**Problem: Current system operation is rigidly data-centric vice flexibly information-centric**

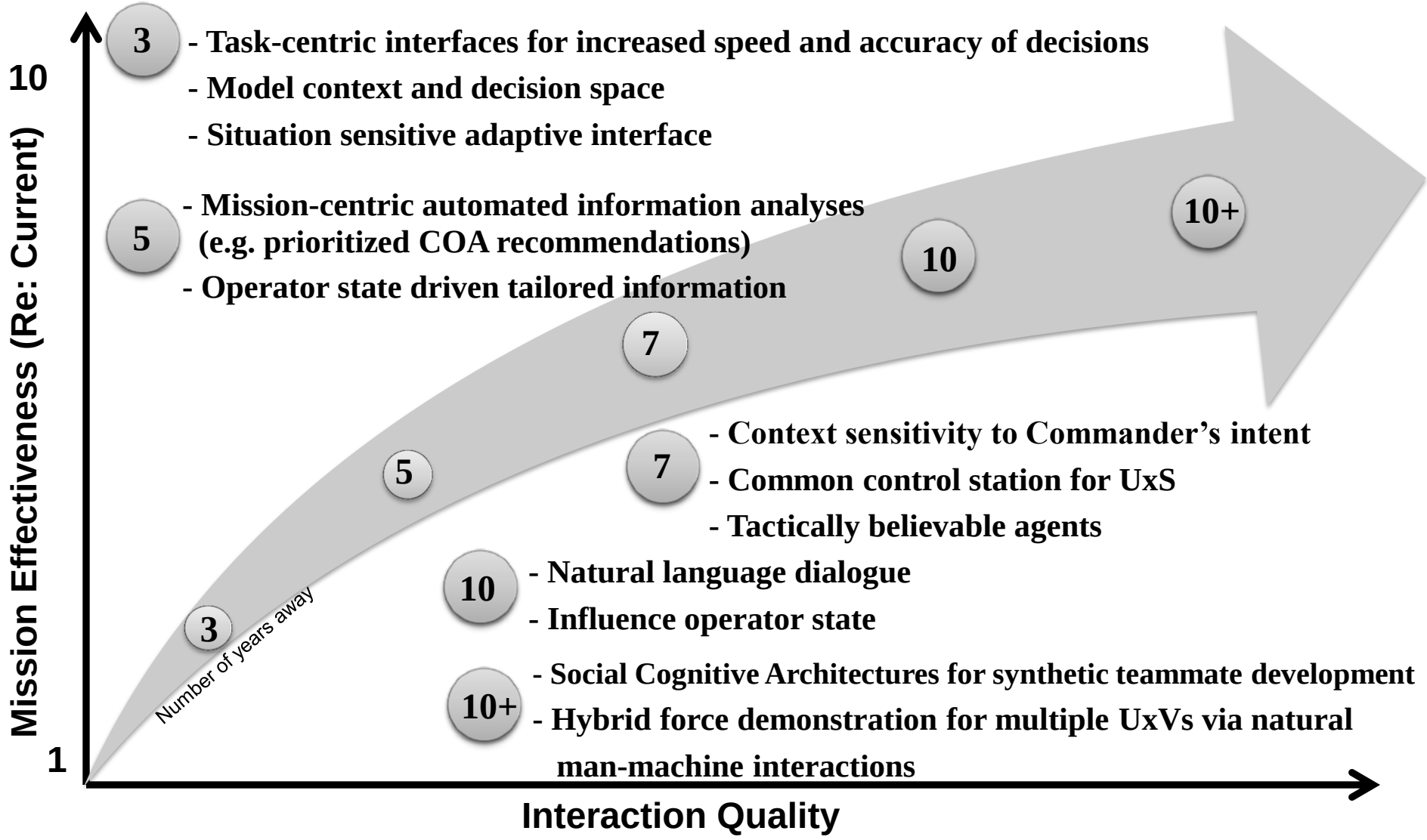
- Modern technologies exacerbate critical manning and talent pool deficiencies by ignoring role of Mission, Task & Context – Moving & presenting data vice information
- Current adaptive planning tools do not allow rapid “course of action” analysis and generation
- Information displays typically non-interactive, adapting little to changing needs
- Data quantity will continue to increase nonlinearly

**Virtual lab**



**Actual lab**

# Interface Technology End States



# Human Systems Interface Technical Challenges

## Challenge 1: Human-Machine Teaming

- Developing representation and inference frameworks that capture and reason over the beliefs, goals, intentions and obligations of the human user
- Integrating low-level operator state modeling with representations of human user's estimated mental states (see below)

## Challenge 2: Intelligent, Adaptive Aiding

- Measuring, assessing, and modifying operator's mental and physical state
- Adapting estimates of user's mental states via successful and unsuccessful interactions
- Iteratively learning user model via natural, multi-modal interfaces (E.g. gesture, natural language dialogue)

## Challenge 3: Intuitive Interaction

- Natural, anticipatory interaction
- Trust

# Interface Challenges

## #1 – Human-Machine Teaming

**Gaps**

- Non-verbal cue understanding between the interface and the operator
- Natural interfaces to manage multiple scale (one to many), multiple role systems

## #2 – Intelligent, Adaptive Aiding

**Gaps**

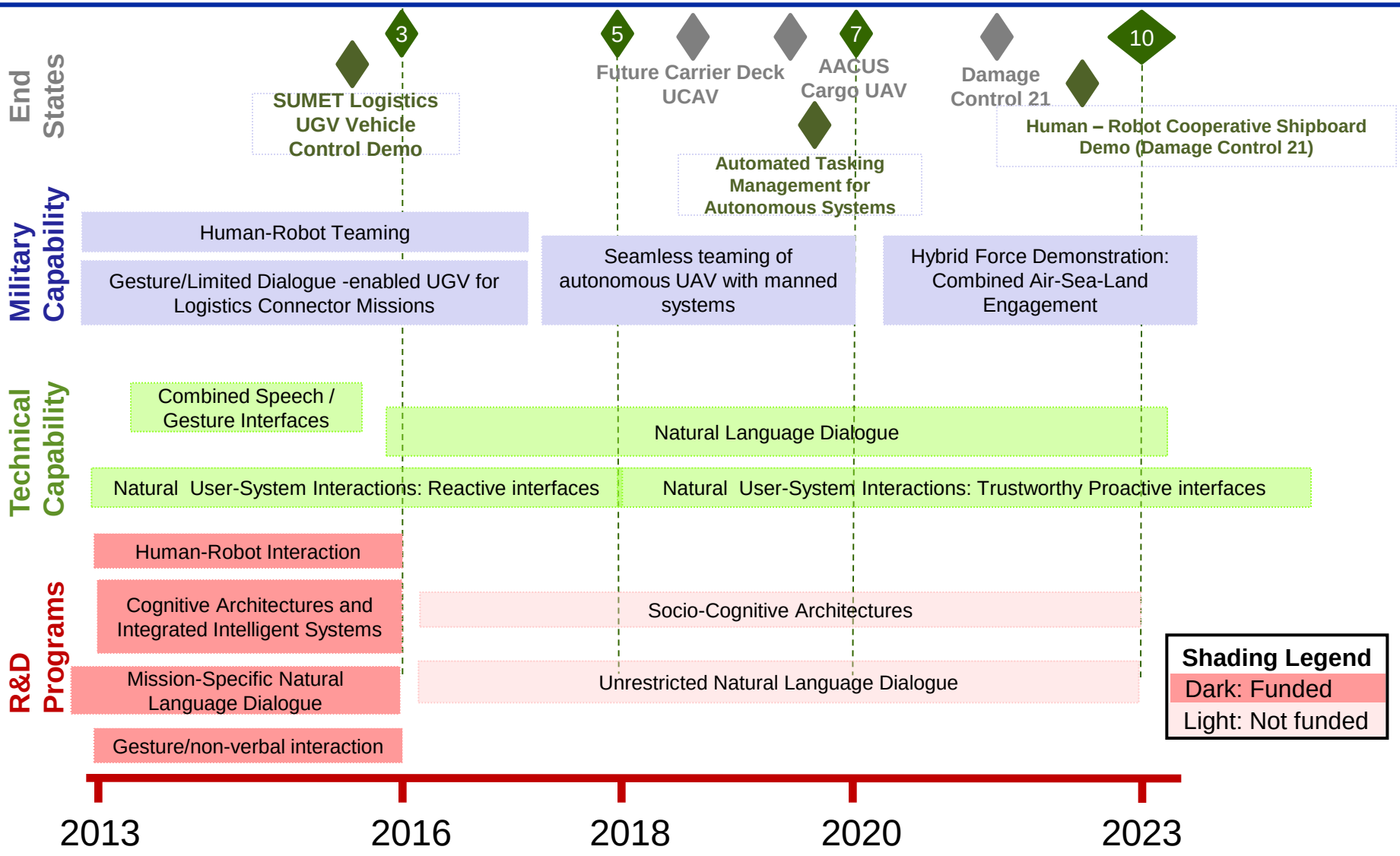
- Metrics (systematic, scalable, relevant) for free form interactions
- Interfaces which adapt to the user's mental state
- Heuristics to determine relevant information to be exchanged during operations

## #3 – Intuitive Interaction

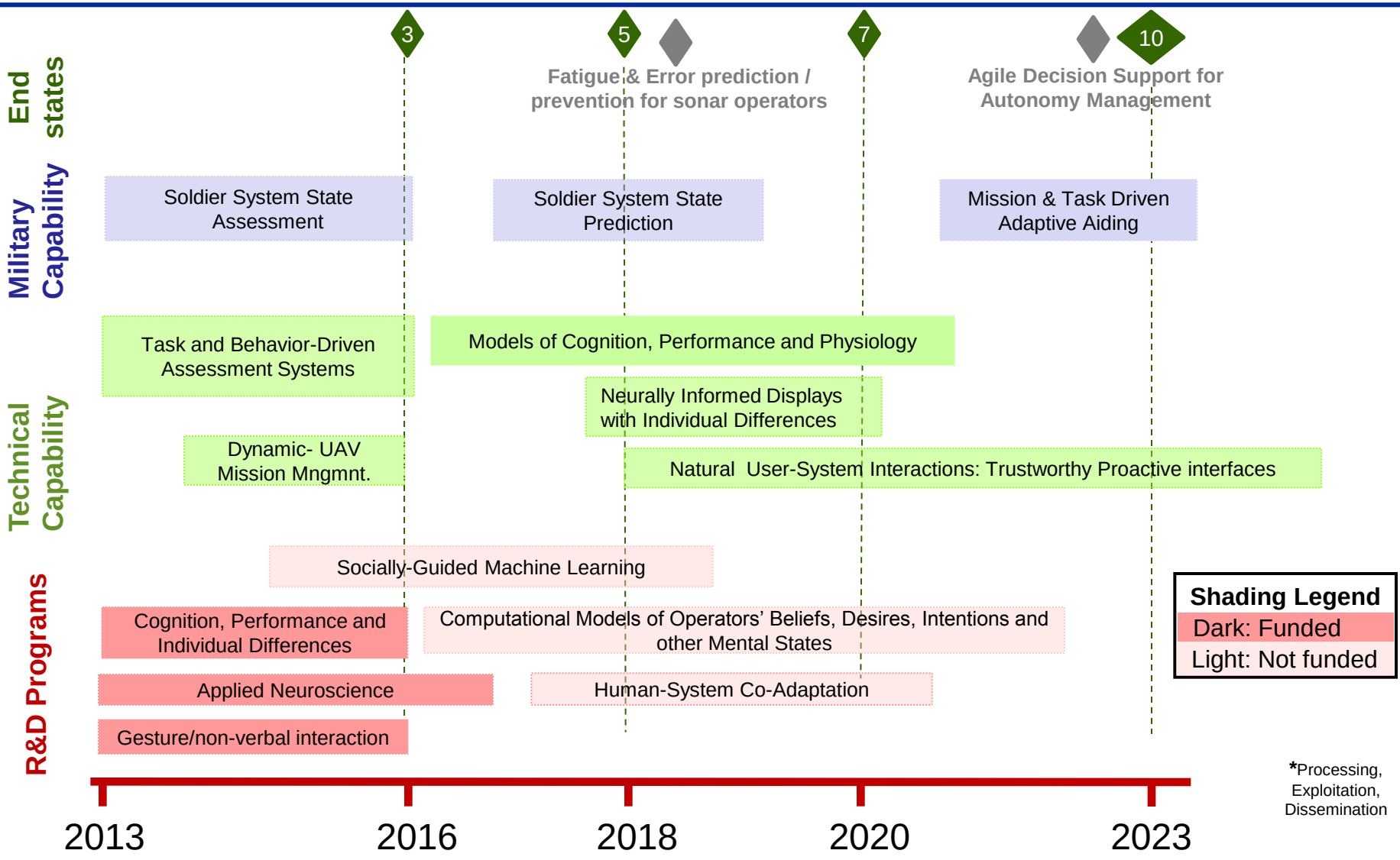
**Gaps**

- Human-centric parameters for management of autonomous systems
- Goal-oriented interfaces for simultaneous multiple domain operations

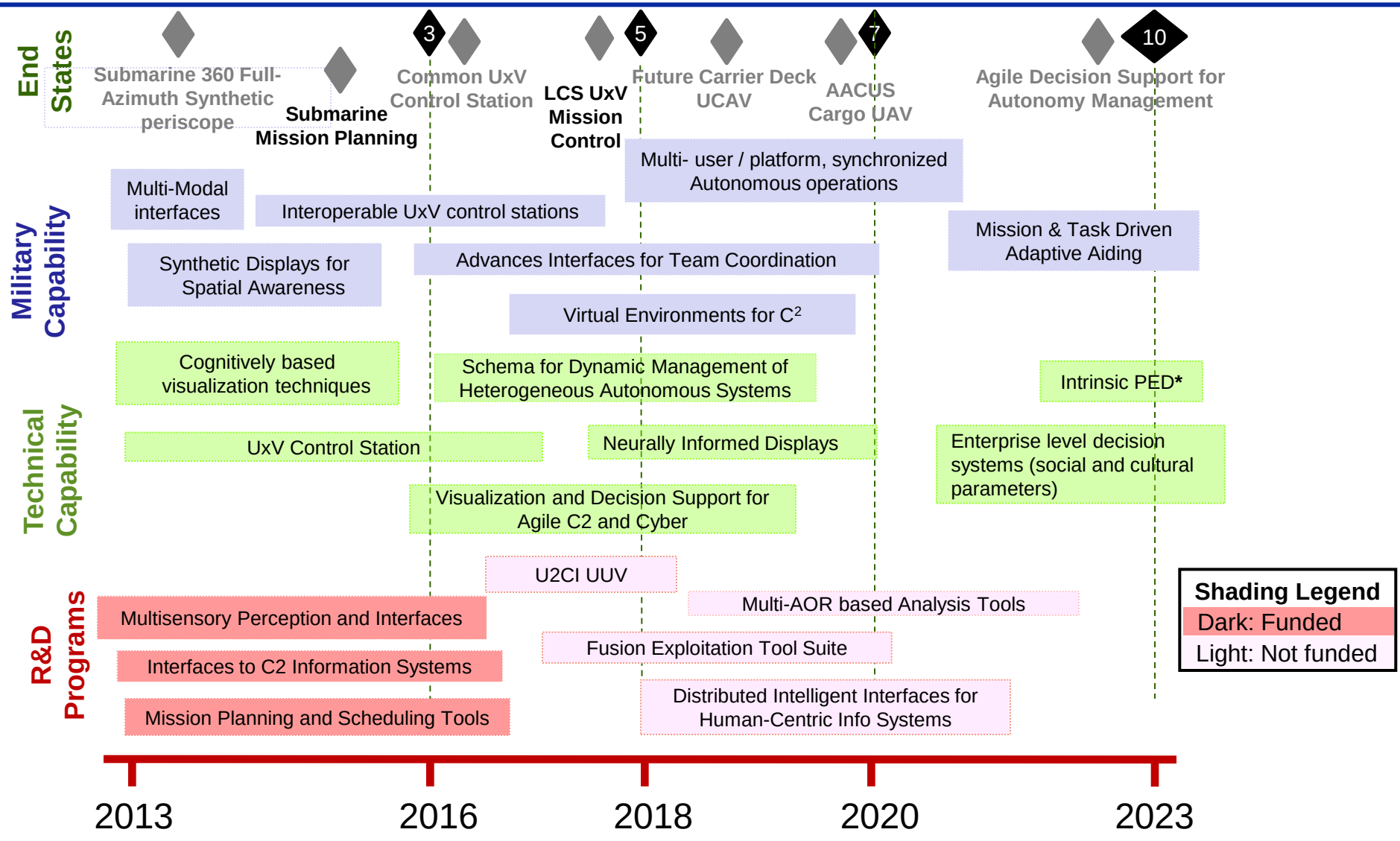
# Interface Roadmap – Human-Machine Teaming



# Interface Roadmap – Intelligent, Adaptive Aiding



# Interface Roadmap – Intuitive Interaction



# Summary

- **Engineering and Assessment for Joint Mission Effectiveness**
- **Natural interfaces to manage multiple scale multiple role systems**

# BACKUP

# Interfaces and Training End States

Lessons Learned from the field

Continually Updated Training Regimen

Up to date, synergistic training

Training & Tactics

LVC with Current Tactics
Adaptive Tutoring / Training
Home-based Combat Training
Mission Rehearsal

Training & Tactics

"Instrumented" Operator

"Instrumented" System

*Today*

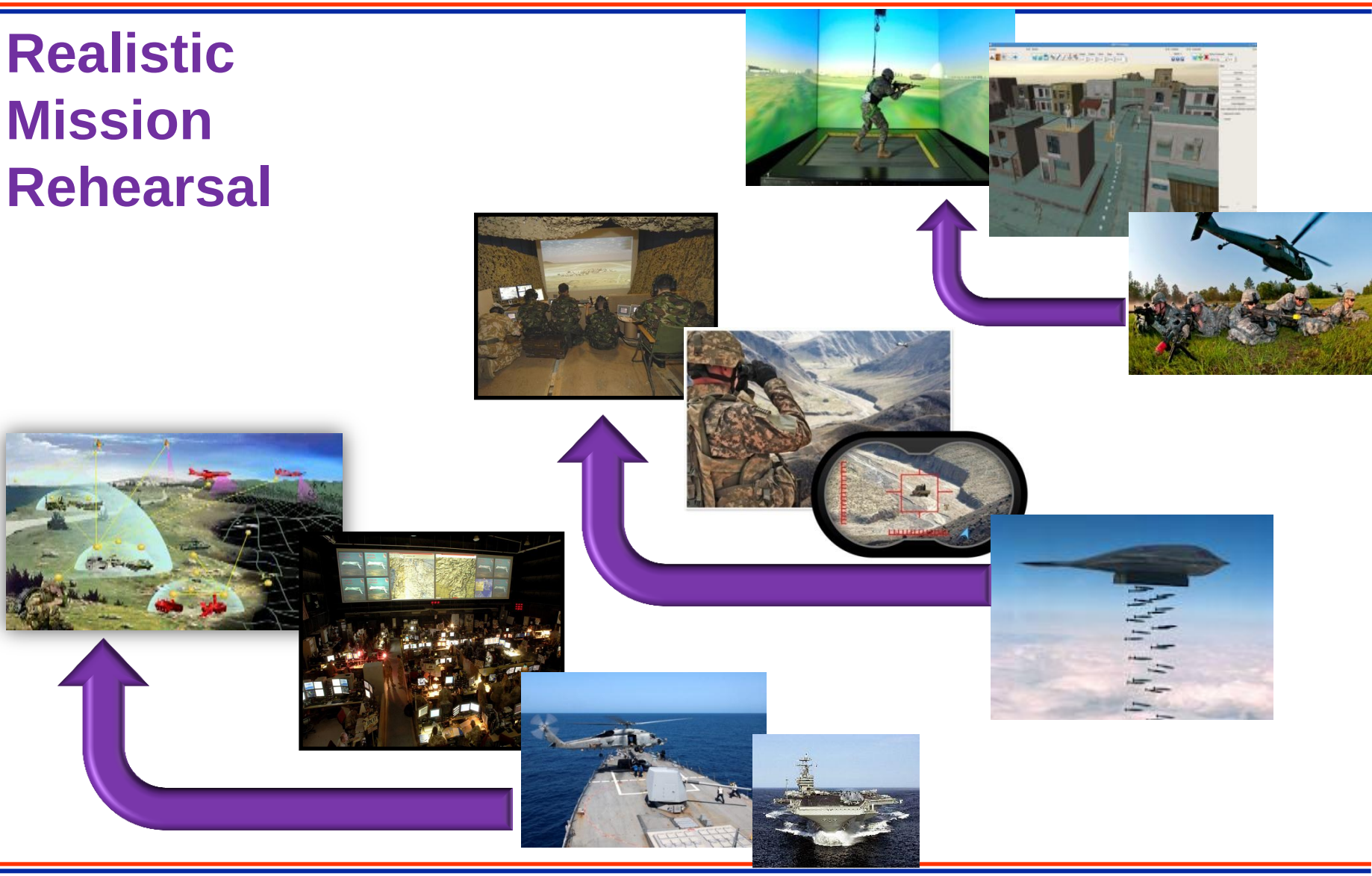
*The Future:*
*Human Systems - Autonomy*

Cognitive Processing, Visualization, Neuroscience, System State Adaptation, Continuous Learning

Operator-State Adaptation, Autonomous Intent, Cognitive Modeling

# Training Vision

## Realistic Mission Rehearsal



# Interface Vision

## Constant, reciprocal state awareness between humans, machines, and information sources

# Human Systems Training Measures of Success

## Challenge 1: First Principles for Training Design

- At least one sigma performance improvement of trainees across domains / applications
- Automated measurement capability that produces meaningful feedback for individual and/or collective performance in live and virtual training exercises

## Challenge 2: Realistic, Adaptive and Interactive Scenario Based Training

- Automatic players in training scenarios indistinguishable from live players ('Turing Test')
- Improved performance resulting from training that automatically adapts in near real time
- 25% reduction in time and cost to develop training scenarios

## Challenge 3: Persistent, Affordable, Integrated Training

- Capability to deliver training to any internet-capable device
- Affordable, turnkey capability to link simulations across services for joint training exercises

# Human Systems Measures of Success

## Challenge 1: Human-Machine Teaming

- Number of UxVs controlled by single operator
- Number of warfighters and UxVs supported in roles
- Per cent of operator requests anticipated
- Latency for machine-generated alternative courses of action

## Challenge 2: Intelligent, Adaptive Aiding

- Speed and accuracy of decisions X scope
- Transaction rate of relevant information
- Increased situation awareness

## Challenge 3: Intuitive Interaction

- Accuracy of operator state assessment
- Effectiveness of natural language dialogue
- Ease of interaction, time to achieve full competency