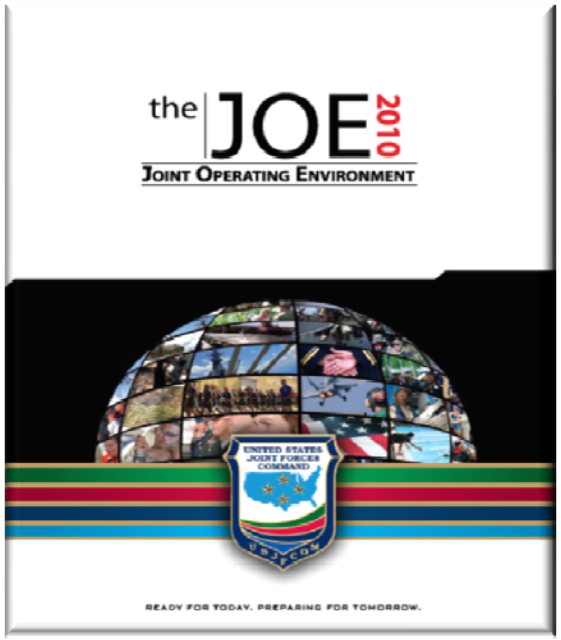
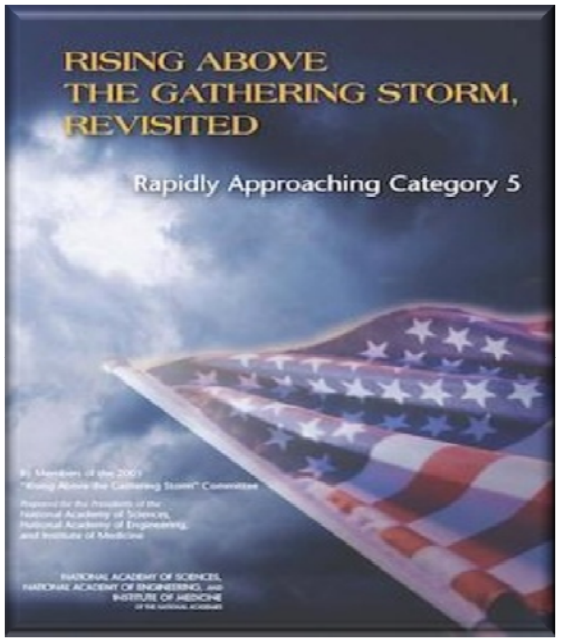
DoD Science & Technology Thrusts

19 August 2011

The Honorable Zachary J. Lemnios
Assistant Secretary of Defense for
Research and Engineering

Global Shifts → Global Challenges





Shift in World Demographics

Technology Globalization

Shifting Global Economics

Limited World Energy Resources

Challenges to Existing State Structures

WMD proliferation

Innovation & Competitiveness

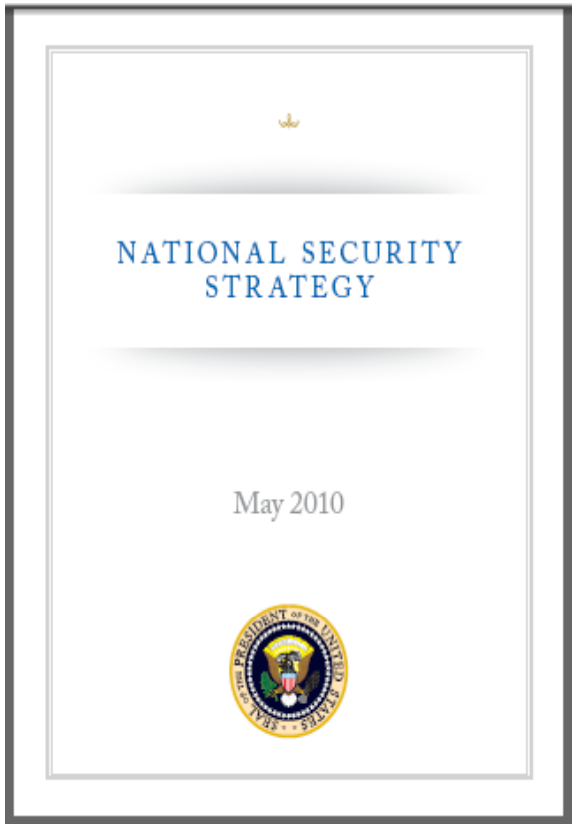
Knowledge Capital

Human Capital

Creative "Ecosystem"

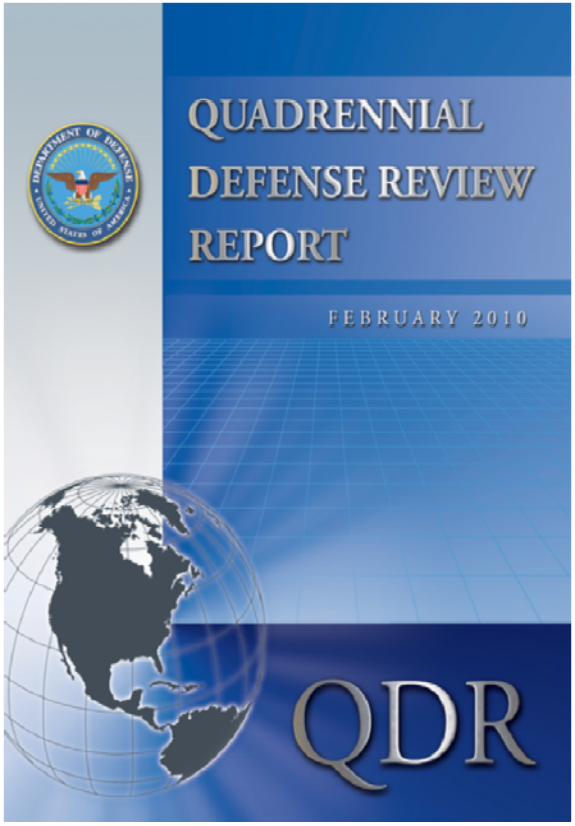
S&T Investment Drivers

President's National Security Strategy



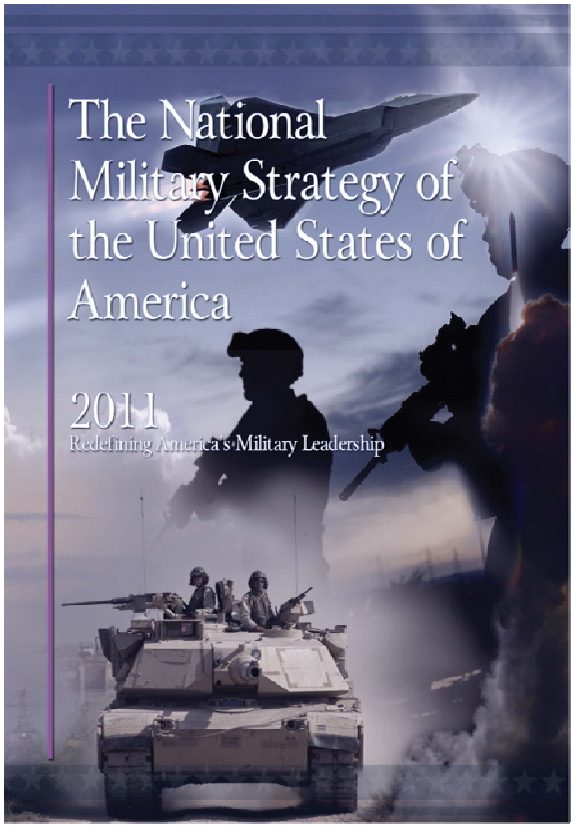
May 2010

SECDEF's Quadrennial Defense Review



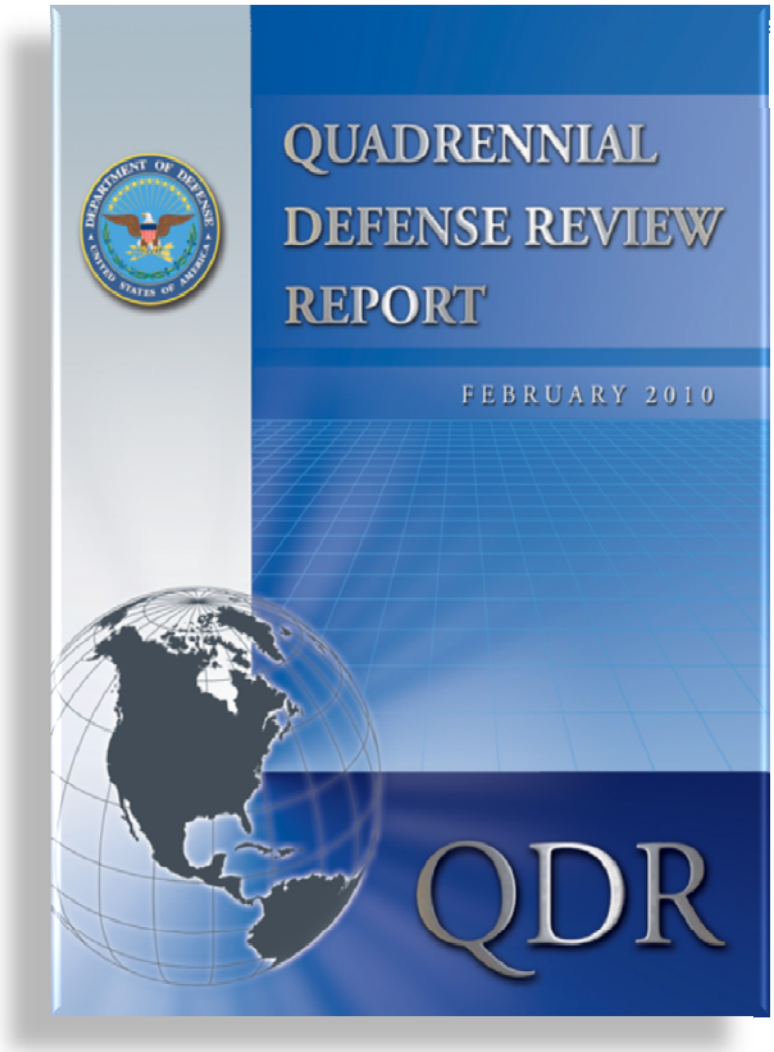
February 2010

CJCS' National Military Strategy



February 2011

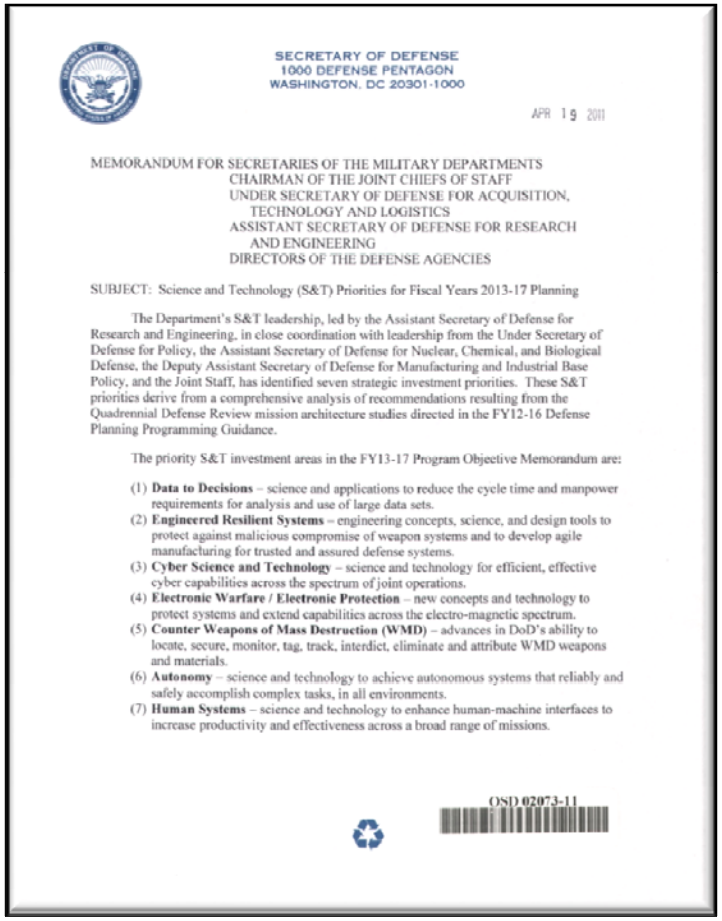
QDR Missions Require New Capabilities



1. **Defend the United States and Support Civil Authorities at Home**
2. **Succeed in Counterinsurgency, Stability, and Counterterrorist Operations**
3. **Build the Security Capacity of Partner States**
4. **Deter and Defeat Aggression in Anti-Access Environments**
5. **Prevent Proliferation and Counter Weapons of Mass Destruction**
6. **Operate Effectively in Cyberspace.**

DoD S&T Focus Areas

SECDEF Guidance



SECRETARY OF DEFENSE
1000 DEFENSE PENTAGON
WASHINGTON, DC 20301-1000

APR 19 2011

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY AND LOGISTICS
ASSISTANT SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Science and Technology (S&T) Priorities for Fiscal Years 2013-17 Planning

The Department's S&T leadership, led by the Assistant Secretary of Defense for Research and Engineering, in close coordination with leadership from the Under Secretary of Defense for Policy, the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense, the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy, and the Joint Staff, has identified seven strategic investment priorities. These S&T priorities derive from a comprehensive analysis of recommendations resulting from the Quadrennial Defense Review mission architecture studies directed in the FY12-16 Defense Planning Programming Guidance.

The priority S&T investment areas in the FY13-17 Program Objective Memorandum are:

(1) **Data to Decisions** – science and applications to reduce the cycle time and manpower requirements for analysis and use of large data sets.
(2) **Engineered Resilient Systems** – engineering concepts, science, and design tools to protect against malicious compromise of weapon systems and to develop agile manufacturing for trusted and assured defense systems.
(3) **Cyber Science and Technology** – science and technology for efficient, effective cyber capabilities across the spectrum of joint operations.
(4) **Electronic Warfare / Electronic Protection** – new concepts and technology to protect systems and extend capabilities across the electro-magnetic spectrum.
(5) **Counter Weapons of Mass Destruction (WMD)** – advances in DoD's ability to locate, secure, monitor, tag, track, interdict, eliminate and attribute WMD weapons and materials.
(6) **Autonomy** – science and technology to achieve autonomous systems that reliably and safely accomplish complex tasks, in all environments.
(7) **Human Systems** – science and technology to enhance human-machine interfaces to increase productivity and effectiveness across a broad range of missions.

OSD 02073-11

19 April 2011

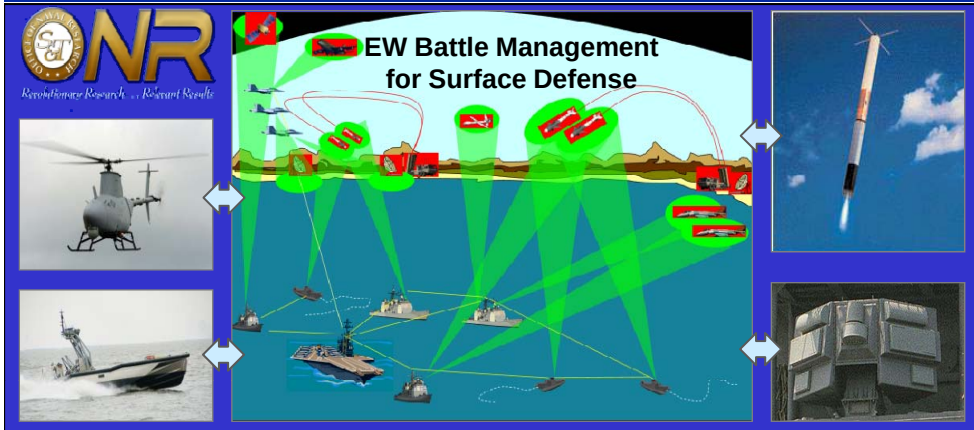
Complex Threats

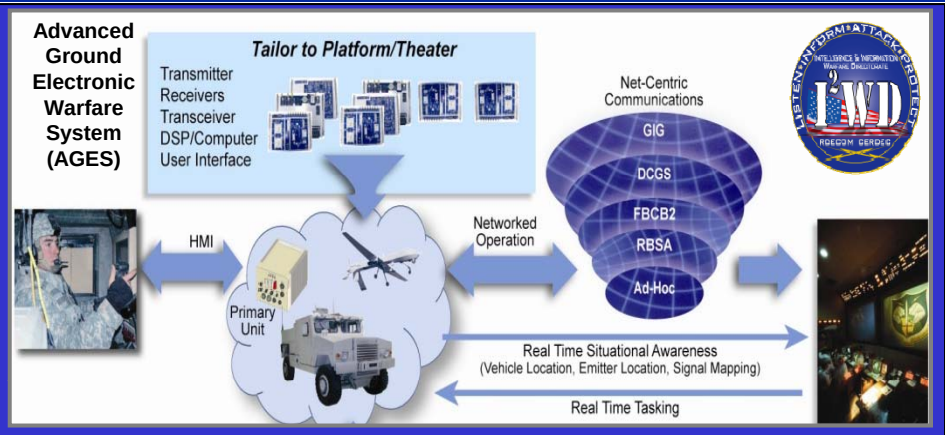
- **Electronic Warfare / Electronic Protection**
- **Cyber Science and Technology**
- **Counter Weapons of Mass Destruction**

Force Multipliers

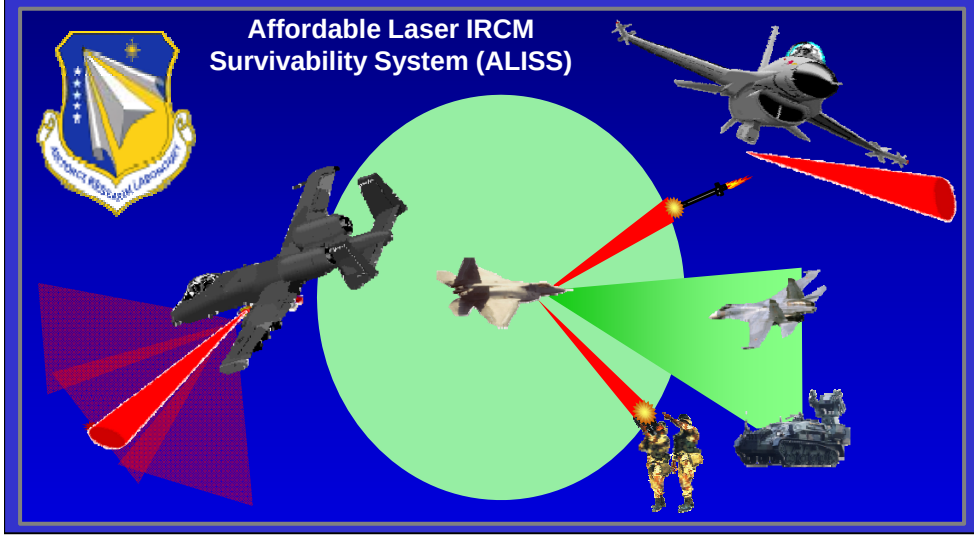
- **Engineered Resilient Systems**
- **Data-to-Decisions**
- **Human Systems**
- **Autonomy**

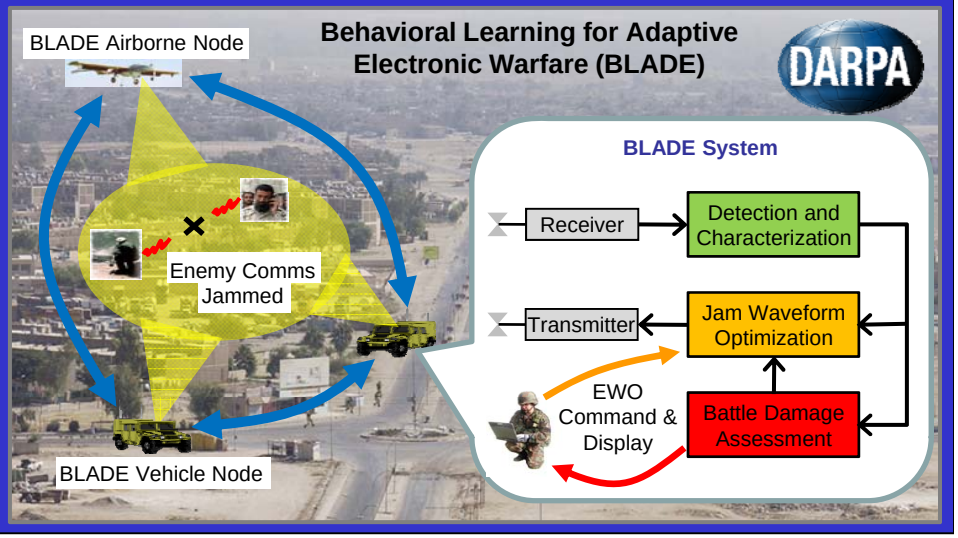
Electronic Warfare / Electronic Protection



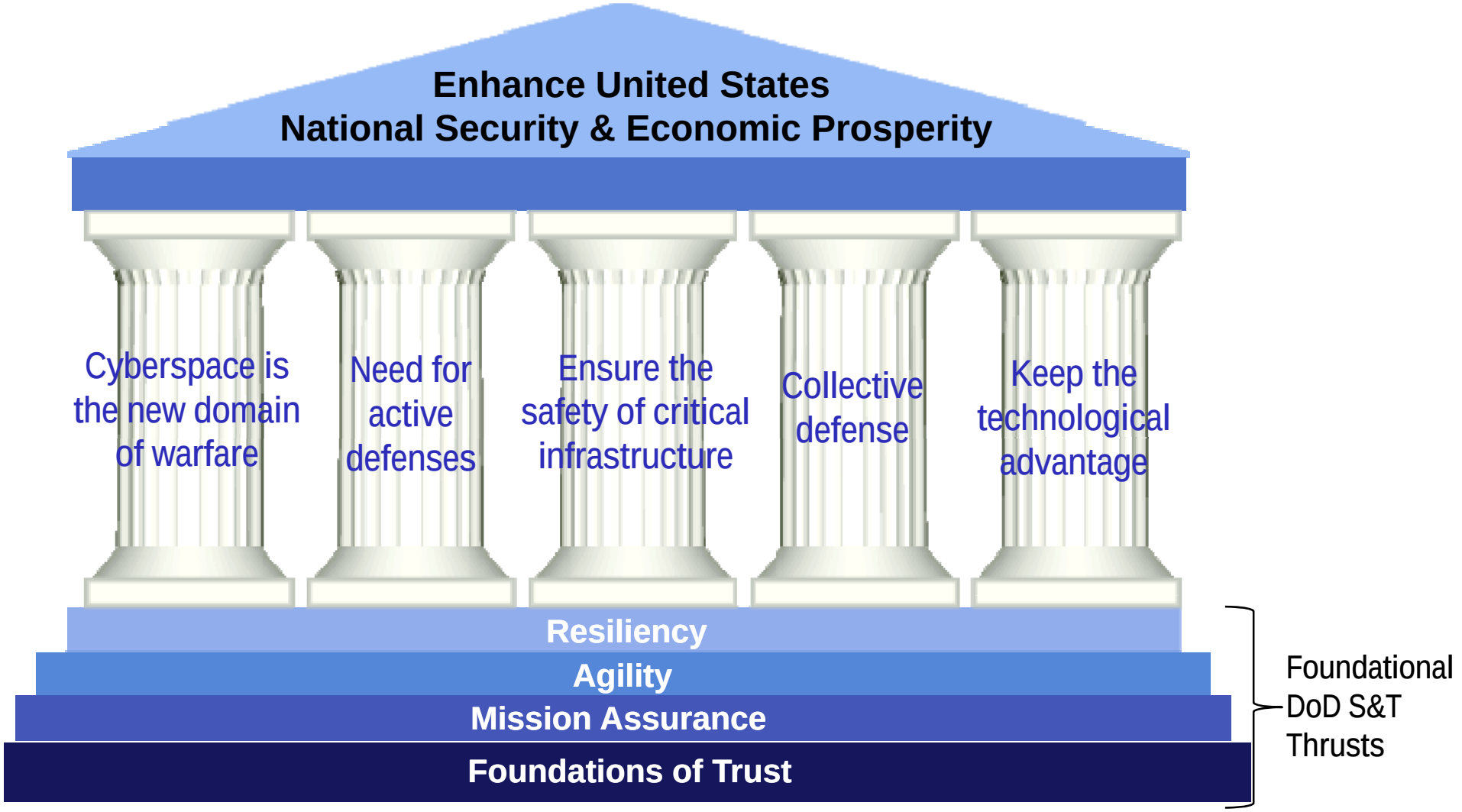


New capabilities to dominate the electromagnetic spectrum

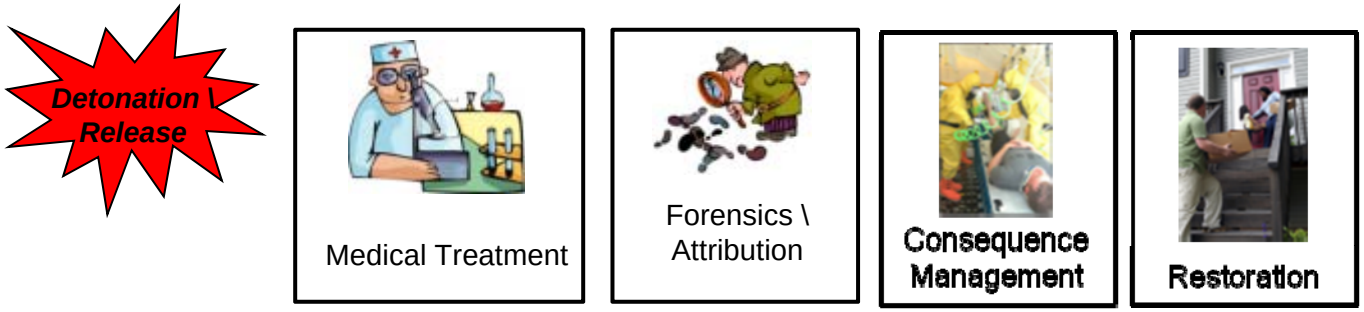




Cyber: Architecture for S&T Investments



Countering Weapons of Mass Destruction



- **Advanced sensors**
- **Rapid response capabilities**
- **Advanced defeat mechanisms**

Engineered Resilient Systems
Complex Systems Design

Trustworthy Systems Design

Conceptual Engineering

Technical Thrusts

Trustability: design patterns, analytic tools

Tying design, physical and computational testing

Virtual worlds projecting alternative futures

Model-based tools: Analysis and simulation

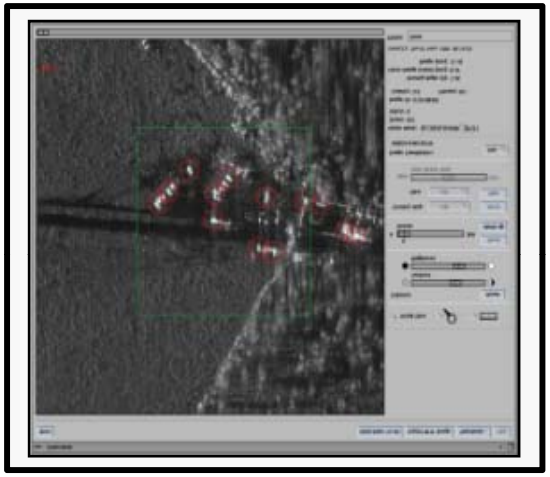
Tradespace exploration

Platform-based analysis and architecting

Model Based Engineering

Platform Based Engineering

Data-to-Decisions

Data Management Layer	Analytics Layer	User Interaction Layer
		

- **Investments span all aspects of this challenge with emphasis shifting from imagery to motion and text analytics**
- **Unstructured data analytics is the most challenging and critical component**

Human Systems

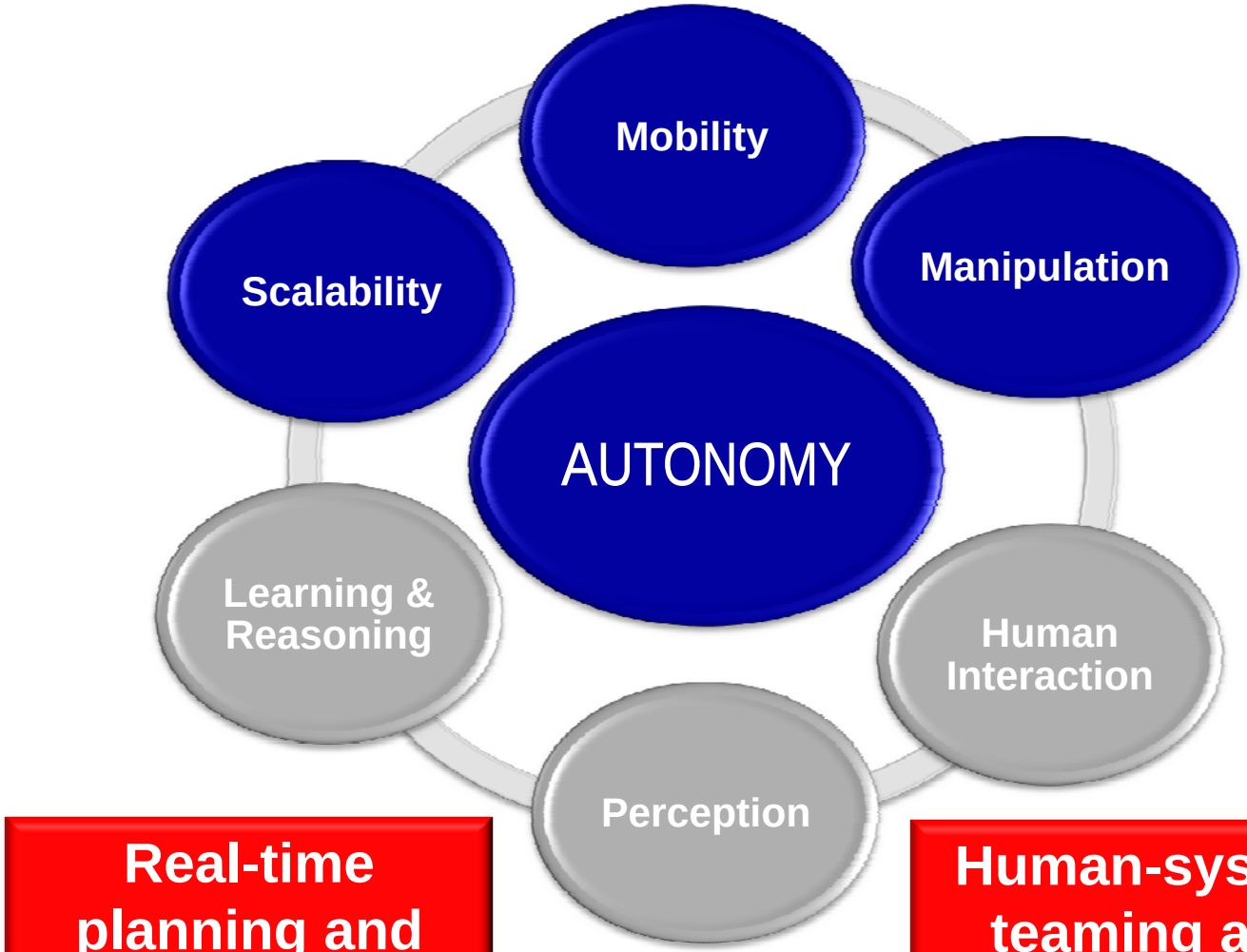
Personnel & Training

- Realistic, immersive training
- Adaptive, tailored instruction
- Train partner state forces

Strategic Decision Support

- Battle management
- Autonomous system control

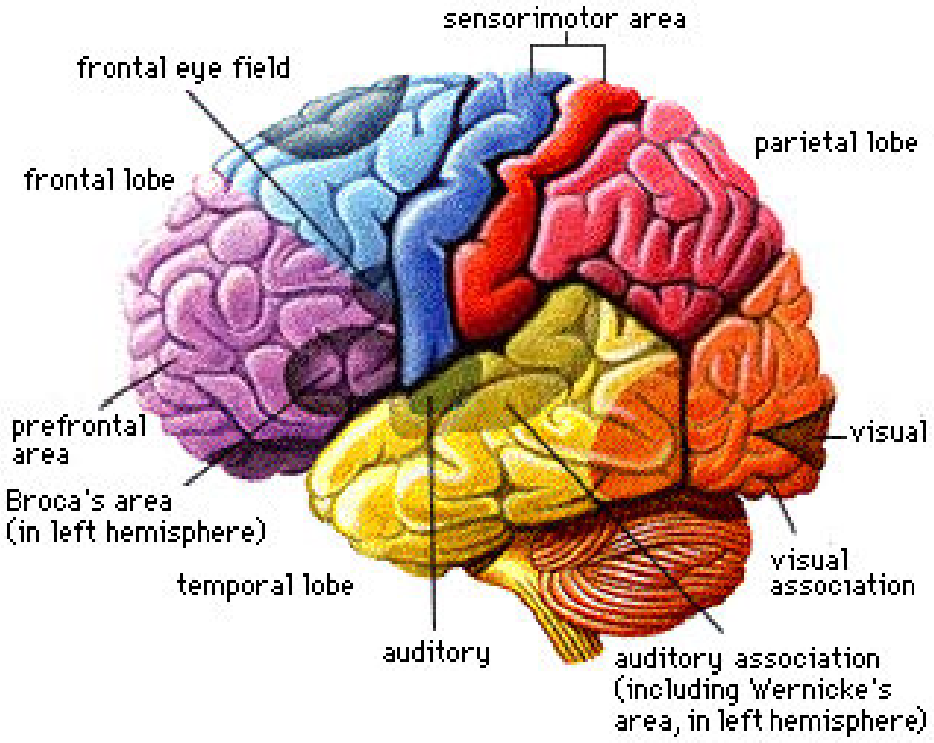
Autonomy



Real-time planning and understanding

Human-system teaming and collaboration

Learning & Reasoning



Mass	**1.5 kg**
Volume	**1.5 l**
Energy Consumption	**~10w**
Speed	**~10 Hz**
Neurons	**10^{12}**
Synapses/Neuron	**1000**
Performance	**~10^{12} ops/sec**
Bandwidth	**~10^{12} synapse -ops/sec**

- **Physically reconfigurable**
- **Operationally adaptive**
- **Informationally convergent**

Increasing Reliance on Autonomous Vehicles

Mk18 Mod2 Kingfish

MQ-9 Reaper

MQ-8B Fire Scout

SUGV

Human Interaction

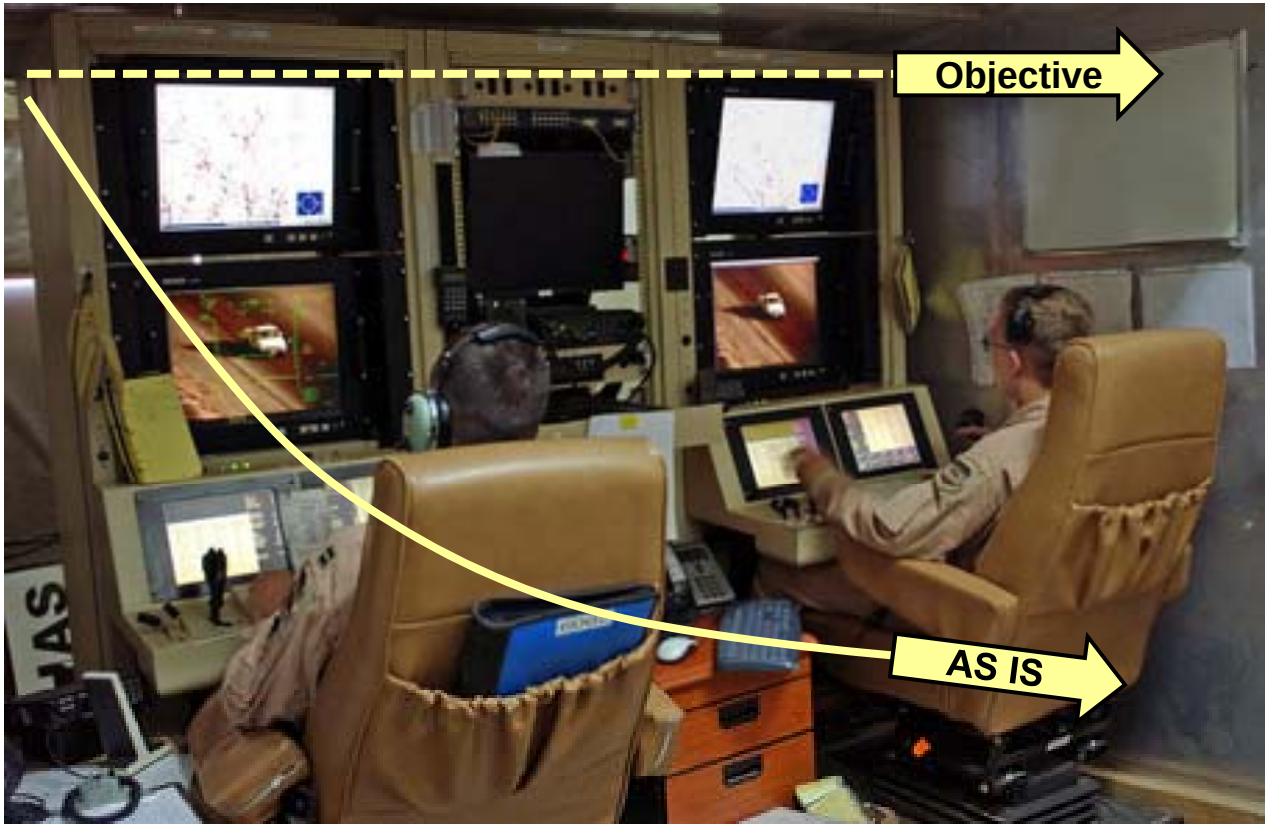
Supported Human Independence

Fully autonomous

Human supervised

Human delegated

Human operated



Complexity

(Environment, Mission)

Commercial Industry Advances

Stanley – First Place
DARPA Grand Challenge, 2005

Junior – Second Place
DARPA Urban Challenge, 2007

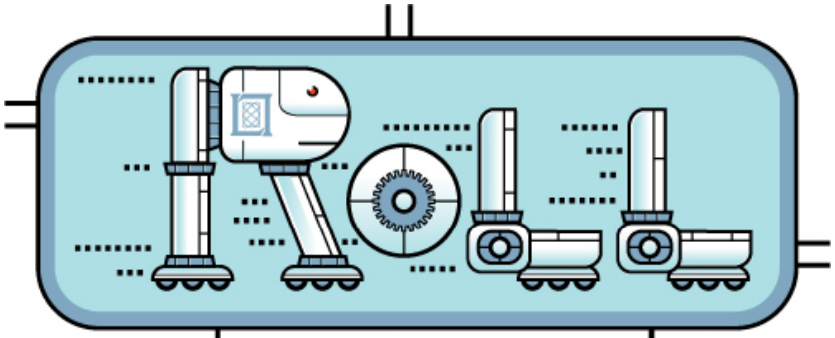
Google's autonomous fleet, 2011

ASD(R&E) Science, Technology, Engineering & Math Strategy

PRE-K & ELEMENTARY	MIDDLE SCHOOL	HIGH SCHOOL	BACHELORS	MASTERS	DOCTORAL	FACULTY
K-12 INFORMAL EDUCATION						
			ASSURE			
			SE CAPSTONE			
			SMART			
			HBCU / MSI PROGRAM			
				BASIC RESEARCH		
					NDSEG	
				NSSEFF		
						PECASE

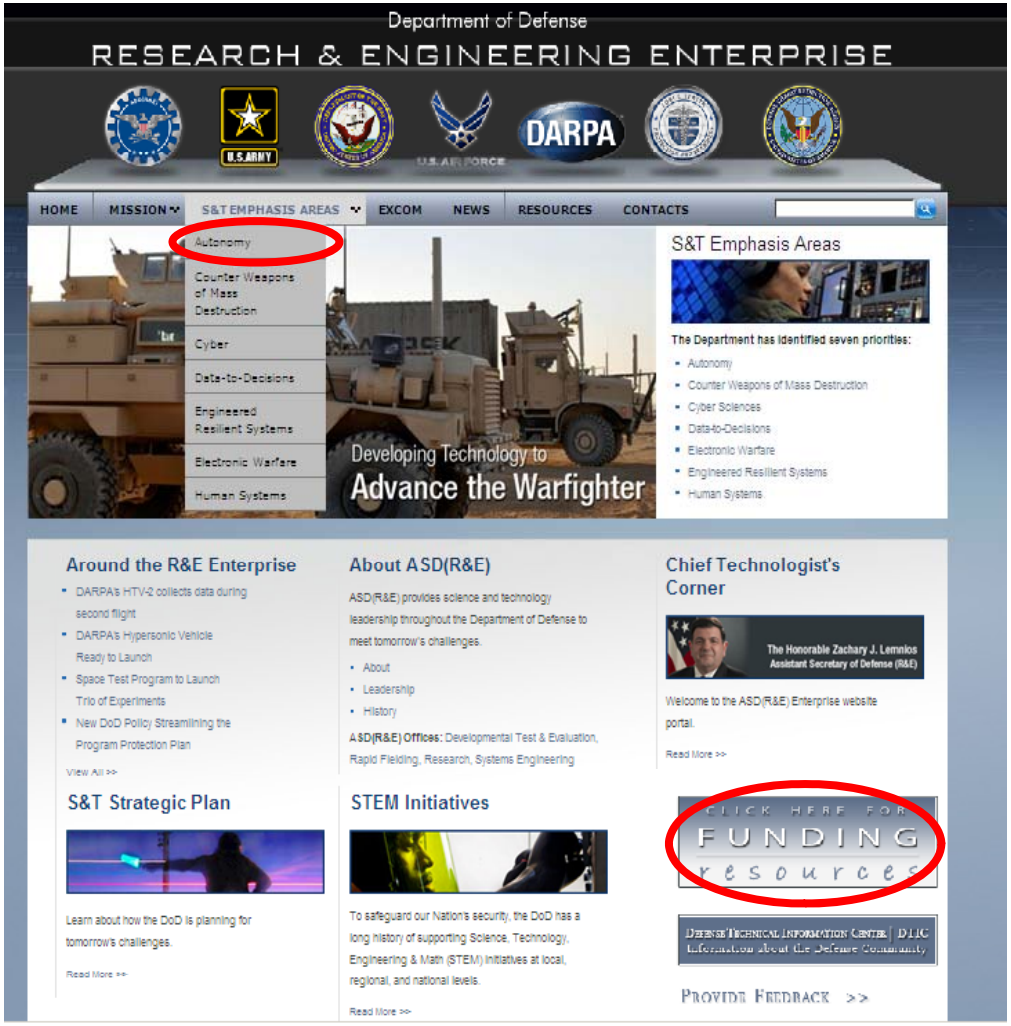
STEM & Autonomy

seaperch
TEACH • BUILD • BECOME



ROBOTICS OUTREACH AT
MIT LINCOLN LABORATORY

Engagement Opportunities



http://www.acq.osd.mil/chieftechnologist/index.html