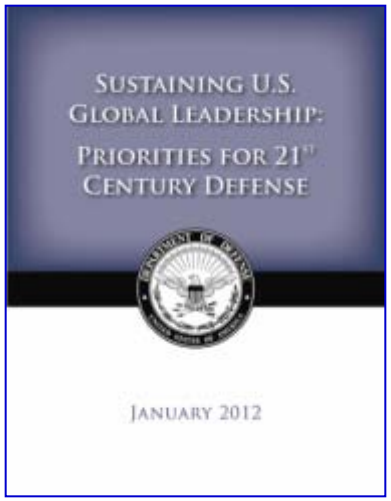
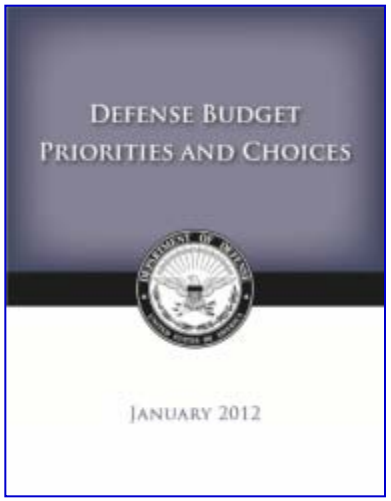
2012 ASEE Engineering Research Council (ERC) Annual Conference

21 February 2012

Dr. Reginald Brothers
Deputy Assistant Secretary of Defense for Research

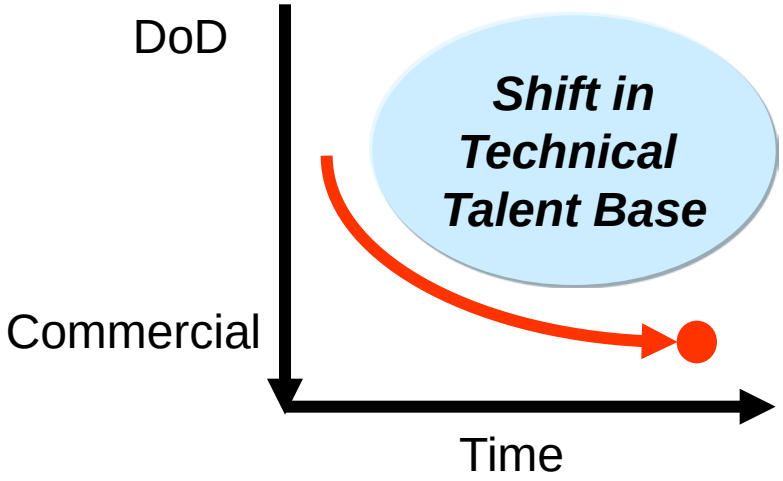
Key Elements of Defense Strategic Guidance

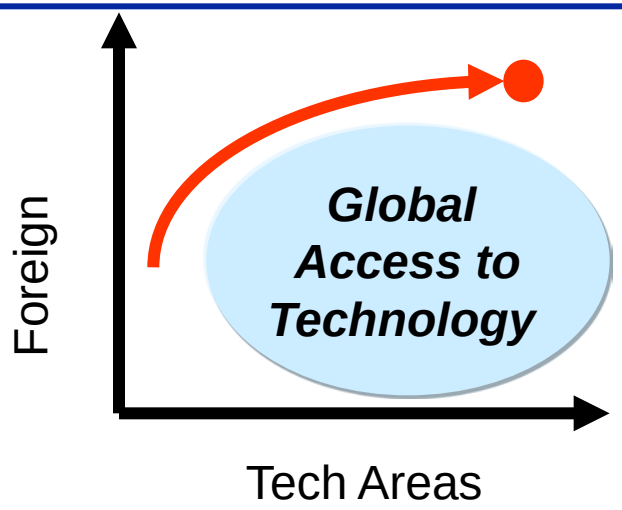


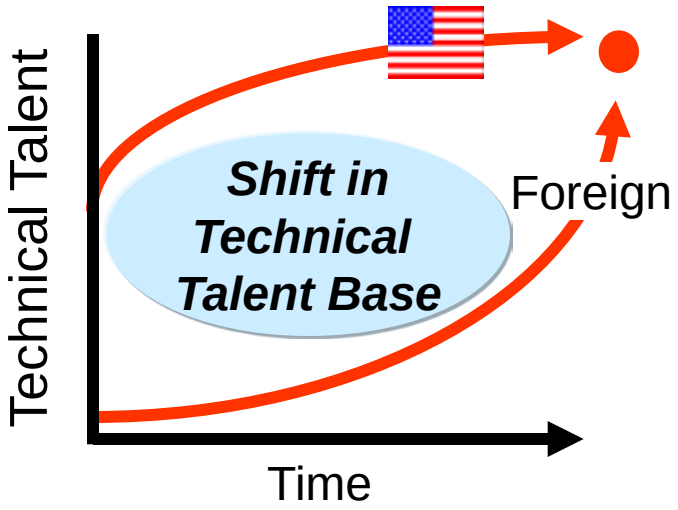


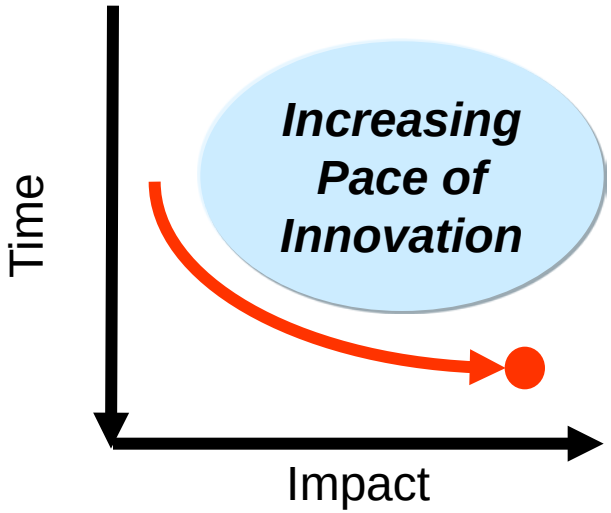
- **The military will be smaller and leaner, but it will be agile, flexible, ready and technologically advanced.**
- **Rebalance our global posture and presence to emphasize Asia-Pacific and the Middle East.**
- **Build innovative partnerships and strengthen key alliances and partnerships elsewhere in the world.**
- **Ensure that we can quickly confront and defeat aggression from any adversary – anytime, anywhere.**
- **Protect and prioritize key investments in technology and new capabilities, as well as our capacity to grow, adapt and mobilize as needed.**

Key Challenges to our Technical Base

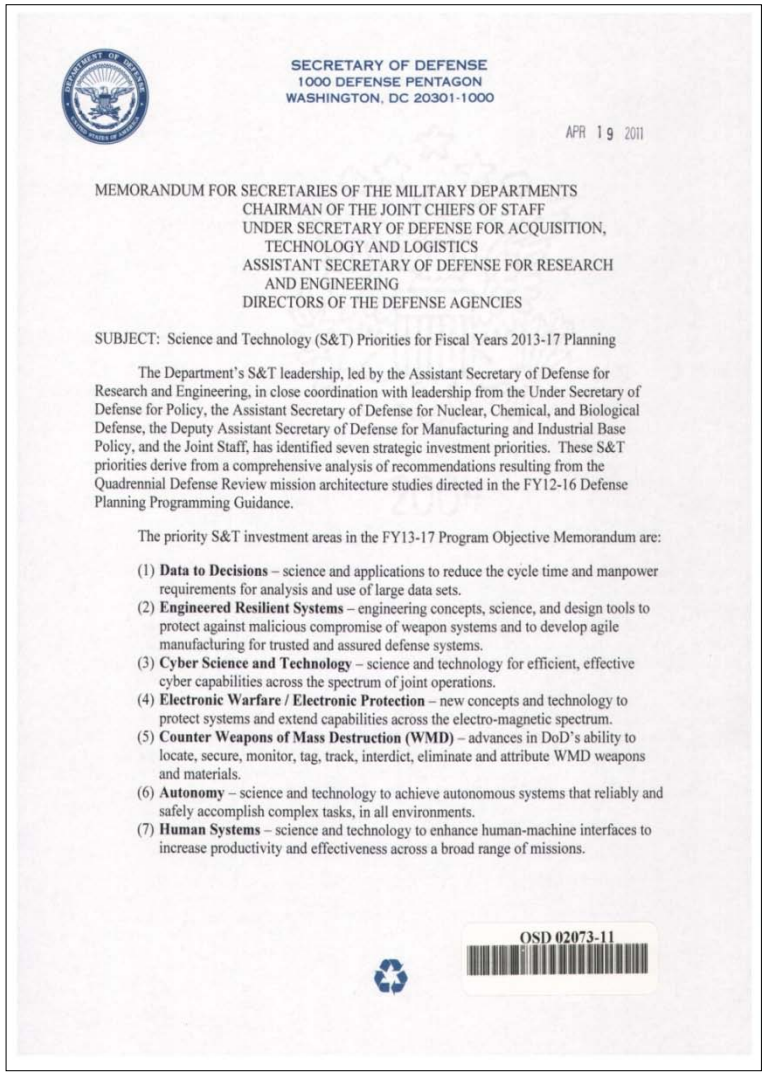








"Technology Enabled Strategy"



SECRETARY OF DEFENSE
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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

- **Counter AA/AD capabilities**
- **Low-cost, agile, flexible small-footprint operations**
- **Integrated partnership capabilities**
- **Humanitarian, Disaster, Relief and Other Operations**
- **Safe, Secure and Effective Nuclear Deterrent**

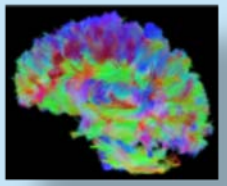
High Interest Basic Science Areas

Synthetic Biology

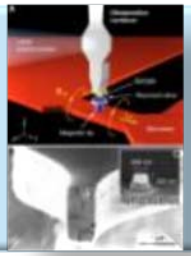
Modeling of Human Behavior

Engineered Materials

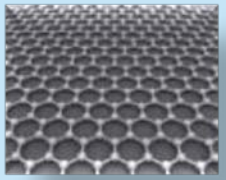
Cognitive Neuroscience



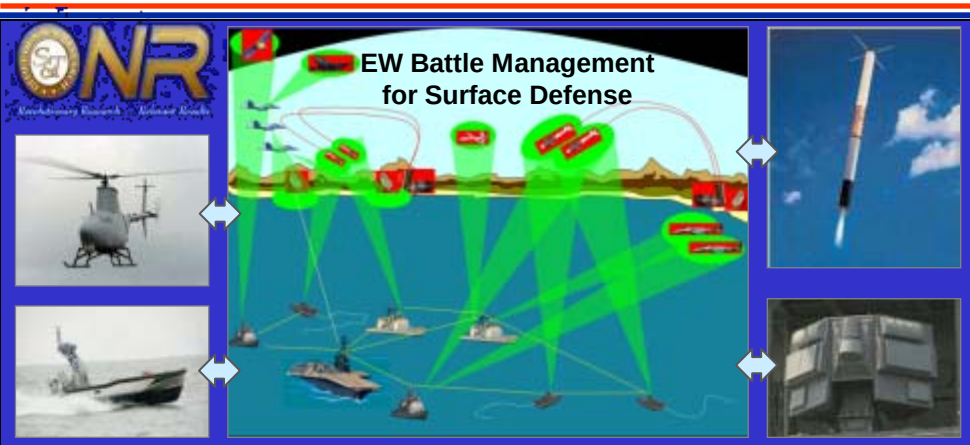
Quantum Systems

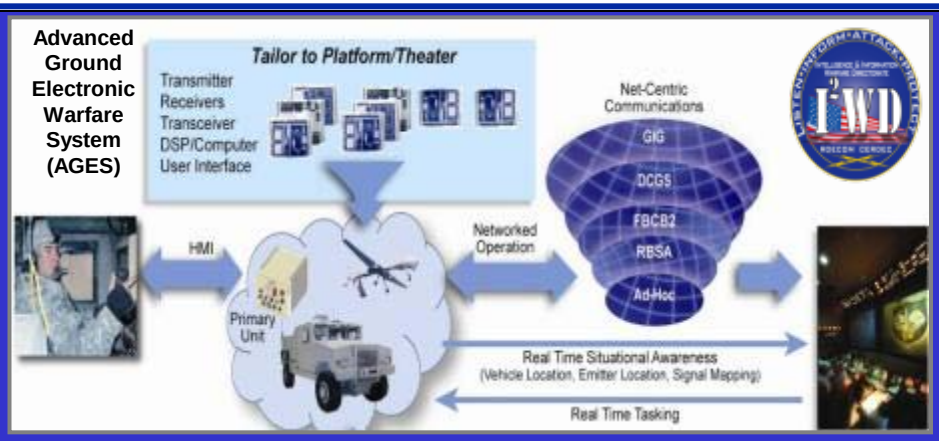


Nano Science and Engineering

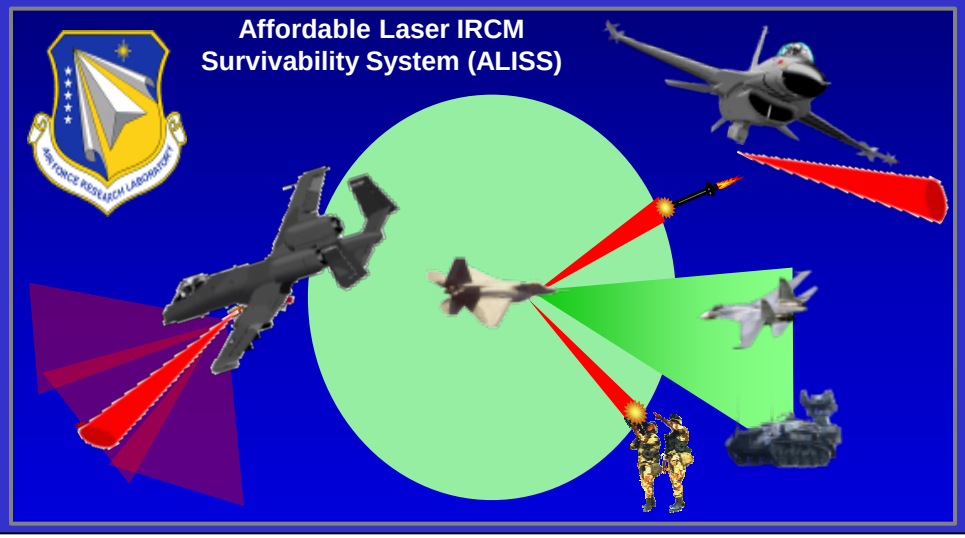


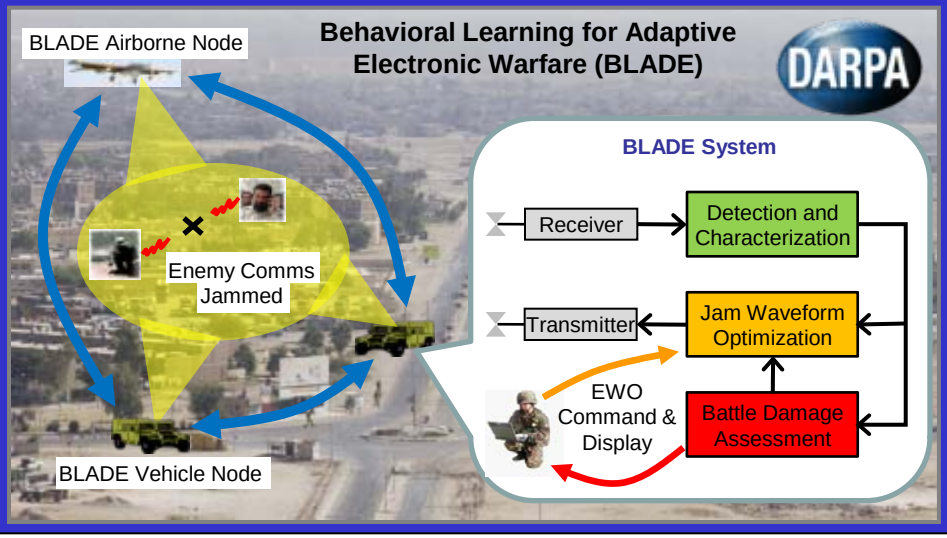
Electronic Warfare / Electronic Protection



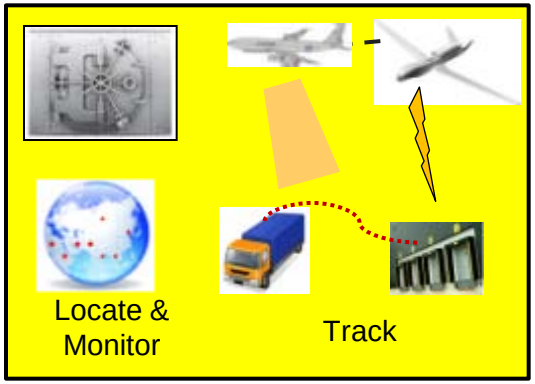


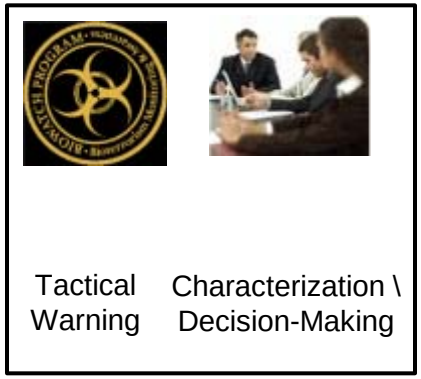
New capabilities to dominate the electromagnetic spectrum

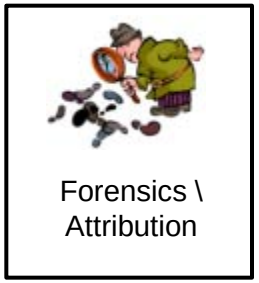


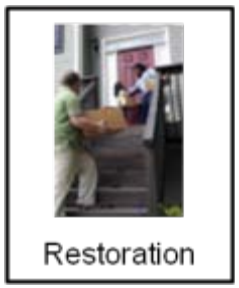


Countering Weapons of Mass Destruction







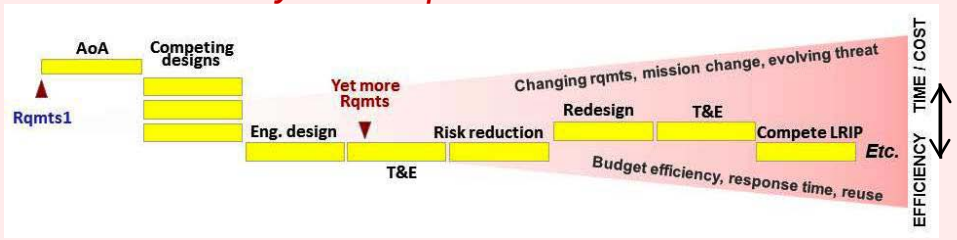


- **Advanced sensors**
- **Rapid response capabilities**
- **Advanced defeat mechanisms**

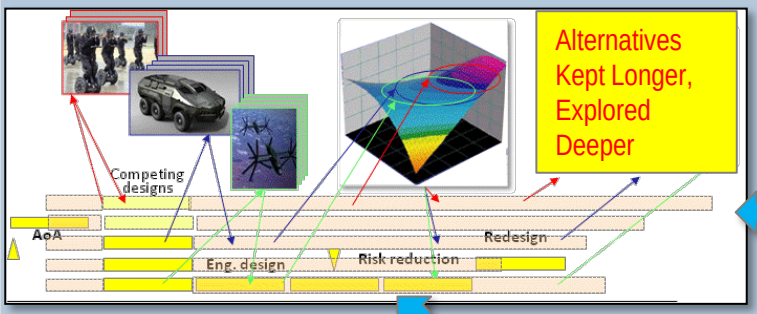
Engineered Resilient Systems (ERS)

More effective, affordable, adaptable

50 years of process reforms haven't controlled time, cost and performance



- Prematurely reduces alternatives
- Decisions made with incomplete information
- Sequential, slow
- Information lost at every step
- Ad hoc requirements refinement



Alternatives Kept Longer, Explored Deeper

New tools help engineers & users:

- *Understand interactions*
- *Identify implications*
- *Manage consequences*

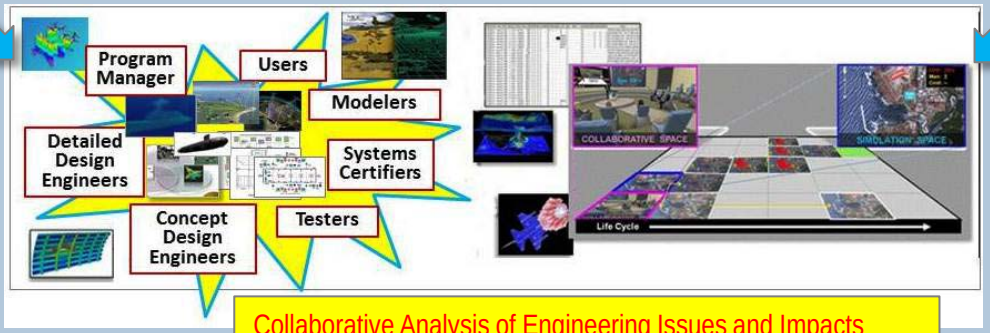
Refinement in Context of Operational Missions

Effective

- *Better informed*

Affordable

- *Faster engineering*



Collaborative Analysis of Engineering Issues and Impacts

Adaptable

- *Wider range of mission contexts*

ERS envisions an ecosystem in which a wide range of stakeholders continually cross-feed multiple types of data that inform each other's activities

Data-to-Decision Systems
Mission Span and Problem Statement

Tactical Operations

- Low Latency
- Narrow Field-of-View
- Limited Fusion
- Automatic Target Recognition
- Data: ~MB-GB

Operations Intelligence

- Medium Latency
- Wide Field-of-View
- Hard Sensor Fusion
- Assisted Target Recognition
- Data: ~GB-TB

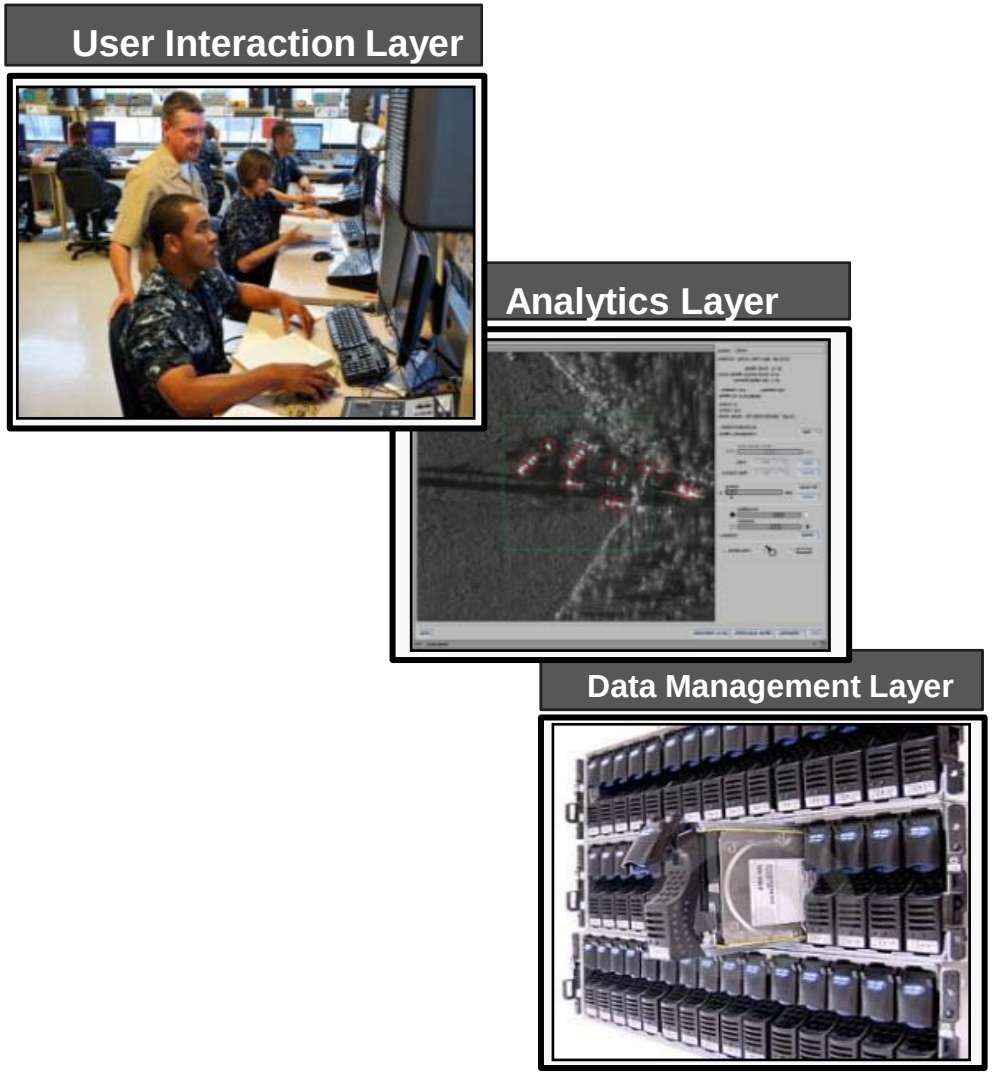
Strategic Intelligence

- Long Latency
- Synoptic Field-of-View
- Hard/Soft Sensor Fusion
- Multiple Hypotheses
- Data: ~PB-EB

The complexity and adaptability of threats has surpassed our ability to find them in large data volumes within mission timelines

Highest Payoff Capabilities and Associated Metrics

- Data Management
- MOVINT Analysis
- IMINT Analysis
- Text Analysis
- User Interface



Autonomy

Mk18 Mod2 Kingfish

MQ-9 Reaper

MQ-8B Fire Scout

SUGV

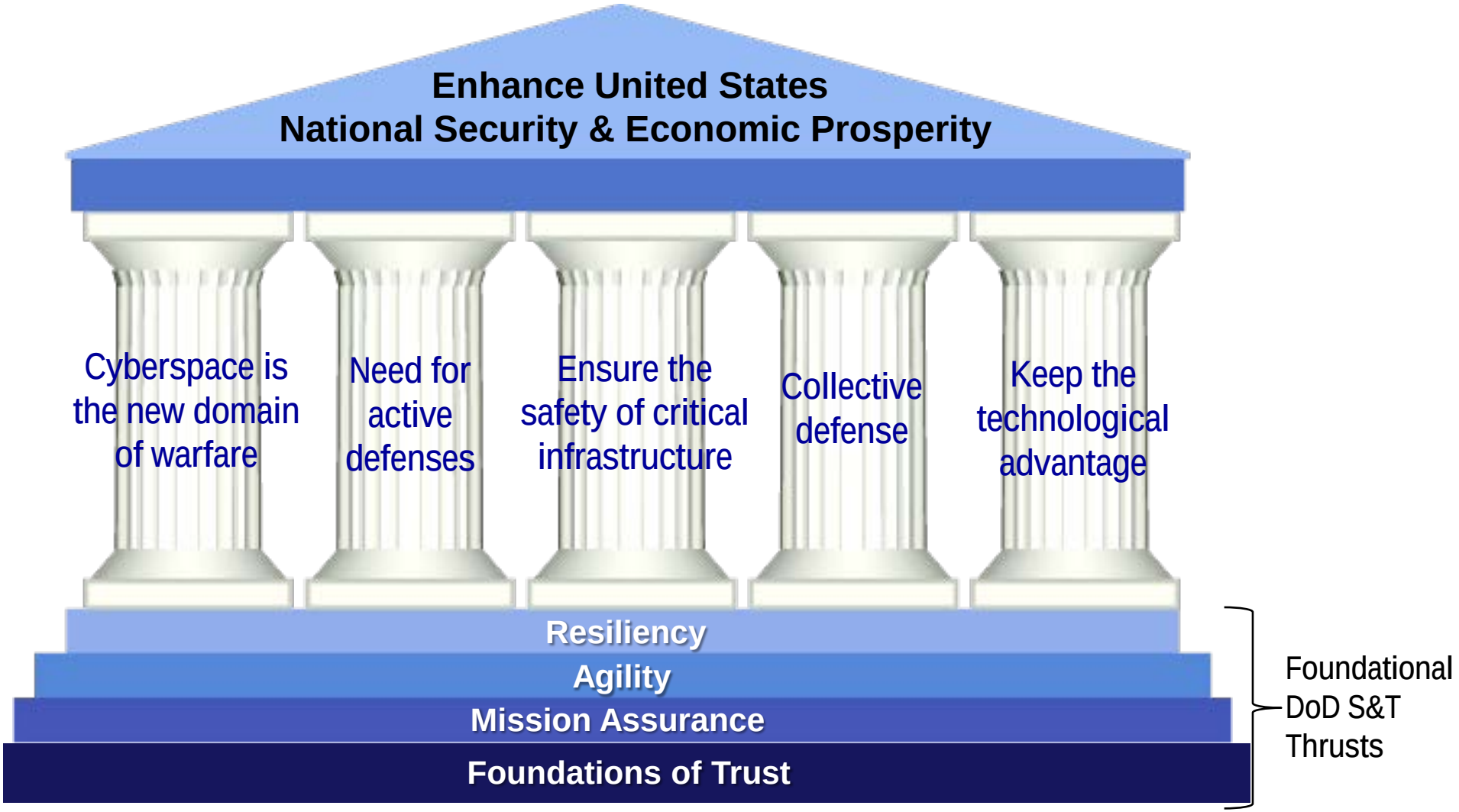
- Autonomy paradox; systems designed to reduce human operator footprint require increased manpower support
- In Iraq and Afghanistan, nearly 20,000 robots and remotely operated vehicles have deployed in support of US troops[1]
- The MQ-1/9 fleet is collecting > 20,000 hours of FMV each month. Analysis personnel now outnumber aircrew by 8:1[\]

Focus on developing technologies that enable the same or greater mission effectiveness with reduced manpower requirements

Challenges in Science of Autonomy

- Human/autonomous system collaboration
- Perception & intelligent decision-making
- Scalable & robust collaboration
- Intelligence enablers/architectures
- Scalable planning and replanning
- Learning
- Social cognition and metacognition
- Intelligence for decentralized systems

Cyber Science



DoD internal/external engagement

Services and Agencies

- **DoD Priority Steering Committees**
  - Membership includes:
    - Service Scientific Research Organizations & Laboratories
    - NSA
    - DARPA
    - DoD Chief Information Officer
    - The Joint Staff
    - US Cyber Command
    - USD for Policy & USD for Intelligence

Industry and Academia

- **Key Elements of PSC S&T Roadmap shapes:**
  - Service Broad Agency Announcements
  - Small Business Innovative Research themes
  - Small Business Technology Transfer themes
  - Multidisciplinary University Research Initiatives topics

EmergingTechnologies Symposium

21 February 2012

Dr. Reginald Brothers
Deputy Assistant Secretary of Defense for Research