



National Defense Industrial Association Disruptive Technologies Conference

14 October 2009

**The Honorable Zachary J. Lemnios
Director, Defense Research and Engineering**



Our Guidance



- **Defense Budget Recommendation Statement**
Secretary of Defense Robert M. Gates, April 06, 2009
 - *reaffirm our commitment to take care of the all-volunteer force*
 - *rebalance this Department's programs*
 - *institutionalize and enhance our capabilities to fight the wars we are in today and the scenarios we are most likely to face in the years ahead*
 - *provide a hedge against other risks and contingencies*
 - *fundamental overhaul of our approach to procurement, acquisition, and contracting*
- **Economic Club of Chicago**
Secretary of Defense Robert M. Gates, July 16, 2009
 - *What is needed is a portfolio of military capabilities with maximum versatility across the widest possible spectrum of conflict*



DDR&E Imperatives

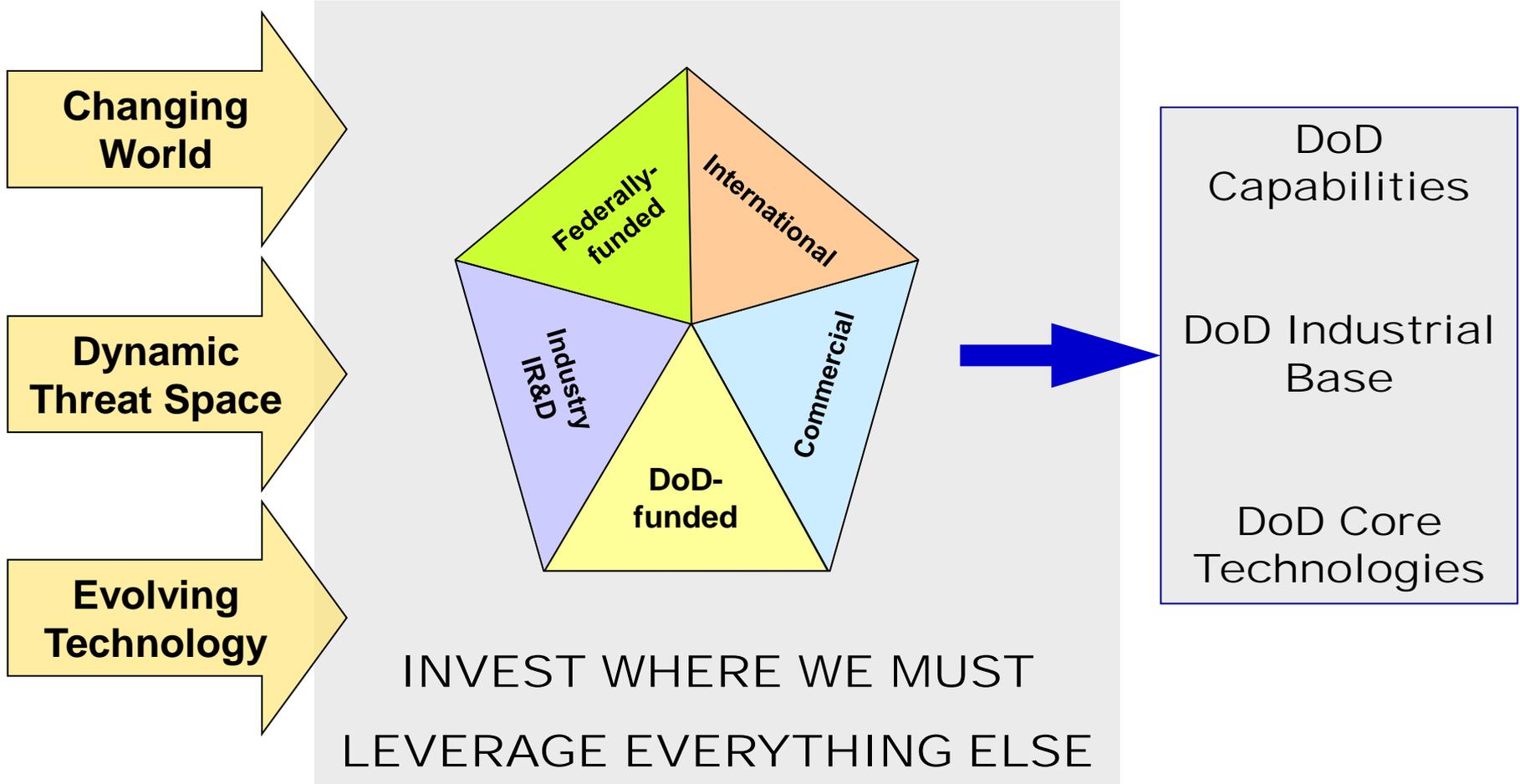


- 1. Accelerate delivery of technical capabilities to win the current fight.**
- 2. Prepare for an uncertain future.**
- 3. Reduce the cost, acquisition time and risk of our major defense acquisition programs.**
- 4. Develop world class science, technology, engineering, and mathematics capabilities for the DoD and the Nation.**



The Challenge Space

UNDERSTAND THE LANDSCAPE





Comments from COCOMs



“We need to detect IED’s at range... I am willing to test technologies in the field... We need persistent communications on the move...”

“I need the 70% solution today, rather than the 100% solution in 5-8 years...”

“...we are concerned about our technological edge against a near peer competitor...”

“It took us 10 years to get to the Moon, we are 8 years into our research efforts for defeating IED's...we need to find a solution to reliably detect and defeat IED's at range...”

“I like the 1 year acquisition cycle rather than the standard 5-8 year cycle, get the prototypes into the hands of the warfighters, turn the feedback into a quick redesign and deliver relevant capability now...”

“Often times we fail due to shortage of imagination...”



The Big Three



Innovation

Speed

Agility



Perspective for the Next Decade

1950 1960 1970 1980 1990 2000 2010 2020



Cold War

Vietnam War

Desert Storm

Bosnia

Collapse of Soviet Union

Kosovo

OIF

OEF

Irregular/Hybrid Warfare

National Security Challenges

Defense Capabilities

ICBM

Satellite comms

C4ISR

Precision Strike

UAV

LGB's

GPS

Stealth

Robotics

Nuclear propulsion

Night Vision

Human Terrain
Ubiquitous Observation
Contextual Exploitation
Scaleable Action

Enabling Technologies

Transistor

Composite Materials

MEMS

Solid state laser

Superconductors

Space tracking

Web protocols

VHSIC

MIMIC

Digital computing

IR Sensors

High Performance Computing

- Advanced Electronics, Photonics Algorithms, MEMS
- Nano; Meta; & New Materials
- Cognitive Computing
- Bio-Revolution



Forces of Change... Irregular and Hybrid Warfare



*Operations in
Austere
Locations*

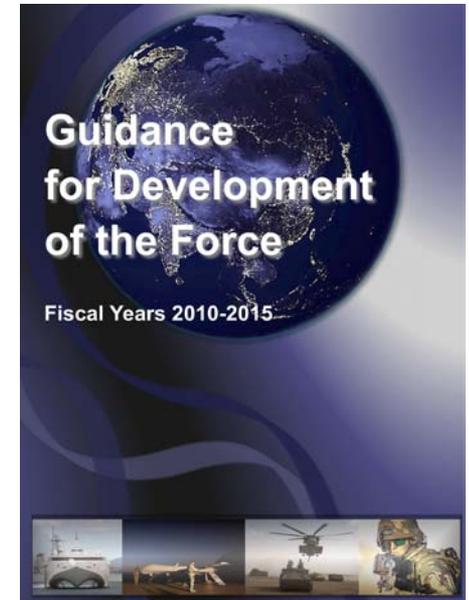
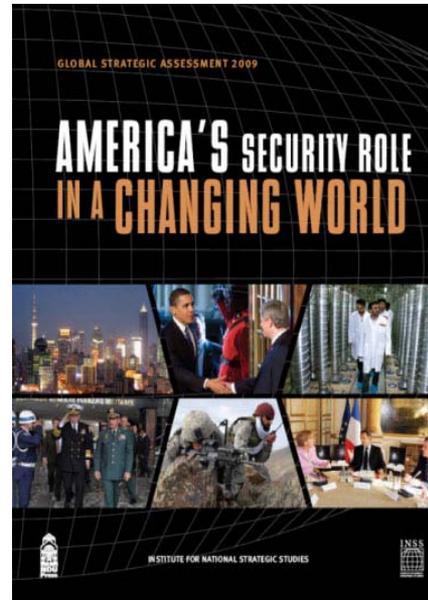
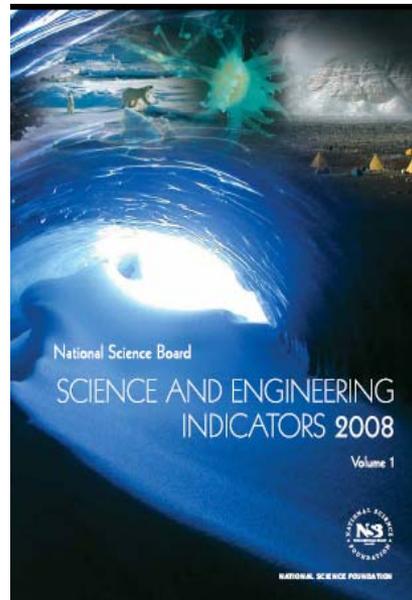
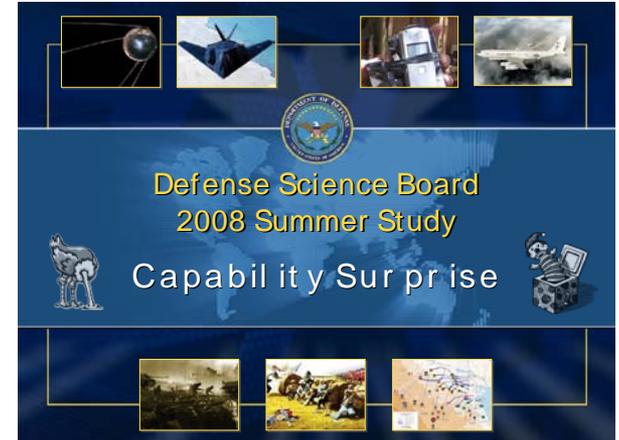
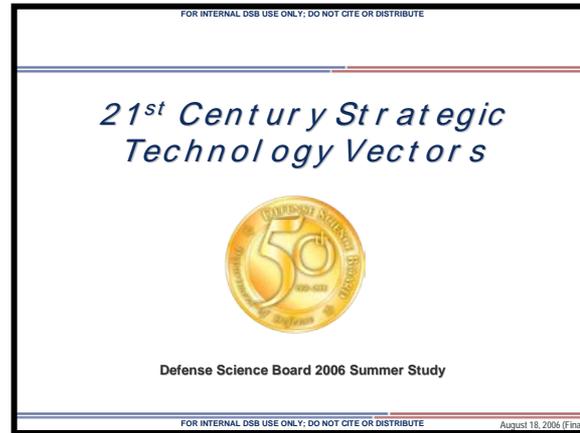
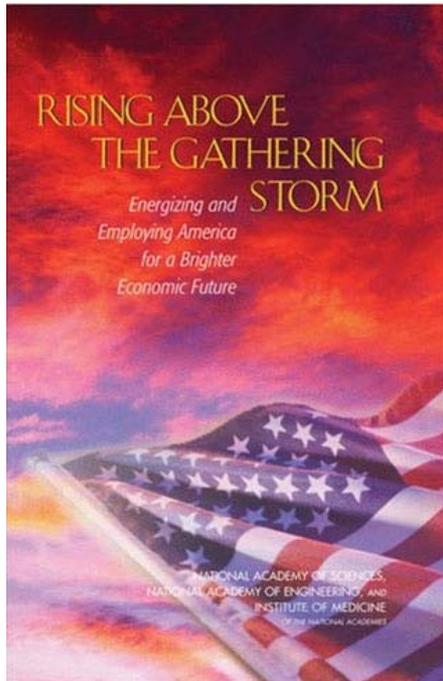
**Defense S&T for
Persistent /
Irregular Warfare**

*Humanitarian
Assistance /
Provincial
Reconstruction
Teams*

**NEW TECHNOLOGY NEEDED
Affecting the Hearts and Minds...**

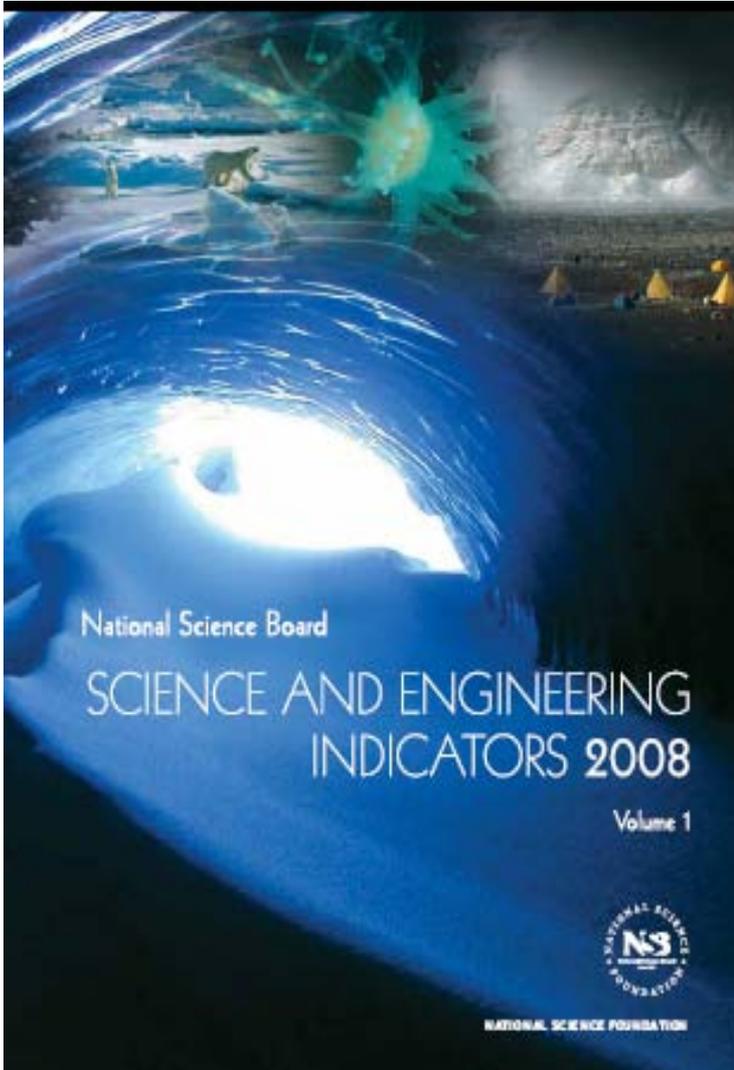


Some Common Threads





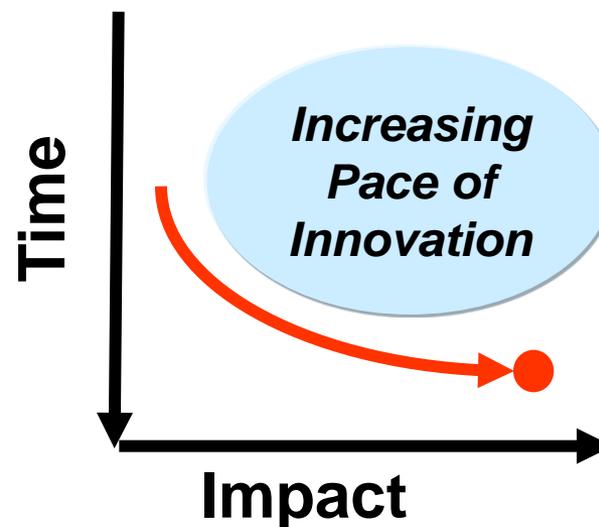
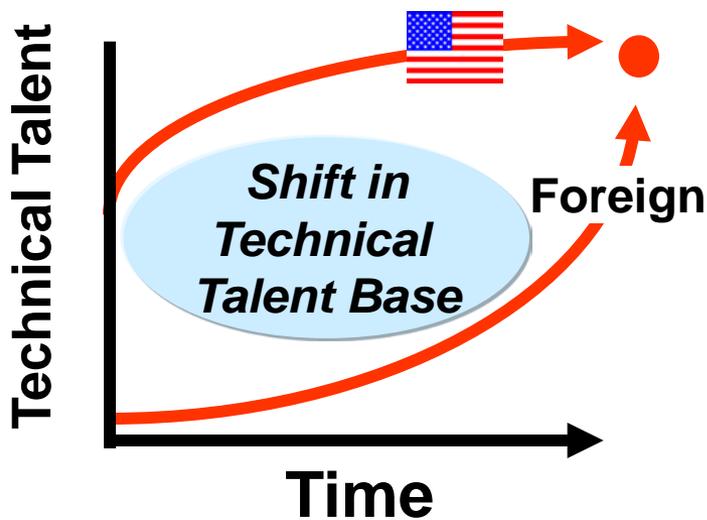
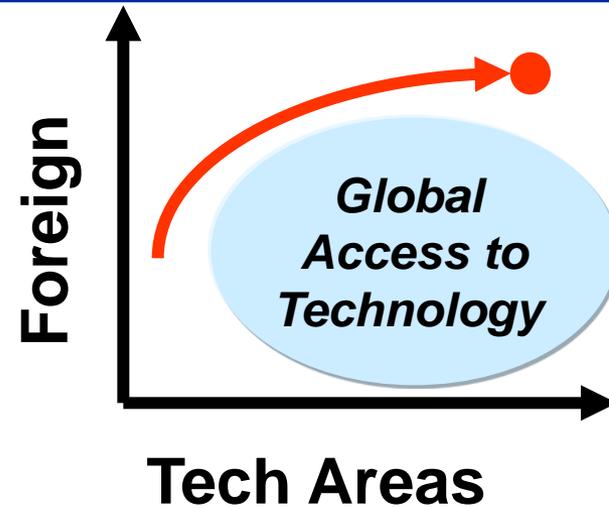
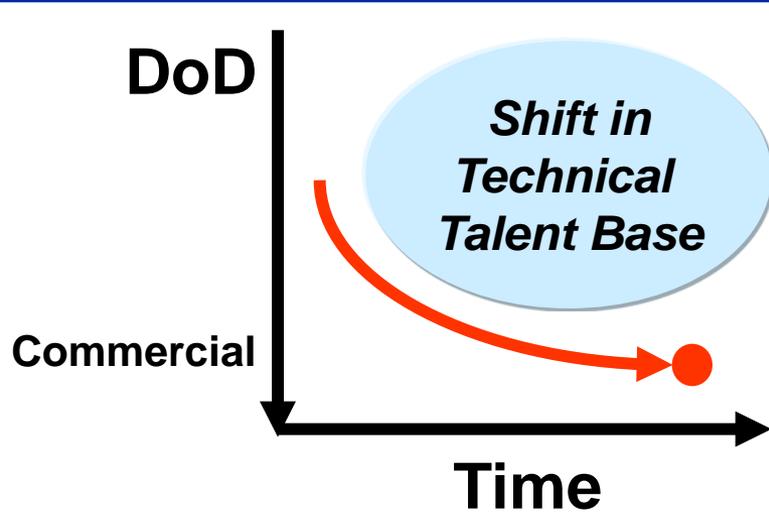
Concerning Trends



- **Knowledge-intensive industries are reshaping the world economy.**
- **Industry R&D in manufacturing and services is expanding and increasingly crossing borders.**
- **R&D in the United States is robust and dominated by industry.**
- **Advanced training in natural sciences and engineering is becoming widespread, eroding the U.S. advantage.**



Four Key Challenges to our Technical Base





The Timeline has Collapsed!

Conventional Warfare

USAF Capability

High Altitude Aircraft



Electronic Countermeasures



Endgame Countermeasure



Engage SAM



Adversary Capability

High Altitude SAM



Monopulse SAM



SAM with ECCM



Response loop measured in years

Counter-Insurgency Warfare

US Capability

Jammers



Mine Resistant Ambush Protected (MRAP)



Adversary Capability

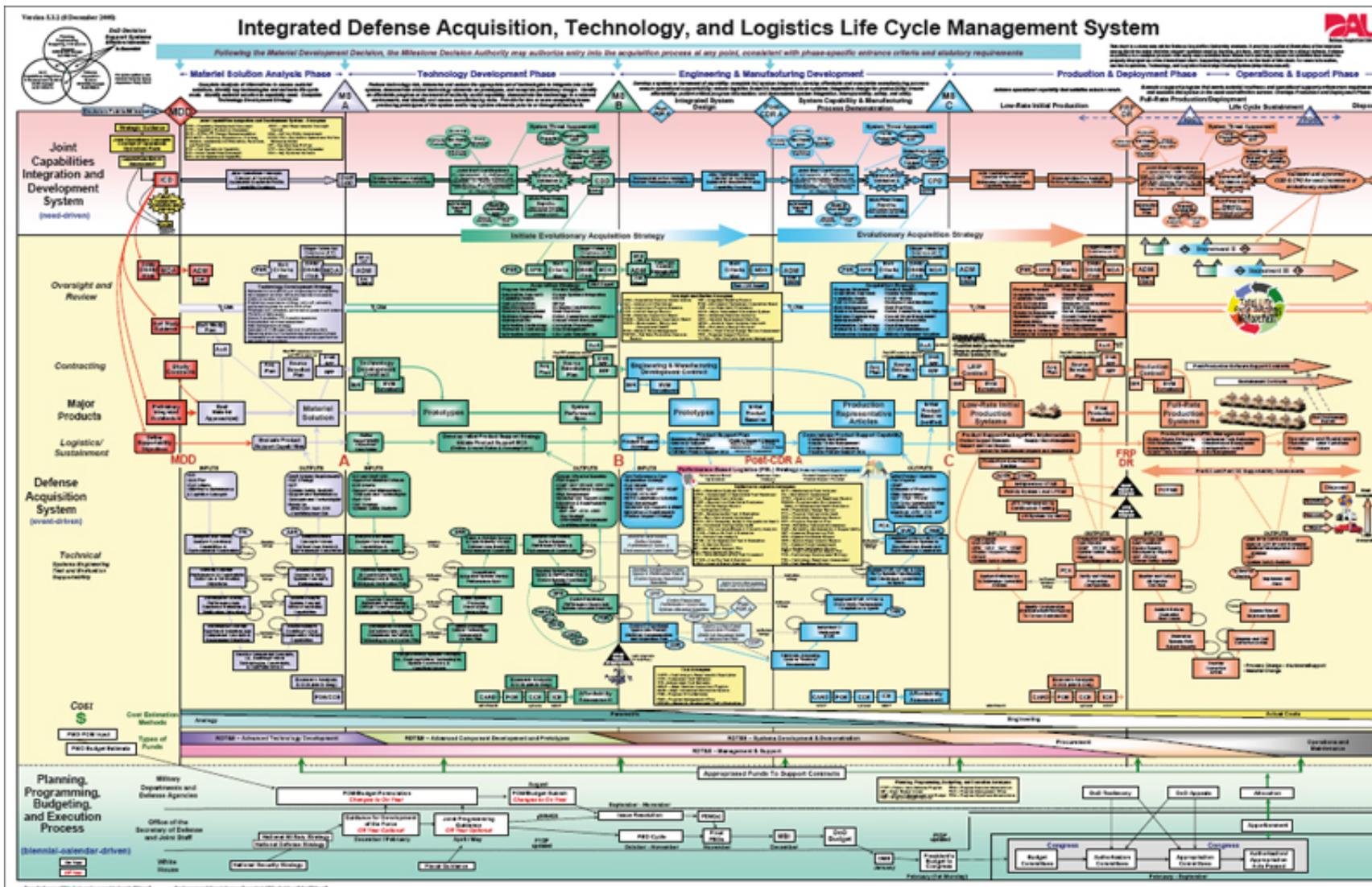


Advanced Technology

Response loop measured in months or weeks

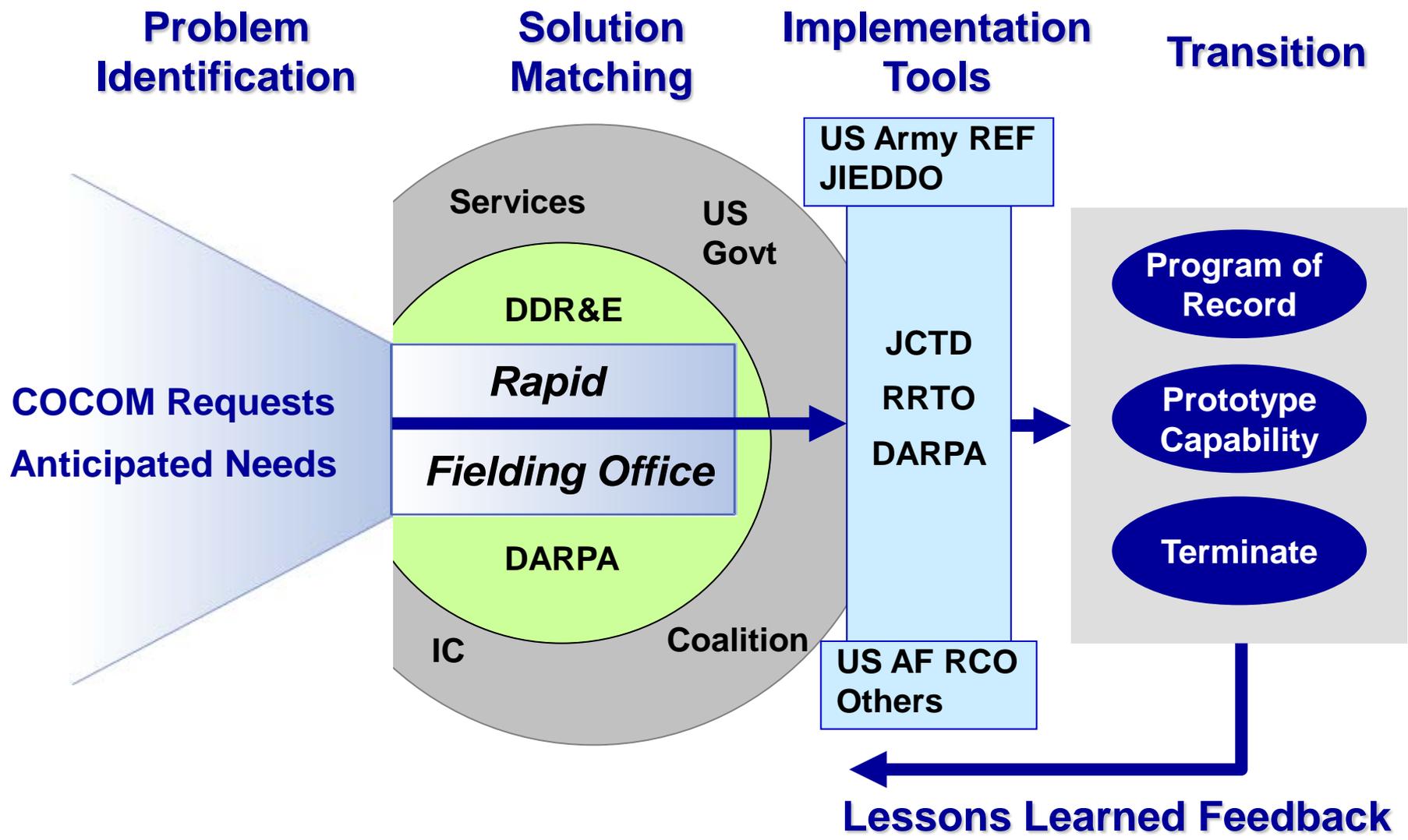


An Effective Process for Major Defense Systems – but not for Disruptive Technologies





Accelerate Delivery of Capabilities: 6-12 months from concept to capability





Major Shifts In The Department Of Defense



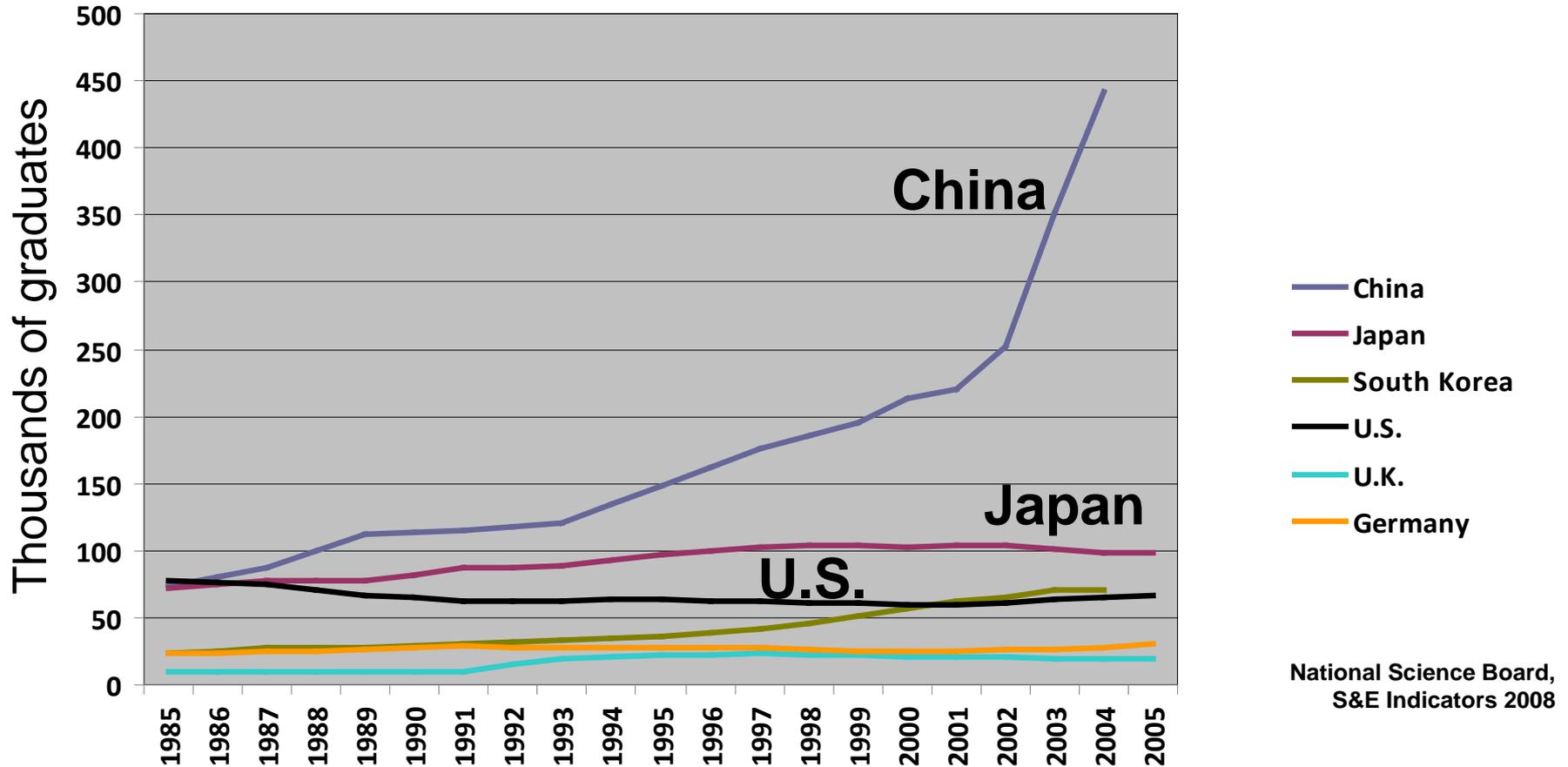
- **Significant shifts in operational needs**
 - More complex operations (coalition, logistics challenge)
 - Shift in operations from Iraq to Afghanistan
 - Preparedness for disaster relief
 - Energy and environmentally-aware focus
- **Emerging threats**
 - New class of maritime threats (piracy, DF-21, SSN26)
 - Global asymmetric threats
 - Global cyber threats
 - Proliferated WMD
 - Adversary's exploitation of commercial technologies
- **Acquisition**
 - Getting it right
 - Competition for budget
 - Rapid capability to the warfighter



Engineering Graduate Global Competition: Numbers Matter



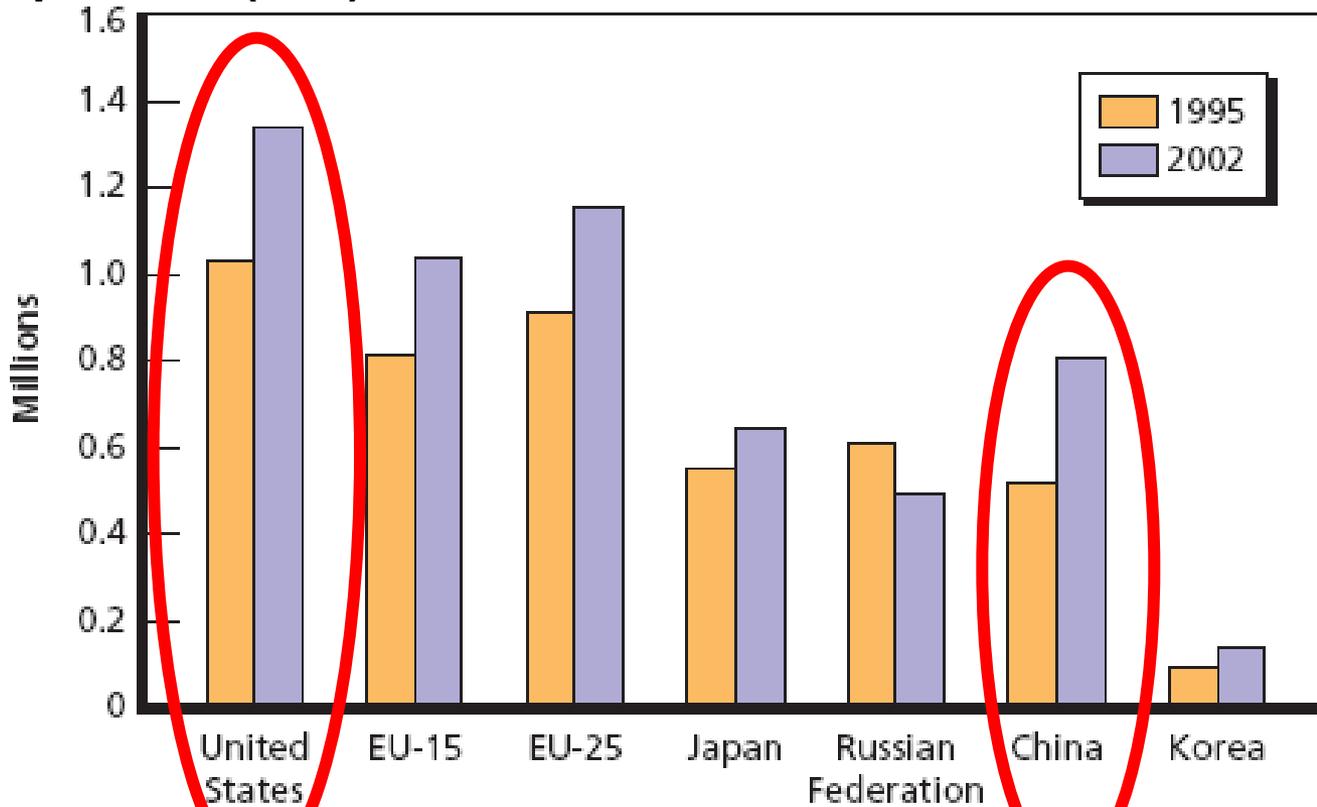
First engineering degrees by country (1985 – 2005):





Private Sector Research Workforce: The Shifting Research Base

Full-Time Equivalent (FTE) Researchers



3.7%
Growth / Year

6.5%
Growth / Year

Source: OECD Science, Technology and Industry Outlook (2006)



Global Competition is Attracting U.S. Talent



- **KAUST (King Abdullah University of Science and Technology) - IEEE Spectrum – September 2009**
- **CSTDC (China Science and Technology Exchange Center) – September 2009**

- **CITDC (China International Talent Development Center)**

NEWS
Saudi Arabia's New Technology University Opens Its Doors

The university, called KAUST, has the Middle East's fastest supercomputer and a multibillion-dollar endowment

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Photos: JB. Picoulet/S. Loulié

Oasis of Learning: The main entrance to the King Abdullah University of Science and Technology Jeddah, is flanked by construction cranes (top). The photograph below provides a vista of the main

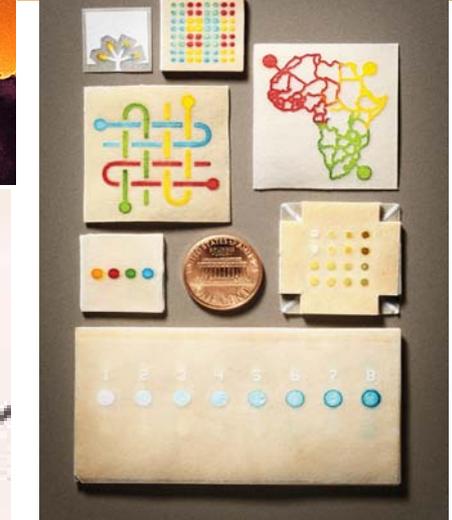
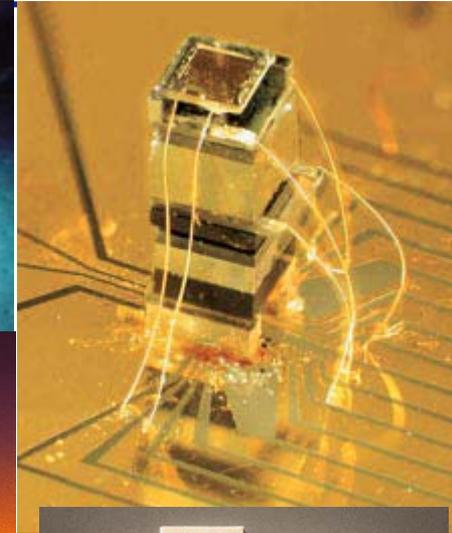
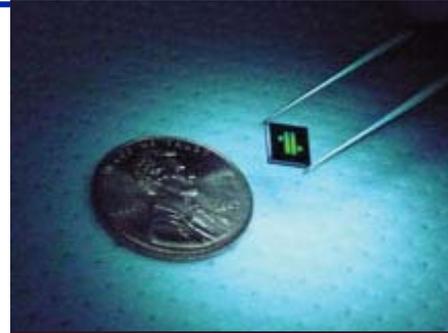


Where Will These Technologies Lead? Science Becoming Global, Multidisciplinary



2009 MIT Innovations List of Top 10 Emerging Technologies:

- *Biological Machines*
- *Traveling Wave Reactor*
- *Racetrack Memory*
- *\$100 Genome*
- *Software Defined Networking*
- *Intelligent Software Assistance*
- *Liquid Battery*
- *HashCache*
- *Nanopiezotronics*
- *Paper Diagnostic Tests*
- *Nanoradios (2008 holdover)*



Technology opportunities are expanding, but not well understood...



Prepare for an Uncertain Future – Do we have it right ?



- Combating Weapons of Mass Destruction
- Advanced Tagging, Tracking, & Locating
- Cyberspace Operation/Protection Technologies
- Battlespace Awareness
- Energy & Power
- Unmanned Vehicles
- Advanced Electronics
- Advanced Materials
- Processing Large Data Sets
- Intelligence, Surveillance & Reconnaissance
- Human, Social, Cultural, Behavior Modeling
- Software Development





Final Thoughts



Innovation

Speed

Agility