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10th Annual Science & Engineering Technology Conference / DoD Tech Exposition

"Creating Capability Surprise Through Innovative S&T and Operational Prototyping"

Charleston, SC

21 - 23 April 2009

Agenda

Tuesday, 21 April 2009

Strategic Imperatives for DoD S&T Program
Mr. Alan R. Shaffer, Principal Deputy Director, Defense Research & Engineering

The Advanced Systems & Concepts Portfolio of Opportunities
Dr. Charles Perkins, Acting, Deputy Under Secretary of Defense for Advanced Systems & Concepts

The DoD T&E/S&T Program
Mr. Gerald Christenson, T&E/S&T Program Manager, Defense Test Resource Management Center

Quick Reaction and Rapid Reaction Funds
Mr. Glenn Fogg, Deputy Director, Rapid Reaction Technology Office

Coalition Warfare Program
Colonel Kathleen Hithe, USAF, Deputy Director for Coalition Warfare

Allied Science & Technology… Changes at the Defence Science & Technology Organization
Featured Speaker: Professor Robert Clark, CDS, Australian Defence Science & Technology

Keynote Address
Dr. Zachary J. Lemnios, Chief Technology Officer, MIT Lincoln Laboratory

Session 1: Army Session
Co-Chairs:
- Dr. Cary Chabalowski, Director for Science & Technology Integration, Office of the Deputy Assistant Secretary of the Army (Research & Technology)
- Dr. Walter (Rick) F. Morrison, Principal, Booz Allen Hamilton

Army Science & Technology: Empowering Soldiers Through Innovative Technology
Dr. Thomas Killion, Deputy Assistant Secretary of the Army (Research &Technology)/Chief Scientist

Technology Focus Teams/Systems Integration Domains
COL Craig G. Langhauser, Director, Simulation and Training Center, RDECOM

Power and Energy
Dr. Edward C. Shaffer, Sensors and Electronic Devices Directorate, U.S. Army Research Laboratory

Network Science
Dr. David Skatrud, Director, Army Research Office

Robotic Systems

Mr. Jeffrey F. Jaster, Deputy Associate Director for Autonomous Systems Intelligent Ground Systems, RDECOM-TARDEC

Special Presentation: The Focus Center Research Program
Dr. Jeffery Rogers, Program Manager, Focus Center Research Program, Defense Advanced Research Projects Agency (DARPA)

Wednesday, 22 April 2009

Air Force STEM Workforce Today and Tomorrow
Mr. Leif E. Peterson, National Research Council, Air Force Science Board Committee on "*Examination of the U. S. Air Force's STEM Workforce Needs in the Future and Its Strategy to Meet Those Needs*"

Panel Discussion on "*Processes for Effective R&D Planning & Technology Transition*"
Panel Moderator: Dr. John W. Betz, Chair, Air Force Scientific Advisory Board

- Ms. Roberta M. Ewart, Chief Scientist, Air Force Space & Missile Systems Center
- Mr. Wendell D. Banks, Director, Plans and Programs, Air Force Research Laboratory

Session 3: Naval Session
Innovating for the Future
Dr. Larry Schuette, Director of Innovation, Office of Naval Research

Panel on Naval Open Architecture
Panel Moderator: Mr. Nick Guertin, Deputy Director for Open Architecture (PEO IWS 7B)

- Dr. Wayne Meeks, Executive Director, Deputy Assistant Secretary of the Navy - Ships
- Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research

Thursday, 23 April 2009

Session 4: Capabilities Needed by the Combatant Commanders
How Capabilities are Developed and Delivered to the Combatant Commanders
Mr. Mike Knollmann, Assistant Deputy Under Secretary of Defense (Joint & Coalition Operations Support)

USCENTCOM
Mr. Martin Drake, Science Advisor, USCENTCOM

USPACOM
Mr. Jim Burdell, Science Advisor, USPACOM

EUCOM
Mr. Forrest G. Ruble, EUCOM Science Advisor, ECJ8-Q

USSOUTHCOM
Mr. Herb Warden, JCTD Program Manager, USSOUTHCOM

NORT NORTHCOM
Mr. Edmund M. Doray, Chief, Concepts and Technology Division, N-NC Interagency Directorate, NORTHCOM

USTRANSCOM
Mr. Lou Bernstein, Science Advisor, USTRANSCOM

USSTRATCOM
Mr. Dave Tyner, Deputy Division Chief, J81, USSTRATCOM

Session: Strategic Discussion on DoD Independent Research and Development
Opening Remarks
Dr. Andre van Tilborg, Deputy Under Secretary of Defense for Science and Technology

Military Department Presentations

- **Army** - Dr. Jagadeesh Pamulapati, Deputy Director for Laboratory Management
- **Navy** - Rear Admiral Nevin P. Carr, USN, Chief of Naval Research
- **Air Force** - Mr. Wendell D. Banks, Director, Plans & Programs, Air Force Research Laboratory

10th Annual Science & Engineering Technology Conference/DoD Tech Exposition

April 21-23, 2009
Embassy Suites Hotel/Convention Center
Charleston, SC
Event 9720

"Creating Capability Surprise Through Innovative S&T and Operational Prototyping"

Conference Co-Chairs:
Colonel Jocelyn M. Seng, USAFR, Ph.D., Mobilization Assistant to the Deputy Assistant Secretary (Acquisition Integration)

Colonel Mark Stephen, USAF (Ret)
Vice President, Strategic Planning and Business Development, L-3 Coleman Aerospace

Science and Technology (S&T) advancements are key enablers for the onset of DoD system development. New technology can support the achievement of new capabilities to fill gaps identified through intelligence, testing and military operations. While essential to maintain awareness of emerging threats, it is also time to increase the focus on offense by delivering truly game changing capabilities which increase our advantage by overwhelming potential adversaries and forcing defensive reaction to U.S. warfighting capabilities. Additionally, with countering terrorism being a top priority for the DoD, game-changing capabilities are needed to deal with irregular warfare. S&T advancements provide opportunities to create capability surprise; however, it often takes a decade or more to get that technology into the hands of the war fighters. Operational prototyping provides hope for creating a streamlined technology transition and acquisition process.

Speakers from government, industry and universities will present their views on accomplishments and successes in applying innovative technology across the life cycle of DoD systems. Speakers will be available in the "Speakers Corner" after each session. This year, the conference will again feature poster paper sessions with authors available for discussion and interaction on emerging concepts and technology. There will also be opportunities for industry and academia to present ideas to Service representatives in one-on-one sessions.

NDIA Science and Engineering Technology Division Mission

The mission of the Science and Engineering Technology Division of NDIA is to examine various research and development issues affecting national defense. In pursuing this mission, the Science and Engineering Technology Division will provide a forum for discussion of the nation's defense needs by examining our existing capabilities and suggesting appropriate measures to overcome deficiencies in defense research and development. An important part of this activity is the opportunity for individuals from industry, government and academia to examine vital information in open forum on technical needs and planned efforts. The division will be dedicated to conducting conferences that foster an increased interest in meeting the Department of Defense technology requirements by creative research and advanced development throughout industry, government and academia.

TUESDAY, APRIL 21, 2009

7:00 AM **Conference Registration and Continental Breakfast - (Sign-up for one-on-one sessions begins)**

8:00 AM **Welcoming Remarks**
Major General Barry D. Bates, USA (Ret), VP Operations, NDIA

Mr. James Chew, Vice President, Science & Technology, ATK
S&ET Division Chair

8:15 AM **Preliminary Session: Opportunities for Collaboration**
Chair:
Mr. Robert W. Baker, Deputy Director, Plans & Programs, ODDR&E

In this session we will present Strategic Imperatives that provide focus for the investment of the DoD S&T program. Specific programs that provide conference attendees opportunities to engage in collaborative efforts with the DoD S&T community will also be highlighted. Presentations will provide information on technology areas of high interest to the DoD, time lines and points of contact for the submission of proposals. Opportunities for both industry and academia will be covered. A wide range of programs, from the larger technology demonstrations funded by the Joint Capability Technology Demonstration program that lead to the evaluation of military utility of advanced technology by a Combatant Commander; to the more focused technology development efforts that are funded by the Test & Evaluation/ Science & Technology (T&E/S&T) program will be covered. Opportunities for proposing commercial off-the-shelf technology to meet current military needs will be addressed by the Quick Reaction Fund/Rapid Reaction Fund presentation. The session will also include a presentation on opportunities for collaborative research and technology development through the Coalition Warfare Program and be rounded out with a presentation on collaborative international research and technology development.

8:15 AM **Strategic Imperatives for DoD S&T Program**
Mr. Alan R. Shaffer, Principal Deputy Director, Defense Research & Engineering

8:45 AM **The Advanced Systems & Concepts Portfolio of Opportunities**
Dr. Charles Perkins, Acting, Deputy Under Secretary of Defense for Advanced Systems & Concepts

9:15 AM **The DoD T&E/S&T Program**
Mr. Gerald Christenson, T&E/S&T Program Manager, Defense Test Resource Management Center

9:45 AM **Break**

10:30 AM **Quick Reaction and Rapid Reaction Funds**
Mr. Glenn Fogg, Deputy Director, Rapid Reaction Technology Office

11:00 AM **Coalition Warfare Program**
Colonel Kathleen Hithe, USAF, Deputy Director for Coalition Warfare

11:30 AM **Allied Science & Technology… Changes at the Defence Science & Technology Organization**
Featured Speaker: Professor Robert Clark, CDS, Australian Defence Science & Technology

12:00 PM **Luncheon – Exhibits and Poster Papers Open**

1:00 PM **Keynote Address**
Dr. Zachary J. Lemnios, Chief Technology Officer, MIT Lincoln Laboratory

1:45 PM **Session 1: Army Session**
Co-Chairs:

- Dr. Cary Chabalowski, Director for Science & Technology Integration, Office of the Deputy Assistant Secretary of the Army (Research & Technology)
- Dr. Walter (Rick) F. Morrison, Principal, Booz Allen Hamilton

The Army Science and Technology (S&T) Strategy has a dual approach to delivering technology to the Warfighter. Army S&T fosters innovation and accelerates maturing technology to enable Future Force capabilities while exploiting opportunities to rapidly transition technology to the Current Force.

TUESDAY, APRIL 21, 2009

The goal of S&T is to develop technologies that will enable a Future Force that is more mobile, survivable and sustainable, and dominant on the battlefield. Three research areas which are essential to meeting this goal are Power and Energy, Network Science, and Robotic Systems. S&T research in power and energy is aimed at reducing fossil fuel and battery demand through reduced platform energy consumption, more efficient power sources, smart energy management and the development of alternative energy options. Our efforts in Network Science will provide the foundation for enhancement of Battle Command in a highly mobile, highly distributed, information-rich environment. The increased utilization of unmanned robotic systems has proven to be extremely effective in current operations. Advancing research in autonomous perception, maneuver and tactics technology will result in unmanned air and ground systems that remove the soldier from dangerous and "dirty" work. The Army's Research, Development and Engineering Command (RDECOM) Technology Focus Teams/Systems Integration Domains provides a means for industry to engage in partnerships with the research and development community within the RDECOM.

1:45 PM **Army Science & Technology: Empowering Soldiers Through Innovative Technology**
Dr. Thomas Killion, Deputy Assistant Secretary of the Army (Research &Technology)/Chief Scientist

2:30 PM **Technology Focus Teams/Systems Integration Domains**
COL Craig G. Langhauser, Director, Simulation and Training Center, RDECOM

3:00 PM **Break in Exhibit Hall**

3:30 PM **Power and Energy**
Dr. Edward C. Shaffer, Sensors and Electronic Devices Directorate, U.S. Army Research Laboratory

4:00 PM **Network Science**
Dr. David Skatrud, Director, Army Research Office

4:30 PM **Robotic Systems**
Mr. Jeffrey F. Jaster, Deputy Associate Director for Autonomous Systems Intelligent Ground Systems, RDECOM-TARDEC

5:00 PM **Special Presentation: The Focus Center Research Program**
Dr. Jeffery Rogers, Program Manager, Focus Center Research Program, Defense Advanced Research Projects Agency (DARPA)

5:30 PM **Reception in Exhibit Hall**

WEDNESDAY, APRIL 22, 2009

7:00 AM **Conference Registration and Continental Breakfast**

8:00 AM **Administrative Remarks**

8:15 AM **Session 2: Air Force Session**
Co-Chairs:

- Dr. Patrick A. Mason, Senior Planner, Strategy Office in the Office of the Deputy Assistant Secretary (Science, Technology and Engineering)
- Colonel Jocelyn M. Seng, USAFR, Ph.D., Mobilization Assistant to the Deputy Assistant Secretary (Acquisition Integration)

This session begins with an Air Force R&D overview on how the Air Force S&T is focused and protected in order to provide continued dominance in air and space. This focus and protection is a strategic imperative of the Air Force as DoD budgets compete in tight fiscal environments of the future. The Air Force must maximize its R&D resources to strengthen the systems planning, engineering and analysis processes required for transition from research into Air Force weapons systems. The second presentation provides an overview of the Air Force basic science program that champions research that in the future, could profoundly impact the Air Force. As the R&D community is composed primarily of scientists, technologists, engineers and mathematicians (STEM) and acquisition professionals, this session will include a presentation on developing the Air Force's intellectual capital required to meet current and future Air Force priorities.

8:15 AM **Overview of Air Force R&D**
Mr. Terry J. Jaggers, Deputy Assistant Secretary (Science, Technology and Engineering)

9:00 AM **Overview of Air Force Basic Research**
Dr. Brendan B. Godfrey, Director, Air Force Office of Scientific Research

WEDNESDAY, APRIL 22, 2009

9:30 AM **Air Force STEM Workforce Today and Tomorrow**
Mr. Leif E. Peterson, National Research Council, Air Force Science Board Committee on "Examination of the U. S. Air Force's STEM Workforce Needs in the Future and Its Strategy to Meet Those Needs"

10:00 AM **Break - Exhibits and Poster Papers Open**

10:45 AM **Panel Discussion on "Processes for Effective R&D Planning & Technology Transition"**
Discussions will include:
- Air Force R&D Strategy and Technology Transition Efforts
- Value of 6.4 in Providing a Strong Foundation for Technology Transition
- Air Force Research Laboratory Perspective on Technology Transition

Panel Moderator: Dr. John W. Betz, Chair, Air Force Scientific Advisory Board

- Dr. Brendan B. Godfrey, Director, Air Force Office of Scientific Research
- Lieutenant Colonel Ralph A. Sandfry, Chief, R&D Strategy Branch, Office of the Deputy Assistant Secretary (Science, Technology and Engineering)
- Lieutenant Colonel Scott Nowlin, Chief, Air Force Technology Transition Office in the Office of the Deputy Assistant Secretary (Science, Technology and Engineering)
- Ms. Roberta M. Ewart, Chief Scientist, Air Force Space & Missile Systems Center
- Mr. Wendell D. Banks, Director, Plans and Programs, Air Force Research Laboratory
- Ms. Anne Carstens, Chief, Acquisition Center of Excellence, Air Armament Center

12:00 PM **Luncheon - Exhibits and Poster Papers Open**
Speaker: Mission to Outer Space
Mr. Bill Shepherd, Chief Science Advisor, USSOCOM

1:30 PM **Session 3: Naval Session**
Co-Chairs:
- Mr. Dennis L. Ryan, III, Science and Technology Planning Director, Johns Hopkins University, Applied Physics Laboratory
- Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research
- Mr. E. Terrence Dailey, Director of Operations, Software Engineering Institute

The Navy and the Marine Corps have long relied upon Science and Technology to inject new capabilities into the naval warfighter's toolkit. Tools from that kit must perform reliably in challenging operational environments and the reliability has often been achieved by combining technologies inseparably in a single system, weapon or piece of equipment. Previously, new technologies were mainly injected through totally new systems, weapons or equipments, but that has changed. Key enablers to improving the speed of technology refresh and improvement in naval systems are open architecture and common hardware. Use of these principles will allow the U.S. to remain ahead of potential adversaries in the evermore technologically advanced global arena. Thus, this session will focus on the Department of the Navy's efforts to reduce costs while introducing new capability faster.

1:30 PM **Avoiding Cost Growth through Open System Architecture**
Mr. Jim Thomsen, Principal Civilian DASN, ASN RD&A

2:15 PM **Innovating for the Future**
Dr. Larry Schuette, Director of Innovation, Office of Naval Research

2:45 PM **Break - Exhibits and Poster Papers Open (Last Chance to View Exhibits)**

3:30 PM **Panel on Naval Open Architecture**
Panel Moderator: Mr. Nick Guertin, Deputy Director for Open Architecture (PEO IWS 7B)

- Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research
- Dr. Wayne Meeks, Executive Director, Deputy Assistant Secretary of the Navy - Ships
- Mr. James Smerchansky, Director for Above Water Sensors, Program Executive Office for Integrated Warfare Systems
- Mr. John Andrews (PEO C4I) *(Invited)*

5:00 PM **Session Adjourned**

THURSDAY, APRIL 23, 2009

7:00 AM **Conference Registration and Continental Breakfast**

7:40 AM **Administrative Remarks**

7:45 AM **Session 4: Capabilities Needed by the Combatant Commanders**

Co-Chairs:

- Mr. James S. B. Chew, Vice President, Science & Technology, ATK
- Mr. Robert W. Baker, Deputy Director, Plans & Programs, ODDR&E

Meeting the capability needs of the warfighter is the most important goal of the DoD Science and Technology program. Establishing strong communications between the warfighter and the researcher is essential for understanding these capability needs. Warfighters traditionally communicate their needs in terms of capability gaps. The DoD S&T community must be able to address those gaps in S&T projects and demonstrate how enabling technology can effectively and rapidly fill these capability gaps. In this session, representatives of U.S. Combatant Commanders will describe what new operational capabilities would make a big difference in their ability to conduct military operations in their areas of responsibility.

7:45 AM **How Capabilities are Developed and Delivered to the Combatant Commanders**
Mr. Mike Knollmann, Assistant Deputy Under Secretary of Defense (Joint & Coalition Operations Support)

8:15 AM **USCENTCOM**
Mr. Martin Drake, Science Advisor, USCENTCOM

8:45 AM **USSOCOM**
Mr. Bill Shepherd, Chief Science Advisor, USSOCOM

9:15 AM **USPACOM**
Mr. Jim Burdell, Science Advisor, USPACOM

9:45 AM **USSOUTHCOM**
Mr. Herb Warden, JCTD Program Manager, USSOUTHCOM

10:15 AM **Break**

10:30 AM **Best Poster Winner Announcement**

10:45 AM **NORTHCOM**
Mr. Edmund M. Doray, Chief, Concepts and Technology Division, N-NC Interagency Directorate, NORTHCOM

11:15 AM **USTRANSCOM**
Mr. Lou Bernstein, Science Advisor, USTRANSCOM

11:45 AM **USSTRATCOM**
Mr. Dave Tyner, Deputy Division Chief, J81, USSTRATCOM

12:15 PM **Box Lunches**

1:15 PM **Session: Strategic Discussion on DoD Independent Research and Development**

Chair:

- Dr. Andre van Tilborg, Deputy Under Secretary of Defense for Science and Technology

In this session, we will discuss DoD strategic technology interests as well as set the stage for additional deliberations later in 2009 for maximizing benefit to the DoD from investments in the approximately $2.4B of annual Independent Research and Development (IR&D) efforts. The Office of the Secretary of Defense (OSD) and the Services will present technology and engineering investment opportunities which are best addressed by industry-led initiatives or considered high priority but not uniquely aligned with an individual Service or Agency mission. Discussions will be held to address collaborative IR&D oversight mechanisms between DoD and industry to catalog and promulgate the results of on-going investments, and identify high-potential opportunities to provide increased capabilities to the warfighter or reduce acquisition development risks, costs, and schedule. In conjunction with industry representation and collaboration, DoD has reinvigorated the Technology Coordination Group (TCG) activities established by DoD Directive 3204.1. Discussions will help to shape TCG responsibilities and define those collaborative oversight activities and set the stage for a more lengthy discussion later in 2009.

THURSDAY, APRIL 23, 2009

1:15 PM	**Opening Remarks** Dr. Andre van Tilborg, Deputy Under Secretary of Defense for Science and Technology
1:30 PM	**Military Department Presentations** Army - Dr. Jagadeesh Pamulapati, Deputy Director for Laboratory Management Navy - Rear Admiral Nevin P. Carr, USN, Chief of Naval Research Air Force - Mr. Wendell D. Banks, Director, Plans & Programs, Air Force Research Laboratory
3:00 PM	**Break**
3:15 PM	**Topics for Consideration** Dr. Andre van Tilborg, Deputy Under Secretary of Defense for Science and Technology
3:30 PM	**Discussion**
5:15 PM	**Conference Adjourns**

ONE-ON-ONE SESSIONS

There will be the opportunity to have fifteen minute one-on-one conversations with Technology Managers from the Air Force Army and the Navy. Sign up for sessions can be done at the registration counter.

SCHEDULE:

Tuesday, April 21, 2009

Air Force:
3:00 PM - 5:00 PM
Colonel Kenneth L. Echternacht, Science and Technology Division Chief, Office of the Deputy Assistant Secretary (Science, Technology and Engineering)

Navy:
1:45 PM - 5:00 PM
Dr. Larry Schuette, Director of Innovation, Office of Naval Research
Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research

Wednesday, April 22, 2009

Air Force:
3:00 PM - 5:00 PM
Colonel Kenneth L. Echternacht, Science and Technology Division Chief, Office of the Deputy Assistant Secretary (Science, Technology and Engineering)

Army:
9:00 AM - 12:00 PM, 1:30 PM - 5:00 PM
Dr. Cary Chabalowski, Director for Science & Technology Integration, Office of the Deputy Assistant Secretary of the Army (Research & Technology)

Navy:
9:30 AM - 11:30 AM and 5:00 - 6:00 PM
Dr. Larry Schuette, Director of Innovation, Office of Naval Research
Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research

Thursday, April 23, 2009

Navy:
8:15 AM - 10:15 AM
Dr. Larry Schuette, Director of Innovation, Office of Naval Research
Dr. Joseph Lawrence, III, Director of Transition, Office of Naval Research

Strategic Imperatives for the DoD Science & Technology Program

Mr. Al Shaffer
Principal Deputy
Defense Research and Engineering

The Next Phases of Development
--Thoughts from the Secretary of Defense--

"I believe the Department should seek increasing competition, use of prototypes, and ensure technology maturity so that our programs are ready for the next phases of development…"

Secretary Gates before the SASC, January 27, 2009

The strategy (National Defense Strategy) strives for balance in three areas: between trying to prevail in current conflicts and preparing for other contingencies, between institutionalizing capabilities such as counterinsurgency and foreign military assistance and maintaining the United States' existing conventional and strategic technological edge against other military forces, and between retaining those cultural traits that have made the U.S. armed forces successful and shedding those that hamper their ability to do what needs to be done.

Foreign Affairs Magazine Jan / Feb 2009

DDR&E VISION: To develop technology to defeat any adversary on any battlefield

Any Battlefield includes physical, cyber, space, undersea, etc

Any adversary includes both State & non-State actors

Forces of Change…

Changing International Factors

Defense S&T for Persistent Conflict

Changing Warfare Factors

NEW TECHNOLOGY NEEDED

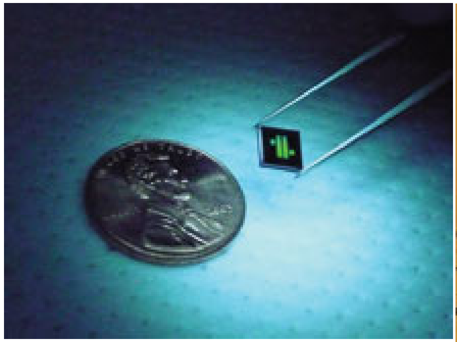
What does this mean for the Department…?

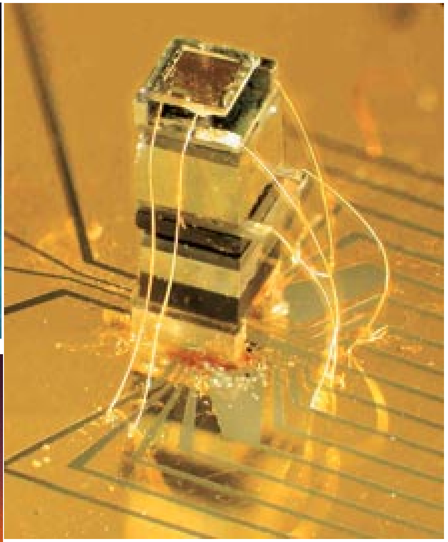
Expanding Knowledge Base

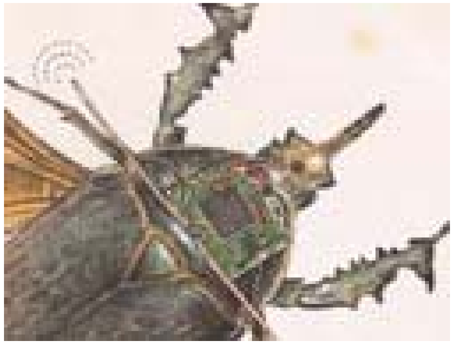
Science Becoming Global, Multidisciplinary

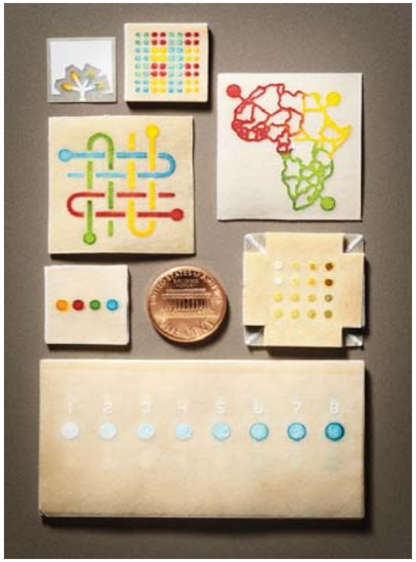
2009 MIT Innovations List of Top 10 Emerging Technologies:

- *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)*





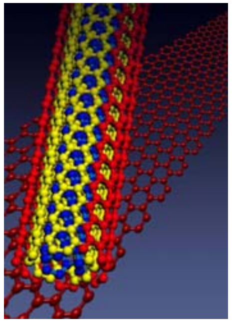


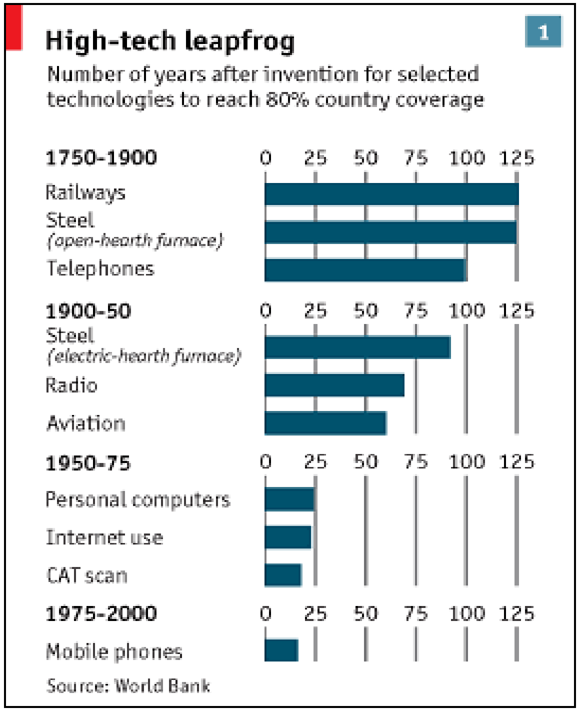


Technology opportunities are expanding, but not well understood…

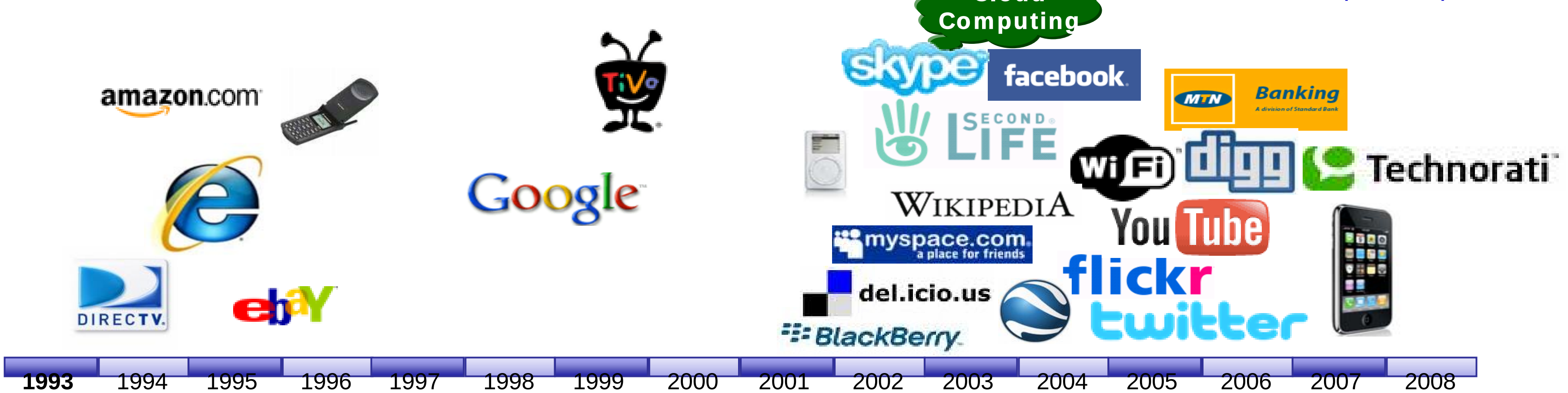
Pace of Technology Continues to Increase

- **Time between modeling of semiconducting properties of germanium in 1931 and first commercial product *(transistor radio)* was 23 years**
- **Carbon nanotube**
  - **Discovered by Japan (1991)**
  - **Researchers recognized carbon nanotubes were excellent sources of field-emitted electrons (1995)**
  - **"Jumbotron lamp" - nanotube-based light source available as commercial product (2000)**
- **Information Technology**





***The Economist*, Feb. 9, 2008**



Strategic Plans Drive Strategic Imperatives

FY2010 Budget will contain "recommendations that are the product of a holistic assessment of capabilities, requirements, risks and needs for the purpose of shifting this Department in a different strategic direction" *

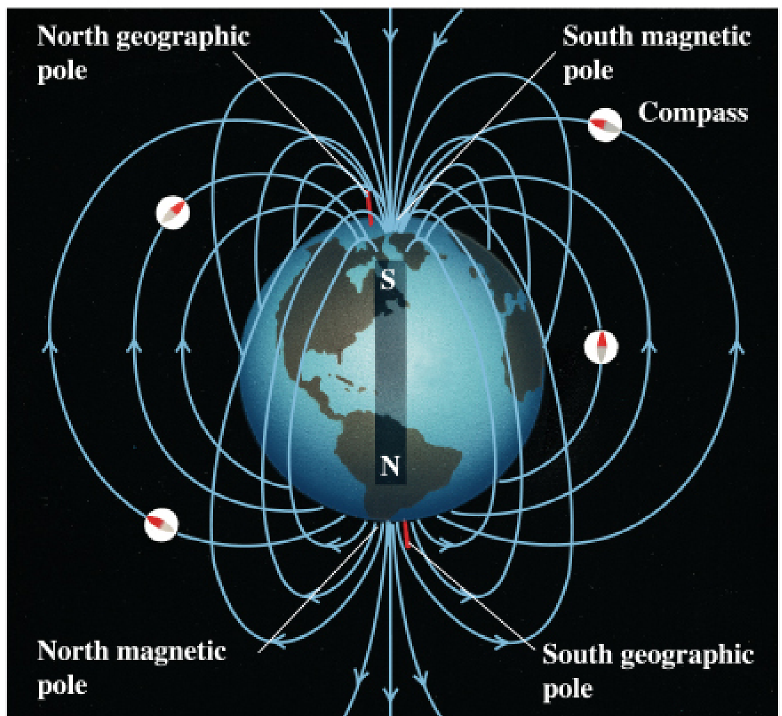
** Secretary Gates, Defense Budget Recommendation Statement, Arlington, VA, April 6, 2009*

Shifting away from an emphasis on ships, tanks, and planes—to focus on protection, information, knowledge, and timely, actionable intelligence

Rise of the Commons

- **Military operations increasingly depend on being able to operate in places “no one owns” – The Commons**

- **U.S. DoD science and technology is increasing to assure capability to operate in the commons.**



The Fallout From Desert Storm

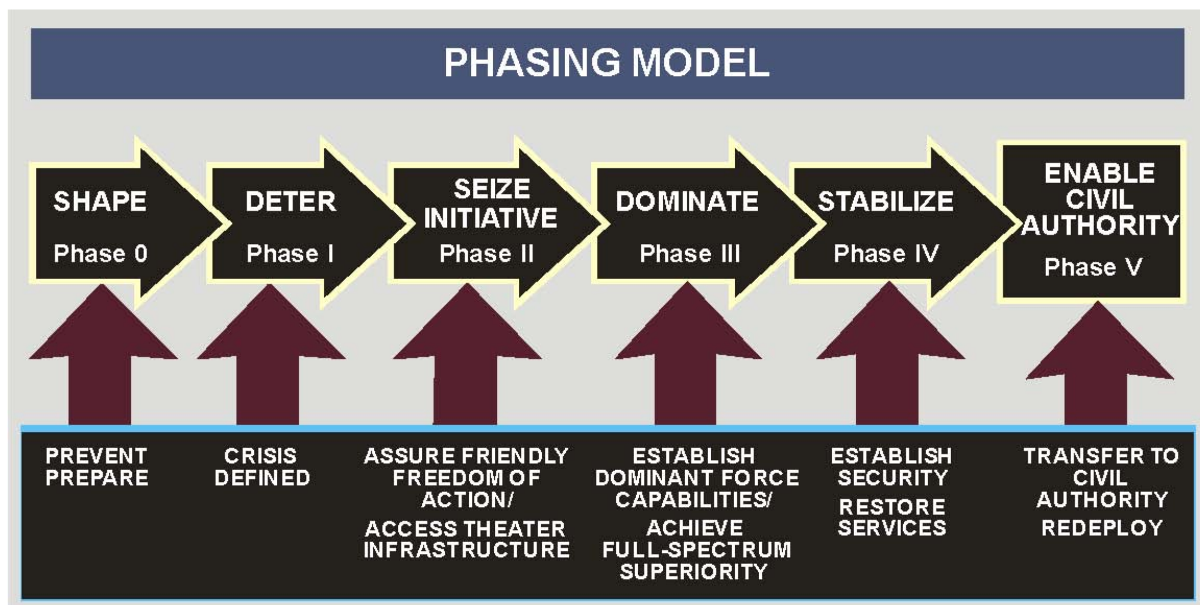
- **US dominance over Soviet-era systems “shocked” potential adversaries and combined to give US conventional superiority**
  - **Precision Weapons**
  - **Night Vision**
  - **Low Observability**
  - **Networked Systems**
  - **Space**
  - **Command and Control**

- **The advent of information-based warfare fed the emergence of irregular warfare**

Led To Resurgence of Irregular Military Operations

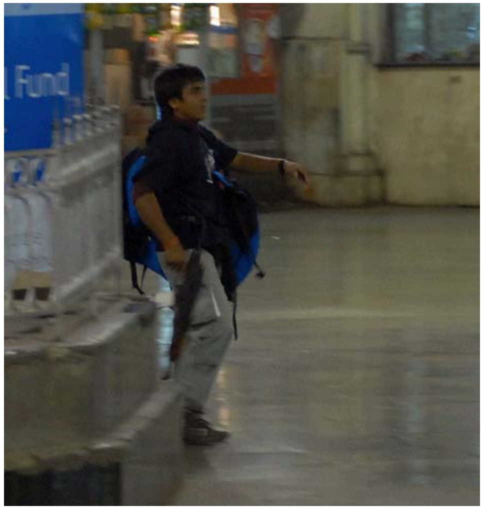
Implications

- US and Allies have unquestioned advantage With Conventional Systems
- World wide resurgence of Tribal Alliances
- New Capabilities Needed to Deal with the New Strategic Framework
- Engagement Includes Soft Power
- Phase 0, 1, 4, and 5 Coming to the Force



Complex Operating Environment

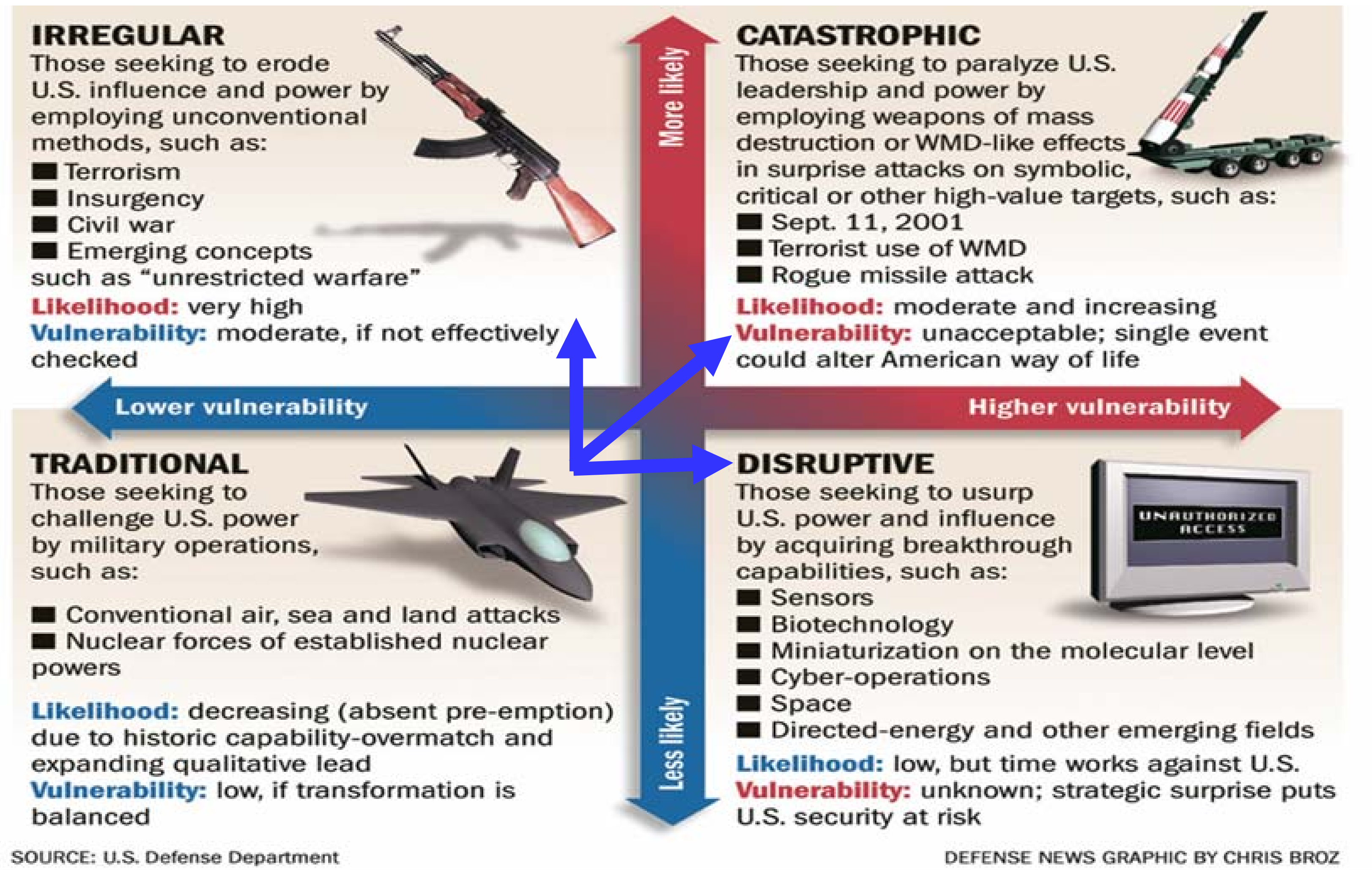
- **Today's global economy is technology driven**
- **Adversaries will increasingly leverage technology to challenge U.S Armed forces capabilities**
- **Irregular and asymmetric forms of warfare are likely**
- **Economic, demographic, resource, technology, and climate trends will present new challenges**



Strategic Plans

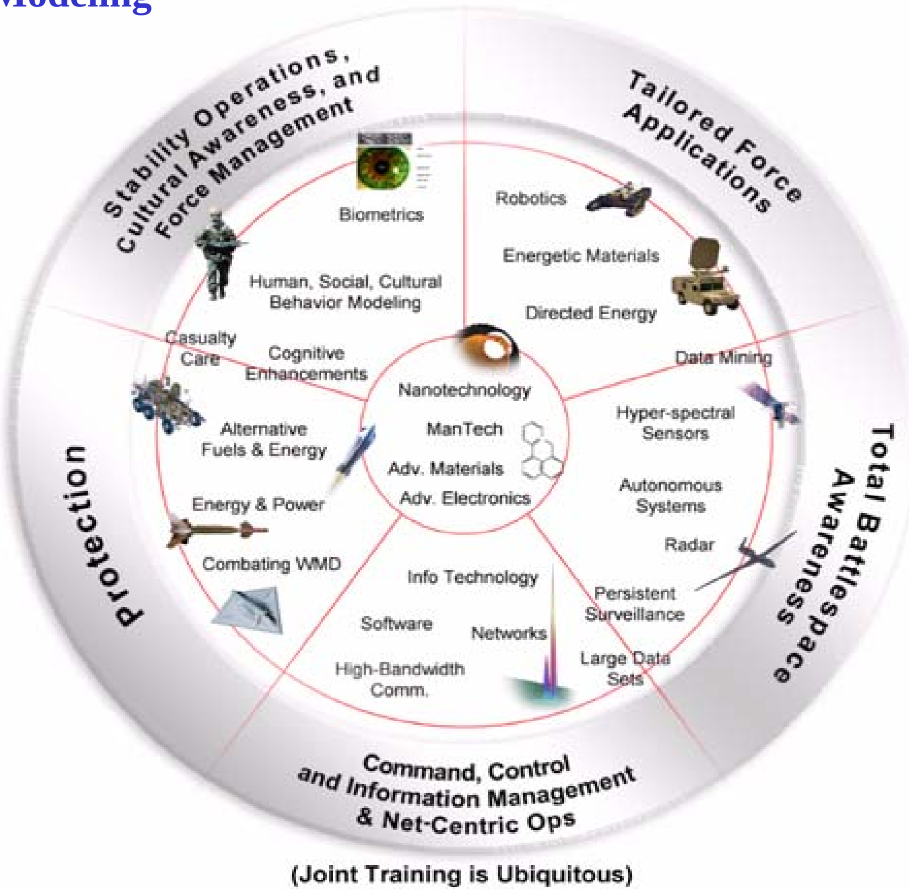
Defense Science and Technology Strategy and Planning

National Defense Strategy Drives Investment Strategy



S&T Enabling Technology Priorities
-Supporting the QDR Strategic Outcomes-

- **Technology focus areas:**
  - **Human, Social, Cultural, and Behavioral Modeling**
  - **Biometrics and Biological exploitation**
  - **Information Technology and applications**
  - **Persistent Surveillance Technologies**
  - **Networks and Communication**
  - **Language Translation Technologies**
  - **Manufacturing Technologies**
  - **Cognitive Enhancement**
  - **Directed Energy Technologies**
  - **Autonomous Systems Technologies**
  - **Hyperspectral Sensors**
  - **Nanotechnology**
  - **Advanced Materials**
  - **Energy and Power Technologies**
  - **Organization, Fusion, & Mining Data**
  - **Combating WMD Technologies**
  - **Energetic Materials**



Blue Text—Areas with substantial increases in FY08/09 President's Budget Request

Strategic Imperatives

Four Principal Objectives

- Basic Research and Three DoD Strategic Imperatives

Secretary of Defense Posture Statement on the FY2009 Budget, February 2008

"As changes in this century's threat environment create strategic challenges – irregular warfare, weapons of mass destruction, disruptive technologies – this request places greater emphasis on basic research, which in recent years has not kept pace with other parts of the budget."

Secretary of Defense, Budget Recommendation Statement, Arlington, VA, April 6, 2009

1. **Take care of our people**
2. **Develop the right capabilities for today and tomorrow**
   - **Persistent surveillance**
   - **Cyberspace operations/protection**
   - **Combating weapons of mass destruction**
   - **Irregular warfare**
3. **Reform the Procurement, Acquisition, and Contracting processes**

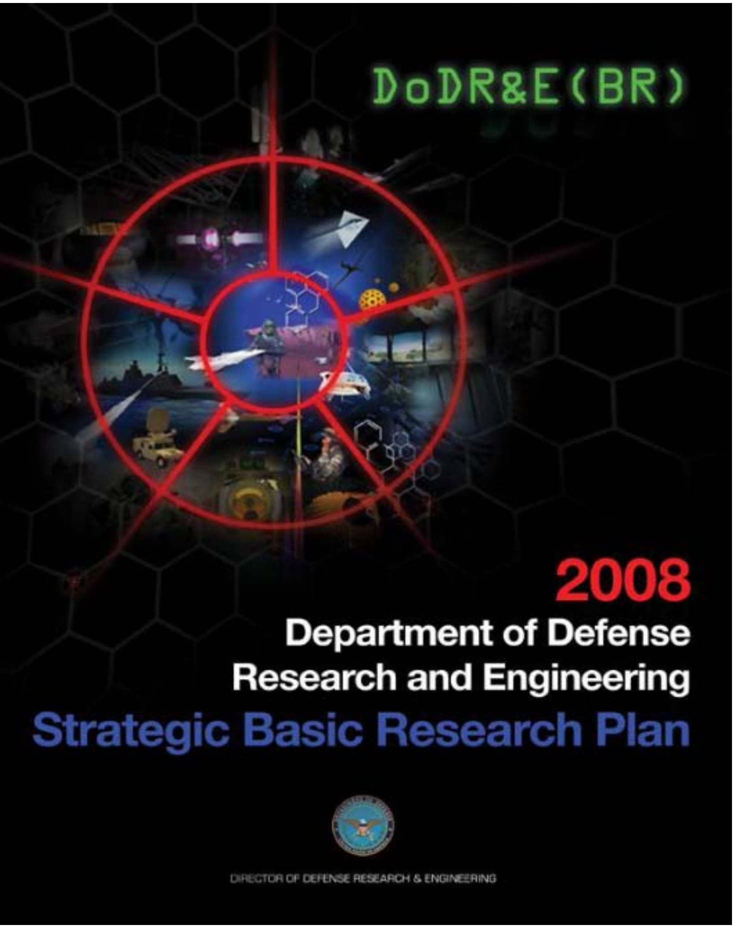
Connecting Researchers to the Warfighter

President Obama, Science Debate, September 2,2008

"My administration will put basic defense research on a path to double and will assure strong funding for investments in DoD's applied research programs. We will enhance the connections between defense researchers and their war-fighting counterparts."

Investment in Basic Research is a commitment to the future warfighter

Strategic Basic Research Plan (BRP)



- **$270M Basic Research Increase (PBR 09)**
  - **Enhance the science and engineering personnel base and Emphasize research to address Grand Capability Challenges:**
    - **Cyber protection/ information assurance**
    - **Network sciences**
    - **Science of autonomy**
    - **Information fusion and decision sciences**
    - **Biosensors and biometrics**
    - **Human sciences (cultural, cognitive, behavioral, neural)**
    - **Software sciences and materials**
    - **Immersive sciences for training and mission rehearsal**
    - **Power and energy management**
    - **Counter directed energy weapons**
  - **About 500 focused research efforts**

A Strategic plan guiding DoD research, built around National Science Foundation (NSF) Taxonomy

April 2009 Budget Statement

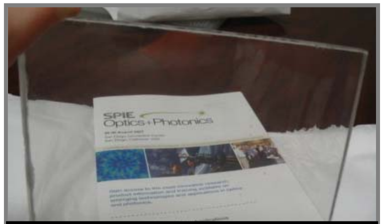
- Imperative 1: Take care of our people -

- **Personnel & Platform Protection**
- **Advanced Medical Research**
- **Education**

Example – Protection
Lightweight Armor

Objective: To overcome the traditional cost/performance tradeoff through innovative arrangement (topology) of known materials, rather than invention of new materials

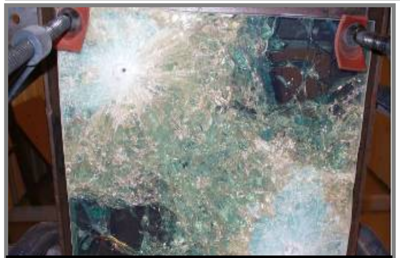
Improved Strike-face: Transparent Spinel (MgAlO)



Glass Coated 6" x 6" Spinel Plate

Topological Features on Back Face

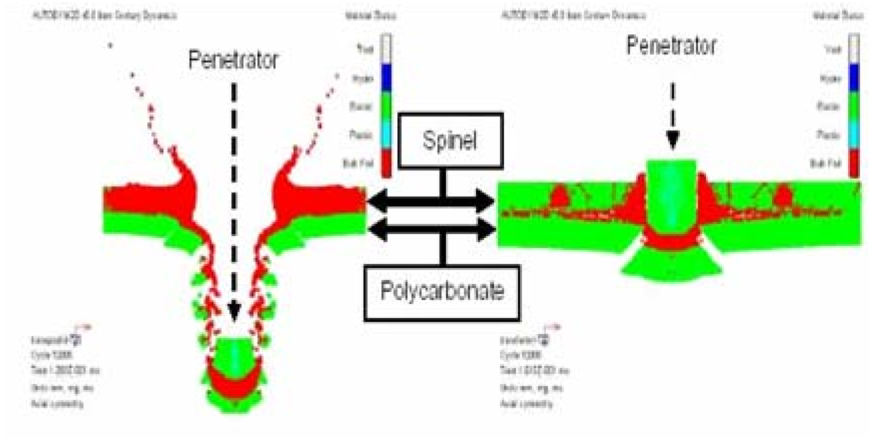
Improved Backing Materials: Glass Ceramics and Transparent Polymers



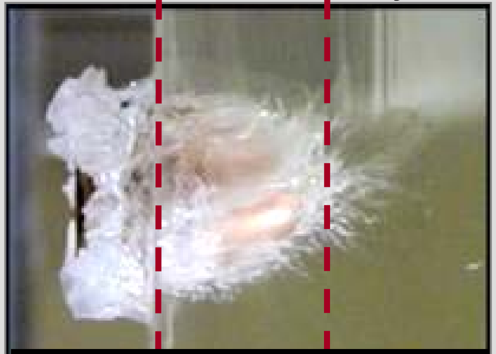
Glass Ceramic

Glass Fiber Reinforced Polymer

Ballistic testing completed at Army Research Lab with areal density ~18 lbs/ft^2



Spinel | Glass Ceramics | Fiber Polymer



Transparent Armor System

Increase Performance, Reduce Weight, and Maintain Optical Requirements of Transparent Layered Armor

Example – Medical R&D
Military Operational Medicine Research Program

- **Capabilities structured into four key focus areas:**
  - **Injury Prevention**
  - **Psychological Health and Resilience**
  - **Physiological Health and Well-Being**
  - **Environmental Health and Protection**

Priority 1
Injury Prevention

Priority 2
Psychological Health

Priority 3
Physiological Health

Priority 4
Environmental Health

Example – Educating Our Force

National Defense Education Program (NDEP)

Building Science, Technology, Engineering & Math (STEM) Skills

Challenge:

- Downward trend in S&E degrees at all levels of education
- General erosion of US competency in math and science at mid/high school

STEM Development:

- Science and Math competence is gained in K-12
- Forms foundation of educated, capable, and technical workforce for DoD

Path Forward:

- Promote STEM Education in mid/late educational years combined with defense community employment

NDEP website = http://www.ndep.us

DoD employs nearly half of all Federal physical scientists, technologists, engineers, and mathematicians

April 2009 Budget Statement

- Imperative 2 -

Develop the right capabilities for today and tomorrow

- **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**

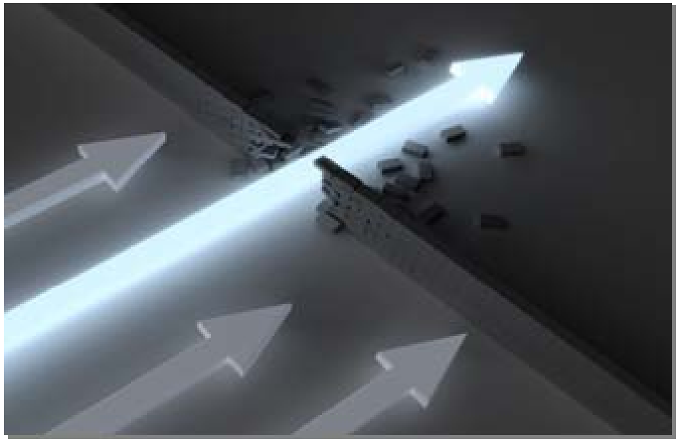
April 2009 Budget Statement
- Imperative 3 - Reform the Procurement, Acquisition, and Contracting processes

- **Joint Analysis Teams**
- **Milestone Development Decisions**
- **Information Access**
- **DoD Challenge Programs**
- **Technology Transition Initiatives**
- **Operational Prototyping**

DoD Techipedia

Why a Wiki for DoD Technology Collaboration?

- **Break across community barriers**
  - **Foster communication between those with needs and those with potential solutions**
- **Success of Wikipedia, Intelipedia make Wikis more familiar, especially to Generations X and Y**
  - **Builds on how people are interacting at home, and at schools**
  - **Increasing awareness of wiki's in the DoD S&T users community are through interaction with Intelipedia's S&T areas**
- **Low technical barriers to entry**
  - **Browsers based - no specialized tools**
  - **Low bandwidth**



https://www.dodtechipedia.mil

2008 DDR&E Wearable Power Prize

The Challenge

Demonstrate a Wearable Power System that provides 20 watts of power on average for 96 hours weighing 4 kg or less (minimum 480 W-hr/kg)

Prize Purse

1st $1,000,000
2nd $500,000
3rd $250,000

Competition Description

- **Competition Announced** **July 2007**
- **169 Teams Registered** **Nov 2007**
  (> 500 competitors/ ~ 20 countries)
- **Fuel Plans Due** **Mar 2008**
- **System Description Due** **Jun 2008**
- **Capstone Events** **Sep – Oct 2008**
  - Competition Sep 22 – Oct 4
  - Kids' Day Oct 3rd
  - Awards Ceremony Oct 4th

$1,000,000 3.762 Kg

DuPont SFC/Smart Fuel Cell M-25 Team
Wilmington, DE

Direct Methanol Fuel Cell/Li-Ion Battery/ Power Electronics Hybrid
Fuel – Liquid Methanol

$500,000 3.790 Kg

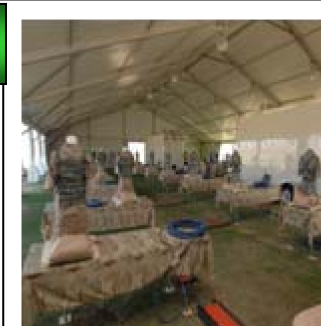
Adaptive Materials Inc. - Ann Arbor, MI

Solid Oxide Fuel Cell/ Li-Ion Battery/ Power Electronics Hybrid
Fuel – Pressurized Propane &

$250,000 3.865 Kg

Jenny 600S – Middleburg, VA

Direct Methanol Fuel Cell/ Li-Ion Battery/ Power Electronics Hybrid
Fuel – Liquid Methanol



92-Hour Bench Test

4-Hour Field Test

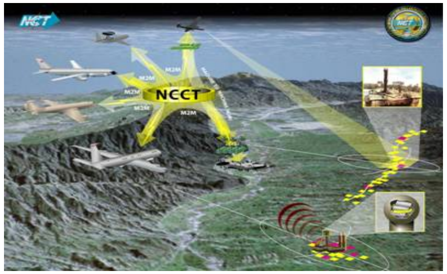
Joint Capability Technology Demonstration (JCTD)

- **Improves ACTD process/replaces ACTDs (Oversight--not Program Management)**
- **Designed to speed transformational, joint and coalition capabilities**
- **Works with combatant commands to identify solutions emerging/validated needs**
- **Partners with services/agencies to push technology solutions**
- **Final demonstration phase reached in two years for most JCTDs**
- **Majority of JCTD start up and transition costs centrally funded in DDR&E/AS&C**

Transformational

The SPARTAN ACTD demonstrates a multi-mission unmanned surface vessel (USV) capability that will can transform the way our forces provide ship/harbor security.

Joint



U.S. Army, Navy, and Air Force are working with UK on the Network Centric Collaborative Targeting ACTD to horizontally integrate intelligence, surveillance, and reconnaissance platforms for target identification and geolocation.

Coalition

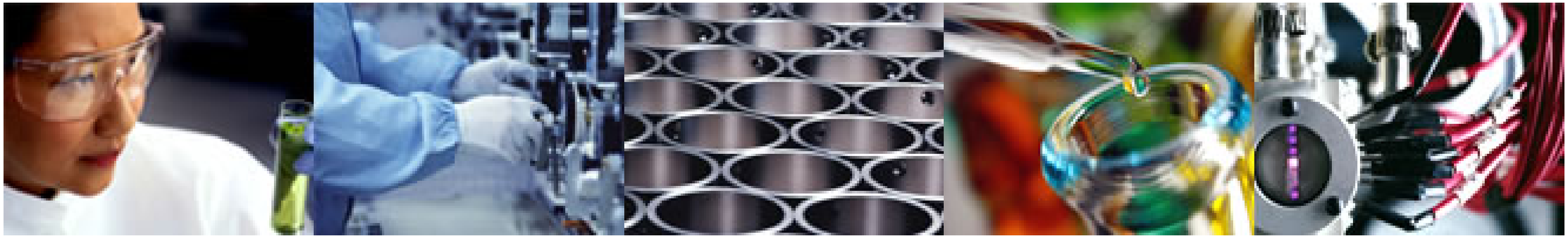
Pakistani troops deploying for Tsunami relief effort with help from Coalition Theater Logistics ACTD

"We are encouraged by recent actions taken by DOD to initiate a Joint Capabilities Technology Demonstration business process as it is intended to meet joint and coalition forces needs we have outlined." GAO--**Michael Sullivan, Director Acquisition & Source Mgt, HASC sub-committee on Tactical Air and Land Forces Subcommittee, 9 March 2005.**

Director of Defense Research & Engineering Vision

VISION:
To develop technology to defeat any adversary on any battlefield

Example – Educating Our People



STEM Education Delegated to DDR&E - New Initiative to Develop a Strategic Plan

Vision:

- **Build and develop science, technology, engineering, and mathematics (STEM) talent that is sustainable for national security**

Mission Includes:

- **Attract, engage, and stimulate a global national security STEM community to meet the needs of the Department of Defense (DoD)**
- **Organize and coordinate Department-wide policies and resources in support of education and outreach**
- **Ensure the Department's portfolio is synchronized with the whole of government**

DoD employs nearly half of all Federal physical scientists, technologists, engineers, and mathematicians

Theater Support Vessel (TSV)

Problem: Need for a joint expeditionary capability to deliver combat ready units configured for immediate employment in JOA.

- **High Speed Rapid Littoral Maneuver and Force Closure**
- **Rapid Unassisted Ingress and Egress Enables Austere Port Operations**
- **Reduction of Reception and Staging Times in Theater of Operations**
- **Mitigate Anti-Access and Area Denial Efforts**

Solution:

- **High Speed Vessel Capable of:**
  - **Intra-Theater Movement of Combat Ready Units**
  - **Ship-to-Ship and Ship-to-Shore Operations**
  - **Supporting Operations in the Littorals**

Quick Reaction Special Projects (QRSP)

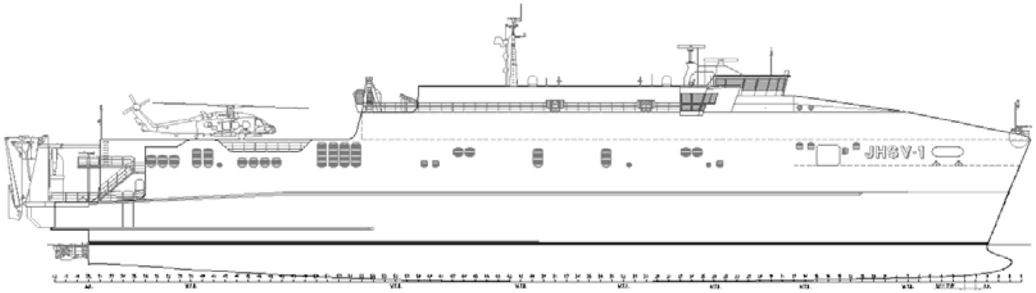
(PE 0603826D8Z~$115M/Yr)

- **Technology Transition Initiative – For DoD S&T Community**
  - **Establishes a Technology Transition Council**
  - **Jump starts selected components/subsystems into systems**
  - **Bridges the "Valley of Death"**
- **Quick Reaction Fund**
  - **Provides flexibility to respond to emergent DoD needs within budget cycle**
  - **Takes advantage of technology breakthroughs in rapidly evolving technologies**
  - **Completion of projects within a 6-12 month period**
- **Rapid Reaction Fund**
  - **Develops, procures, tests, and fields critical force protection needs in Iraq**
  - **Enhances force protection to counter Improved Explosive Devices (IEDs)**

JOINT HIGH SPEED VESSEL

DIMENSIONS

LENGTH	**103.0 m**	**(337.9 ft)**
BEAM	**28.5 m**	**(93.5 ft)**
DRAFT	**3.83 m**	**(12.57 ft)**



WEIGHTS

LIGHTSHIP	**1453 mt**	**(1430.0 Lt)**
FULL LOAD	**2397 mt**	**(2359.1 Lt)**
FUEL	**682 mt**	**(671.2 Lt)**
JP-5	**148 mt**	**(145.7 Lt)**
PAYLOAD	**635 mt**	**(700.0 st)**

MATERIAL

ALUMINUM

PERFORMANCE

SPEED

- **Average** — **35 knots @ 90% MCR with 635 mt (700 st) Payload**
- **Maximum** — **43 knots without Payload**

RANGE

Maximum Transit	**1200 nm**
Self-Deployment	**5600 nm**
SURVIVAL THROUGH	**SS-7**

ACCOMMODATIONS

CREW	**41 p**
Single SR	**2**
Double SR	**6**
Quad SR	**7**
TROOP SEATS	**312 p**
TROOP BERTHS	
Permanent	**104 p**
Temporary	**46 p**
GALLEY & MESSING	**48 p**

MACHINERY

- **(4) MTU 20V8000 M71L Diesel Engines (9.1 MW each, 36.4 MW total)**
- **(4) ZF 60000NR2H Reduction Gears**
- **(4) Wartsila WLD 1400 SR Waterjets**
- **(4) IF V1312C2ME-HPCR Diesel Generators (600 kW each, 2.4 MW total)**

MISSION BAY

AREA (with Tie-Downs)	**1863 m^2**	**(20053 ft^2)**
CLEAR HEIGHT	**4.75 m**	**(15.6 ft)**
TURNING DIAMETER	**26.2 m**	**(86.0 ft)**
ISO TEU STATIONS	**6 Interface Panels**	

AVIATION FACILITIES

- **NAVAIR Level 1 Class 2 Certified Flight Deck for one helicopter**
- **Centerline parking area for one helicopter**
- **NAVAIR Level 1 Class 4 Type 2 Certified VERTREP**
- **Helicopter Control Station**

C4I SYSTEMS

- **IFF / TACAN / MORIAH**
- **Aviation VLS / Stabilized GSI**
- **Integrated Shipboard LAN /NIPRNET / SIPRNET**
- **VMS / ECDIS-N, Four-Node**
- **Fiberoptic Gyrocompass MK-27F and UPS**
- **Surface Search RADAR (X-Band and S-Band)**
- **Dual GPS,**
- **Vessel Automatic Identification System (AIS)**
- **Autopilot**
- **Voyage Data Recorder**

AUXILIARY SYSTEMS

ACTIVE RIDE CONTROL

Transom Interceptors

Foils: 3.24 m^2 (34.9 ft^2) each, forward on inboard sides of demi-hulls

VEHICLE RAMP

Articulated Slewing Stern Ramp

Straight Aft to 45° Starboard

TELESCOPING BOOM CRANE

12.3 mt @ 15m, 18.2 mt @ 10 m

(13.6 Lt @ 49.2 ft, 20.1 Lt @ 32.8 ft)

ARMAMENT

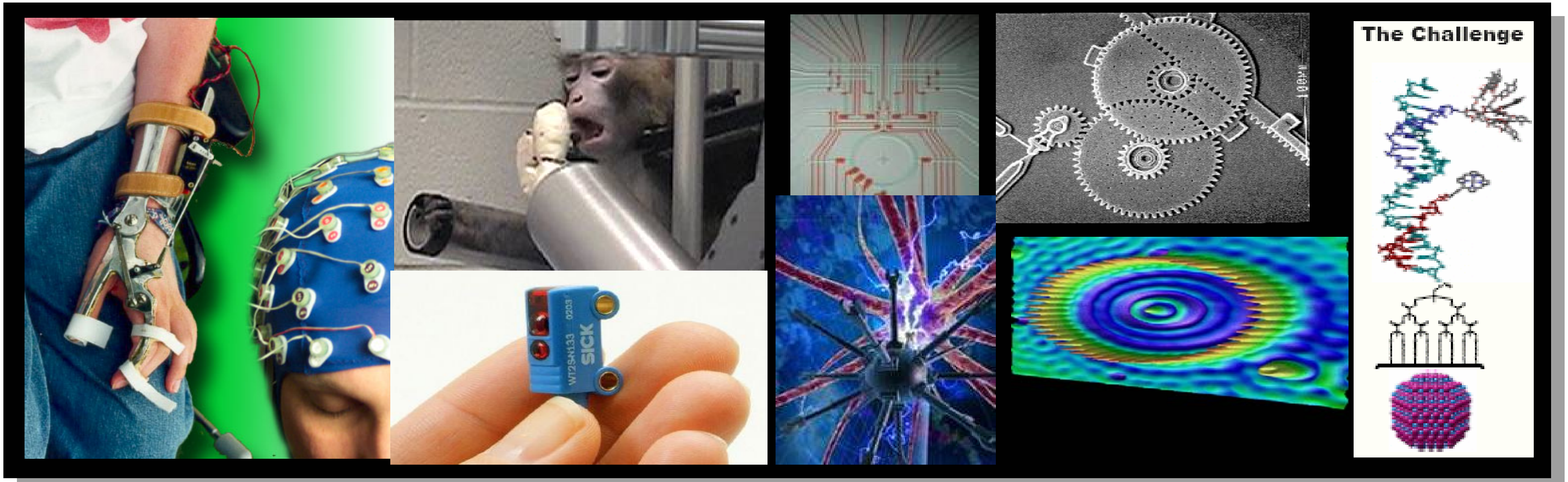
- **(4) .50 Caliber Machine Guns**
- **Reservation for AT/FP System**
- **Reservation for Non-Lethal Effectors**

FIREFIGHTING

- **High Expansion Foam in Mission Bay**
- **AFFF on Flight Deck, Mission Bay and in Machinery Spaces**

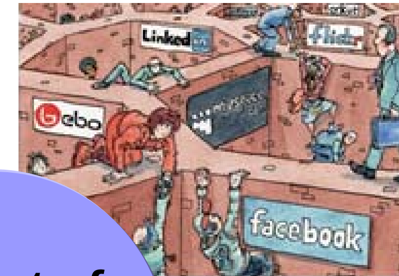
Implications

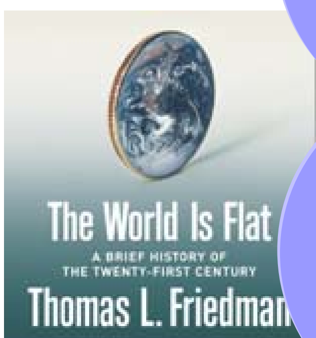
- **Greater base of technology development, more agility than previous**
- **Probability of technology surprise – rapidly**
- **Technology increasingly hybrid, commercial/military**

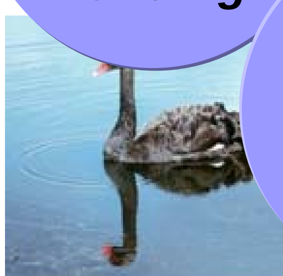


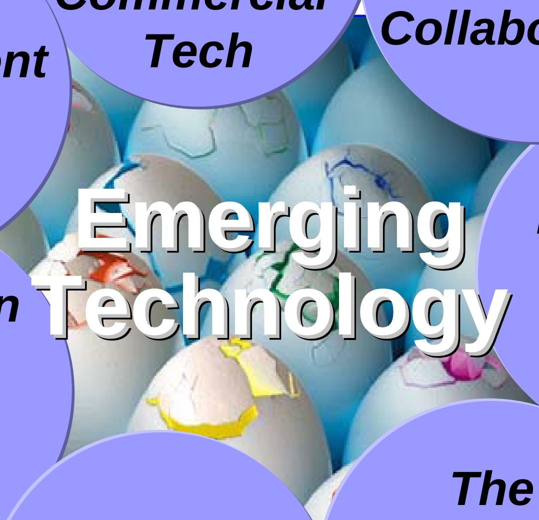
All factors drive to enhanced ambiguity.

A Changing World . . .









Emerging Technology

- *Disruptive Military Uses of Commercial Tech*
- *Impact of Mass Collaboration*
- *Economic Mega Trends*
- *The Expanding Education Base*
- *The Black Swan Syndrome*
- *Expansion Of R&D Funding*
- *Development Pace*

Dictates More Agility / Technology Options

Example – Medical R&D
Combat Casualty Care Research Program

…technologies that save lives far forward on the battlefield, maintain critical care at all levels of the battlefield, and enhance recovery from combat trauma.

Meet demands on first responders
- Warrior Medic Diagnostic System
- Warfighter Physiological Status Monitor
- Decision assist tools for lifesaving interventions

Improve en route care
- Oxygen conservation
- Closed-loop algorithms
- Lightweight modules

Reduce the number of deaths on the battlefield
- Recombinant Factor VIIa
- Freeze-Dried Plasma
- Damage control resuscitation
- Enhanced resuscitation fluids
- Cryopreserved Platelets

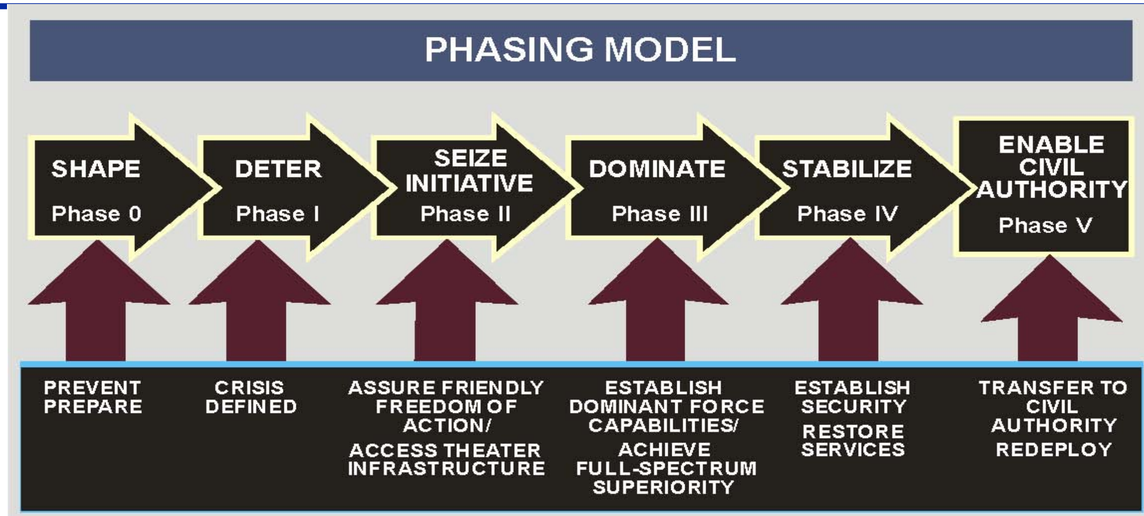
Restore full function
- Armed Forces Institute of Regenerative Medicine

Fingertip regeneration in a 78-year-old man

Limit brain damage
- Biomarkers
- Diagnostic device
- Neuroprotective drugs
- Silent seizure drug

Explore treatments for blast injury
- Pneumothorax detector
- Restoration of hearing loss
- Blast lung

6 Phase Model of Joint Operations
From Joint Pub 3-0



Phase 0 – ***Shape*** – Operations designed to assure success by shaping perceptions and influencing the behavior of both adversaries and allies

Phase 1 – ***Deter*** – Operations to deter undesirable adversary action by demonstrating the capabilities and resolve of the joint force

Phase 2 – ***Seize Initiative*** – Operations to gain access to theater infrastructure and to expand friendly freedom of action while degrading enemy capabilities

Phase 3 – ***Dominate*** – Operations focused on breaking the enemy's will for organized resistance

Phase 4 – ***Stabilize*** – Operations to perform limited local governance, integrating the efforts of other multinational, OGA, IGO, NGO participants

Phase 5 – ***Enable Civil Authority*** – Operations by the joint force to support legitimate civil governance

The Minerva Initiative

A DoD-sponsored, university-based social science research initiative focusing on areas of strategic importance to U.S. national security policy

Initial research in the following areas:

- **Chinese Military and Technology Studies**
- **Iraqi and Terrorist Perspectives Projects**
- **Religious and Ideological Studies**
- **New Approaches to National Security, Conflict and Cooperation**

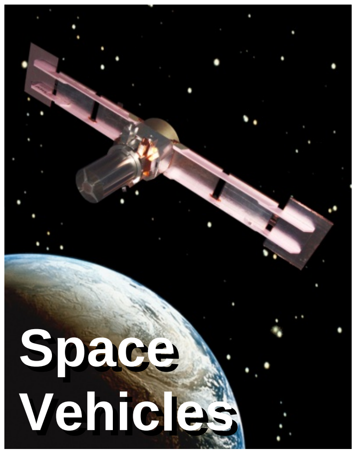
Technology Transition

22 April 09

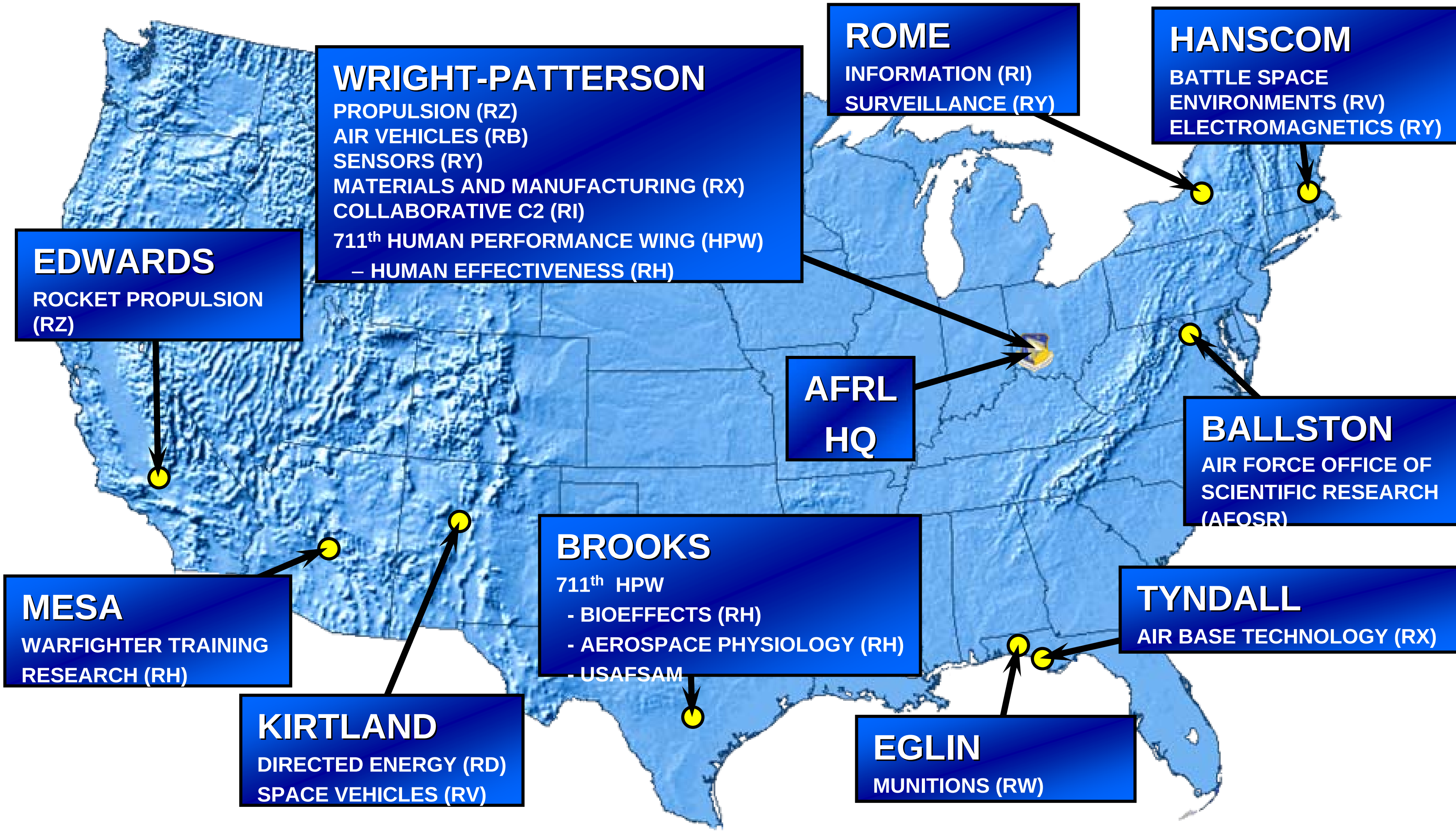
Wendell Banks
Director, Plans and Programs
Air Force Research Laboratory

Air Force Materiel Command

Ten Technical Directorates



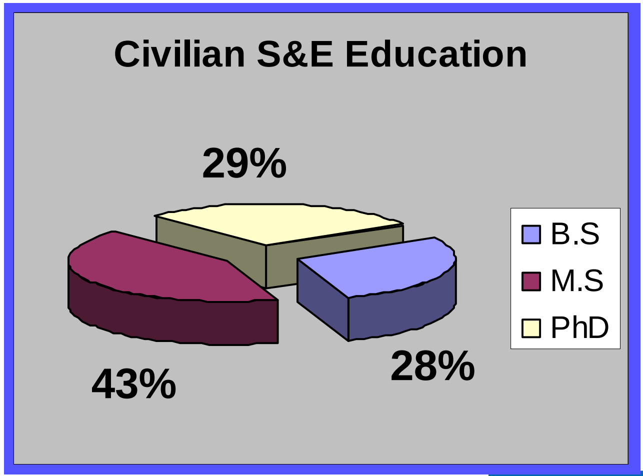
Major AFRL Sites

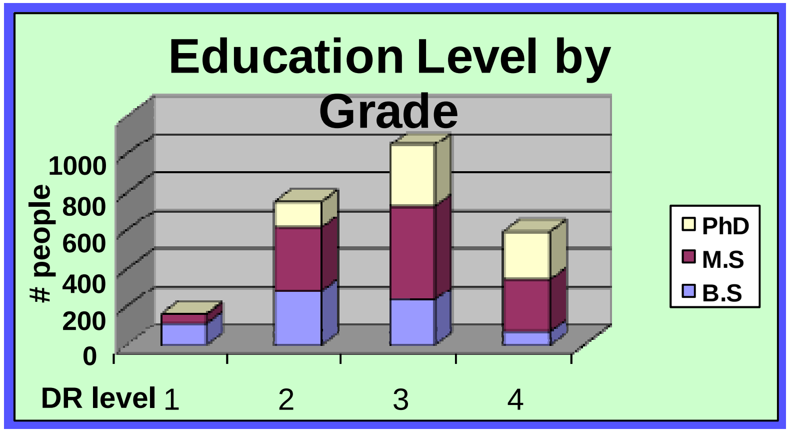


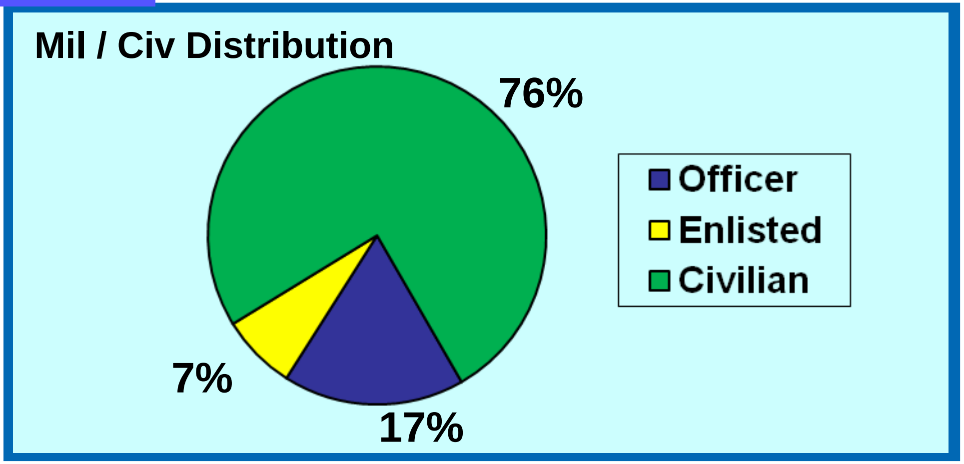
40 Sites World-Wide

AFRL Workforce

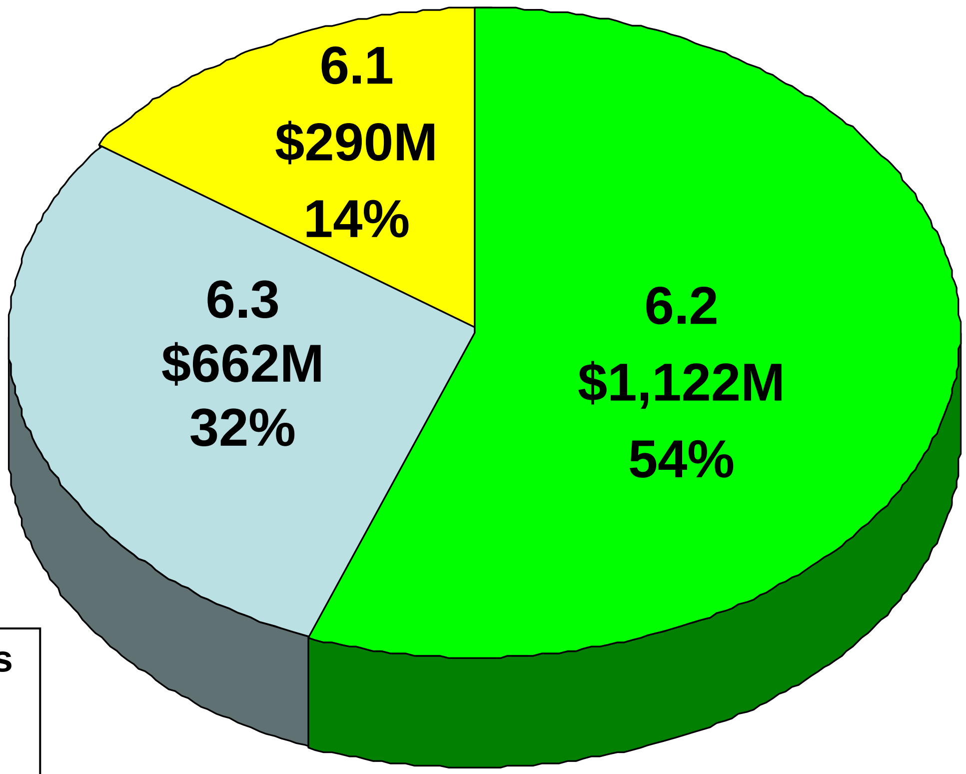
	Employees	Civilian	Military	Contractor
Total	~10800	~4750	~1450	~4600
S&Es	~ 6750	~2800	~ 850	~3100







AF Budget Investment By Budget Activity



6.1 Basic Research Funds

6.2 Applied Research Funds

6.3 Advanced Technology Development Funds

TOTAL: $2.075 Billion

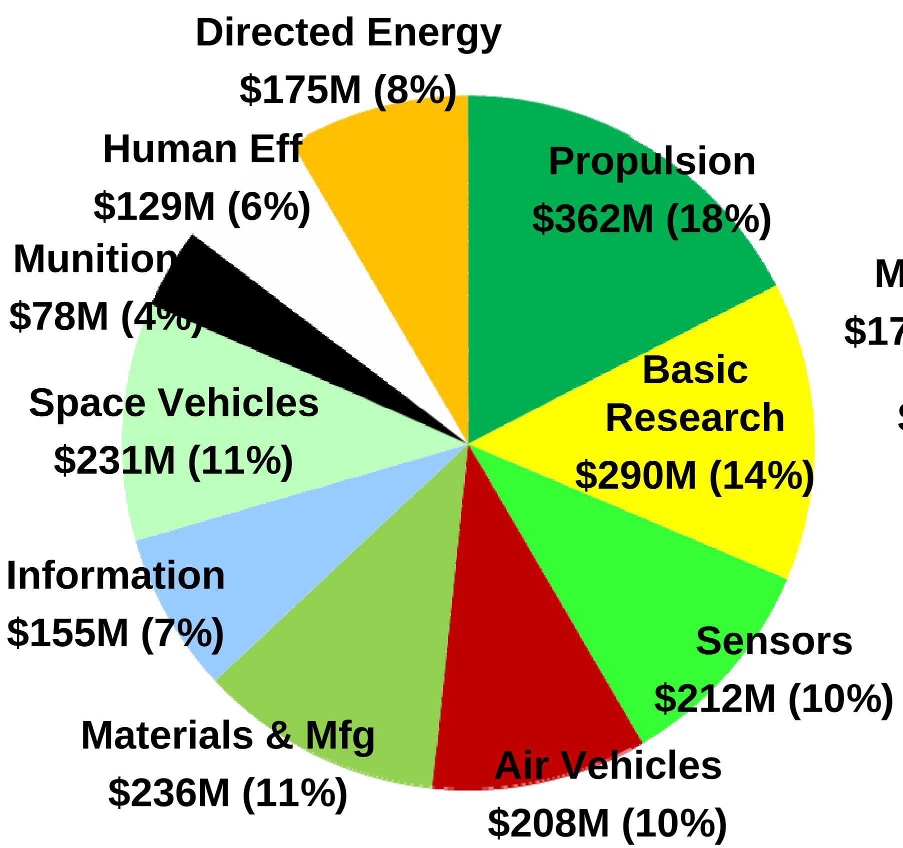
TOTAL: $1.722 Billion

FY08 S&T Appropriation

FY08 Core TOA

AFRL FY08 Funding

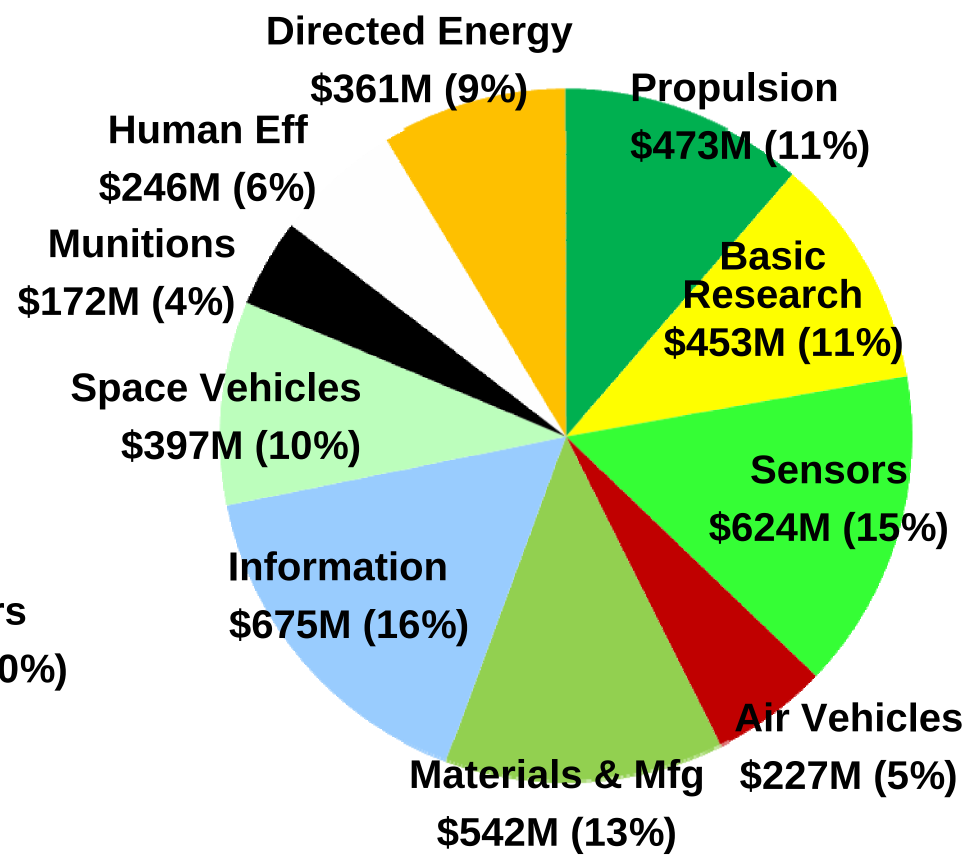
S&T



S&T Total: $2.075B

(PB plus Cong Adds)

Total



Total: $4.170B

Tech Transition is a Process

…and the “event” doesn’t happen until the end.

- Technology transition is a process where technology is developed in strong collaboration with system managers and users of end products* with the intent to insert the matured technology into that end product
- The process is complete when the technology is operational (TRL 9) and supportable. Only then has the technology “transitioned.”

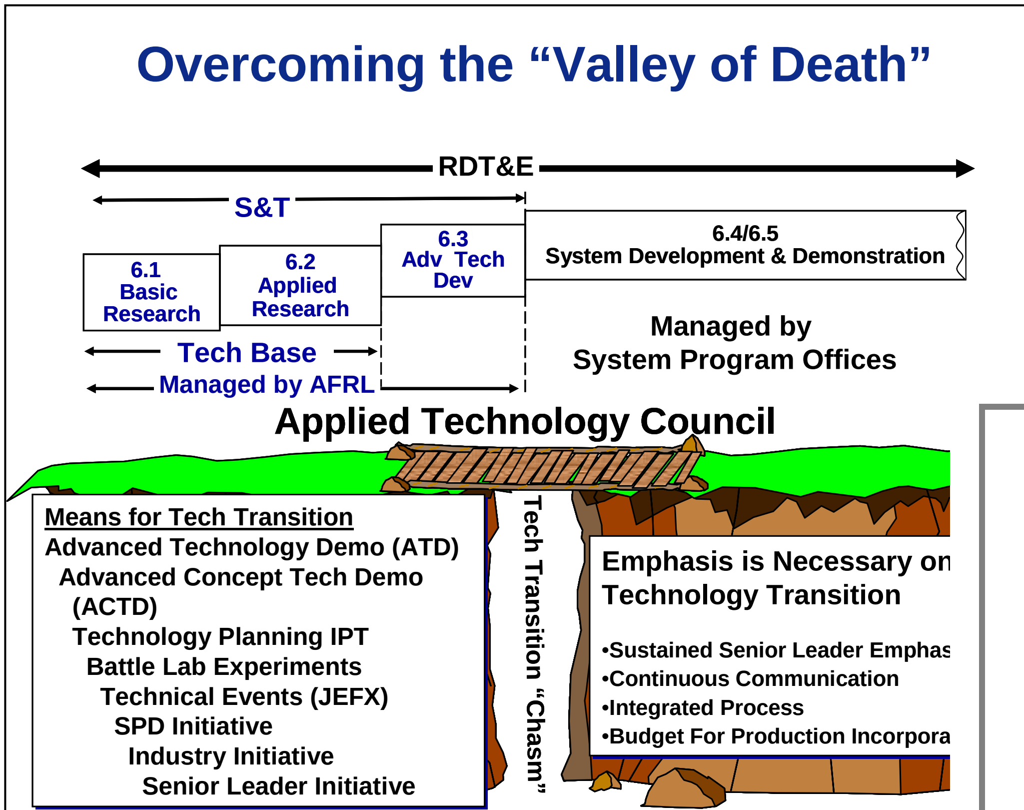
AFRL “Controlled”

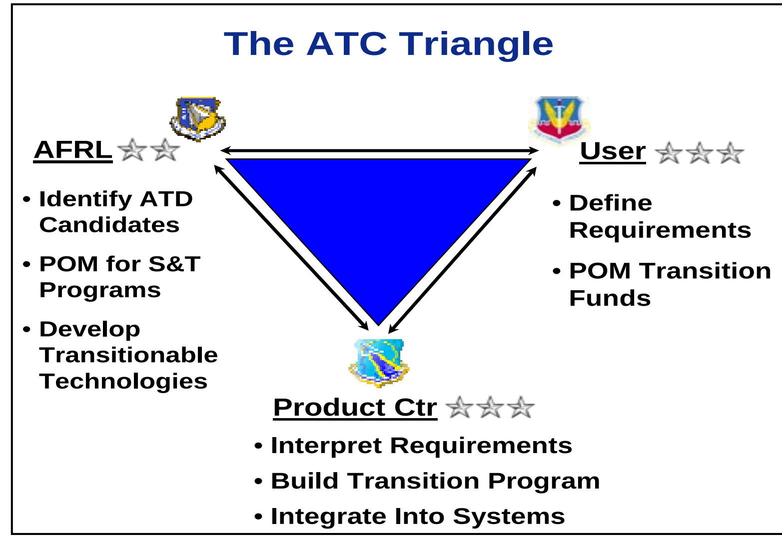
User or Sys Mgr “Controlled”

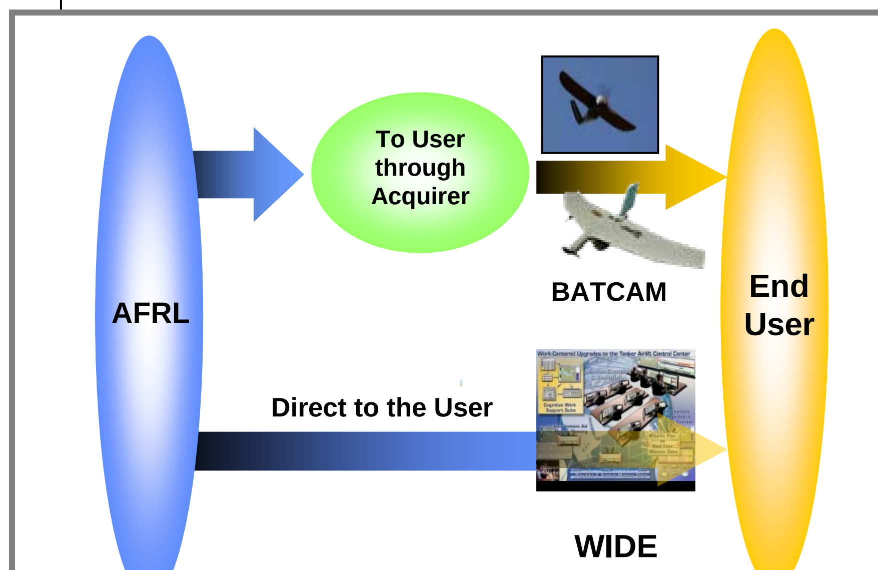
TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Basic Principles Observed	Concept Formulation	Proof of Concept	Breadbrd in Lab	Breadbrd in Rep Environmt	Prototype in Rep Environmt	Prototype in Ops Environmt	System Qual	Mission Proven

*Weapon systems, manufacturing processes, analysis tools, and other systems intended to support the warfighter

Processes & Programs to Facilitate Technology Transition







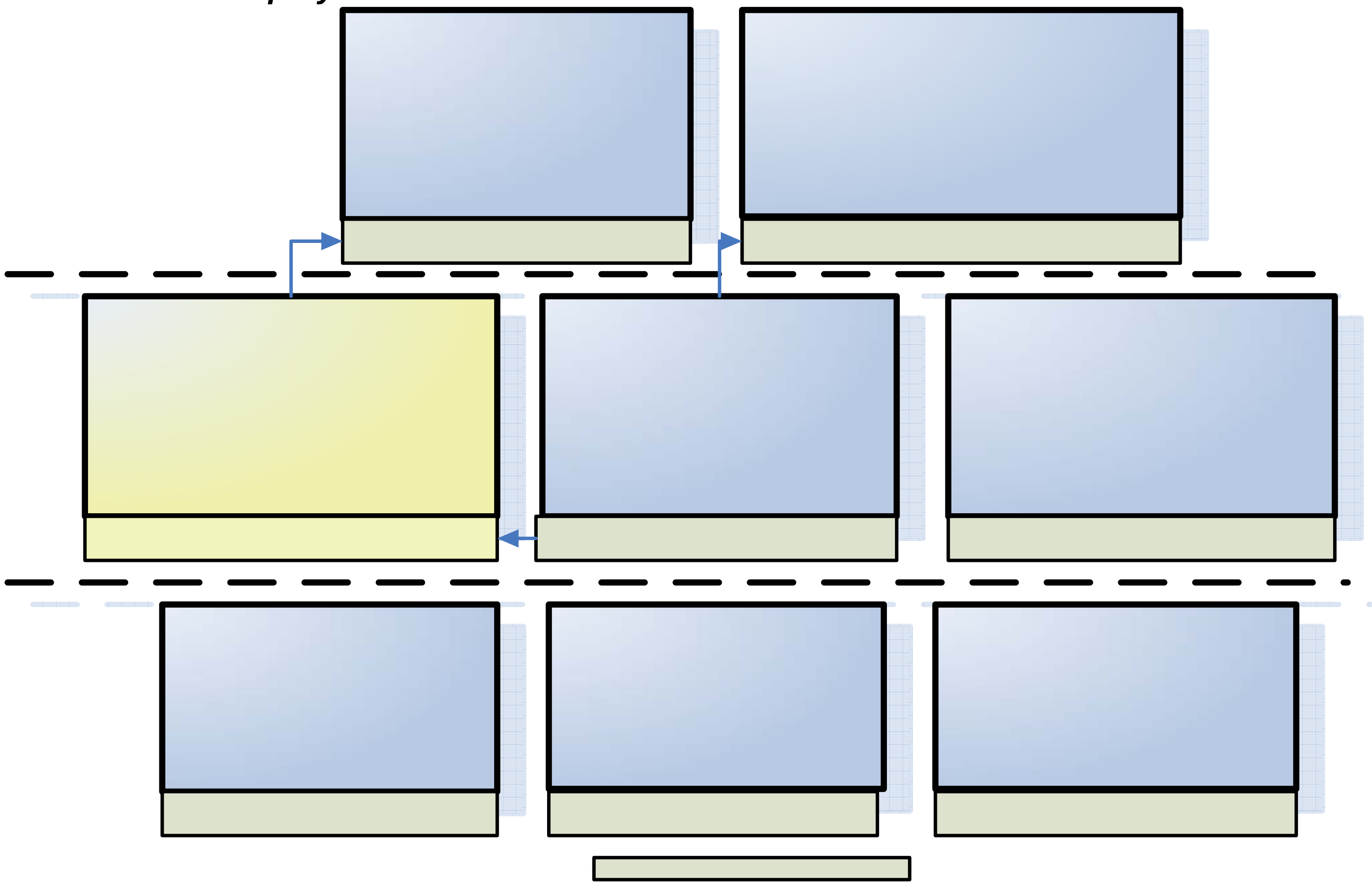
Transition Myths and Realities

- **M: AFRL is responsible for technology transition**
  – R: System managers typically determine what transitions to use on their system
- **M: Technology maturation and transition can be worked independently**
  – R: Must be worked together
- **M: Transition planning starts after TRL 6**
  – R: Must start as early as TRL 3 or 4
- **M: Technology doesn’t have to be “operational” (TRL 9) to be “transitioned”**
  – R: If it’s not “operational,” no benefit to the user
- **M: ATDs and ATCs are the primary way of transitioning**
  – R: Most technology is transitioned through other means

D&SWS Sub-Processes

Sub-Process Owners, Co-Leads, Design Team Leads

Process Owner/Co-Lead	**Gen Donald Hoffman / Lt Gen Mark Shackelford / Lt Gen Loren Reno**
Chief Process Officer / Deputy	**Maj Gen Marshall Sabol / Col John Griggs**



Three D&SWS Technology Development Initiatives

3 Initiatives with the goal of institutionalizing one AF level process to manage investments in technologies to ensure they are mature for AF systems

TD 1-12 Improved Tech Maturity Assessments

- Comprehensive Qualitative Criteria
  - Tech Performance
  - Manufacturability
  - Integrability
  - Other 'ilities
- Better Assessment of Risk
- Improved Tech Forecasting

TD 1-13 High Confidence Tech Transitions

- Early & complete lifecycle transition planning
  - IPT Approach – maximize coordination
- "Stage/gated" transition of technology
  - Clearly defined entrance/exit Criteria

TD 1-14 Identify & Prioritize Tech Needs

- Enterprise process to gather & prioritize tech needs
  - Focus S&T on highest priority needs
- Game-changing "Tech Push"influencing capability planning

Summary

- Tech Transition is process and a team sport -- Ends when Technology is being used
- Successful Transition starts by working on what the customer needs…and can afford
- Tech Maturation and Transition must be worked simultaneously by the same team…Earlier is better
- More complete measures of Tech Maturity required…TRLs necessary but not sufficient (cost, MRL, “ilities”, etc)
- D&SWS Tech Development Team and AFRL working this hard
  - SAF/AQR, AFMC/A2/5, AFRL, and many others

Approved for public release.

Air Force IR&D Program

Wendell D. Banks, SES
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Air Force Research Laboratory
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IR&D History

PL 91-441
Sec 203
Revoked

IR&D
DODD
3204.1

USECAF
Requests
IR&D Study

AFMC/CC
IR&D Tasking
6 Sep 06

Briefed
SAF/AQR
18 Dec 06

SAF/AQ
Memo to
Prod/Log Ctrs
27Aug 07

Outbrief to
AFMC/CV
21 Feb 07

AFMC/CC
Endorsement
21Dec 07

Briefed
SAF/AQ
16 Jun 07

1992

Mandatory IR&D Reporting & Onsite Review: Very Resource Intensive

1999

Little IR&D Guidance: Diminishing Activity

2004

Voluntary Reporting to IR&D Electronic Database

Ad-hoc Info Exchanges

2006

Pilot Programs:

Space

Fixed Wing

AF IR&D IPT

2007

2008

AF/Industry Interchange Workshops

SMC-S1 Apr 07
SMC-S2 Aug 07
AAC-S1 Sep 07
AAC-S2 Dec 07

ESC-S1 Jan 08
SMC-S1 Apr 08
ESC-S2 May 08
ASC/ALC-S1 Jul 08
SMC-S2 Aug 08
ASC/ALC-S2 Dec 08

AF AFMC/CC charge to Reinvigorate IR&D

- Study & Pilot Options to Re-Invigorate IR&D
  - Implement AF-Wide IR&D Integrated Process Team
  - IPT stood up in late 2006
    - Participants
      - AF MAJCOMs
      - PEO/Product Centers
      - Air Logistics Centers
      - Test Centers
      - AFRL
      - Industry (AIA)
- Results
  - AF IR&D Framework
  - AF/Industry Technical Interchange Workshops

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

MEMORANDUM FOR SEE DISTRIBUTION

SEP 06 2006

FROM AFMC/CC
4375 Chidlaw Road
Wright-Patterson AFB OH 45433-5001

SUBJECT: Independent Research and Development (IR&D) Integrated Process Team (IPT)

1. In the coming years, our ability to exploit industry's IR&D efforts will profoundly affect the future Air Force. One of our major challenges is to develop and implement a new Air Force IR&D process that effectively supports both industry and Air Force needs. In concert with SAF/AQ, an effort is presently underway to review and propose changes to the existing Air Force IR&D process. The initial emphasis will be on the four enterprise areas of Air, Space, Munitions/Weapons and Cyber. As a result of their review, a new Air Force IR&D process will be developed.

2. We would appreciate your support to ensure this new IR&D process and implementation plan is robust. Your organization is invited to nominate a candidate at the O-6 or equivalent rank to be a working member of an Air Force IR&D IPT. The defense industry Aerospace Industries Association (AIA), will also be asked to provide input into this process, to ensure this new IR&D process and implementation plan is acceptable to industry. Our initial planning includes several meetings to develop a draft process by late 2006. Additional information regarding the team, presented in the Terms of Reference (TOR), is furnished as an attachment to his letter.

3. Please have your representative contact Mr. Giovanni Pagán, Air Force Research Lab IR&D Manager, (937) 656-9176, or Giovanni.Pagan@wpafb.af.mil, concerning this matter. I would appreciate a response within 14 days of the date of this letter.

BRUCE CARLSON
General, USAF
Commander

Attachment:
IR&D IPT Terms of Reference (TOR)

IR&D Framework Objectives

- Make better use of limited resources
- Effectively communicate AF technology needs
- Understand / Leverage IR&D investments
- Capitalize on recurring Industry Days and Small Business Innovation Research (SBIR) events
- Exploit major contractor / SBIR Synergies

AF/Industry IR&D Interchange Framework + Focus

2 Year Cycle

AF Transmits Tech Needs/Gaps To Industry

Gov → Ind

Step 1

Industry Describes IR&D

Ind → Gov

Step 2

ID Partnering Opportunities

Assess/Align

Investment Strategies

- **AF POM**
- **Industry IR&D**

Step 3

Aligned with Major AF & Industry Events

Created/Adopted by the AF/Industry IR&D IPT – Dec 06
Endorsed by SAF/AQ & AFMC/CC

AFRL IR&D Process Endorsed by SAF/AQ

I would like to enlist your assistance in reinvigorating Air Force participation in the Independent Research and Development (IR&D) program. I believe IR&D can lend valuable support to maintaining a strong acquisition program and I am committed to taking a more active role in this important program…

To ensure the maximum benefit to the Air Force, these exchanges should be conducted in time to incorporate results in the Fiscal Year 2010 Program Objective Memorandum. I encourage everyone to solicit user/Combatant Command (COCOM) inputs to the maximum extent possible. My focal point for IR&D policy is the Deputy Assistant Secretary for Science, Technology and Engineering (SAF/AQR)."

"General Carlson, I applaud Christine Anderson's approach to this and stand by to support in any way."

The Honorable Sue C. Payton
Assistant Secretary of the Air Force
27 August 2007

High Level Leadership Support

DEPARTMENT OF THE AIR FORCE
WASHINGTON DC

OFFICE OF THE ASSISTANT SECRETARY

AUG 27 2007

MEMORANDUM FOR HQ AFMC/CC

FROM: SAF/AQ
1060 Air Force Pentagon
Washington, DC 20330-1060

SUBJECT: Management of Air Force Independent Research and Development Programs

I would like to enlist your assistance in reinvigorating Air Force participation in the Independent Research and Development (IR&D) program. I believe IR&D can lend valuable support to maintaining a strong acquisition program and I am committed to taking a more active role in this important program.

Recently, the Air Force Research Laboratory (AFRL) and Space and Missile Systems Center (SMC) hosted an IR&D exchange between industry and the Air Force. This event, called SMC Space Day, capitalized on recurring Industry Days and Small Business Innovation Research activities and offers an excellent model for other Product Centers to effectively communicate Air Force needs to leverage technology developments from industry. Towards this end, I am asking my PEOs and request you to encourage the Logistics Centers to conduct similar government/industry IR&D exchanges with AFRL in the near future.

To ensure the maximum benefit to the Air Force, these exchanges should be conducted in time to incorporate results in the Fiscal Year 2010 Program Objective Memorandum. I encourage everyone to solicit user/Combat Command inputs to the maximum extent possible. My focal point for IR&D policy is the Deputy Assistant Secretary for Science, Technology and Engineering (SAF/AQR).

Sue C Payton

SUE C. PAYTON
Assistant Secretary of the Air Force
(Acquisition)

cc: See Distribution

General Carlson, I applaud Christine Andersons approach to this and stand by to support in any way. Best, Sue

OSD Statement on IR&D…2008

"Currently, the Department pays IR&D costs with: limited awareness of the work being accomplished; no standards for quality; and no assurance of value for the taxpayer….

…The IR&D DST will make a series of recommendations to improve the effectiveness, efficiency and fairness of the Government's IR&D expenditure."

The Honorable John J. Young, Jr.
Under Secretary of Defense
21 June 2008

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION, TECHNOLOGY AND LOGISTICS

JUN 21 2008

MEMORANDUM FOR DEPUTY UNDER SECRETARY OF DEFENSE (ACQUISITION AND TECHNOLOGY)
DIRECTOR, DEFENSE RESEARCH AND ENGINEERING
SERVICE ACQUISITION EXECUTIVES
DEPUTY UNDER SECRETARY OF DEFENSE (INTERNATIONAL TECHNOLOGY SECURITY)
DEPUTY UNDER SECRETARY OF DEFENSE (INDUSTRIAL POLICY)
CHIEF, NAVAL RESEARCH
DEPUTY ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH AND TECHNOLOGY
DEPUTY ASSISTANT SECRETARY OF THE AIR FORCE FOR SCIENCE, TECHNOLOGY AND ENGINEERING

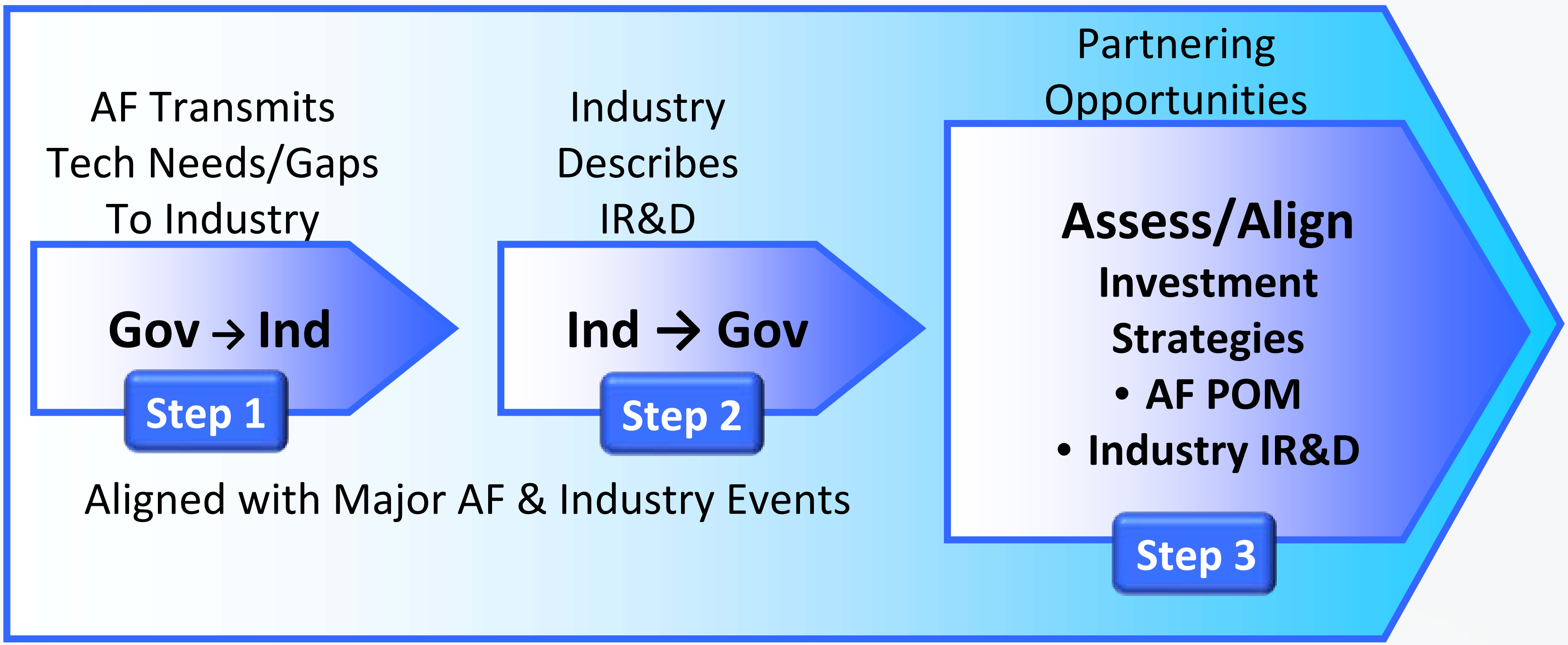
SUBJECT: Independent Research and Development (IRAD)

The Department of Defense has for years had a policy of reimbursing IRAD efforts conducted by industry. IRAD reimbursement comes in the form of an indirect expense against our contracts.

In the 1970s, IRAD was graded by the government, and payments depended on the quality of the work. Additionally, the Department of Defense participated in guiding the research and assured that the taxpayer received value for these tax dollars. This process changed in the 1980s. Currently, the Department pays IRAD costs with: limited awareness of the work being accomplished; no standards for quality; and no assurance of value for the taxpayer.

I am directing the formation of a Defense Support Team (DST) on IRAD. The DST will be co-chaired by Mr. Alan Haggerty, Deputy Under Secretary of Defense for International Technology Security, and Mr. William Greenwalt, Deputy Under Secretary of Defense for Industrial Policy. The DST will include all relevant government stakeholders, including one or more representatives from each Service. The Service Acquisition Executives are to each designate one acquisition person to participate fully in this DST. The DST will include broad representation from industry, including companies that participate in production and those companies that do not. The team will also seek participation from non-defense firms. Appropriate industry representation will include experienced acquisition and technology development professionals from small, medium and large companies.

AF/Industry IR&D Framework Step by Step



3-Step Process

- Step 1 – Effective Communication of AF Needs to Industry
  - Product Center Briefs Technology Needs
  - AFRL Briefs Corresponding Development Efforts
  - Govt Team Identifies Gaps and IR&D Opportunities
- Step 2 – Focused and On-Target Response from Industry
  - Industry SMEs Selects Candidate IR&D Efforts to Brief
  - AF SMEs Down select from Candidate Abstracts
  - Industry Tranforms Selected Abstracts into Briefs
- Step 3 – Incorporate Acquired Knowledge into AF's and Industry's Investment Strategy
  - AF Selects Most Promising Needs vs IR&D Efforts
  - 1-on-1 AF & Industry Deep Dives Into Selected Efforts
  - Define, Seek, and ID Synergies and Partnering Opportunities

Approved for public release.

Representative Agenda
Technology Interchange Workshop – Step 1

Day 1

PLENARY SESSION

0700 Registration Opens
0800 Welcome
0815 AFMC/A5 Perspective on Sustainment Technology Process
0830 ASC/XR Perspective on ASC Needs
0845 AF/Industry Technology Interchange Workshop Process Focused on Aeronautical and Depot Sustainment Systems
0900 AFMC STC Technology Working Group Views of ALC Technology Needs
1040 ASC Systems Groups' Views of Air Technology Needs
1200 Lunch
1300 AFRL Responses to AFMC STC and ALC Technology Needs
1600 Break
1615 AF IR&D Program
1630 AF SBIR Transition Support
1645 Reception

Day 2

IR&D Q&A Sessions

0730 Govt team review
0800 Contractor team # 1
0830 Contractor team # 2
0900 Contractor team # 3
0930 Contractor team # 4
1000 Gov Meeting
1030 Contractor team # 5
1100 Contractor team # 6
1130 Contractor team # 7
1200 Lunch
1300 Contractor team # 8
1330 Contractor team # 9
1400 Contractor team # 10
1430 Gov Meeting
1500 Contractor te
1530 Contractor te
1600 Contractor te

Day 2

Facilitated SBIR One-on-One Sessions

0800 Prime # 1 with Small Business (SB) # 1
0830 Prime # 1 with SB # 2
0900 Prime # 1 with SB # 3
⋮ ⋮ ⋮
1700 Prime # 1 with SB # n

[Note: The ops tempo shown above for SBIR CPP occurs simultaneously with approximately 10 prime contractors; each prime contractor meets with Small Business to discuss their Phase II SBIR which is

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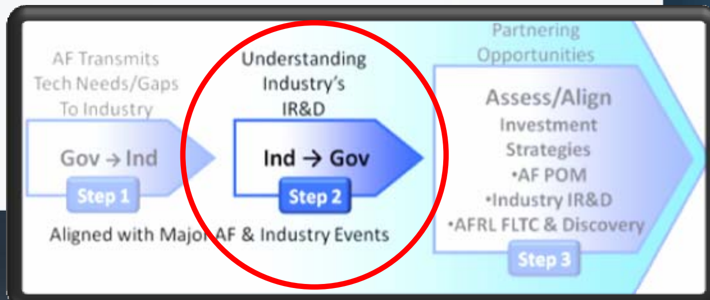
Representative Agenda
Technology Interchange Workshop - Step 2

Electronic Systems Workshops

- 6-8 May 2008 in Billerica, MA

Time	Tue 6 May 08	Wed 7 May 08	Thu 8 May 08
800	GOV	GOV	0800 – 0915 LMCO
830	0830 – 1030 BOEING	0830 – 1030 GENERAL DYNAMICS	
900			GOV (0915-0930)
930			0930-1200 RAYTHEON
1000			
1030	GOV (1030-1045)	GOV (1030-1100)	
1100	1045-1145 SWRI	1100-1200 L3COM	
1130	1145-1230 LUNCH		
1200		1200-1300 LUNCH	GOV
1230	1230-1400 TEXTRON		
1300		1330 – 1600 NORTHROP GRUMMAN	
1330			
1400	GOV (1400-1415)		
1430	1415-1615 BOEING		
1500			
1530			
1600	GOV	GOV	
1630			

Yr	Attnds	KTRs in S1	Q&A Break Out	KTRs in S2	IR&D Funds ($M)
2008	230	12	35 38	9	$XXX



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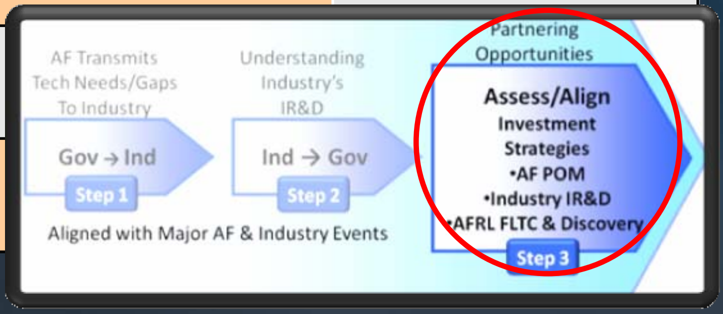
Representative Agenda
Technology Interchange Workshop - Step 3

ALLOTTED TIME/ CAPABILITY AREAS	ROOM 1	ROOM 2	ROOM 3	ROOM 4
	NEED 1	NEED 2	NEED 3	NEED 4
0900 – 0950			Company C	
1000 - 1050	Company A	Company B	Company C	
1100 - 1150			Company D	
1150 - 1250	LUNCH			
1300 - 1350	Company A	Company C		
1400 - 1450	Company B	Company A		
1500-1550				



Recent & Planned	Step 1: Gov → Ind	Step 2: Ind → Gov	Step 3: Assess/Align
SMC	Industry Day 20 Apr 07	One-on-One AFRL BFI 23-24 Aug 07	KTR + AF Align Investment Strategy
AAC	Workshop 12-13 Sep 07	One-on-One Workshop 10-12 Dec 07	KTR + AF Align Invest Strategy Sep 09
ESC	New Horizons 24-25 Jan 08	One-on-One Workshop 6-8 May 08	KTR + AF Align Investment Strategy
SMC	Industry Day 14 Apr 08	One-on-One AFRL BFI 21-22 Aug 08	KTR + AF Align Investment Strategy
ASC + ALCs	AFRL WDI 17-18 Jul 08	One-on-One Workshop 9-11 Dec 08	KTR + AF Align Invest Strategy Oct 09

Past Workshops Proceedings in DTIC

Report Number	AFRL Report Title	Accession #
AFRL-WS-WP-TM-2007-9003	2007 AF/Industry Space Technology Interchange Workshop for IR&D and SBIR (Step 1)	ADB326755
AFRL-WS-WP-TM-2007-9004	2007 AF/Industry Air Armament Technology Interchange Workshop for IR&D and SBIR (Step 1)	ADB333428
AFRL-WS-WP-TM-2008-9005	2008 AF/Industry Electronic Systems Technology Interchange Workshop for IR&D and SBIR (Step 1)	ADB337023
AFRL-WS-WP-TR-2008-9008	2008 AF/Industry Space Technology Interchange Workshop for IR&D and SBIR (Step 1)	ADB340533
AFRL-WS-WP-TR-2008-9010	2008 AF/Industry Air and Sustainment Technology Interchange Workshop for IR&D and SBIR (Step1)	ADB345303

IR&D Interchange Workshop Statistics

Product Center	Step 1		Step 2	
	Attendees	KTRs Q&A	1-on-1	Reported ($M)/ Total ($M)
Space & Missile Ctr (2007-SMC)	180	14	9	$158 / $319 6 Reported
Space & Missile Ctr (2008-SMC)	140	12	11	$280 / $748 10 Reported
Air Armament Ctr (2007-AAC)	186	12	9	$184 / $184 7 Reported
Electronic Systems Ctr (2008-ESC)	230	12	9	$312 / $1051 9 Reported
Aeronautical Systems Center and Air Logistic Ctrs (2008-ASC + ALCs)	228	14	10	$113 / $113 5 Reported
Totals	**964**	**64**	**48**	**$1047 / $2415**

Planned Events	Step 1: Gov → Ind	Step 2: Ind → Gov	Step 3: Assess/Align
	AAC Workshop Sep 09	One-on-One TBD 10	KTR + AF Align Investment Strategy
	ASC + ALCs Workshop Oct 09	One-on-One TBD 10	KTR + AF Align Investment Strategy
	ESC Workshop Jun 10	One-on-One Oct 10	KTR + AF Align Investment Strategy
	SMC Workshop Apr 10	One-on-One Aug 10	KTR + AF Align Investment Strategy
	NWC TBD	One-on-One TBD	KTR + AF Align Investment Strategy

Industry Workshop Feedback

- AF needs presented to Industry as a "Single Voice"
  - Needs vetted through strategically-driven process
- Improved competitive position
  - Better knowledge of Air Force technology interests and Acquisition Programs reduces guessing about what AF thinks is important
  - Opportunities for collaboration and partnerships
- Optimizes Resource Allocation within IR&D
  - IR&D portfolios can be tailored to market
- Small Business / Large Business relationships

Helps Industry Target Products Towards Near-Term Investment Opportunities

Workshop Benefits to AF

- Insight into Industry programs and capabilities
- Improved responses to DoD/AF Requirements
  – Better Support Air Force Acquisition Programs
- Ability to Leverage Industry Capabilities
  – Opportunities for collaboration and partnerships
- Improved resource allocation within AF
  – AF S&T investment informed by IR&D investment

Helps AF Fulfill The Mission Through Leveraging Opportunities

Summary

- DoD and AF take IR&D very seriously
- We have a shared interest in improving IR&D productivity
- IR&D Workshops have been very successful to date
  - Linking IR&D with SBIR is paying great dividends
  - Industry Feedback has been extremely positive
- Please join us at an upcoming AF event

For more info, contact: **Mr. Giovanni Pagán**
AF IR&D Program Manager, AFRL/XPPN
AFRL Plans & Programs Directorate
Wright-Patterson AFB OH 45433
giovanni.pagan@us.af.mil
Comm Phone: 937-656-9176
DSN: 986-9176

United States Transportation Command (USTRANSCOM)

Improving Warfighter Support by Creating Capability Innovation/Prototyping

through

Science & Technology

OPR: Mr Lou Bernstein

(A/O 19 Mar 09)

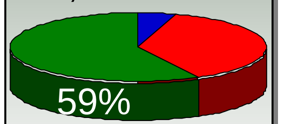
Overview

- **Command Overview**
- **Summarize USTRANSCOM's RDT&E Program**
- **Review Capability Gaps/Operational & Technical Challenges**
- **Sample of Warfighter Benefits/Savings**
- **Overview of Ongoing Projects**
- **Outline FY11 RDT&E Call for Proposals**

The USTRANSCOM Team

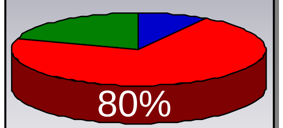
24 / 7 / 365

Force =
~4,700



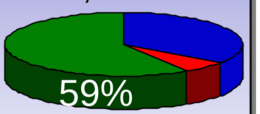
Active Duty
Civilian
Guard/Reserve

Force =
~8,100



Active Duty
Civilian
Guard/Reserve

Force =
~123,600



Active Duty
Civilian
Guard/Reserve

Commercial Industry Contribution

1,231 Aircraft
312 Vessels

Single Manager for Common-User Transportation

Projecting National Military Power

Research, Development, Test & Evaluation (RDT&E)

Program Pays for Itself

- DoD RDT&E funding source dedicated to improving logistical / supply chain performance

PE 0603713S	FY09	FY10	FY11	FY12	FY13	FY14	FY15
DOD/PB	$30M	$29.3M	$29.2M	$29.2M	$29.1M	$29.2M	$30.2M
Authorized	$30M						
Appropriated	$30M						

- USTRANSCOM leverages technology to gain efficiencies and reduce the costs
  - Develop joint technologies to improve warfighter support
  - Improve precision/reliability/visibility/efficiency of the DOD supply chain
  - Assure superior strategic/operational/tactical mobility support for the warfighter

Identified by OSD(AT&L) as "model program" and #1 in DoD for transitioning new capabilities to the warfighter

Deployment and Distribution Enterprise Technology Program Element: PE0603713S Overview

Cost ($ in millions)	FY 2009	FY2010
Project 1: Capabilities Based Logistics	6.074	1.540
Project 2: Deployment and Distribution Velocity Mgmt	6.591	7.635
Project 3: Cross Domain Intuitive Planning	1.815	2.430
Project 4: End-to-End Visibility	2.779	4.916
Project 5: Distribution Planning and Forecasting	2.750	2.870
Project 6: Joint Transportation Interface	7.174	8.831
Project 7: Distribution Protection/Safety/Security	1.925	1.125
Total PE Cost	29.108*	29.337

*** $733K reprogrammed to BA7/$159K in taxes**

OPR: Mr Lou Bernstein

(A/O 20 Mar 09)

USTRANSCOM Deployment and Distribution Enterprise Technology

- Program Element Projects

1. **Capability Based Logistics** - Improve performance of DOD supply chain
2. **Deployment and Distribution Velocity Management** - Optimize throughput
3. **Supply Chain Planning and Execution** - Improve decision-making and collaboration
4. **End-to-End Visibility** - Provide end-to-end visibility of the projection and sustainment of forces and equipment
5. **Distribution Planning and Forecasting** – Customer focused planning to optimize distribution process
6. **Joint Transportation Interface** - Synchronizing strategic/theater delivery capabilities
7. **Distribution Protection/Safety/Security** – Providing appropriate security during operations

Top Operational/Technical Challenges

- **Command, Control, Computers, and Communications Info Ops**
  - En route comms
  - Facilitate requirements capture/assessment/planning
  - Total Asset Visibility/In-transit Visibility
- **Mobility Air Forces All Weather Capability**
  - Improve precision airdrop accuracy
  - Autonomous landing and refueling
- **Defensive Systems for Mobility Lift Assets** (e.g., Counter MANPAD)
- **Transportation and Connector Systems**
  - Synchronize strategic/theater delivery capabilities
  - Protect physical/C2 supply chain continuity
  - Optimize flow
  - Synchronize data/lift with Commercial Providers
- **Reduce Fossil Fuel Dependency**
  - Explore alternative fuels/fuel blends
  - Reduce aircraft weight
  - Improve planning/execution tools

OPR: Mr Lou Bernstein

(A/O 11 Feb 09)

Selected Warfighter Benefits/Costs Savings

- Joint Precision Air Drop System – Mission Planner (JPADS-MP)
  - Dramatically increased precision/non-precision airdrop accuracy
  - Allows friendly forces to take the fight to the enemy in austere locations
  - Millions in costs avoidance savings by protecting ground and aviation assets & troops
- Wireless Gate Release System (WGRS) for JPADS
  - Automatic aircraft release gate for airdrop missions
  - Doubles C-130 JPADS/non-precision cargo carrying capacity
  - Eliminates cargo damage due to cargo mid-air collisions
- En Route Trauma Patient Care Module
  - Provide continuous care/monitoring of the wounded from battlefield to definitive care
  - More efficient use of liquid oxygen supply will save DOD millions of dollars
  - Technology to be used on future NASA space missions
- Joint Modular Intermodal Container (JMIC) JCTD
  - Standardized container for efficient use/transfer between conveyances
  - 23% reduction in 20FT container requirement and 32% reduction in air pallets required
  - $16M annual savings in cardboard uni-pack use

Selected Warfighter Benefits/Costs Savings

- Deployable Cargo Screener (DCS) ACTD
  - Screen cargo pallets for explosives
  - Army incorporated technology into robotics for IED detection
- Joint Air Lift Information System-Next Generation (JALIS-NG)
  - Web-based tool to enhance Operational Support Airlift (OSA) global C2
  - 20% increase in OSA asset use efficiency will save millions
- Coalition Mobility System JCTD
  - Gain visibility/improve scheduling of coalition transportation assets
  - 100% return on investment within 2 years and $2.3M estimated annual ROI there after
- Node Management and Deployable Depot (NoMaDD) ACTD
  - Deployable depot to manage in-theater logistics
  - Processed 4000 truck loads of meals and ice in support of Hurricane Ike
  - During user evaluation achieved 53% reduction in airlift for DLA managed items and reduced customer wait time from 19.8 days to 10.8 days
- Joint Enabled Theater Access-Seaport of Debarkation (JETA-SPOD) JCTD
  - Planning/decision support tool for analysis of austere ports locations for anti-access areas
  - Lightweight modular causeway supporting seabasing to shore movement of forces

Overview of FY09 RDT&E Projects

$30M/Year Line Providing Cross-Service/JDDE Distribution Capabilities

ARMY

Next Generation Wireless Communications

En Route Trauma Patient Monitoring Module

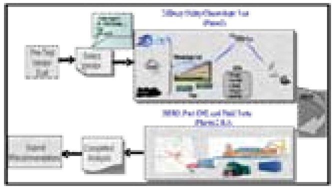
USAF

Joint Precision Air Drop Guidance, Navigation, Control

Fusion Center Operational Effectiveness

JDDE

Single Load Planning

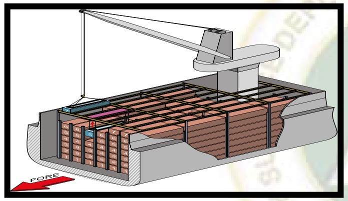


Controlled Testing of Premium AIT Devices

Expeditionary Theater Distribution

Common Operating Picture Deployment & Distribution (COP D2)

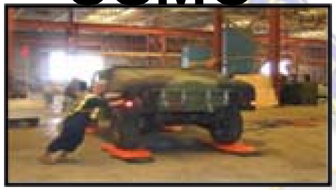
NAVY



At Sea Selective Discharge

Large Vessel Interface – Lift On/Lift Off

USMC

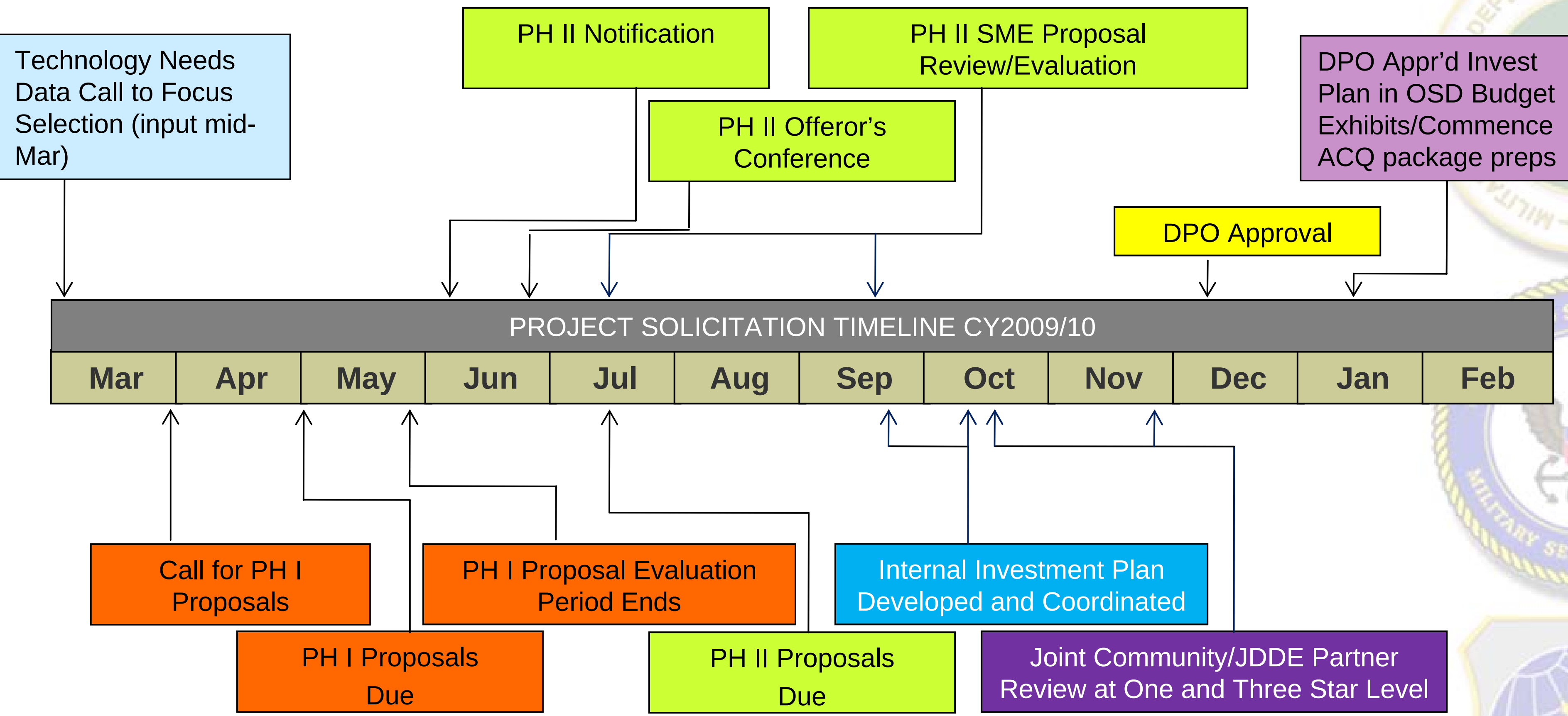


Shipboard Selective Access and Retrieval System

Next Generation Autonomic Logistics

Only DOD RDT&E Funding Solely Dedicated to Transportation/Distribution Technologies

FY11 RDT&E Program Project Solicitation Timeline



OPR: Mr Lou Bernstein

(A/O 6 Feb 09)

USTRANSCOM RDT&E Portal: www.ustranscom.mil

QUESTIONS

Back up

Project 1: Capability Based Logistics

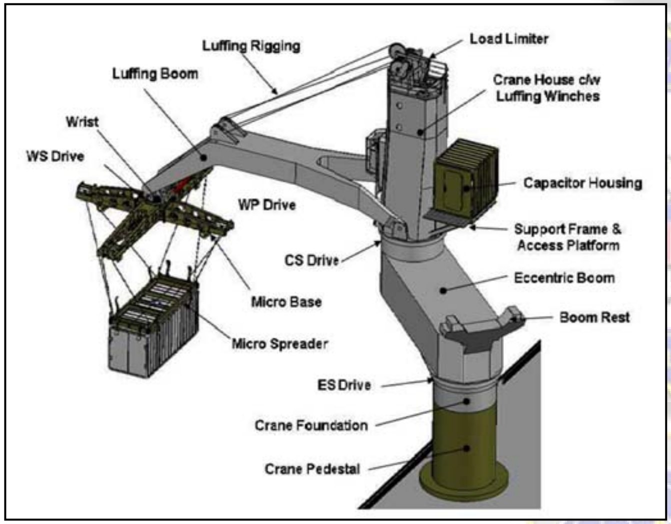
Description: Critical enterprise-level distribution system capabilities to improve DOD supply chain performance

Applies to JCA Tier 1/2 activities: Logistics/Deployment & Distribution and Command & Control/Decide

•

arge Vessel Interface-Lift-on/Lift-off:

- Inter-ship transfer of fully loaded 20ft containers at sea in up to sea state 4
- Collaborative partnership with Navy to demonstrate capability to transfer ½ loaded container Fall 09
- Field initial capability as part of Maritime Positioning Force-Future (MPF-F) in FY15



OPR: Mr Lou Bernstein

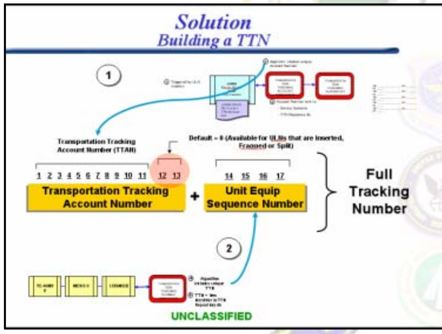
(A/O 16 Mar 09)

Project 2: Deployment and Distribution Velocity Management

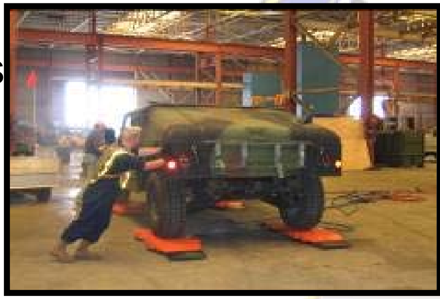
Description: Increase force projection and sustainment velocity

Applies to JCA Tier 1/2 activities: Logistics/Deployment & Distribution and Supply

- **Transportation Tracking Number:**
  - Create a FedEx like commodity tracking number to increase end-to-end visibility of transportation requirements
  - Significantly reduce re-ordering errors, reduce costs and enhance warfighter confidence
  - Complete development/transition FY10



- **Shipboard Selective Access and Retrieval System:**
  - Adapt commercial air skid type technology to move cargo and vehicles in a Large, Medium-Speed Roll-on/Roll-Off (LMSR) cargo hold in conditions up to sea state 5
  - Enhanced ability to conduct at sea/seabase operations
  - Complete development/transition FY11



- **Joint Recovery and Distribution System (JRaDS) JCTD:**
  - Common Joint Cargo Handling System that meets – or exceeds – the requirements for multiple Joint Operational Concepts for MCO, GWOT & Stability Operations
  - Enable more efficient, seamless multi-mode transport of cargo between Ships, Aircraft and Tactical Wheeled Vehicles, from Port of Debarkation to dispersed forces - transition FY12

OPR: Mr Lou Bernstein

(A/O 16 Mar 09)

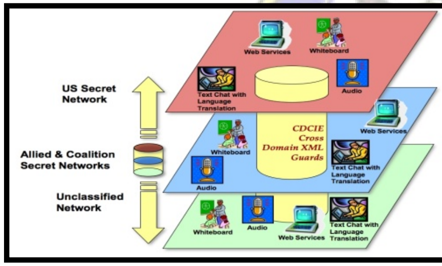
Project 3: Supply Chain Planning and Execution

Description: Improve supply chain decision-making/collaboration

Applies to JCA Tier 1/2 activities: Logistics/Deployment & Distribution and Command & Control/Planning and Decide

- **Next Generation Autonomic Logistics:**
  - Monitor/report maintenance status of combat assets in tactical operations; distribution demand forecasting/execution monitoring tools
  - Timely tactical logistics demand data "injected" into operational and strategic level distribution systems
  - Complete development/transition FY12

- **Cross Domain Collaborative Info Exchange (CDCIE) JCTD:**
  - Deliver a suite of tools for the Joint Warfighter with Text chat language translation, whiteboard, audio and XML Guard functionality
  - Enable cost-effective coalition and interagency information sharing for effective Command and Control
  - Complete development/transition FY13



- **Future Center Organizational Effectiveness (FCOE):**
  - Organizational simulation that can manipulate key parameters (e.g., manpower, task complexity, etc.) to optimize Fusion Center performance
  - Allows weighing of alternatives before engaging in risky activities… saves time, money, and manpower

OPR: Mr Lou Bernstein

Project 4: End-to-End Visibility

Description: Provide end-to-end visibility of all aspects of the projection and sustainment of forces and equipment

Applies to JCA Tier 1/2 activities: Logistics/Supply and Command & Control/Planning

- **Next Generation Wireless Communications (NGWC):**
  - Provide a mobile, adhoc wireless mesh network linking various existing communication technologies to improve theater-wide asset visibility
  - Provides immediate, reliable, and accurate shipment status through system access or event management
  - Complete development/transition FY11

- **Expeditionary Theater Distribution (ETD):**
  - Provide next-generation Portable Deployment Kit (PDK) capability with improved security, communications, and miniaturization
  - Quick deployment of RFID technology in austere/mobile environments extending asset visibility to the last tactical mile
  - Complete development/transition FY11

OPR: Mr Lou Bernstein

(A/O 16 Mar 09)

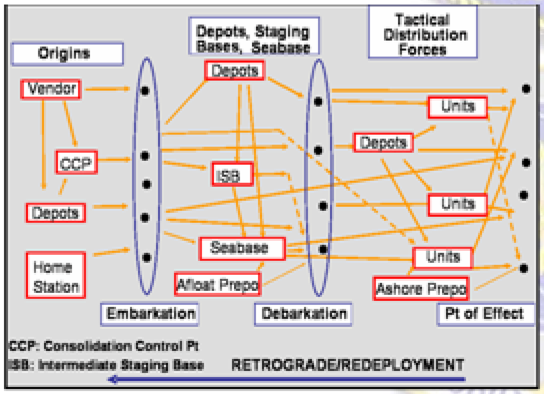
Project 5: Distribution Planning & Forecasting

Description: Planning, based on an understanding of customer requirements, for optimizing distribution process

Applies to JCA Tier 1/2 activities: Logistics/Deployment & Distribution and Command & Control/Planning

- **Single Load Planning Capability:**
  - Integrate cross-JDDE load planning capability applicable to air, sea, rail, and road movement
  - Provide a collaborative info workspace where incoming cargo can be dragged and dropped into load plans for follow-on conveyance
  - Complete development/transition FY11

- **Distribution Performance Nodal Model:**
  - Develop a highly configurable model to express and analyze complex/detailed business processes within distribution nodes
  - Enhance DOD's ability to conduct programmatic distribution analysis
  - Complete development/transition FY11



OPR: Mr Lou Bernstein

(A/O 16 Mar 09)

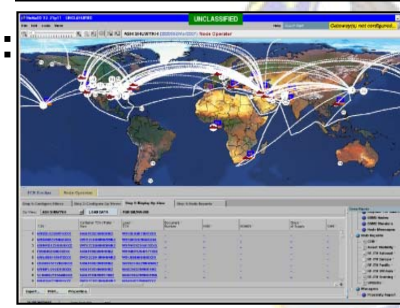
Project 6: Joint Transportation Interface

Description: Synchronizing, through information exchange, strategic/theater delivery capabilities to meet customer needs

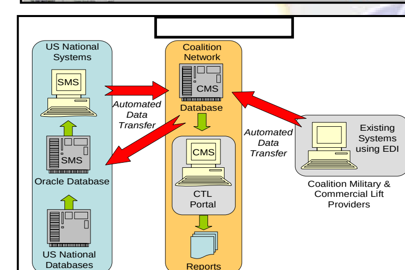
Applies to JCA Tier 1/2 activities: Logistics/Deployment & Distribution, Command & Control, Understand and Net-Centric/Enterprise Services

- **Multi-Modal Optimization/Booking:**
  - Enhance war fighter support through the optimization of transportation lift assets
  - Perform automated/integrated (air/land/sea) booking functions (saving both manpower and reducing costs through improved system performance)
  - Capability to see and understand problems impacting execution movement prior to and during execution

- **Collaborative Operational Picture-Deployment & Distribution (COP D2):**
  - COP D2: Link disparate distribution systems across the JDDE for a common logistics picture and actionable C2 information
  - Data Quality Improvement for COP D2: Accurate and standardized distribution data to enable performance of COP D2
  - Spirally transition capabilities across FYDP



- **Coalition Mobility System (CMS) JCTD:**
  - Ability to collect and query operationally relevant information pertaining to force movement and sustainment supporting coalition operations
  - Allows for visualization of coalition movements and improved lift efficiency
  - Complete development/transition FY10



Project 7: Distribution Protection/Safety/Security

Description: Providing the appropriate security in a timely manner during deployment and distribution operations

Applies to JCA Tier 1/2 activities: Logistics/Deployment & Distribution, Command & Control/Decide, and Force Support/Health Readiness

- **Next Generation Guidance, Navigation & Control:**
  - Effort across FYDP to increase the delivery accuracy of Joint Precision Air Drop System (JPADS) cargo in support of the warfighter
  - Collaborative Army/Air Force/USTRANSCOM initiative
  - Required capability is 50 meters (previous efforts decreased landing zone from 260 to 5 acres (98% improvement))

OPR: Mr Lou Bernstein

(A/O 16 Mar 09)

RDT&E Program Metrics

Performance Metric	Measure
Project Selection Focus	At least 50% are collaborative efforts with other gov't organizations
Enduring Capabilities	At least 75% transition to Program of Record, Service, NSN, or GSA
Delivering Timely Militarily-relevant Capabilities	25% of projects provide an operationally relevant product within 2 years after start and 75% complete final demo within 3 years
Reduced Costs	At least 25% of transitioned technologies producing positive ROI
Technically relevant	At least 80% achieve appropriate TRL and 90% validated by independent MUA/LOE
Program Execution	FMR-mandated obligation/expense goals are exceeded on annual basis (1st yr 89% O/60%E; 2nd yr 100%O/90%E; 5th yr 100%E)

The DoD T&E / S&T Program

Gerry Christeson

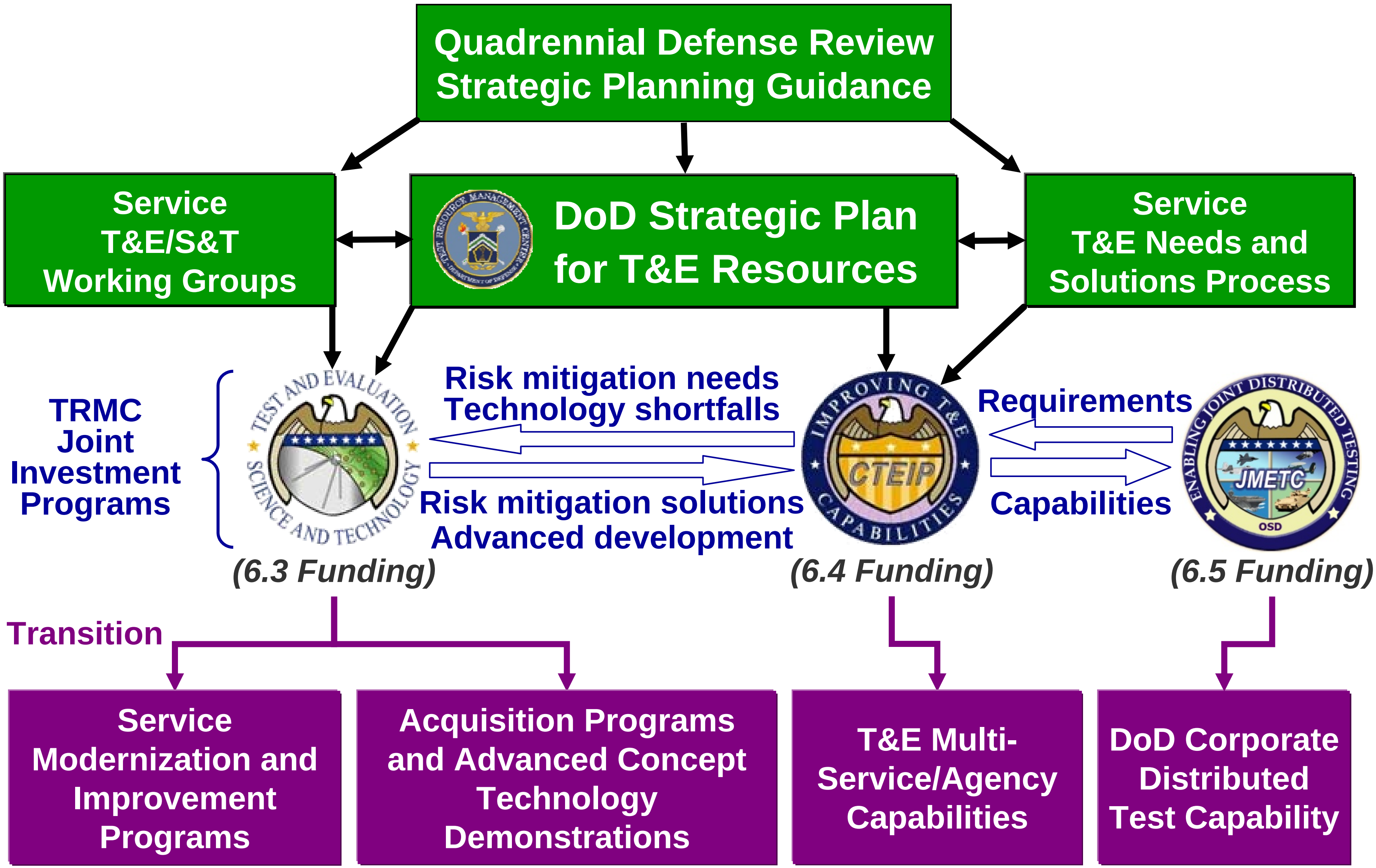
Defense Test Resource Management Center
Test & Evaluation / Science & Technology Program
(TRMC, T&E/S&T)

NDIA 10TH Annual Science & Engineering Technology Conference

Test Resource Management Center (TRMC)

- DoD Field Activity
  - Established to ensure that the DoD T&E infrastructure is adequate to support the development and acquisition of defense systems
  - Led by Dr. John Foulkes, SES
    - Direct report to the Under Secretary of Defense (Acquisition Technology and Logistics) and Director, Defense Research and Engineering (DDR&E)
- Annually certify that the T&E budgets of the military departments and defense agencies are adequate
- Develop a biennial DoD Strategic Plan for T&E Resources
  - Assesses T&E requirements for a period of ten years
  - Identifies required T&E infrastructure investments
- Responsible for all T&E infrastructure policy for the DoD's Major Range and Test Facility Base (MRTFB)
- Manage OSD funded T&E investment programs:
  - Joint Mission Environment Test Capability Program (JMETC)
  - Central Test and Evaluation Investment Program (CTEIP)
  - Test and Evaluation/Science and Technology (T&E/S&T) Program

Synergy through Aligned Investment



NDIA 10TH Annual Science & Engineering Technology Conference, 23-25 April 2009

T&E/S&T Program
Overview

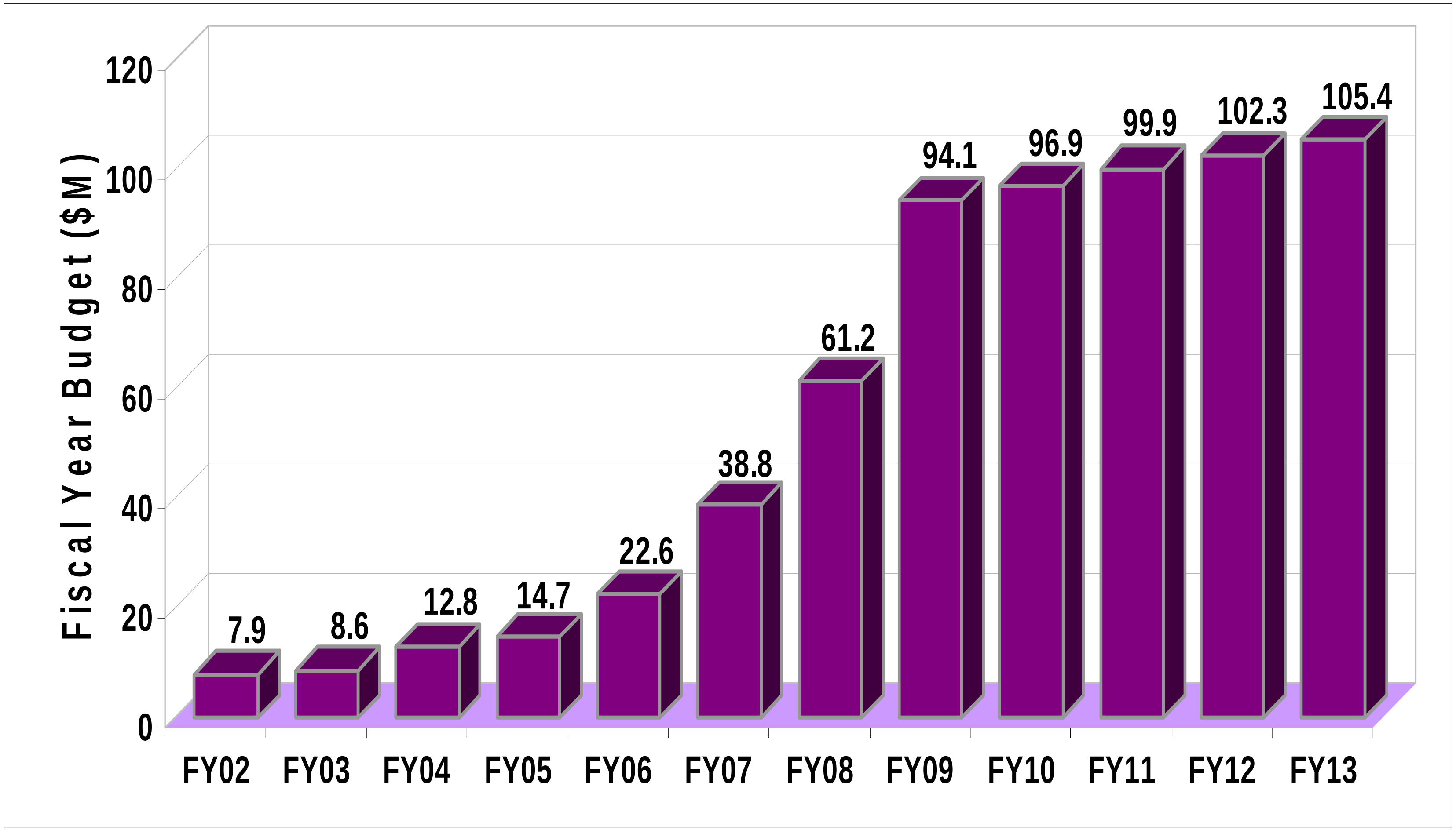
- **Test & Evaluation / Science & Technology (T&E/S&T) Program started in FY 2002**
  - **Joint DDR&E / DOT&E initiative**
- **Mission**
  - **Investigate and develop new technologies required to test and evaluate our transforming military capabilities**
    - **Include any system that makes our warfighters more survivable and effective in combat**
    - **Mature test technologies from TRL 3 to 6**
- **Goal**
  - **Transition emerging technologies into test capabilities in time to verify warfighting performance**

Shaping Technology into Tomorrow's T&E Capabilities

T&E/S&T Program Office

- **What We Do?**
  - Fund Test & Evaluation related R&D projects
  - Foster technology transition to MRTFB and other DoD T&E field activities
- **How We Do It?**
  - Issue annual Broad Agency Announcement (BAA)
  - Tri-Service working groups draft BAAs and participate in proposal evaluation
  - Award T&E R&D projects at TRL 3, 4 or 5 and mature to TRL 6
  - Executing Agents (EA) manage test technology Focus Areas
- **Who Do We Fund?**
  - Academia
  - Industry
  - Government laboratories
  - Teams of academia / industry / government labs

T&E/S&T Program Annual Budget



Technology Readiness Level

T&E Technology Transition

TRL 9	Actual system 'flight proven' through successful mission operations
TRL 8	Actual system completed and 'flight qualified' through test and demonstration
TRL 7	System prototype demonstration in an operational environment
TRL 6	System/subsystem model or prototype demonstration in a relevant environment
TRL 5	Component and/or breadboard validation in relevant environment
TRL 4	Component and/or breadboard validation in laboratory environment
TRL 3	Analytical and experimental critical function and/or characteristic proof of concept
TRL 2	Technology concept and/or application formulated
TRL 1	Basic principles observed and reported

T&E/S&T Program Management

TRMC HQ

Army

Navy

Air Force

NII: Naval Undersea Warfare Center
Newport, RI

MST: Aberdeen Test Center
Aberdeen Proving Ground, MD

SET: Edwards AFB
Lancaster, CA

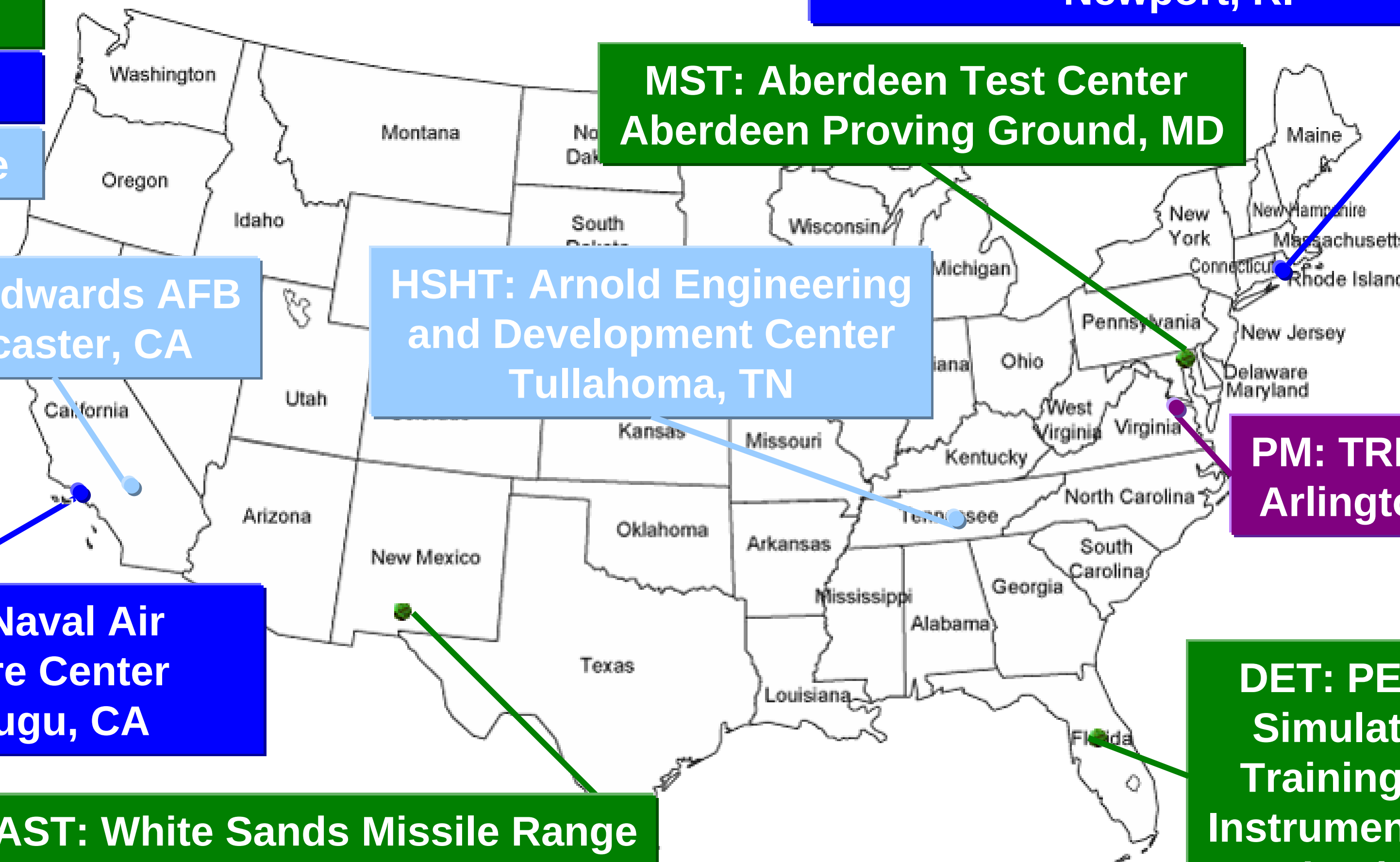
HSHT: Arnold Engineering and Development Center
Tullahoma, TN

PM: TRMC HQ
Arlington, VA

NST: Naval Air Warfare Center
Pt. Mugu, CA

DET: PEO for Simulation, Training and Instrumentation
Orlando, FL

UAST: White Sands Missile Range
Las Cruces, NM



Central Oversight – Distributed Execution

FY09 T&E/S&T Focus Areas

- **Directed Energy Test (DET) –** On-board and off-board technologies to assess performance of high energy laser and high power microwave weapon systems
- **High Speed/Hypersonic Test (HST) –** Technologies to provide high fidelity environments, M&S and instrumentation for ground and flight tests of air breathing hypersonic vehicle propulsion systems
- **Multi-Spectral Test (MST) –** Technologies to enable real-time, realistic T&E of multi-spectral and hyperspectral seekers and sensors through scene prediction, simulation and measurement
- **Non-Intrusive Instrumentation (NII) –** Technologies for non-intrusive sensors, power sources, time & positioning system, and data acquisition to provide continuous, non-obtrusive T&E

FY09 T&E/S&T Focus Areas
(continue)

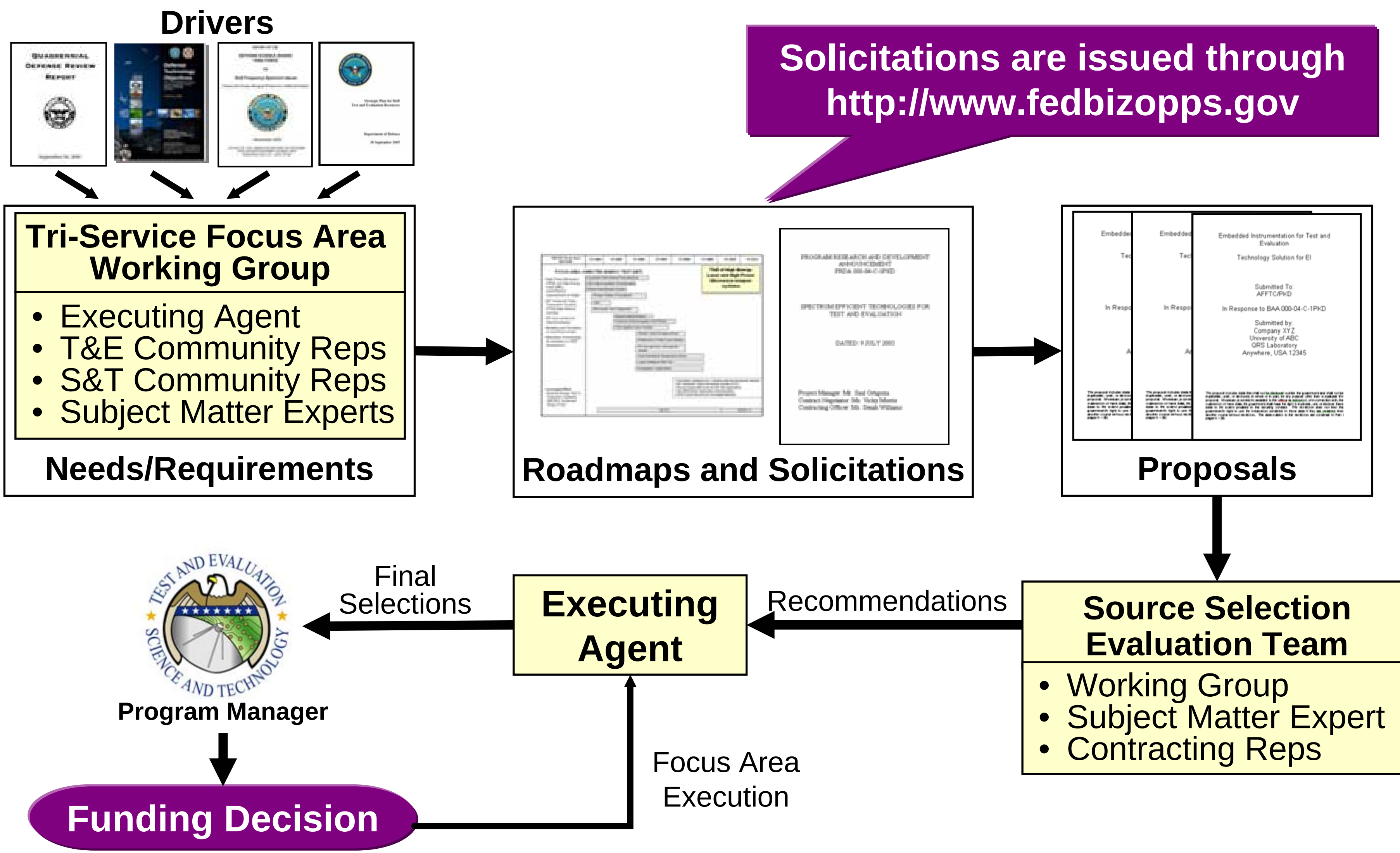
- **Netcentric Systems Test (NST) –** Technologies to measure and assess the performance of the physical, information domains of the Joint, integrated netcentric architectures

- **Spectrum Efficient Technology (SET) –** Technologies to enable more efficient use of legacy telemetry bands and expand into non-traditional areas of the RF spectrum and the optical spectrum

- **Unmanned Autonomous Systems Test (UAST) –** Technologies for T&E of unmanned systems ranging from full tele-operation to totally autonomous, learning performance

Approximate 115 active projects

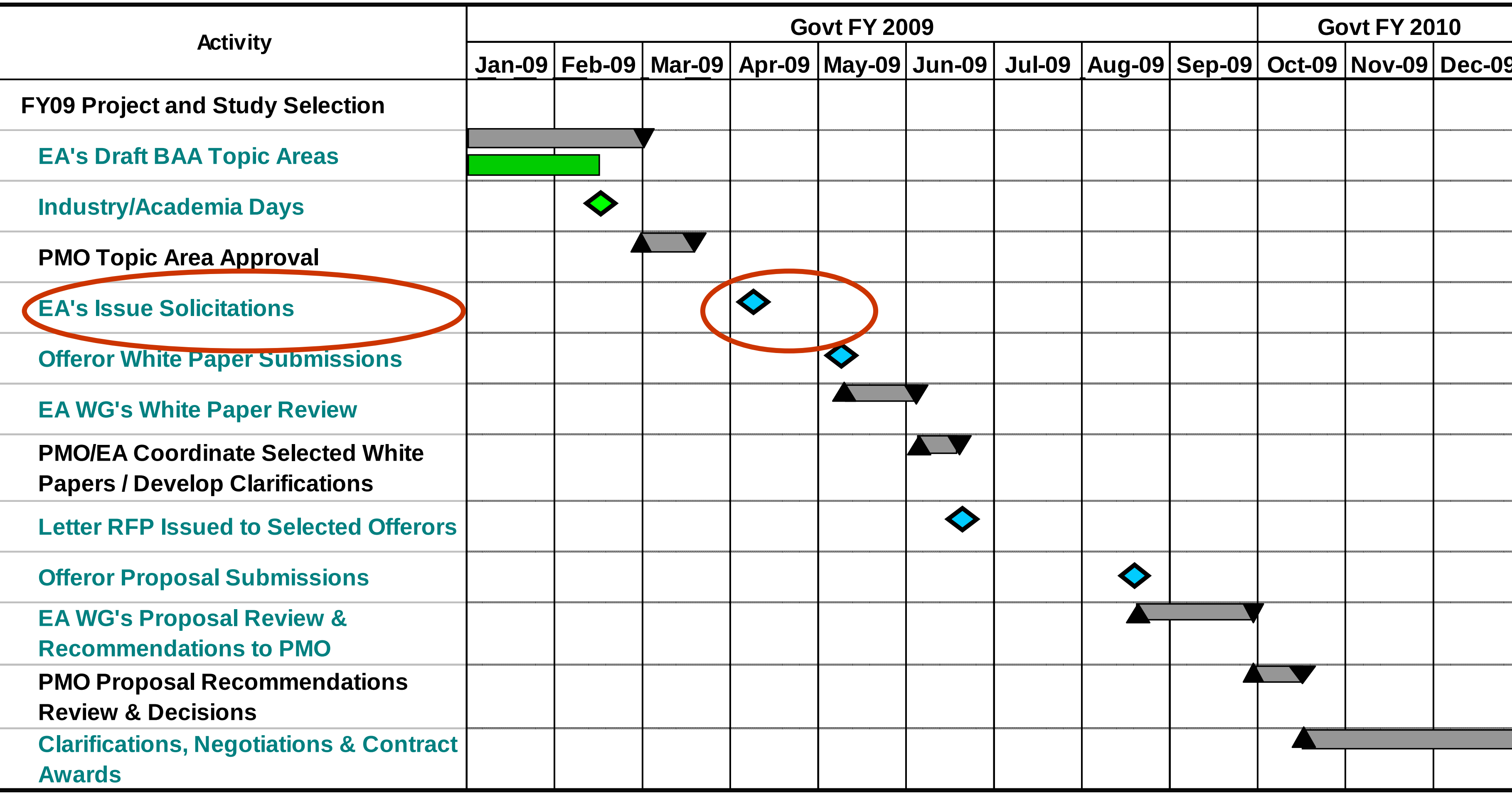
T&E/S&T Program
Project Selection Process



Working Group Participants

Army	AMRDEC	IEW
	AMSAA	NVESD
	ARL	OTC
	ATC	PEO STRI
	ATEC	RDEC
	ATTC	RTTC
	HELSTF	TRADOC
Navy	NAVAIR	NAWC
	NAVSEA	NUWC
	NRL	SPAWAR
Air Force	AEDC	AFRL
	AFEWES	AFWDC
	AFFTC	46th TW
	AFOTEC	452nd FLTS
DoD	DDR&E	IO Range
	DISA / JITC	JCS
	DOT&E	JFCOM

BAA Schedule



BAA – Broad Agency Announcement
PMO – Program Management Office
EA – Executing Agent
RFP – Request for Proposal
WG – Working Group
FY – Fiscal Year

FY10 BAA Release Schedule

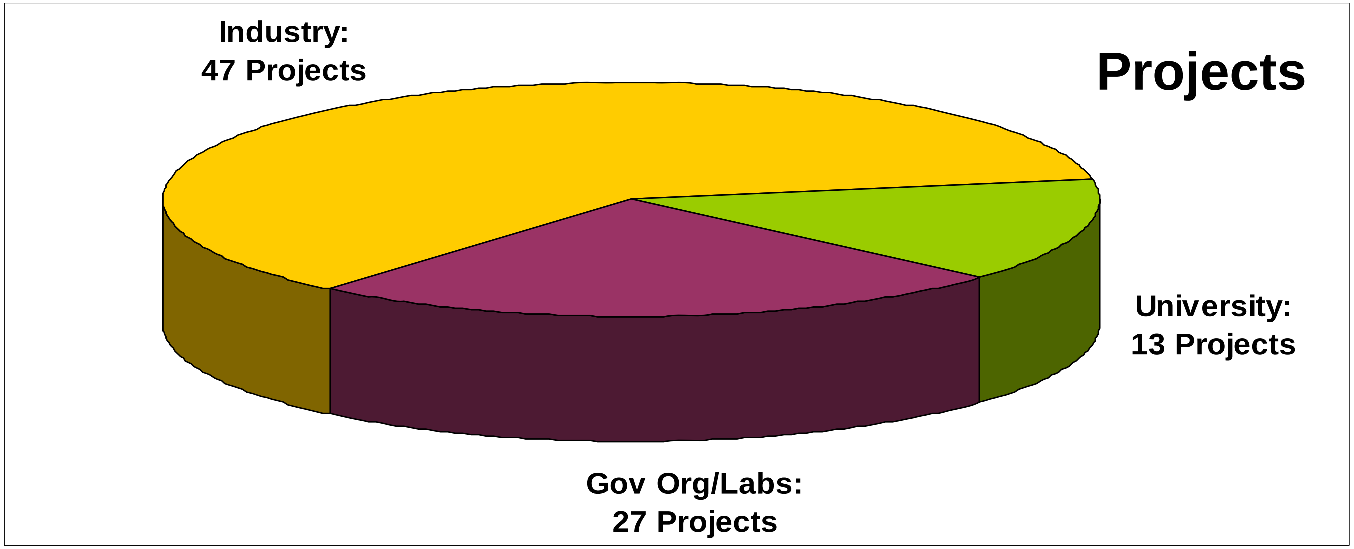
	BAA Release	Whitepaper Due	"Invited" Proposal Due
Directed Energy Test	3/25/09	5/1/09	7/29/09
High Speed / Hypersonic Test	4/15/09	6/2/09	8/25/09
Multi – Spectrum Test	4/2/09	5/1/09	8/4/09
Non-Intrusive Instrumentation	By 4/30/09	TBD	TBD
Netcentric System Test	4/15/09	6/2/09	8/25/09
Spectrum Efficient Technology	By 4/30/09	TBD	TBD
Unmanned & Autonomous System Test	By 4/30/09	TBD	TBD

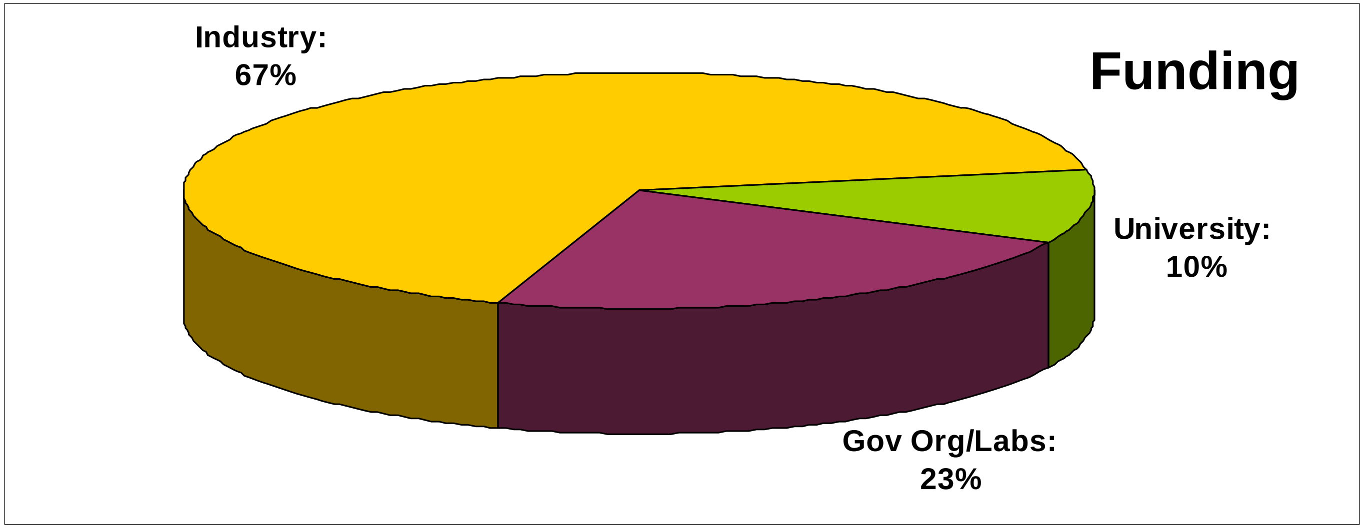
FY10 BAA Announcements

http://www.fedbizopps.gov/ → Search for “TRMC”

	TRMC FY10 BAA RFP #
Directed Energy Test	W900KK-08-R-0012
High Speed / Hypersonic Test	W900KK-08-R-0017
Multi – Spectrum Test	W91ZLK-08-T-0211
Non-Intrusive Instrumentation	W900KK-09-R-0037
Netcentric System Test	W900KK-08-R-0018
Spectrum Efficient Technology	W900KK-08-R-0019
Unmanned & Autonomous System Test	W900KK-09-R-0038

FY 2009 T&E/S&T Distribution





Note:
Numbers apply only to FY 2009 funding profile

The Proposal — Key Criteria

- Meets a T&E Need
- Requires S&T work
- High Payoff
- Broad application (more than one DoD test activity)
- High potential for transition to development of a test capability

Technology Development Needs

- **Fill gaps in existing T&E capabilities**
  - Implement new technology to existing systems
  - Satisfy immediate needs before new T&E capability become available
  - Meet urgent needs
- **Field components of T&E capabilities**
  - Improve current capability
  - Accept benefit–risk trade off
- **Develop new and integrated T&E capability**
  - Build state-of-the-art new T&E infrastructure
  - implement systems based on the latest technologies
  - Satisfy long-term version while meeting short-term goals

TRMC Vision

The Department of Defense T&E Ranges & Facilities will be fully capable of supporting the Department with Quality products and services in a responsive and affordable manner.

Key T&E/S&T Focus Area Technology Investments

- **Directed Energy Test**
  - Measure energy on target
  - Visualize and assess target destruction mechanisms
- **High Speed/Hypersonic Test**
  - Clean air propulsion
  - Variable Mach Number nozzle
- **Multi-Spectral Test**
  - High spatial/spectral fidelity, high temperature, wide dynamic range, polarized and high frame rate scenes
  - Emitters and projectors encompassing more than one spectral band (i.e., Near Infrared, Short-Wave Infrared, and Mid-Wave Infrared)
- **Non-Intrusive Instrumentation**
  - High accuracy, high dynamic and GPS-denied TSPI
  - Scalable, open, wireless, self-healing architectures and smart sensors that support various interfaces
- **Netcentric Systems Test**
  - Live, virtual and constructive NST test environment that emulates real-world networks
  - Evaluate interoperability, net-ready KPP, and Joint mission effectiveness
- **Spectrum Efficient Technology**
  - Transmitters: Linear and constant envelope power amplifiers
  - Receivers: Low-noise amplifiers
  - Antennas: Point source trackers, Multi-beam phased arrays, Diversity (spatial, polarization, frequency) combiners
- **Unmanned and Autonomous Systems Test**
  - Predict autonomous performance and behavior
  - Accurately collect and compare autonomous systems situational awareness and ground truth

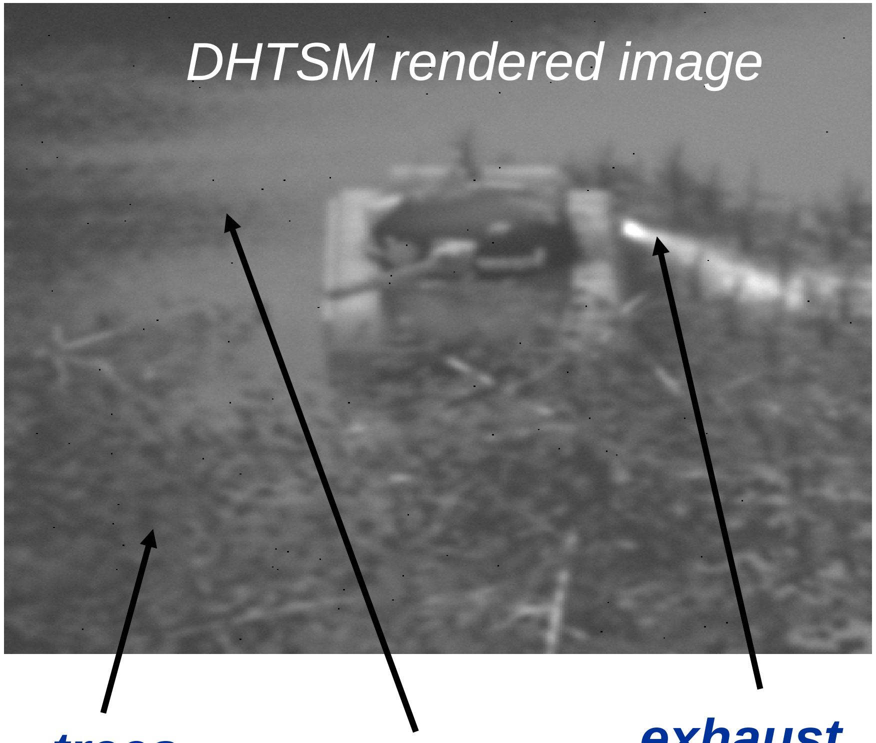
MST Dynamic Hyperspectral Thermal Signature Model (DHTSM)

Successfully demonstrated:
- **Large area (5 km x 5 km) long range infrared scenes**
- **High spatial and spectral fidelity; diurnal effects**
- **20-100 in-scene targets**

Government owned source code; in use by
- **Redstone Technical Test Center**
- **Army Aviation and Missile Research Development and Engineering Center**
- **Army and Air Force Research Labs**
- **National Ground Intelligence Center**
- **Natick Soldier Systems**
- **National Institute of Standards and Technology**
- **Night Vision and Electronic Sensors Directorate**

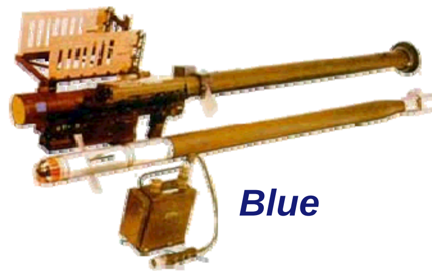
Applications include missile testing, IR seeker dome design, camouflage evaluation, automatic target recognition, advanced hyperspectral sensor T&E

Early Morning Summer Season



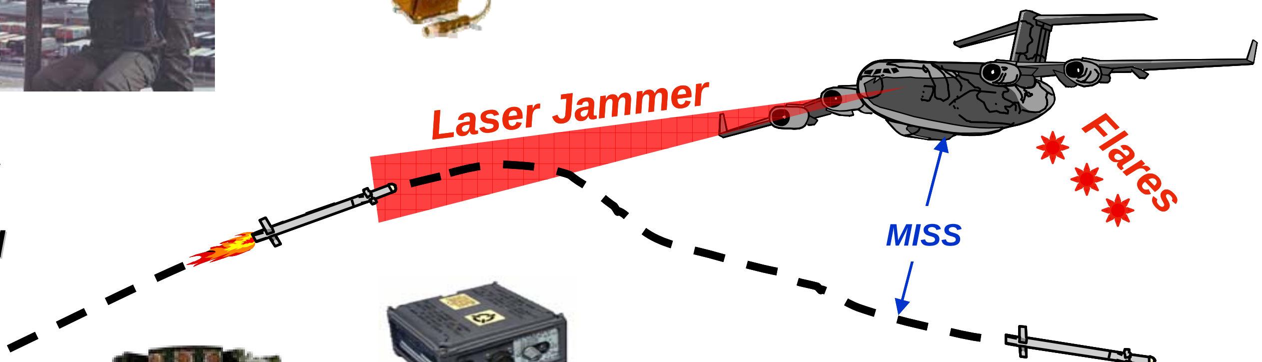
T62 Tank in a foliated environment

Infrared Countermeasures (IRCM) Drivers



Threat Missiles

- *Many thousands proliferated*
- *Many in terrorist hands!*



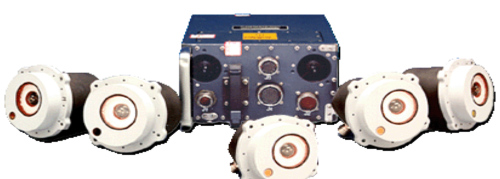
Laser Jamming

Flares

IRCM Systems

Advanced Development Systems

- *Closed Loop Laser Jamming*
- *Visible Missile Warning*
- *Pro-Active (Jam Before Launch)*
- *Airport Protection*
- *HEL, HPM Countermeasures*

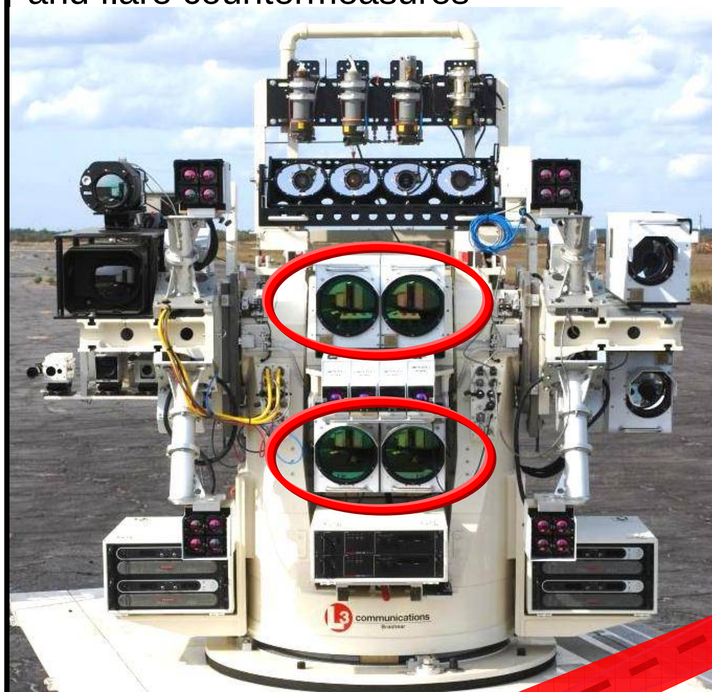


UV Missile Warning

IR Missile Warning

Joint Mobile IRCM Test System (JMITS)

JMITS “paints” UV & IR signatures on IRCM systems and characterizes laser and flare countermeasures



Both Units Delivered Directly to Test in Mar 08

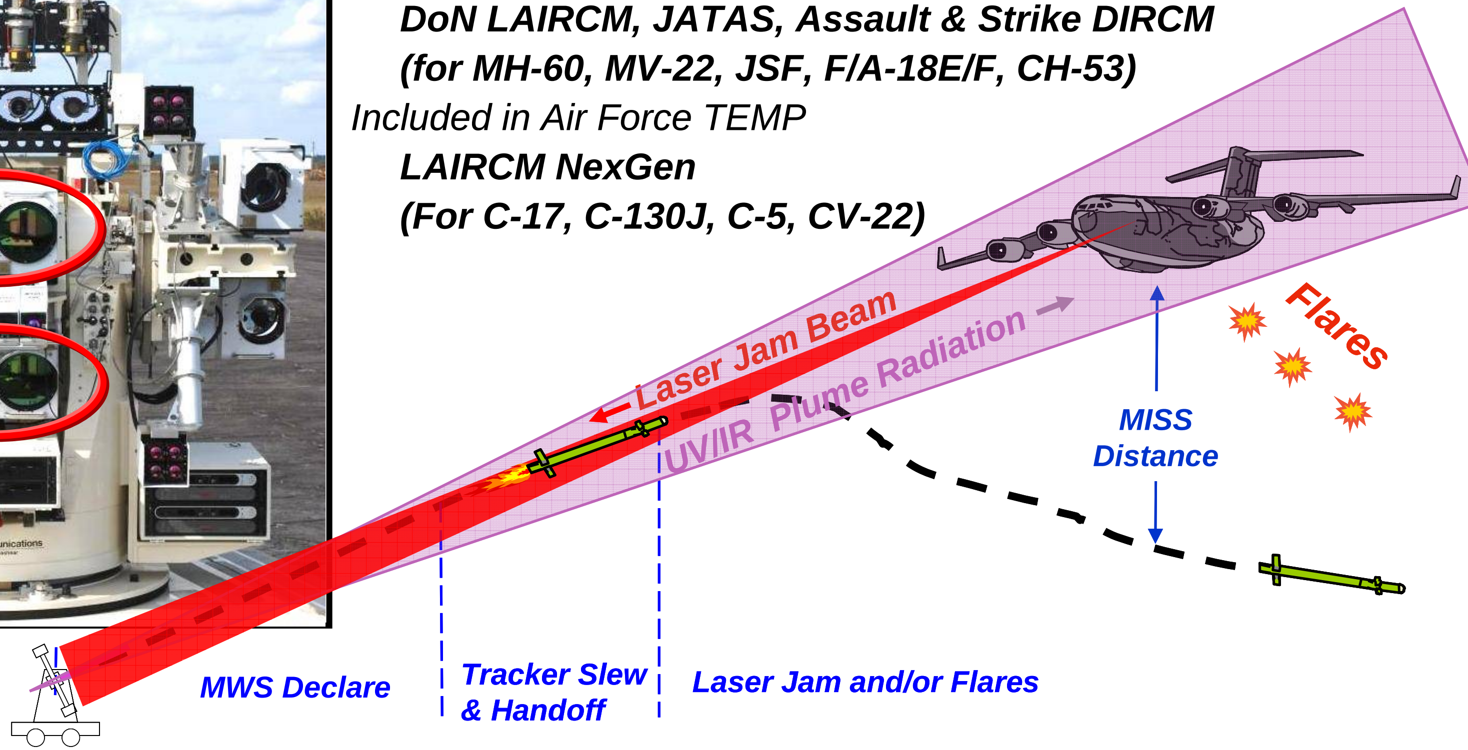
- ***Eglin AFB (DoN LAIRCM Testing on Navy CH-46)***
- ***China Lake (LAIRCM Testing on AFSOC CV-22)***

Included in Navy TEMPS

- ***DoN LAIRCM, JATAS, Assault & Strike DIRCM (for MH-60, MV-22, JSF, F/A-18E/F, CH-53)***

Included in Air Force TEMP

- ***LAIRCM NexGen (For C-17, C-130J, C-5, CV-22)***



Required T&E/S&T Development for Higher Power Continuous Wave Infrared Sources

- **To simulate long range shots within MANPAD operational envelopes**
- **To simulate longer range RF SAMs during multi-spectral testing (RF & IR)**
- **Two Colors (IR-Red & IR-Blue)**

Summary

- Focus on technology transition to DoD's Major Range and Test Facility Base (MRTFB) and other T&E applications
- Develop and mature technology from TRL 3, 4 and 5 to TRL 6
- T&E Technology Development Partners
  - Industry
  - Academia
  - Government labs / ranges

Questions?

Contact Information:

Mr. Gerry Christeson

Defense Test Resource Management Center
T&E / S&T Program

Gerald.Christeson@osd.mil

Back Up

Directed Energy Test

T&E Gaps

- Ability to visualize laser energy on a target to determine beam location, beam pointing, and tracking stability
- Ability to visualize target destruction mechanisms resulting from laser heating
- Ability to model reflectance from a target to assess target destruction mechanisms
- Ability to non-intrusively measure high-power microwave (HPM) fields to assess quality
- Ability to assess HPM target destruction mechanisms or field uniformity for active denial systems

S&T Challenges

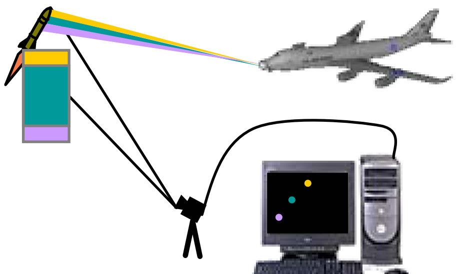
- Develop passive adaptive optics to map laser spot on target (High Energy Laser [HEL])
- Develop high frame rate multi-band infrared cameras (HEL)
- Develop co-located irradiance and temperature sensors on conformal target boards (HEL)
- Develop algorithms to quantify dynamic target surface temperature (HEL)
- Develop non-intrusive, compact, HPM electro-optical and magneto-optical sensors (HPM)
- Develop advanced HPM target board (HPM)

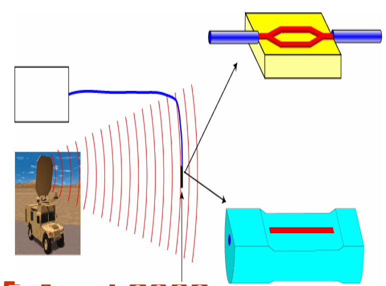
Major Developments

- HEL temperature and irradiance target panel
- Stand-off sensing of HEL target illumination
- On-board sensing of HEL target illumination
- Electric and magnetic field sensors for HPM effects testing using wide-band and narrow-band sources
- Target board for Active Denial System

Budget ($M)

FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
15.0	18.7	21.7	21.2	19.7	20.1	20.5	20.9





High Speed/Hypersonic Test

T&E Gaps

- Ability to test hypersonic propulsion systems in real air conditions in wind tunnels
- Ability to simulate flight vehicle speed changes in ground test for propulsion testing
- Ability to model ground test facilities to predict test results, optimize testing for limited test time, and reduce flight test risk
- Limited ability to non-intrusively measure temperature, pressure, heat flux, or chemistry
- Limited ability to efficiently gather vehicle performance data during flight test

S&T Challenges

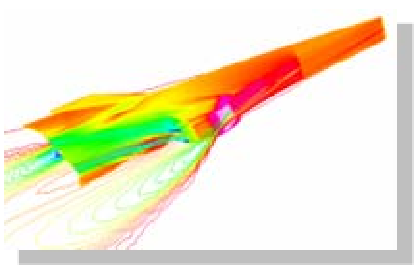
- Research and develop high temperature and high pressure heaters for clean air impulse and continuous flow ground test facilities
- Develop flow control to provide variable Mach
- Research and develop arc heater simulation and control mechanisms for ground test
- Research and develop temperature, pressure, heat flux, and chemistry sensors for hypersonic ground and flight test
- Develop optimized test techniques to obtain flight characteristics in an efficient manner

Major Developments

- Conducting parallel research efforts to obtain clean air and variable Mach in ground test facilities
- Evaluating the effects of combustion products from fuel used to heat air in hypersonic flow for propulsion testing
- Systematically comparing test results between different ground test facilities to better predict and assess data collected in all facilities

Budget ($M)

FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
16.0	17.8	19.0	19.1	19.2	19.5	19.9	20.3



Multi-Spectral Test

T&E Gaps

- Ability to present accurate, high resolution battle scenes for sensor testing (e.g. missile warning system)
- Ability to present temperature ranges for missile plumes and afterburners for sensor stimulation
- Ability to stimulate sensors by projecting simulated scenes in real-time (trick sensor into responding to simulated data)
- Ability to project and inject spatially and temporally correlated high frame rate scenes for hyperspectral and multi-spectral seeker testing

S&T Challenges

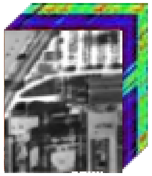
- Develop large-scale hyperspectral signatures and scenes
- Develop real-time, high frame rate battlespace representations with high spectral and spatial resolution
- Develop spatially and temporally correlated dynamic infrared and radio frequency scenes and targets
- Develop realistic spectral radiance and high dynamic range across environmental conditions
- Develop technologies to present high temperature (≥3,000°C) emitters

Major Developments

- Emitters and projectors encompassing more than one spectral band (*i.e.*, Near Infrared, Short-Wave Infrared, and Mid-Wave Infrared)
- High temperature, real-time scene generation using 3-D atmospheric models (more accurate than any existing model)
- High power carrying optical fibers for infrared countermeasure testing

Budget ($M)

FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
9.5	12.7	12.7	12.7	13.1	13.2	13.5	13.7



Non-Intrusive Instrumentation

T&E Gaps

- Non-intrusive, miniaturized sensors and data storage technologies, and supporting architectures
- Miniaturized, long operational life, and efficient power and energy management in a chip
- Data collection for reporting human operator time-space-position information (TSPI) in GPS-denied environments
- High accuracy TSPI for highly dynamic platforms

S&T Challenges

- Develop next generation MEMS, fiber optic sensors, and holographic memory devices
- Develop scalable, open, wireless, self-healing architectures and smart sensors that support various interfaces
- Develop power sources and power mixer-charger-supply electronics embedded within a chip (e.g., lithium-ion strip battery and methanol fuel cell)
- Develop high-resolution location information systems using wide-band, anti-jam technology

Major Developments

- On-board wireless data communication
- Non-perturbing pressure, temperature, chemical species probes (*e.g.*, MEMS and optical)
- TSPI in GPS-denied environments using wideband radio frequency
- Ultra-high dynamic GPS
- Advanced in-situ power sources to support long-term measurements

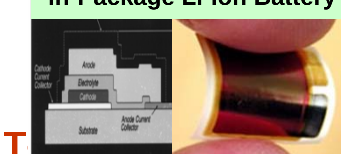
15 active projects

Budget ($M)

FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
7.5	4.8	4.9	6.6	8.6	9.9	10.0	10.2

Holographic Memory Cube

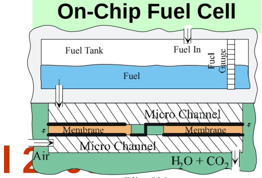
In-Package Li-Ion Battery



Self-Powered Chip

1 cm x 1 cm

On-Chip Fuel Cell



Netcentric Systems Test

T&E Gaps

- Higher fidelity M&S of netcentric battlespace components, and high fidelity network emulation
- Accurately represent effects of the command and control (C2) structure and decision processes
- Representation of Joint mission threads of kinetic and non-kinetic warfighter capabilities
- Ability to evaluate interoperability, net-ready KPP, and Joint mission effectiveness
- Automated intelligent capability to plan, execute, construct, and visualize a netcentric test environment

S&T Challenges

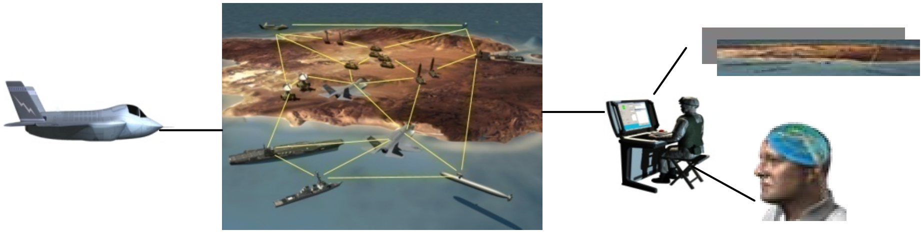
- Develop algorithms to integrate and validate complex simulations in netcentric environments
- Develop algorithms to dynamically manage the test network and conduct compliance testing
- Automate test planning; scenario development; test environment construction; and data capture, analysis, and visualization of netcentric measures
- Represent multiple layers of the C2 structure and simulate the decision processes output

Major Developments

- High fidelity representation and visualization of current and emerging networks
- Live-Virtual-Constructive (LVC) testing to characterize network effects
- Dynamically configure distributed LVC networks with improved efficiency and performance
- Simulate and analyze effects of traditional and non-kinetic actions within Joint mission context
- Manage and analyze the Joint netcentric test environment in real-time or near real-time

Budget ($M)

FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
9.0	13.2	16.1	18.0	18.5	18.8	19.2	19.5



18 active projects

Spectrum Efficient Technology

T&E Gaps

- Ability to transmit higher data rates in reduced bandwidth environments
- Ability to dynamically allocate frequency bands
  - Ability to detect and use available portions of the spectrum
- Ability to operate in super-high frequency
- Ability to use newly acquired spectrum
- Need Quality of Service (QoS) management software

S&T Challenges

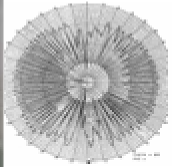
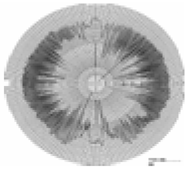
- Develop more efficient modulation and signal coding techniques for greater efficiency (higher data rates in the same bandwidths)
- Develop software for the iNET radio frequency (RF) management telemetry application
- Develop multi-band transmitters and broadband antennas
- Develop QoS management software and simulation tools

Major Developments

- Mitigation of interference between two transmitter antennas
- Simulations to address iNET networking requirements
- RF channel model development to perform ground station system design
- Increased efficiency of linear RF power amplifiers (improved efficiency from 20% to 30%)

Budget ($M)

FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
1.2	6.2	6.2	11.1	11.3	11.5	11.7	11.9


Unmanned & Autonomous System Test

T&E Gaps

- Ability to safely test lethal, intelligent, tele-operated, or autonomous platforms
- Ability to predict autonomous performance and behavior
- Ability to instrument small unmanned and autonomous systems (UAS) without affecting design or performance
- Ability to accurately collect and compare autonomous systems situational awareness and ground truth

S&T Challenges

- Develop “fail-safe” methods to control and disarm weaponized UAS safely, even under operational control systems failure
- Develop predictive behavior models by integrating genetic algorithms and probability theory
- Develop models capable of applying realistic stimuli to systems under test
- Develop on- and off-board instrumentation and test communications networks that do not impact UAS performance

Major Developments

- Multi-data collection sensor system for on-board data capture and real-time measurement at system and sub-system levels for “fail-safe” management and performance assessment
- Modular, self-powered system (<10g) that provides continuous tracking, position, and orientation data
- Situational awareness technologies to perform safe and detailed tests of multiple platforms in diverse environments

13 active projects

Budget ($M)

FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15
4.1	6.3	6.4	6.3	6.5	6.5	6.6	6.8

T&E Needs

The R&D project:

- **Addresses the T&E requirements**
- **Fills known T&E gaps**
- **Articulates how the above are to be achieved**

Example: T&E Need

Ground test facilities generally use combustion processes to create representative flight conditions for hypersonic engine testing. The effects of vitiates on the engine performance is not well known. Ground test facilities need a clean air test capability to more realistically simulate actual flight conditions to accurately predict engine performance in flight.

S&T Challenges

The R&D project:

- **Develops new test & evaluation capabilities that do not currently exist**
- **Utilizes /develops beyond state-of-the-art technologies that can be high-risk**
- **Pushes technology to new limits**

Example: S&T Challenges

- Develop resistively heated elements to routinely operate between 2200 to 2400 Kelvin (4535 to 4927 deg F)
- Develop electrical interface materials that can maintain high current (60 Amp or greater) electrical and mechanical connection at extreme temperatures
- Develop element materials and shapes that can withstand temporal temperature cooling gradients of at least a thousand degrees a minute and maintain air seal to prevent internal cooling air from leaking into external airflow and cooling it

Partnerships

- Partnerships between universities, industry & DoD laboratories
  - Form the best research teams possible
- Collaborate to pursue bigger opportunities
  - Leverage each others’ core competencies
  - Share resources
- Increase transition opportunities through increased involvement in the T&E/S&T Program

North American Aerospace Defense Command & United States Northern Command

Mr. Ed Doray
Chief, IC Concepts & Technology
23 April 2009

How We Fit Together

PRESIDENT

SECRETARY OF DEFENSE

CHAIRMAN OF THE JOINT CHIEFS OF STAFF

CANADIAN PRIME MINISTER

DEFENCE MINISTER

CHIEF OF THE DEFENCE STAFF

UNITED STATES NORTHERN COMMAND

DUAL - HATTED

NORTH AMERICAN AEROSPACE DEFENSE COMMAND

Our Area of Focus

The Threats


Natural Disasters
Cruise Missiles
Illicit Trafficking
Terrorism
Intercontinental Ballistic Missiles
Illegal Migration
Terrorism
Manmade Disasters
Natural Disasters
Illegal Migration
Pandemic Disease
Illicit Trafficking
Russia
Greenland
Canada
Mexico

Our Mission


Aerospace Warning
Aerospace Control
Aerospace Warning
Homeland Defense
Maritime Warning
Civil Support
Maritime Warning
Aerospace Control
Russia
Greenland
(Denmark)
Canada
United States
Mexico
USPACOM
USNORTHCOM
USEUCOM
USSOUTHCOM
HUDSON BAY
BAFFIN BAY
BEAUFORT SEA
ARCTIC OCEAN
NORTH PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
CARIBBEAN SEA
Cuba
Puerto Rico
Venezuela
Colombia
Guyana
Suriname
French Guiana
Brazil
N
S
E
W

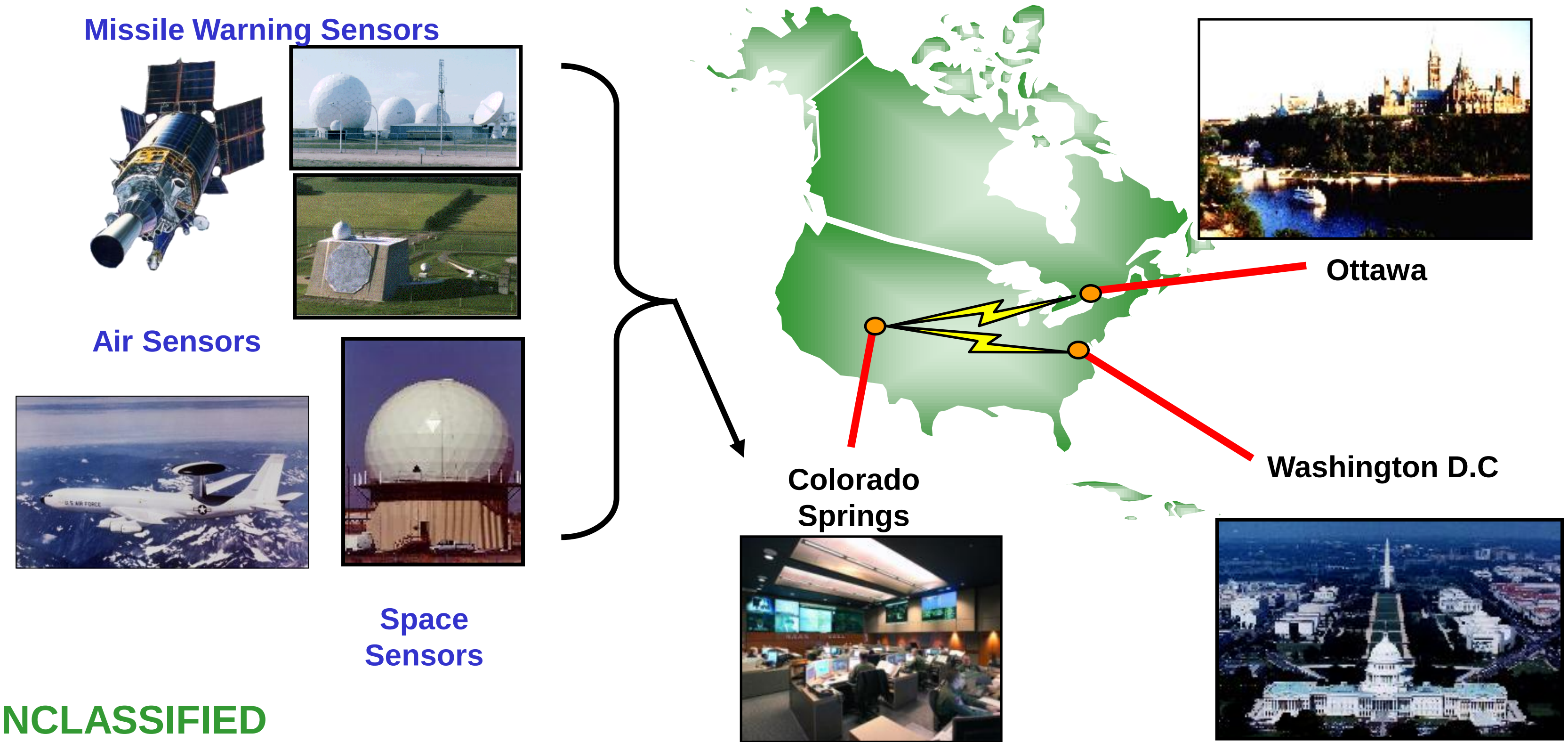
Aerospace Warning

NORAD Agreement:

- Process, Assess and Disseminate intelligence and information related to manmade objects in the aerospace domain

Terms of Reference:

- Includes support of designated commands responsible for missile defense
- Monitor global aerospace activities & related developments

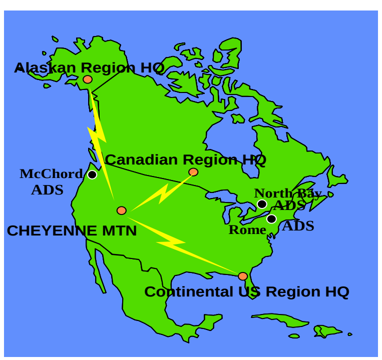


Aerospace Control

__NORAD Agreement:__ Provide surveillance and control of the airspace of Canada & the U.S.

__Terms of Reference:__

- **Airspace of and approaches to North America**
- **Safeguard sovereign airspace of both countries**
- **Capabilities to detect, identify, monitor and take actions (visual ID to destruction) against manned and unmanned airborne objects**

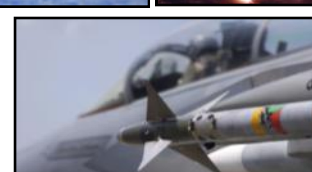


__Surveillance__ (know what is going on)

Detect/Track

Scramble

__Control__ (take appropriate action)



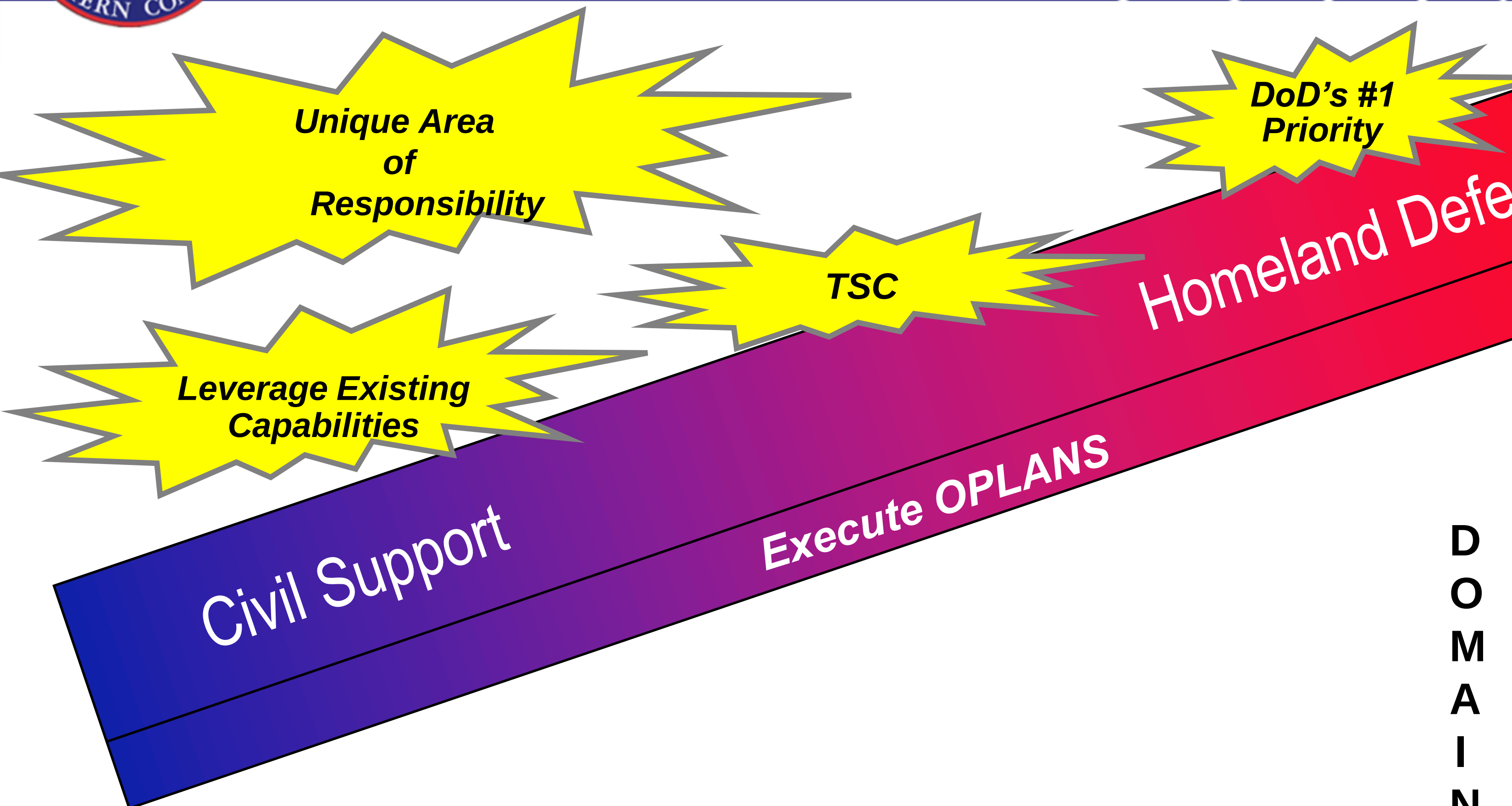
Maritime Warning

<u>NORAD Agreement:</u> **Processing, assessing, and disseminating intel/info related to maritime areas and international waterways & the maritime approaches to the U.S. & Canada**

<u>**Terms of Reference:**</u>

- **process & disseminate intel/info as part of an information sharing network**
- **enables the validation, characterization, and assessment of an attack by traditional or asymmetric maritime threats**

Protecting the Homeland



D O M A I N S

Special Events

Disaster Relief

Civil Disturbances

CBRNE Incident

The National Response Framework for DSCA

Total Force/Interagency Team

60 Organizations are part of our Team!!!

Transport Canada

Public Safety Canada

SEDENA
SECRETARÍA DE LA DEFENSA NACIONAL

SEMAR
SECRETARÍA DE MARINA

American Red Cross

USDA

Redefining Jointness…Success Through Effective Relationships

Capability Focus Areas

Tactical Comms & Data Links:

- BLOS communication with aircraft is a challenge, especially in northern latitudes and in remote areas
- Existing air defense communications equipment is outdated and expensive to maintain

Ballistic Missile Defense (BMD) of the Homeland:

- Integrated defense for continuous, real-time discrimination for threat launch through impact for cruise missile, other low-altitude aircraft and short range missile attacks

Capability Focus Areas

Information Sharing:

- collaborative and effective two-way communication (class and unclass) sharing capability with mission partners

Interoperable Communications

- assured and interoperable (class and unclass) C4 and associated architectures, both fixed and mobile that are resilient and resistant to the effects of an attack
- national architecture

Capability Focus Areas

Homeland Domain Awareness:

-Air Domain:

Detection and tracking of targets with small radar cross sections

- Maritime Domain:

Persistent, all-weather, over the horizon detection tracking, correlation, and reporting of maritime threats

- Land Domain:

Detection of cross border tunnels

- Incident Awareness and Assessment:

Insufficient near real-time full motion video (FMV) capture and transmission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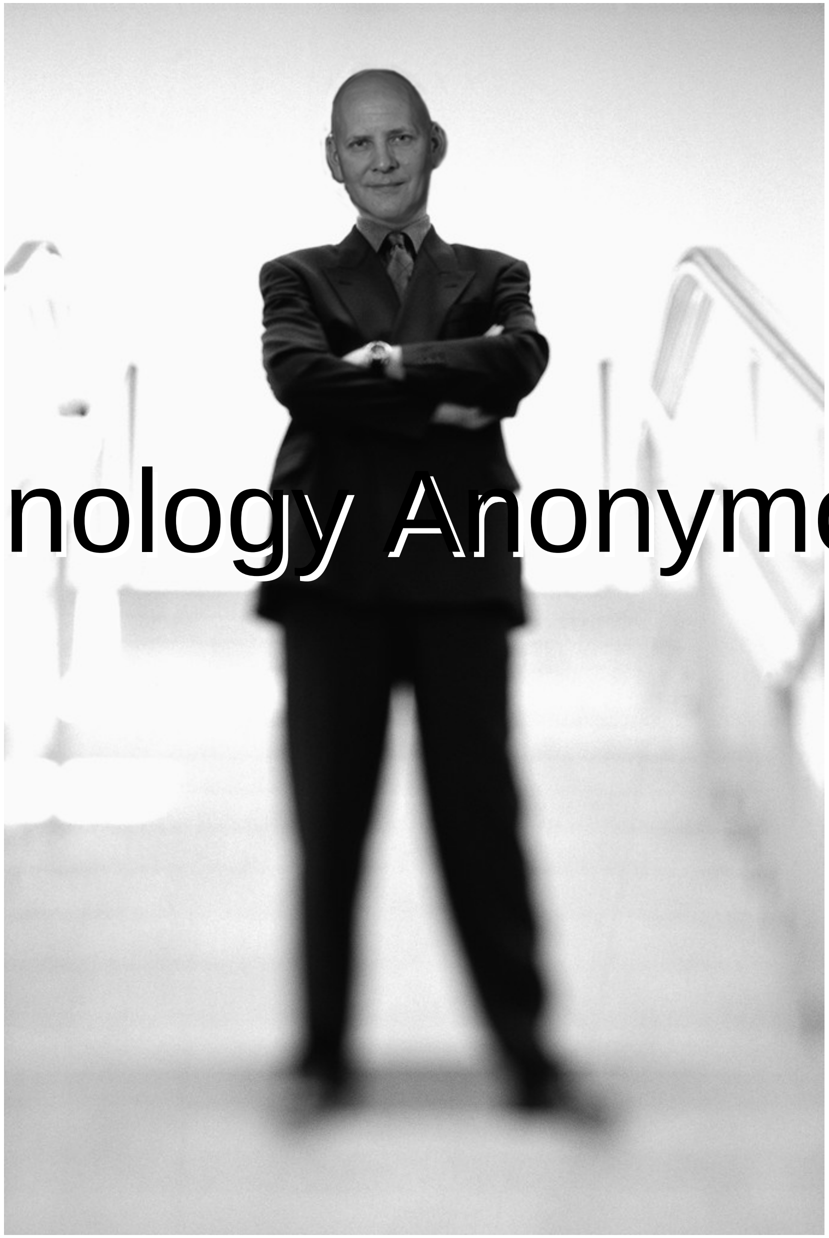
233

Technology Anonymous



How the SCCOs see themselves

How the Servicers view the SCCOs

How the Services see themselves

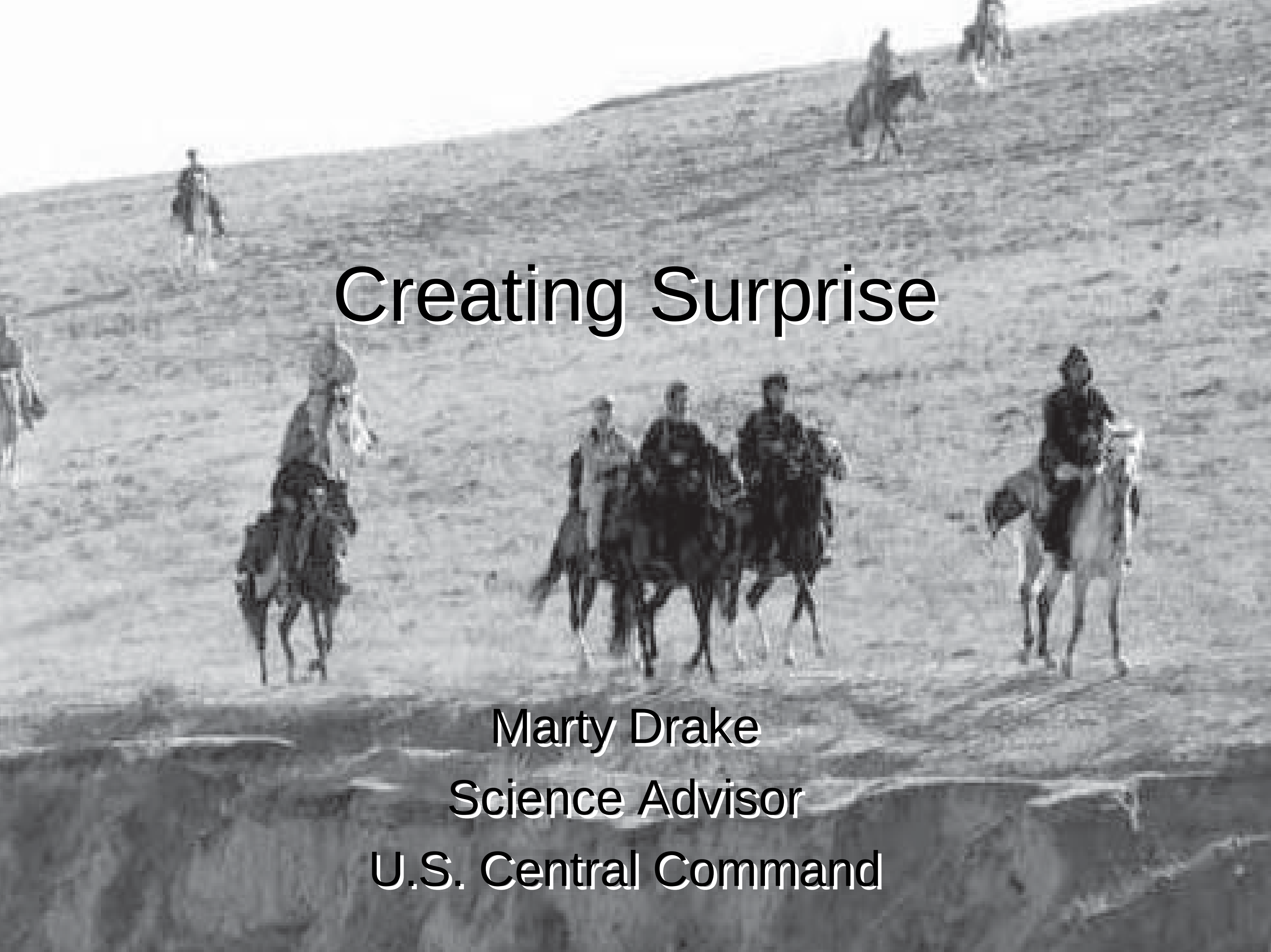
Who Is Right?

We Both Are

How the COCOMs see themselves

How the COCOMs view the Services

How the Services view the COCOMs



Creating Surprise

Marty Drake
Science Advisor
U.S. Central Command

Surprising Three Domains
(Overmatch vs. Capability Surprise)

The peer, or negligible overmatch

- Well studied – analyzed failure points
- Predictable behavior / operations
- Generally, easier to create surprise
- Surprise has the greatest impact

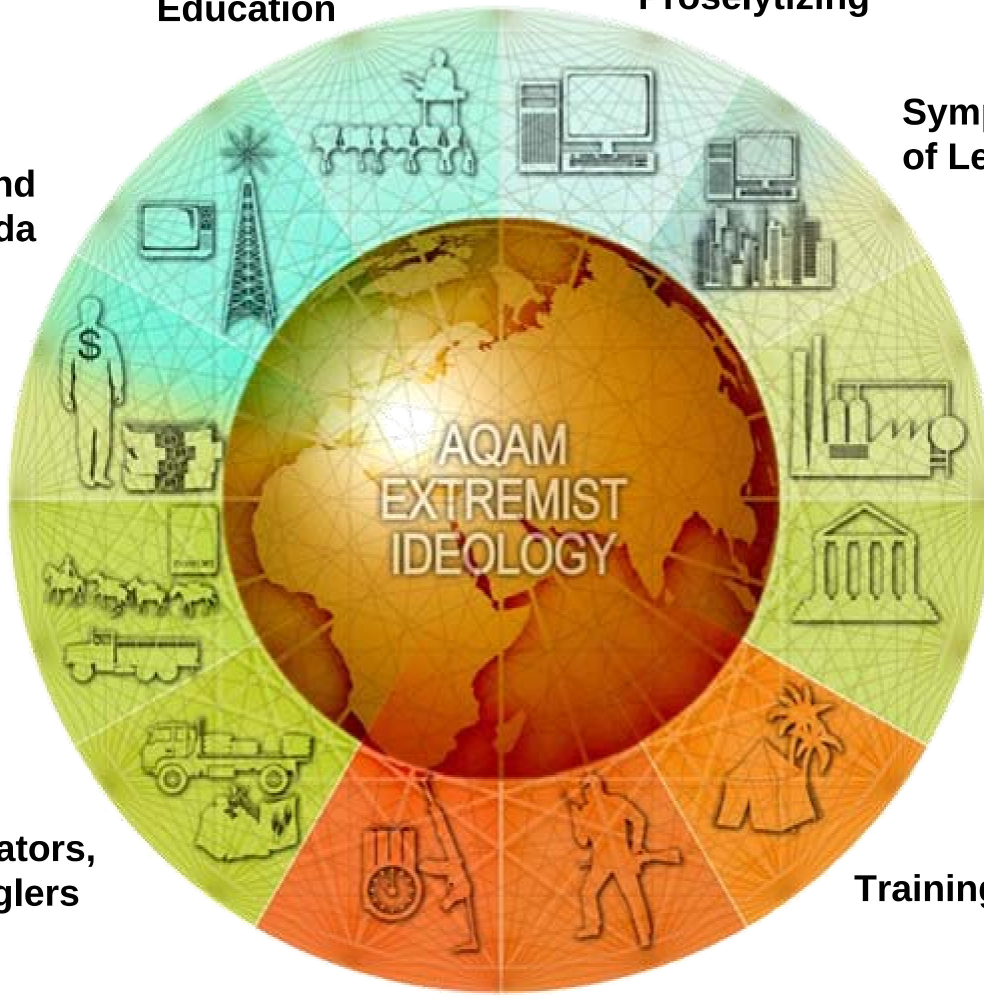
The 3rd world competitor

- More effected by overmatch than surprise
- Even open-source capability creates 'surprise'

Non-state sponsored asymmetric threats

- Hardest to effect through overmatch or surprise

AQAM: A Threat in All Realms



Warfi… T…

Ta…

THE FOG OF WAR

- Pla…

Two Sides of ‘Surprise’

(RED disrupting BLUE – BLUE countering RED)

- **RED**
  - G
  - Ea ... on
    co
  - St ... process
    ar
  - O ... e
    ac
  - If ... on, but if
    st ... pt to
    le ... system
  - G

A Disruptive Technology Creates ‘Surprise’ When Employed

Surprise doesn’t need to be an action we employ on an adversary.

It can also be removal of an impediment to our operations.

A sampling of Blue challenges

- Identifying the "combatant"
- Detecting explosive material or assembled explosive devices at tactically significant distances
- Creating C4ISR persistence in underdeveloped environments with less resources
- True sharing of information across the entire battlespace, independent of existing infrastructure
- Making sense of the data we obtain, and feeding timely & relevant information to the tactical edge
- Being first with the message … in the right context

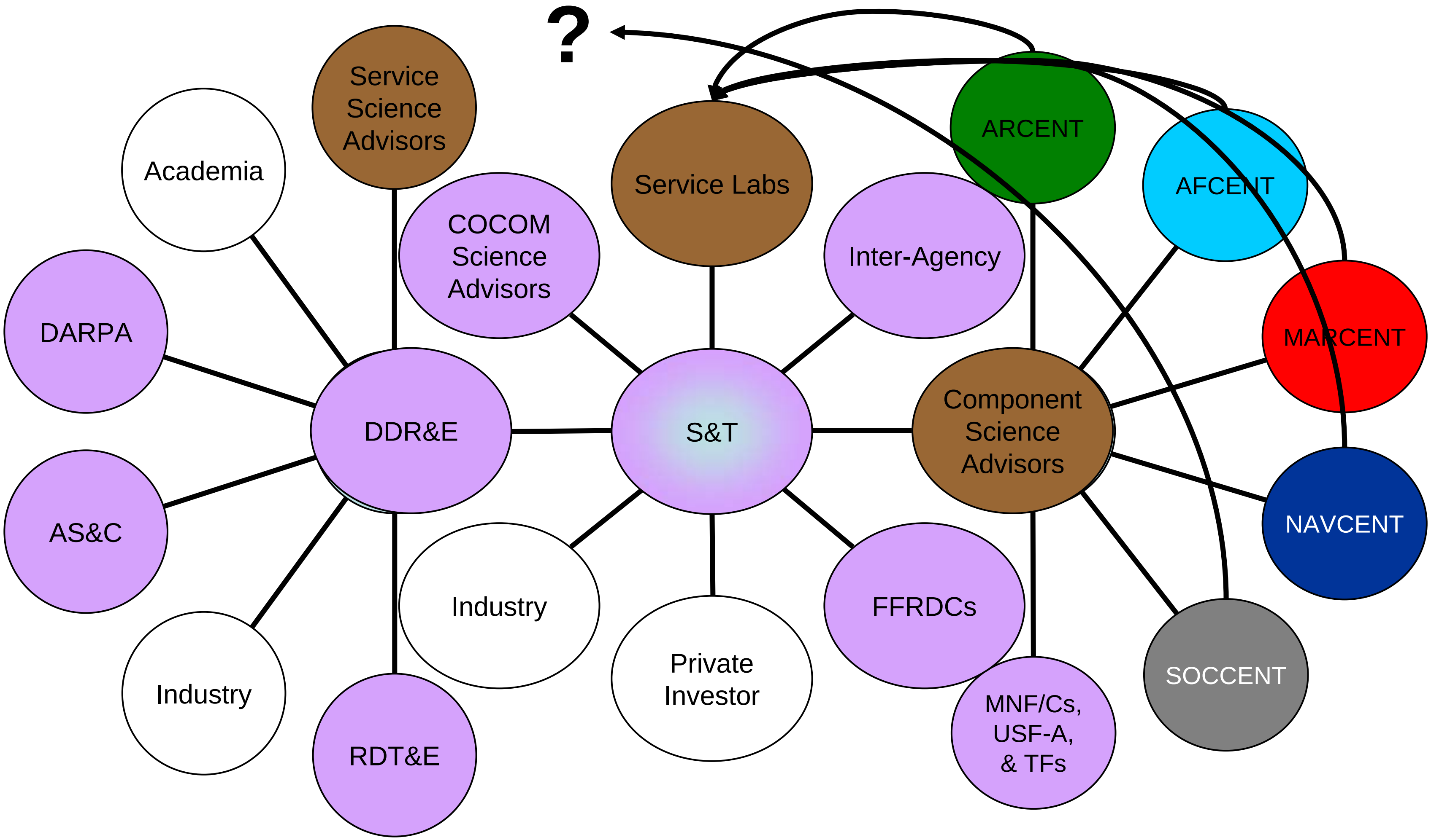
What if …

- Virtual presence could replace physical presence … with the same effect
- Bandwidth was made irrelevant
- Intent could be pre-determined
- Language was no longer a barrier to effective communication
- Warfighter equipment drew its power from the environment – day or night – making power storage devices optional
- Tagants in common-use items, when combined during an attempt to build an explosive device render the device inert
- Force fields existed
- Cloaking worked
- …

Where to go for information

- There's the traditional:
  - Integrated Priority List (IPL - COCOMs)
  - Warfighter Challenges (WFCs – JFCOM J9)
  - Purple Slides (Joint Staff (JS))
  - Joint Quarterly Readiness Review (JQRR – JS)
  - . . . To name just a few
- New effort sponsored by OSD to create a S&T IPL
  - DDR&E directed the COCOMs to review their IPLs and feed back their technical challenges
  - Not a comprehensive look at the full spectrum of challenges; but a good start

Customer – Supplier Interface



U.S. Central Command Focus

- We focus on the JOINT solution that has the potential to satisfy a JOINT validated need
- Separate from the many technology needs of our customer(s) those technology needs which:
  - *Do not have a readily available solution*
  - For high-impact needs there is *insufficient activity pursuing a solution*
- Seek out game-changing technologies which our customer(s) don't know they need

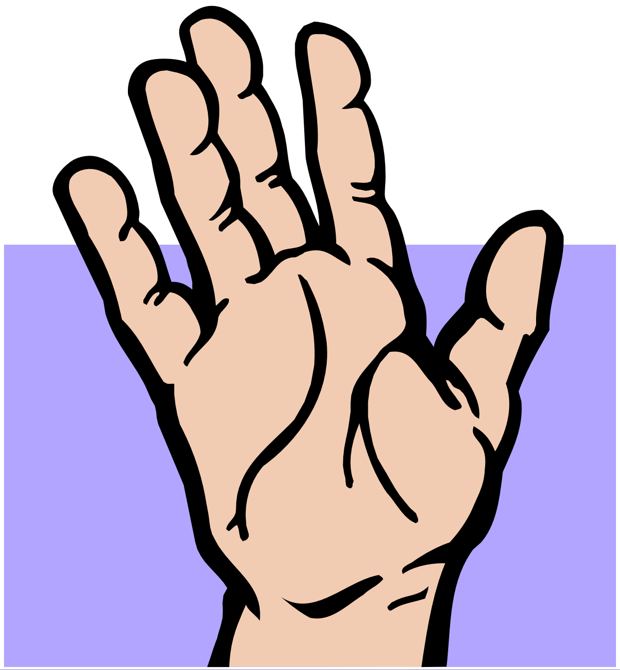
Some technology areas we "pursue":

- Detection of CBRNE at tactically significant distances; with emphasis on the "E"
- Pre-shot counter-sniper, counter-mortar, counter-RPG technologies; with emphasis on automated systems
- Technologies which enable the transfer of information more securely, more quickly, to a wider set of users, to include the warfighter when it makes sense, with less bandwidth and dedicated support resources, e.g.:
  - Multi-level Security over single architectures
  - Bandwidth compression / reduction techniques
  - Data reduction [data=>info=>knowledge=>understanding=>wisdom]
- Through automation, remote action, new and novel techniques, technologies which reduce risk and / or stress on the force and / or improve the efficiency and effectiveness of our action(s)
- Technologies which allow for greater persistence over the battlespace with fewer platforms; employing improved sensor technology providing greater fidelity of information

Common thematic areas of concern

(not in priority order)

- Detect / Defeat:
  - IED initiators / initiator systems
  - Buried / concealed IEDs
  - Production and assembly of IEDs
- HME production standoff detection
- Culvert access denial / alerting
- Persistence in surveillance
- Biometrics
  - Identity dominance
  - Force protection / access
- Non-lethal vehicle / vessel stop
- Reduce stress on the force:
  - Force Protection requirements
  - Increased automation
- Anti-swarm lethal / non-lethal
- More efficient / effective / timely training
- Predictive analysis techniques
- Voice to text technologies
- C4ISR systems:
  - Info sharing between system
  - Multi-level security
  - Cross domain solutions
  - Faster … Better sorting / retrieval
  - On the move w/ GIG access to tactical edge
    - SATCOM, WiFi, WiMax, etc.
- Tagging, Tracking, and Locating (TTL)
- Lightweight “x” with greater “y”
- More power per unit of weight
- Scalable effects – non-lethal to lethal
  - Directed Energy
  - Kinetics
- True SA for Blue … Fused Red
- Sustaining the force – reduced size, weight, amount, and retrograde
- Holding all targets at risk
- Any sensor … any shooter; the Soldier as a sensor; any adversary … any battlespace … anytime



Raise your Hand

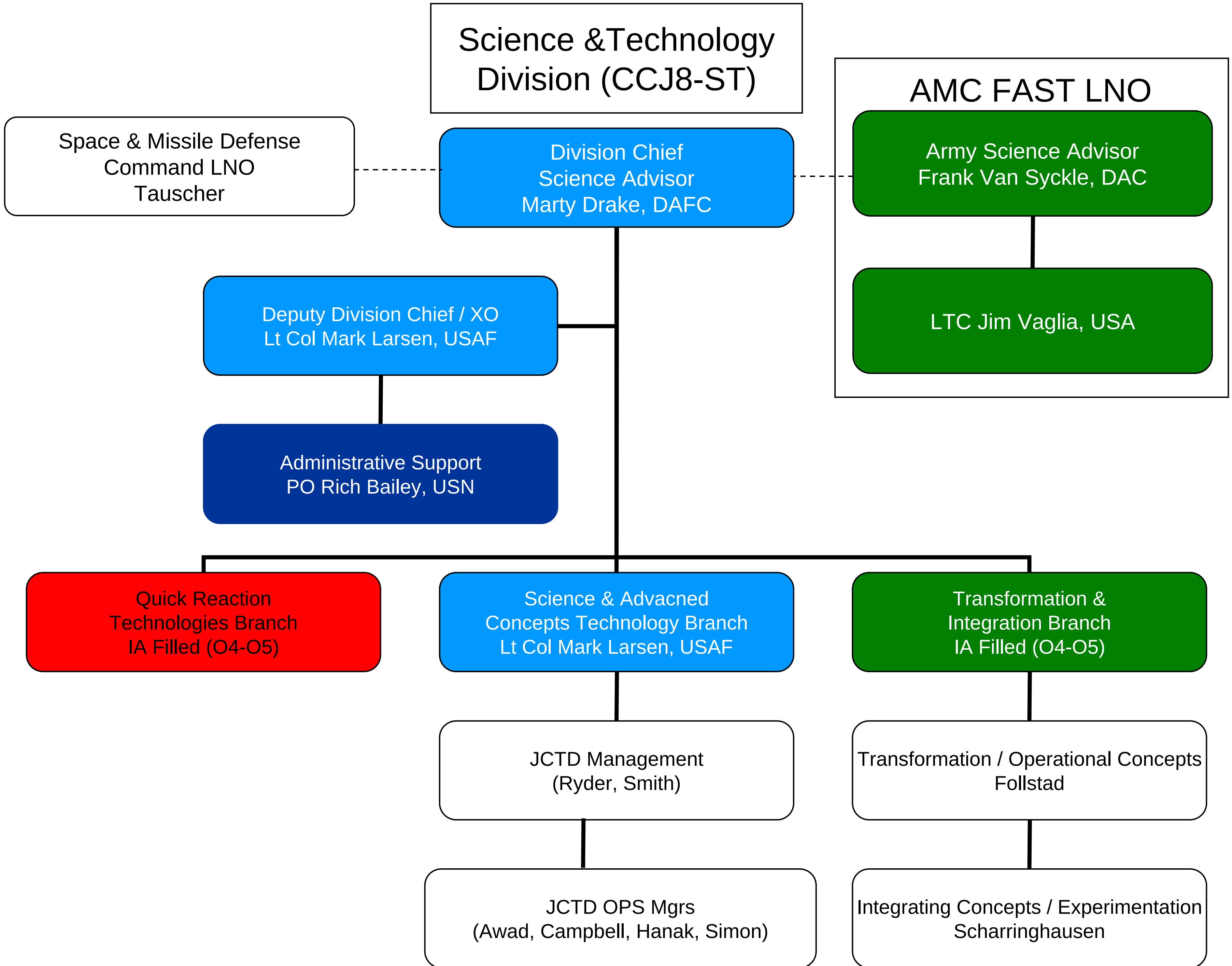

U.S. Central Command
7115 S Boundary Blvd
MacDill AFB, FL 22651-5101
[Your Name Here]
Honorary Deputy Science Advisor
Contact Info
Blah, Blah, Blah

Charter

Conduct ***discovery***, ***research***, ***analysis***, and ***sponsor development*** of new and emerging technologies which have the *potential to provide material solutions* to Headquarters and Component validated Joint needs.

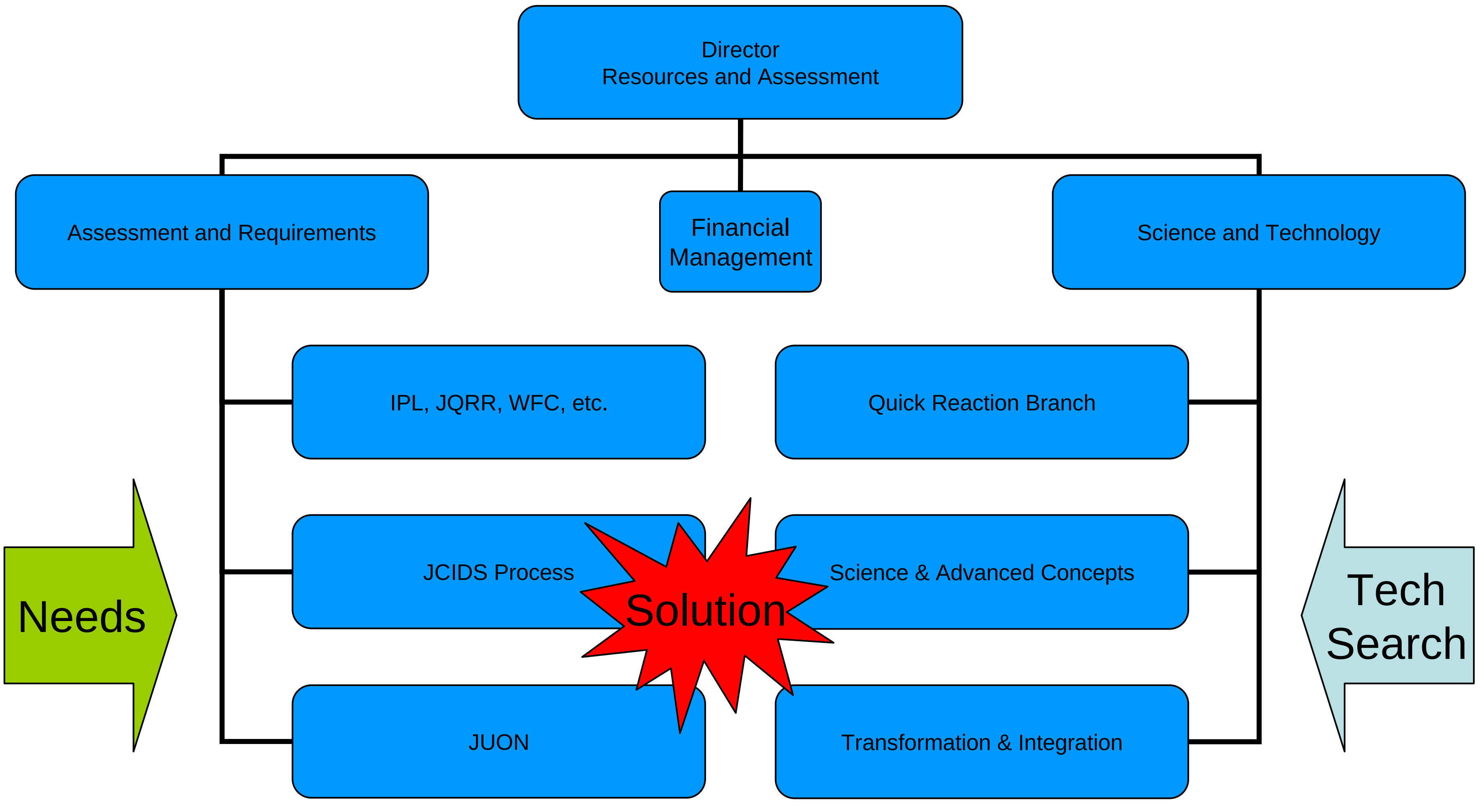
Review USCENTCOM and Component ***plans, operations***, programs, policies and activities for areas where technology will improve efficiency and effectiveness.

Integrate across USCENTCOM headquarters and Component staffs for transformational, integrating, and experimentation activities.


Science &Technology Division (CCJ8-ST)
AMC FAST LNO
Space & Missile Defense Command LNO Tauscher
Division Chief Science Advisor Marty Drake, DAFC
Army Science Advisor Frank Van Syckle, DAC
LTC Jim Vaglia, USA
Deputy Division Chief / XO Lt Col Mark Larsen, USAF
Administrative Support PO Rich Bailey, USN
Quick Reaction Technologies Branch IA Filled (O4-O5)
Science & Advacned Concepts Technology Branch Lt Col Mark Larsen, USAF
Transformation & Integration Branch IA Filled (O4-O5)
JCTD Management (Ryder, Smith)
Transformation / Operational Concepts Follstad
JCTD OPS Mgrs (Awad, Campbell, Hanak, Simon)
Integrating Concepts / Experimentation Scharringhausen

CCJ8 Directorate

[From the Technology Perspective]



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Army Power & Energy: S&T Focus

10th Annual Science & Energy Technology Conference

21 April 2009

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Dr. Edward Shaffer
Chief, Directed Energy & Power Generation Division
Sensors & Electron Devices Directorate
Army Research Laboratory

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Outline

- Army Power & Energy Trends
- TRADOC Warfighter Outcomes
- Power & Energy TFT Taxonomy
- Power Regimes: Definition
- Underlying Technologies
- Power Regimes
  - Soldier Power – attributes, technologies
  - Mobile Power – attributes, technologies
  - Platform Power – attributes, technologies
- Summary

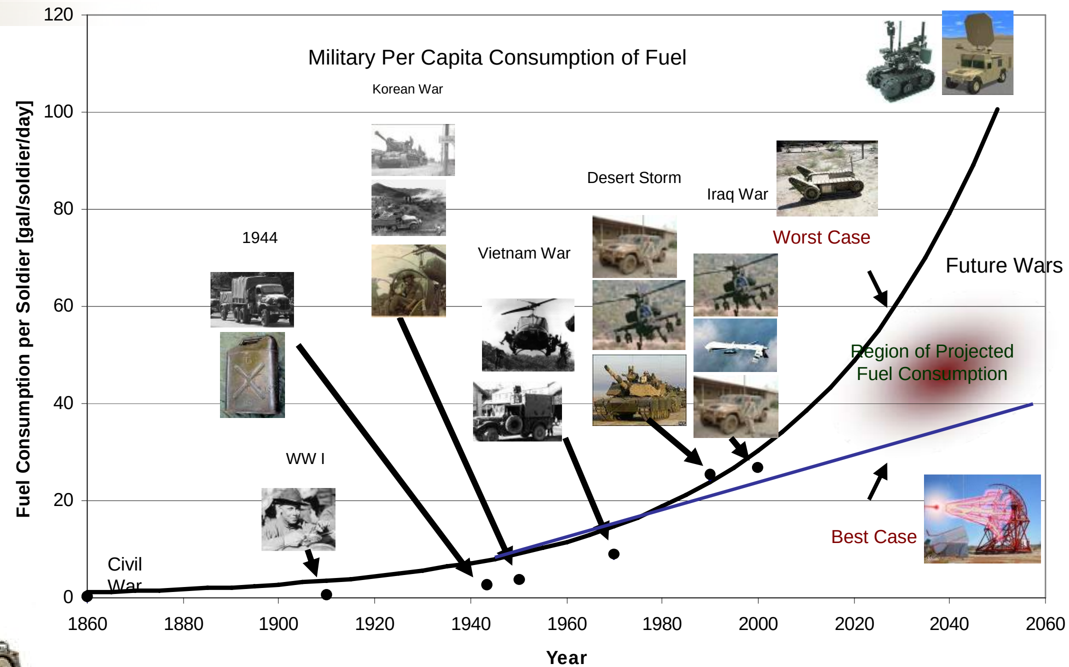
The Challenges

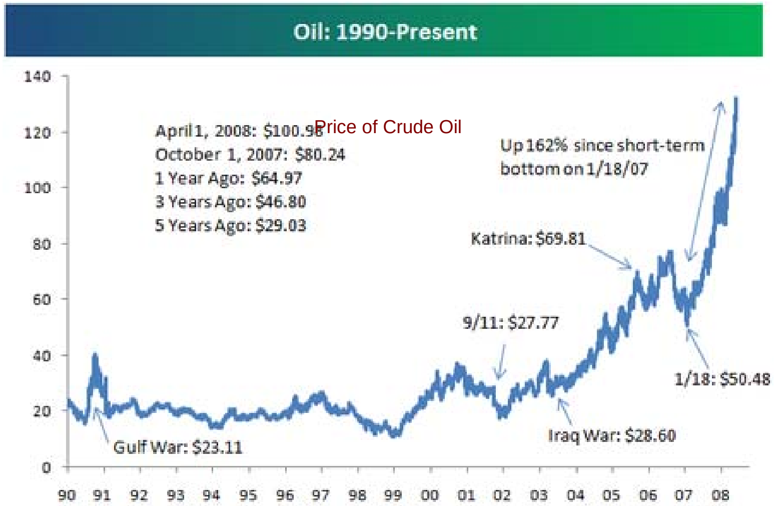
Battlefield consumption of energy increasing
- New C4ISR technologies
- IED Defeat Systems
- New weapons (EM guns, lasers)

Energy security problematic
- Cost of fuel skyrocketing
- Alternative sources sought – wind, solar, bio-mass, waste to energy

Operational issues
- Battery usage & limitations – energy & power density
- Demand for auxiliary power on-board vehicles
- Emphasis on silent ("quiet") watch
- Unmanned vehicles (air/ground)
- Unattended sensors
- Inefficient management/ distribution of power
- Demand for soldier-wearable power

Increased emphasis on system power metrics
(KPPs, low consumption components)





TRADOC - Alignment of Big 5 Integrated Warfighter Outcomes

S&T TOPIC AREA AND INTEGRATED WARFIGHTER OUTCOME STATEMENT		From FY09 Warfighter Outcome Workbook (Dec 07)		
		Force Operating Capability (FOC)	**Priority Within FOC**	**Warfighter Outcome Title**
Power & Energy * ** ***	Provide enhanced agility to operate worldwide by **reducing by half, the weight and volume of fuel** associated with powering the force. Combat platforms require **up to 30 MJ of pulsed power for lethality and 20 percent increase in continuous power** to enable superior tactical mobility, speed and **an excess capacity for on/off board electrical power use while increasing fuel economy by 40 percent.** Emerging electrical components and systems require **dismounted Soldiers to possess a fourfold increase of available power, above current 12.3 Watts/Hr, at half the tactical weight.**	Mounted/ Dismounted Maneuver	4	**Alternative Power for Dismounted Soldiers** ***
			5	**Alternative Power for Platforms** **
		Maneuver Sustainment	10	**Increased Fuel Efficiency** *

RDECOM

Power & Energy Technology Focus Team Current Scope

DEFINITION: Power & Energy includes systems/technologies that generate, store, distribute, condition electrical energy, or produce/distribute non-propulsion power.

Focus Areas

- Energy Storage
- Power Generation & Conversion
- Power components for DE Weapons
- Power Control & Distribution
- Thermal Management

Air Systems
Rotorcraft & UAS

Ground Systems
GCS &TWV, UGV, Water Gen

Soldier Systems
Dismounted, Portable P&E

Effects
DE P&E – Lethal. Non-Lethal

C4ISR
Sensor, Network, Distributed P&E

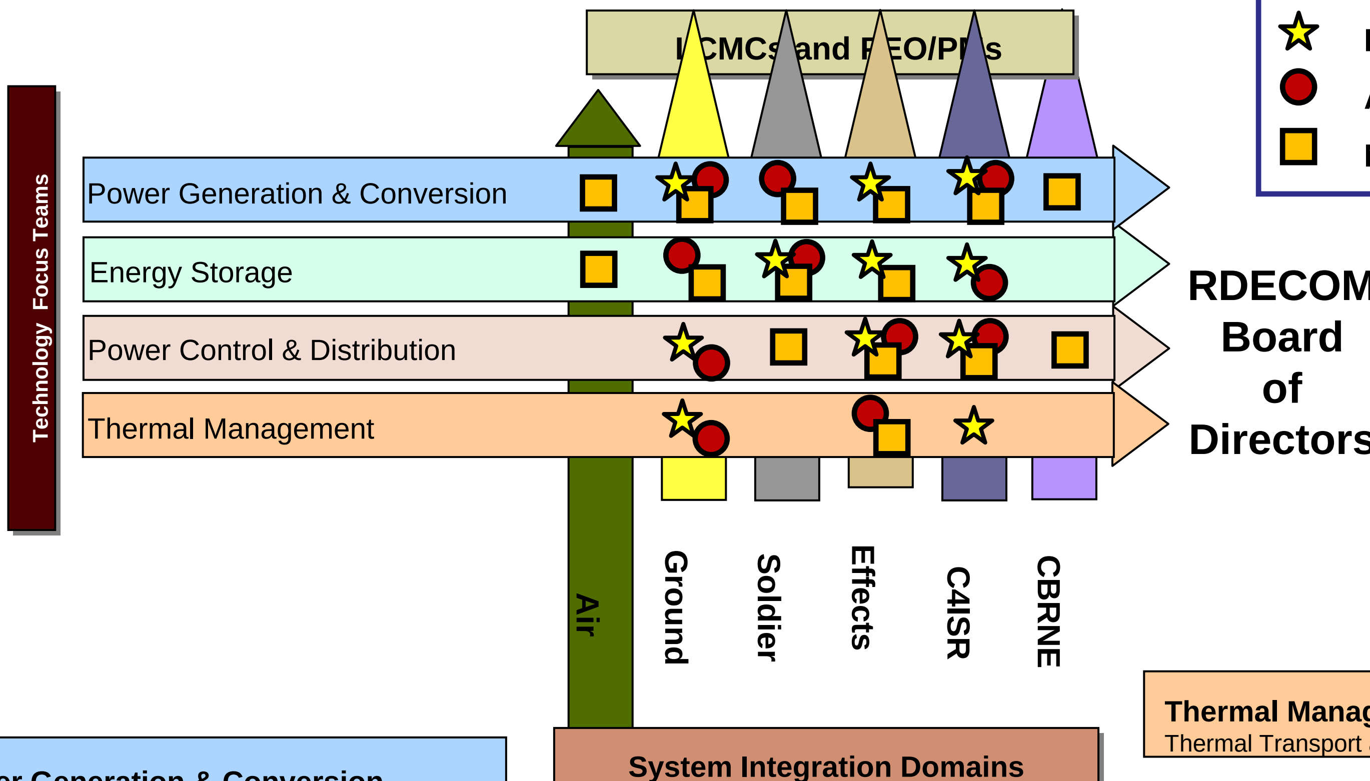
CBRNE
Environmental, Sensor P&E

Related Areas

- Explosives/ propellants for Munitions (Lethality TFT)
- Non-Electic Propulsion (Mobility & Logistcs TFT)
- Fixed & Grid-Based Power (COE)
- Directed Energy Weapons (HEL, RFDE, EMGun) (Lethality, Protection TFT)
- Bulk Class III Fuels (Mobility & Logistcs TFT)

Multiple Technologies, Multiple Applications

Power & Energy
Technology Integration Taxonomy



- ☆ Proposed ATOs
- ● Active ATOs
- ■ Non-ATO Programs

Synchronized and Aligned Command Technology Solutions

Thermal Management
Thermal Transport and Control

Power Generation & Conversion
Fuel Cells and Reforming
Generators (engines, Stirling, alternators)
In Situ Energy Conversion (PV, wind, Waste to Energy)
Power MEMS
Others (actuators, motors, non-propulsion, energy efficiency)

Energy Storage
Primary Batteries
Rechargeable Batteries
Thermal/Reserve Batteries
Capacitors (Pulse, Continuous, Ultracaps)
Packaged Fuels and Fuel Processing

Power Control & Distribution
Power Switches and Electronics (pulsed/continuous)
Power Converters & Inverters
Power Distribution
Intelligent Power Management
Magnetics/Other (Superconducting Storage, Magnetic Materials, Inductors)

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Underlying Technology Example
Power Generation: Fuel Cells

Soldier Power

On-soldier & Battery Charger Applications

- Competing approaches
- Direct Methanol & Reformed Methanol Fuel Cells
- Hybrid solutions

Reformed Methanol

25W Ultracell

IdaTech 250W

20W Smart Fuel Cells (SFC)

Direct Methanol

Giner DMFC for Battery Charger

Solid Oxide Fuel Cells

ADVANTAGES

- Sulfur/CO resistant
- Fuel flexibility
- Co-generation potential

DISADVANTAGES

- Ruggedness -- fragility
- Slow startup times
- High temperatures

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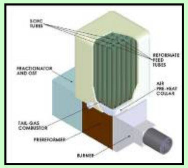
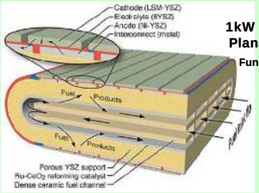


50W Microtubular Propane SOFC
NanoDynamics
(BAA, "On-the-Move" Demo, 2006)



1kW Logistic-fueled Planar Segmented
Functional Coating Technology

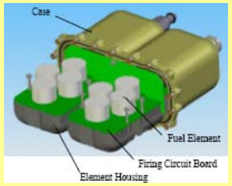
Alternative Fuel & Storage (H2)

Exploring novel alternative fuels & storage.

***Technology Areas of Interest*:**

- **Boranes**
- **Hydride storage**
- **Nanotubes**
- **Acid- Alkaline Membranes**

30 W Protonex Sodium Borohydride



Ensign Bickford
Ammonia Borane Fuel Cartridge (10g H2, 12hrs @ 11 W)

General Atomics
Ammonia Borane PEMFC

Logistic Fuel Reformation (JP8)

5kW Logistics Fuel Reformer
(Regenerable S removable & CPOx reformer)
GD / Aspen

Issues

- **JP8 complexity**
- **ATR/POX/SCW**
- **Infant technology**
- **Little commercial interest**

Supercritical Water Reformer JP8)
Radian, Inc
(w/U. Missouri)

Underlying Technology Example
Energy Storage: Batteries

Low ⟷ High

Investment Priority: High ⟷ Low

Commercial Market

Lead Acid Rechgble (SLI) O
Vehicle, critical backup

Lead Acid Rechgble (HEV) C
Vehicle, deep cycle applications, low cost electrical storage

Alkaline Primary S
Non-critical applications

Ni-MH Rechargeable S
Soldier power, HEV

Li-MnO_2 Primary S
Soldier power, sensors

Zinc-air Primary S
Soldier power, sensors

Li-FeS2 Primary S
Soldier power, sensors, long shelf life applications

Commercial Chemistry requiring Military Adaptation

Hi Power Li-Ion Rechargeable for HEV O,C
SLI, HEV, critical backup

High Energy Li-Ion Rechargeable S
Soldier power, persistent surveillance, sensors

Li-(CF)x Primary S
Soldier power, sensors

Ni-Zn Rechargeable O,C
SLI, HEV, critical backup

Military Unique Chemistries

Li-Air Primary S
Soldier power, persistent surveillance, sensors

Liquid Reserve
•Electric fuzes for artillery, mortar, missiles, submunitions

Thermal Reserve
Electric fuzes for artillery, missiles

Pulse Power Li-Ion Rechargeable P
Weapons, FCS, 600V battery pack

Li-SO2 Primary S
Soldier power, sensors

S: Soldier/portable; C: Veh Continuous; P: Pulse; O: OBVP/Export


RDECOM
Power & Energy Strategy
SOLDIER
Requirement:
72 Hour Missions
Technologies: High Energy
Batteries, Hybrid Power
Sources, Photovltaics
Requirement:
Silent Power
MOBILE
Technologies: Fuel Cell APUs,
Reforming, Power MEMS
Requirement: Platform Surge
Power , Weapon Pulse Power
Technologies: High Power
Switching & Conditioning;
Intelligent Power Management,
Integrated Thermal Management
PLATFORM &
WEAPONS
DOMAINS:
Soldier, C4ISR
C4ISR, Air, Ground
Ground, Effects
MicroWatts to 10s of Watts
100s of Watts to 100s of kW
Up to 1000s of MW

Soldier Power Regime: Attributes & Technologies (Soldier, C4ISR, Effects, CBRNE SIDs)






Near Term (2011)

Attributes

- Fuel Cells: 30 W/kg, 1000 Whr/kg
- Packaged fuels
- Primary Li: 200 Wh/kg, 40 W/kg, -30o to 70oC
- Metal/air: 300 Wh/kg, 10 W/kg, 10o to 70oC
- Rechargeable Li-ion: 150 Wh/kg, recharge in hours

Technologies

- DMFC, RMFC
- Primary Li/MnO2
- Zn/air primaries
- Li-ion cells with carbon anodes

Mid Term (2017)

Attributes

- Fuel Cells: 80 W/kg 40% efficient, packaged/processed fuels
- 100 W/cc (1kW/kg) engine, 30% efficient
- Primary Li: 400Wh/kg, 20 W/kg, -10o to 70oC
- Metal/air: 300 Wh/kg, 10 W/kg, 10o to 70oC
- Rechargeable Li-ion: 120Wh/kg, recharge in minutes

Technologies

- DMFC, RMFC, fuel reforming
- Fuel atomization
- Primary Li/(CF)x, Li/air primaries
- Li-ion cells w/ rapid-recharge anodes

Far Term (2027)

Attributes

- Fuel Cells: 120 W/kg 50% efficient
- Multiple fuels
- Micro Power generation
- Primary Li: 500 Wh/kg, 40 W/kg, -30o to 70oC
- Metal/air: >700 Wh/kg, 20 W/kg, -10o to 70oC
- Rechargeable Li-ion: 200Wh/kg, recharge in minutes

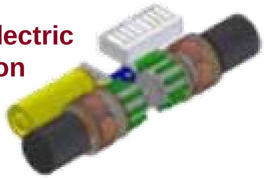
Technologies

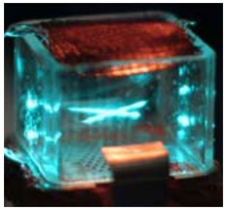
- DMFC, RMFC, Alkaline FC
- Micro fuel cells, PZT MEMS, Direct conversion, MEMS fuel control
- Multi-fuel FCs and engine systems
- Primary Li with doped fluorocarbons
- Li/air primaries, Li-ion cells with rapid recharge

Soldier Power Regime: Micro Power

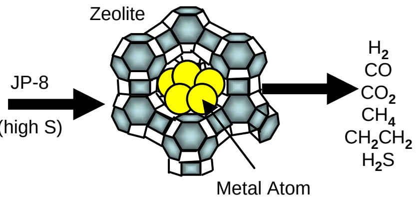
Fuel Atomization

Thermal-to-Electric Conversion

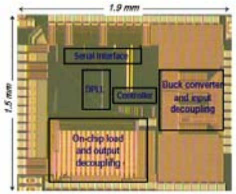




Efficient Combustion



Catalyst Materials



Power Management

Payoff: *Near term*

- Efficient MEMS-based burners for integration with Stirling engine squad battery charger (150-250W)
- Miniature power converters for efficient hybrid system

Payoff: Far term:

- Long-lifetime catalytic micro-combustors with integrated thermoelectric generators
- Advanced power management of autonomous systems

Objectives:

- Provide Warfighter with small, light weight power sources maximizing specific energy for Soldiers, Soldier systems & sensors.

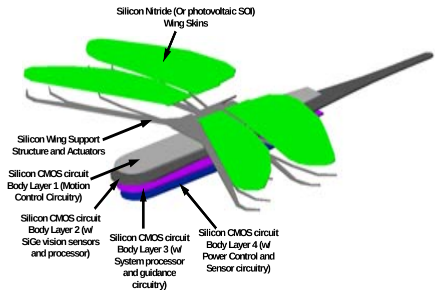
Accomplishments:

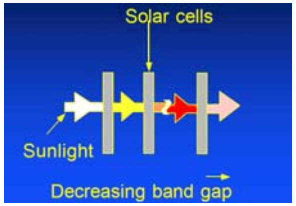
- Demonstrated low power, microfabricated fuel atomizers from 1 - 200 mL/hr (<500 W_{elec} range)
- Integrated atomizer / catalytic micro-combustor operating at 270 MW/m^3

Technical Approach:

- *Leverage MEMS expertise to develop efficient power generation & management components*
  - ***Micro-fuel / air control** – efficient fuel atomization and mixing is required for miniature combustors*
  - ***Catalytic combustion** – heavy fuels (i.e. JP-8) require new sulfur tolerant catalyst materials for long life*
  - ***Power management** – intelligent power conversion & management of hybrid systems improves efficiency*

Soldier Power Regime: PhotoVoltaics





Payoff: Near Term

- Less costly, more efficient Solar panels to the field
- Lower Weight and Volume
- Under one sun illumination, power densities ~ 200W/m2

Payoff: Far Term

- Under one sun, illumination up to 400W/m^2
- Creating "Smart Skins" for Army systems consisting of monolithically integrated thin photovoltaics with power conditioning circuits and thin film batteries
- Potential efficiencies >30%

Objectives:

- High efficiency PV and TPV, crystalline and flexible, for remote power, expeditionary forces, Soldier aux power, un-attended/ autonomous sensors & systems
- Novel micro PV structures integrated with batteries and interconnect schemes for micro devices

Accomplishments:

- Fabricated (5 x 5) 1mm^2 solar cell arrays, yielding 4 volts at 5 ma/cm^2 current
- Initial un-optimized efficiencies of 14%.

Technical Approach:

- Develop substrate removed muli-color tandem photovoltaic arrays with novel interconnects to develop high voltages or currents

One Color Inverted GaAs PV that is 20% efficient on a flexible Substrate Offers 5-times higher power than existing Army PV power systems

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

RDECOM

DoD Wearable Power Prize (WPP) Competition

Grand Challenge Goals:

- Wearable Power System that provides 20 watts of average power with 200 watt peaks for 96 hours weighing 4kg or less (480wh/kg)
  - Inspire students, academia, private inventors, and industry to leverage resources and compete using innovative ideas and approaches
  - Reach non-traditional DoD performers by lowering barriers for participation

Capstone Event 22 Sep – 4 Oct 2008

Marine Corps Air Ground Combat Center (Twentynine Palms, CA)

DoD Prize Execution Team

DDR&E DUSD(LABS) –Sponsor

Army (ARL Lead), Navy, and Air Force

Competition Funding ($5.7 M)

$1,750,000	Prize Purse
$2,550,000	Prize Execution
$1,415,000	Service Cost Share

Wearable Power Prize Results

•Competition metrics were met by 5 Teams:

• 1st Dupont/Smart Fuel Cell, $1M Prize

•2nd AMI, $500K Prize

•3rd Jenny 600S, $250K Prize

•4th Ultralife 5th Ultracell

•7 Teams demonstrated energy densities > 480 Watt-hour/kg

•169 Teams entered, 108 Teams submitted Fuel Plans, 55 Team submitted System Descriptions and 20 Teams competed at Twenty Nine Palms

DuPont/SFC

AMI

Jenny 600S

DoD Wearable Power Prize Competition Outcomes and Way Ahead

- Uniquely demonstrated highest energy density wearable power systems using realistic Warfighter multi-day load profiles
  - Goal: 480 Whr/kg at < 4 kg   Demo: up to 790 Whr/kg at 2.4 kg

- Significant industrial investment - multiple teams spending $1M plus
  - New technologies revealed including materials, devices and system concepts
  - Material approaches from non traditional players (Russia)
  - Wide variety of proposed fuels

- Value to OSD, Services, and Army
  - New interest in S&T challenge prizes and P&E technology
  - Collaboration, joint-service engagement and assessment by the DoD P&E community
  - Raised awareness at Service and National leadership levels
  - Outreach component - exposure to DoD Science and Engineering

- Value to Competitors
  - DoD funded, independent laboratory grade test and evaluation in field-like environment
  - Access to DoD Professionals (Civilians and Warfighters) –
    - Direct feedback and real-time technical assessment from key service SMEs in P&E
  - Exposure to other teams – collaboration and networking opportunities
  - National and international publicity

- Initial Follow-on Actions:
  - Review S&T portfolios for adequacy, opportunities in underlying technologies
  - Assess DoD, Army interest in packaged fuels, qualification
  - Outreach to non-traditional players, new approaches

Mobile Power Regime: Attributes and Technologies (C4ISR, Ground, Air SIDs)

Near Term

Attributes
- High power density (50W/L), quiet power generation (<50 dBA @ 7m)
- Packaged / processed fuels
- Fuel Cells, 40 W/kg 35% efficient
- Hybrid energy storage

Technologies
- Modified COTS engine generators
- Solid oxide fuel cells
- ATR, CPOX, Steam Reforming, Plasma
- Hybridized primary/ rechargeable batteries

Mid Term

Attributes
- Silent power generation (silent @ 10m)
- 100 W/cc (1kW/kg) Power Density, 30% efficient
- Fuel Cells 80 W/kg 40% efficient
- Rapid charge/discharge

Technologies
- Novel, very high power density engine generators
- Compact small engine/generators
- Reformer based fuel cells (SOFC) generators, ATR, CPOX, Steam Reforming, Plasma
- Rapid recharge Li-ion anodes for hybrid sources

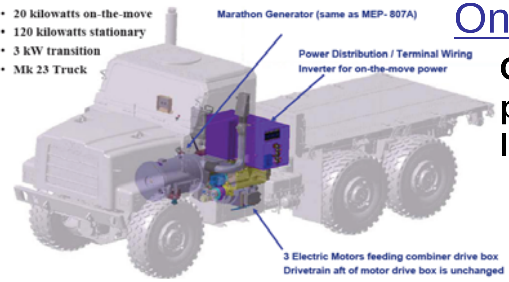
Far Term

Attributes
- Silent power generation (silent @ 50m)
- Fuel Cells 120 W/kg 50% efficient
- Advanced air cooling

Technologies
- Multi-fuel fuel cells (SOFC, PEM) and engine systems
- Compact high power generators/alternators
- Advanced magnetics for generators/ alternators
- Micro air coolers with laminar flow

Mobile Power Regime: OBVP/Under-Armor APU

On Board Vehicle Power



OBVP: additional platform power - increased mission loads (eg idle, low speeds)

Auxiliary Power Units

APUs: Power for sustained engine-off missions

Pay Off: Near Term

- **Abrams UAAPU: extended engine-off mission capability**
  - **Reduce fuel consumption by 4,300 gallons* per day per brigade**
  - **Save over $86,000 per day ($20/gallon JP-8) or 18 miles range.**
- **High power alternator upgrade kits**
  - **Increased power at idle and low speeds**
- **OBVP Demonstrators**
  - **USMC / ONR - 120kW MTVR (MAY 2008)**
  - **PM Stryker / TARDEC – 70 kW CMPS Stryker (AUG 2008)**

Pay Off: Far Term

- **Family of common APUs for ground vehicle fleet**
- **JP-8 fuel cell generation system - silent power demo**

M1A2 System Spec defined battlefield day (12 hours engine-off)

Objectives:

- **Enhance OBVP for operational platforms**
- **OBVP for fleets - reduce idling and fuel consumption**
- **Under-Armor APUs: engine-off, silent watch**

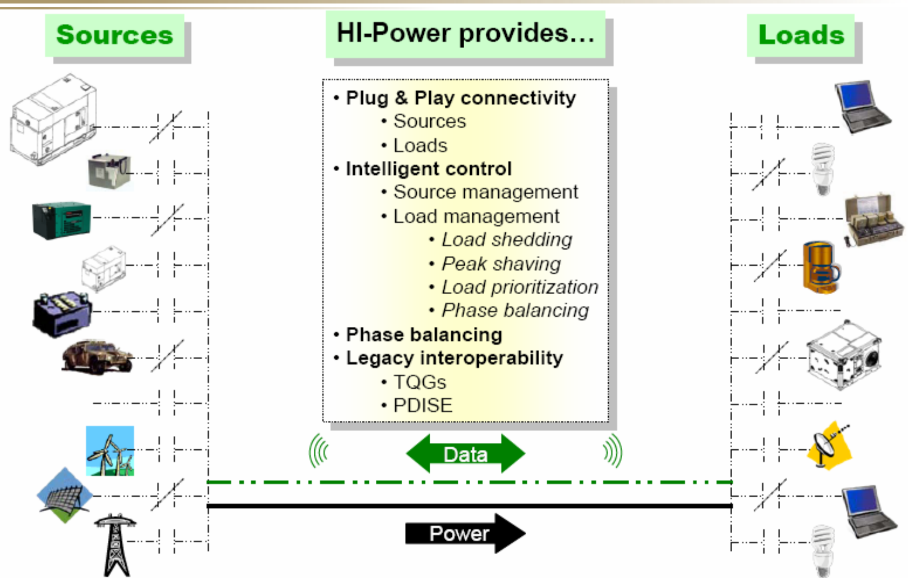
***Accomplishments*:**

- **Fielded OBVP alternator upgrade kits (HMMWV/RG-31)**
- **Gen III rotary APU for Abrams - May 2009 (on-vehicle demonstration and user assessment)**
- **Advanced power generation system for MRAP block upgrade for FUE 4th QTR FY09**
- **Phase I demonstration of idle reduction APU for HTV**

Technical Approach:

- Small engine/ generator development
- CPOX fuel reforming, sulfur removal
- Fuel and combustion control
- Advanced magnetics, structural materials
- Idle reduction techniques
- Intelligent power management

Mobile Power: HI-Power (Hybrid Intelligent Power)



Pay Off: Near Term

- Potential "spin-off" of controls and electronics
- Potential integration into Net-Zero Plus JCTD
- Standard protocols for power distribution systems

Pay Off: Far Term:

- Reduce fuel consumption by up to 40%.
- Increased Force Protection via reduced fuel convoys
- Reduce generator maintenance
- Improved tactical grid reliability
- Energy sharing between soldier, generators, vehicles, forward operation bases

Objectives:

- Seamlessly integrate generators into electric grid
- Reduce fuel consumption by up to 40%.

Accomplishments:

- Leveraged previous RDECOM/CERL SBIRs
- Three technology development contracts (FY08) (deliverables FY09)
- Issued revised BAA for FY09
- Established test bed and support equipment

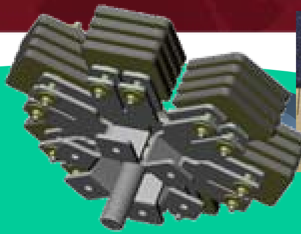
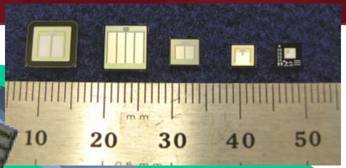
Technical Approach:

- CERDEC Technical Lead; PM-Mobile Electric Power POR; Joint IPT Established
- Integrate competing component technologies
- establish protocols and standards; performance specifications
- Bridge architecture gaps
- competitive down select (FY10-13); final development, qualification; fielding after FY14

Platform & Weapons Power Regime (Ground, Effects SIDs)





Near Term

Attributes
- Power Electronics w/ 80o C coolant, 1200 V continuous
- Room temp, 10 kV pulsed
- Power Density: DC/DC: 5 kW/l; AC/DC: 40 kW/l
- Rechargeable Li-ion: 150 Wh/kg, recharge in hours
- 80oC Water/Ethylene Glycol, 200 oC air cooling

Technologies
- Silicon, SiC switches
- Nanocrystalline magnetics
- Li-ion cells w/ carbon anodes
- Capacitors w/ metallized polypropylene film, 125o C

Mid Term

Attributes
- Power Electronics w/ 100o C coolant, 1200 V continuous
- 80o C, 10 kV pulsed
- Power Density: DC/DC:8 kW/l; AC/DC: 50 kW/l
- Rechargeable Li-ion: 120Wh/kg, recharge in minutes
- Capacitors: msec discharge, 10J/cc, T<100o C
- 110oC Water/Ethylene Glycol; 250 oC Air cooling

Technologies
- SiC high current devices pulsed and continuous
- Nano-particle magnetics
- Li-ion cells with rapid-recharge anodes, high temp capacitor films
- Micro Channel designs

Far Term

Attributes
- 150 oC coolant, 1200 V continuous
- 120 oC, 10 kV pulsed
- Power Density: DC/DC:10 kW/l; AC/DC: 60 kW/l
- Rechargeable Li-ion: 200Wh/kg, recharge in minutes
- 150oC Oil cooling 300 oC Air Cooling

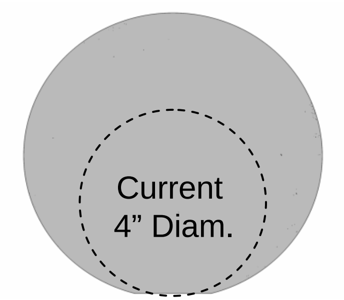
Technologies
- Next gen devices (GaN, diamond)
- Bulk nano-lattice magnetics
- Bulk ceramic capacitors
- Bi-directional solid state/MEMS breakers
- Li-ion cells with rapid recharge, high voltage anodes and cathodes
- Double sided micro channels, MEM based spray cooling, micro air coolers

Platform & Weapons Power: Power Switches

EM Gun

HPM/DE Systems

Mobility Systems



6” Diam. SiC Wafers

SiC Ultra-High Power Large-Area Switches

Payoff: Near term

High temp. compact converters that will enable reliable operation at 80-90 C within weight/size and cost constraints

Payoff: Far-term

- **Advanced platform capability with reliable operation at 100-120 C**
- **Advanced capabilities at reduced power and cooling system size and cost**
- **Limp home capability**

Objective:

Provide high-temperature high-power SiC devices for high-power density high-efficiency power converters for platform mobility, survivability, and lethality systems.

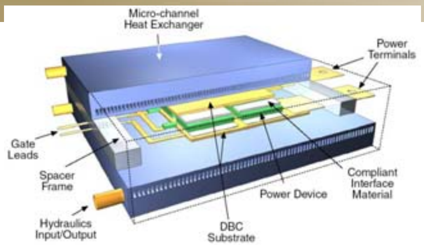
Accomplishments:

- **Demonstrated SiC 10 A switches in 10/20 kW TRL-4 inverter at 110-150C.**
- **Demonstrated SiC 20 A switches in 60/80 kW inverter at 80 – 120 C, TRL-4.**
- **Operated paired SiC MOSFETs and diodes up to 80 A rms (200 A peak) for 20 hours at 150-190 C junction temp.**

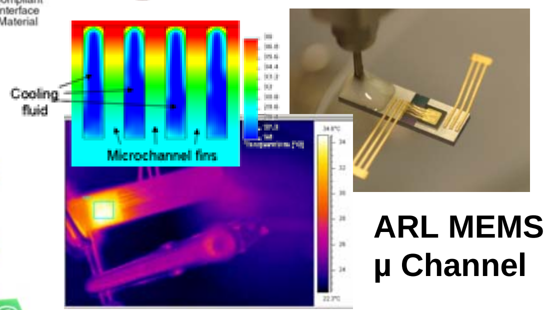
Technical Approach:

- **Develop larger diameter material (current 4”, future 6”)**
  - **Ultra large area SiC devices**
- **Decrease defects in starting material & in processed MOS gating structures**
- **Develop ultra-large area device designs & processes**
- **Enhance identification of process- and stress-induced defects in SiC devices**
  - **Focus: MOS gating, device termination structures**
- **Screening, burn-in, and high-temperature accelerated reliability determination methods.**
- **Investigate next generation semiconductor materials (GaN)**

Platform Power: Component Thermal Management



ARL Wide Gap Off-set Channel



ARL MEMS µ Channel

Advanced Modules

Thermal Management

Payoff: Near term

- •2-5X module volume reduction
- •2X thermal resistivity improvement
- •2X system power density improvement
- •System operation above 100 °C

Payoff: Far term:

- •5-10X module volume reduction
- •6-7X thermal resistivity improvement
- •2X system power density improvement
- •System operation above 115 °C

Objective:

Increased power efficiency to reduce power train cooling burden.

Accomplishments:

- •2X Battery-To-Bus efficiency increase
- •7X MEMS thermal management improvement

Technical Approach:

•Develop high heat rejection and low flow resistance designs.

•Materials with high electrical resistance and low thermal resistance that can replace current package materials.

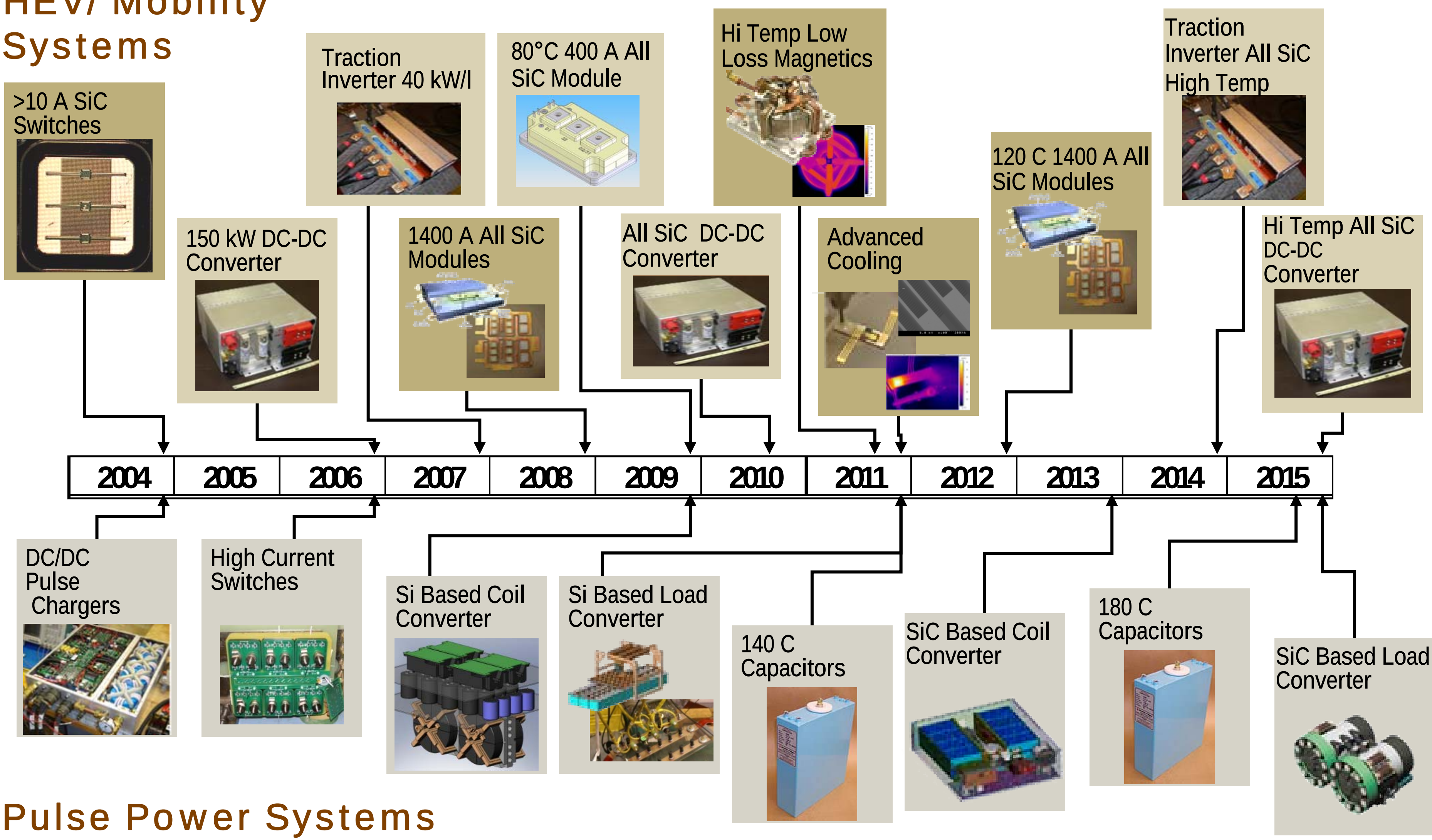
•Improved die attach materials for increased reliability and reduced thermal impedance.

•Advanced computer models for phase change cooling methods.

•Improved di-electric isolation compounds for high temperature operation.

Platform Power: Power Electronic Components HEV and Pulse Power

HEV/ Mobility Systems



Pulse Power Systems

Summary

Power and Energy Portfolio

- Enterprise approach to technology planning
- Analysis of in-place investments
- Accentuate commonality for underpinning science and technology (eg. materials and devices)
- Accommodate differences for application
- Tackling difficult challenges for both low power & high power technologies
- Seeking best technological solutions for the Army in part with the greater community

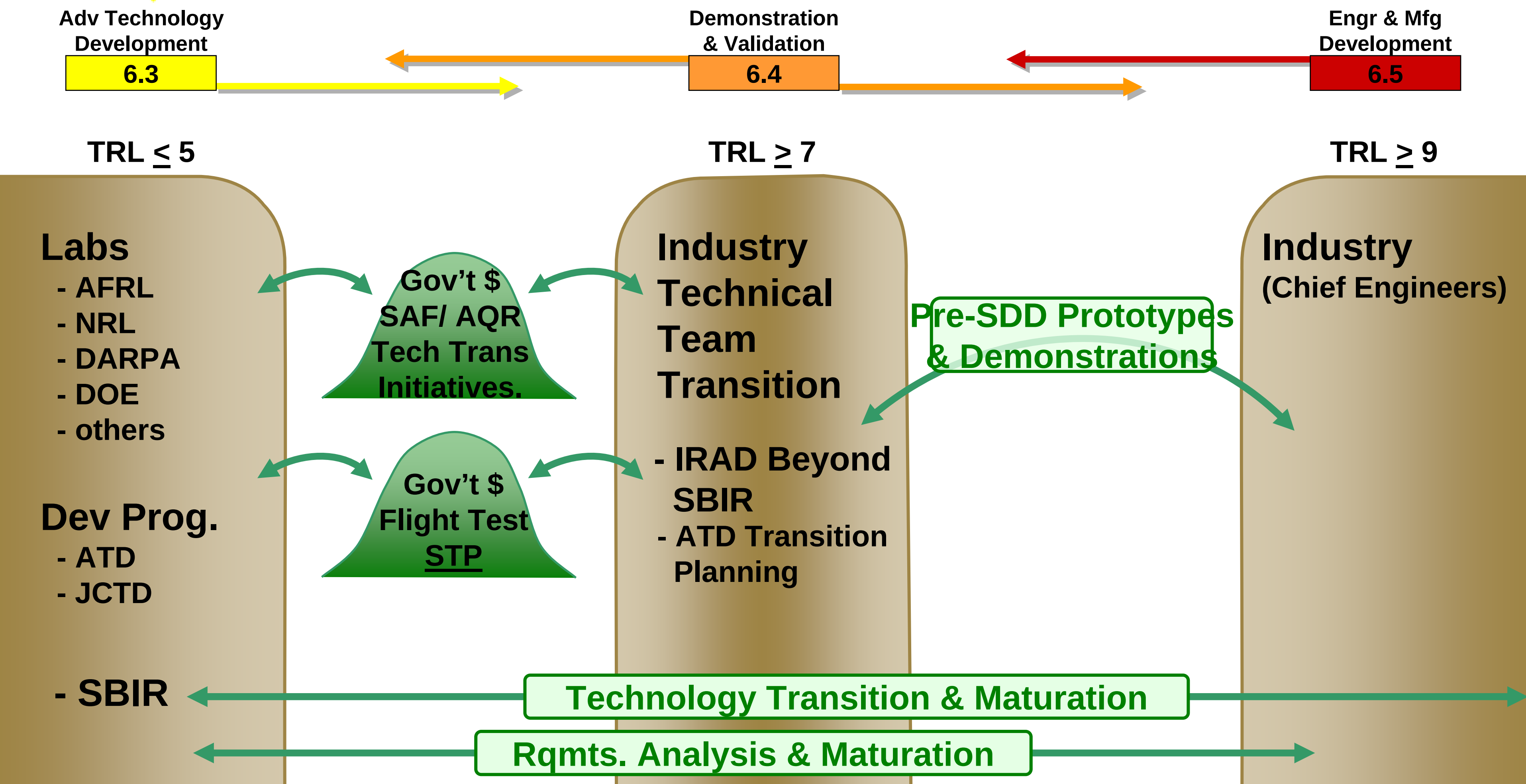
Backup

Technology Transition Efforts to support National Security Space (NSS) Capability

NDIA 10th Annual DoD Tech Expo and Conference

Roberta M. Ewart
Chief Scientist
22 April 2009

Integrated Technology Transition



Build Better Transition Capabilities & Processes to Mitigate Technology Transition "Valley of Death"

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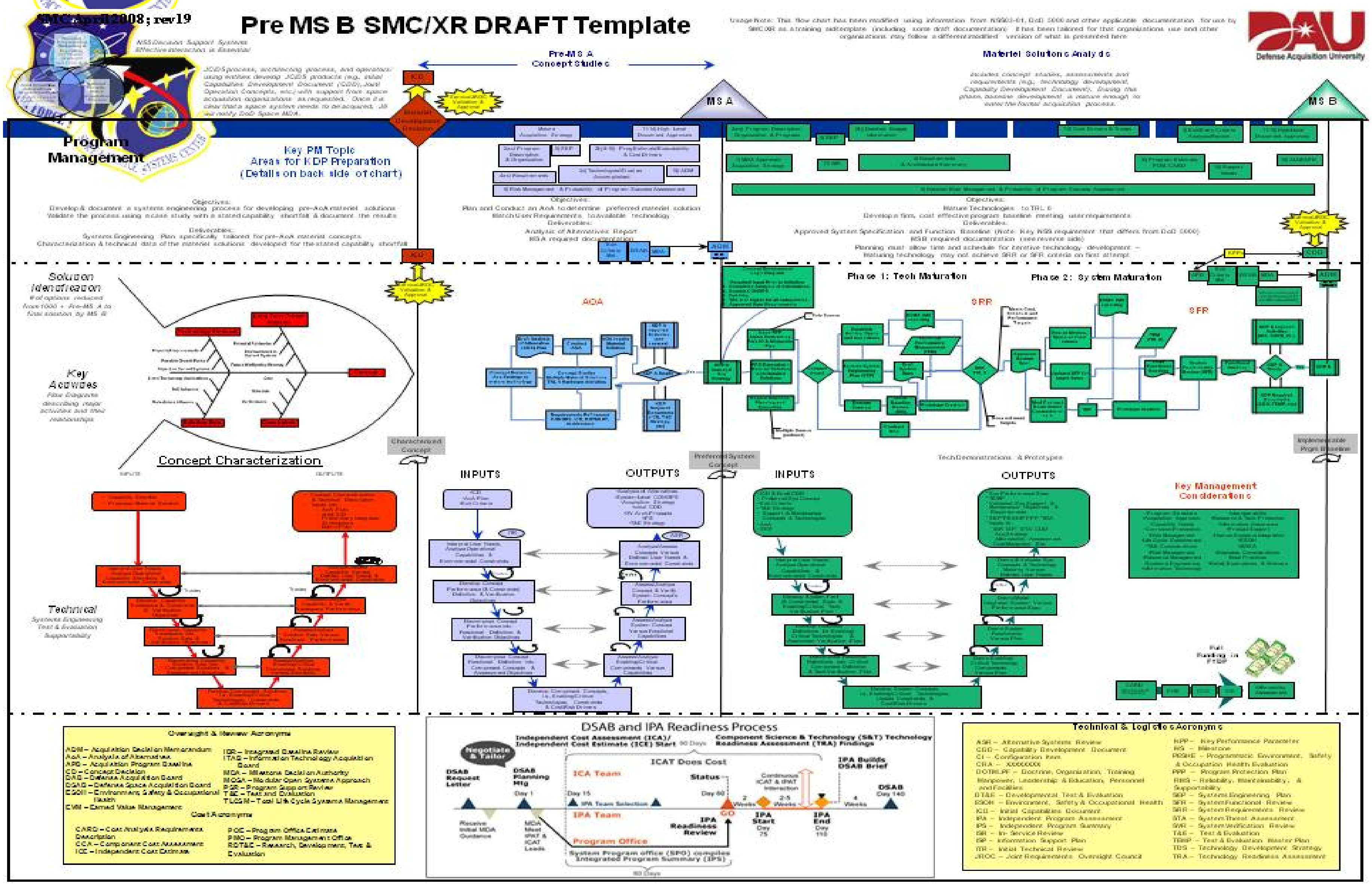
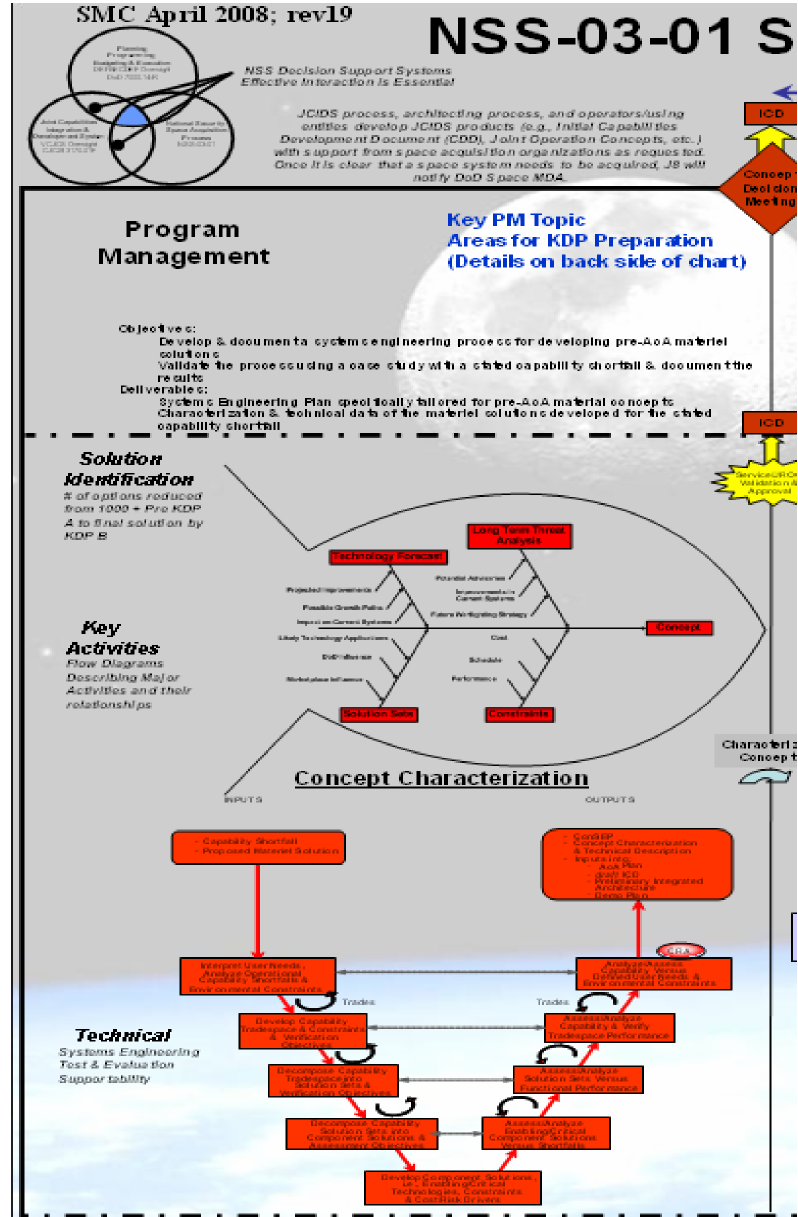
DRAFT SMC/XR Horseblanket



Pre-MDD Concept Maturation Phase

- **SMC/XR Emphasis**
  - Concept characterization elements
  - Early Systems Engineering Rigor
    - SAF/AQR Pre-Acquisition Early Systems Engineering initiative
      - Led to Systems Engineering "V" for this phase
      - Signed Systems Engineering instructions/guidance
- **Potential updates to "Horse Blanket"**
  - Highlight concept development - Functional Solutions Analyses (FSA) linkage
  - AF Policy initiative to require SAF/AQ Technical sufficiency check of CCTDs at the MDD Interface
- **Additional Considerations Lead to Metrics**
  - Technical sufficiency in advance of an AoA
    - Characterization of effectiveness and suitability parameters
      - Quantifiable & Testable?
    - Characterization of "relevant environment" for each concept
    - Logistics "ilities" avoid 'unobtanium'



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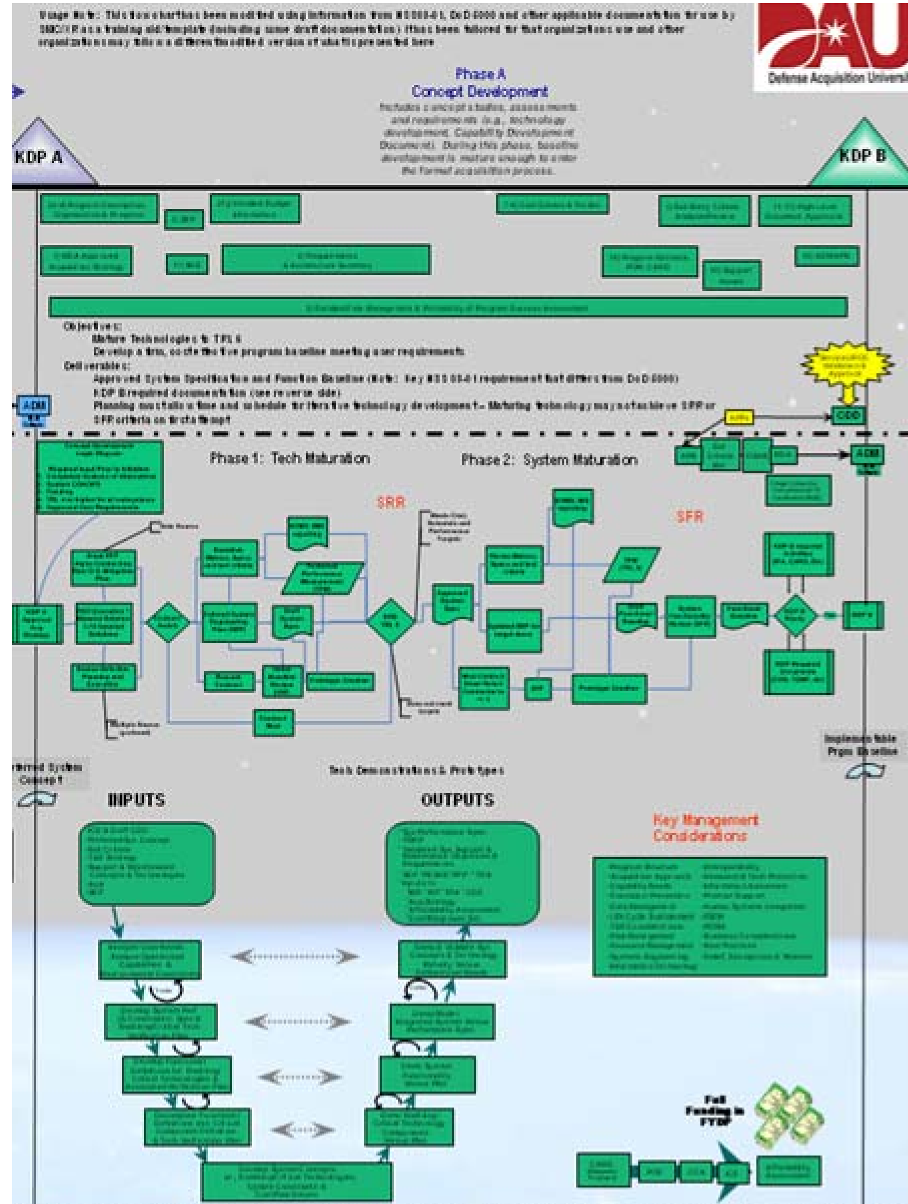
Pre- MS B Demonstration and Prototyping

- **SMC/XR Emphasis**
  - Key PM Data Elements (cost
  - Expansion of Concept Development into 2 phases
    - Tech Maturation and System Maturation
  - Prototyping-per Young 2007 Memo
  - DSAB and IPA Readiness Process (-B preparation)
- **Potential revisions to "Horse Blanket"**
  - Prototyping and competition policy implications
  - DoDI 5000.2 adjustments
  - Verify AFI 63-101 Acquisition and Sustainment Lifecycle Mgmt
- **Additional Considerations Lead to Metrics**
  - Early TEMP development
  - Technical performance measurement/monitoring



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How to Better Support the Need for Quick Reaction Capabilities in an Irregular Warfare Environment

Quick Reaction and Rapid Reaction Funds

"Breaking the Terrorist/Insurgency Cycle"

April 21, 2009

Mr. Glenn Fogg

Rapid Reaction Technology Office (RRTO)

Overview

- Quick Reaction Special Projects
  - QRF
  - RRF
- Emerging Capabilities Fund
- Open Business Cell
- Test / Demonstration Opportunities
- Contact Info

Quick Reaction Special Projects (QRSP)

- Program Motivation: Technology cycle time is as short as 12-18 months in some technologies; adversaries and peers are not bound by a two-year budget process. QRSP allows:
  - DoD to Apply Small Amounts of funding to
    - Provide technology for new capability options for Combatant Commands
    - Accelerate or spur technology options for insertion into acquisition programs
    - Rapidly develop technology to provide capability options to counter adversaries operational capability
    - Jump start discrete demonstrations to counter new adversary capabilities
  - Defined deliverables in less than standard S&T program
- Approach: QRSP is comprised of complementary projects that address different aspects of the maturity / cycle time space
  - **Quick Reaction Fund** (Project 826) – Focus is on shorter cycle time Conventional Forces
  - **Rapid Reaction Fund** (Project 828) – Focus is on Technologies Addressing Counter Terrorism / Counterinsurgency

Quick Reaction Fund (QRF)

- **Description**
  - Managed by DDR&E Plans and Programs
  - Focus on responding to emergent needs during the execution years that take advantage of breakthroughs in rapidly evolving technologies.
- **Goal:**
  - Accelerate promising research that will enable transformation or fill critical gaps in DoD acquisition programs.
  - Maturation of technologies critically needed by combatant commanders for operation.
  - Typically these projects are on the technology maturity scale where an idea or technology opportunity is proven and demonstrated.
  - Projects will last no longer than 12 months.

Rapid Reaction Technology Office

QRF Transition Opportunities

- **Key Technology Areas**
  - Lightweight armor (personnel & vehicle)
  - Data link and Network interoperability
  - Reduced logistics costs
  - Potential "Red Team" activity
  - Spectrum and information management
  - Reduced unanticipated risk in acquisition programs
- **Transition opportunities are realized when the technology is demonstrated**
  - Moved into an acquisition program of record
  - Technology has been demonstrated and made available via
    - GSA schedule, Deploy in AOR, Letters of Availability, etc.
  - Technology is demonstrated and testing continues for other applications

Rapid Reaction Technology Office

USMC M1A1 Rear Sensor (QRF)

Rear Sensor replaces existing taillight

Project Description/Objective

The Tank Commander is exposed to enemy fire when the tank is backing up.

This effort integrated a rear thermal sensor into the tail light of the USMC M1A1 Main Battle Tank.

The rear sensor image is displayed to the driver in a field of view that covers the entire rear of the tank and enables him to know the distance to Marines (on the ground), obstacles, and objects up to 150 meters.

Key Accomplishments/Outcomes

All lab testing has been completed. Rear Sensor integrated into tail light with Driver Display integrated into Driver's Compartment.

Two prototype units were tested in the Joint Assault Bridge. Minor improvements were identified and will be incorporated into the production units.

Deliverables

- QRF Deliverables
  - Seven Rear Sensor Systems
  - Lab Test Report on the Rear Sensor and Display
  - Field Test Report on the M1A1 with Rear Sensor
- Production
  - USMC Systems 447

Rapid Reaction Technology Office

Gunslinger (QRF)

Project Description/Objective

- Gunslinger is the spiral development of a modular, vehicle based, on-the-move hostile fire detection and counter-fire capability.
- Gunslinger Spiral 2 (GS-2) system was integrated onto a modified MXT-MV truck for deployment to Iraq.
- GS-2 is a hostile fire detection system capable of detecting enemy fire, targeting the source, and returning fire.

Key Accomplishments/Outcomes

- System was operationally deployed and provided a capability that did not exist.
- The Remote Gun and high end sensors (especially FLIR) operated 7 days (12-16 hrs/day)
- Gunslinger completed its operational experimentation in support of OIF in September 2007.
- The system remained fully functional throughout the deployment cycle and logged hundreds of missions and thousands of hours.

Deliverables

- Deliverable: GS-2 on-the-move hostile fire detection and counter-fire system.
- GS-2 transitioned to the USMC for operational use in Iraq.
- GS-3, and a remotely controlled version for integration onto an unmanned boat, Unmanned Surface Vehicle Spiral 1 (USV-1).
- USV-1 will transition to PM Robotic Systems JPO.
- Gunslinger systems are being considered for deployment by the Naval Expeditionary Combat Command for naval costal warfare, riverine operations, and expeditionary operations ashore.

Deployable Satellite Communication System (QRF)

Inflatable Antenna during 1-to-1 testing at SOCSOUTH

Project Description/Objective

- **Effort is field-deploying innovative, *inflatable* satellite antenna, designed to provide high-bandwidth SATCOM capability in a smaller, lighter package than conventional systems.**
- **Objective is to increase deployable aperture (dish size) for greater reliability, higher bandwidth and improved portability while lowering transportation and operation costs.**

Key Accomplishments/Outcomes

- **Enabled testing to verify design and performance criteria.**
- **Delivered initial units to integrating command and trained operators.**
- **Supported shore-to-ship communications for 2007 USNS Comfort mission to South America.**
- **Demonstrated interoperability with existing Joint Communication Support Element (JCSE) baseband equipment.**

Deliverables

- **5 systems for utilization by Special Operations Command South operators in exercises and missions within the command's AOR.**
- **5 systems for alternate deployment sites and technical evaluation.**
- **Technology development / fielding plan, and rapid prototype development.**
- **Product integration / documentation / training.**
- **User support, evaluation and reporting.**

Rapid Reaction Fund (RRF)

- Description
  - Managed by DDR&E's Rapid Reaction Technology Office (RRTO)
  - Focus primarily on 6-18 month timeframe for development through a supporting spiral development approach.
- Objectives
  - Leverage all the DoD science and technology base and those of other Federal Departments
  - Stimulate interagency coordination and cooperation
  - Identify and examine technological and organizational impacts of emerging and potential, future military issues
  - Anticipate adversaries' exploitation of technology, including available and advanced capabilities.
  - Provide input and feedback to guide long-term science and technology investments
  - Identify and exploit technology developed outside of DoD in the commercial sector, in academia and internationally
  - Accelerate fielding of affordable, sustainable capabilities and concepts to counter emerging threats

RRTO Developing Focus Areas

- During the past four years the following areas have become the focus for significant S&T Investments:
  - Biometrics & Forensics
  - Ground Based Electronic Warfare
  - Electromagnetic spectrum Monitoring and Management in Urban Environments
  - Cultural & Social Understanding and Modeling
  - Strategic Communications
  - Surveillance & Reconnaissance for CI/CT
- What are the emerging areas which will require S&T Investments?
  - Language Translation Capabilities?
  - Non-Kinetic Capabilities?
  - Large Data Handling and Analysis?

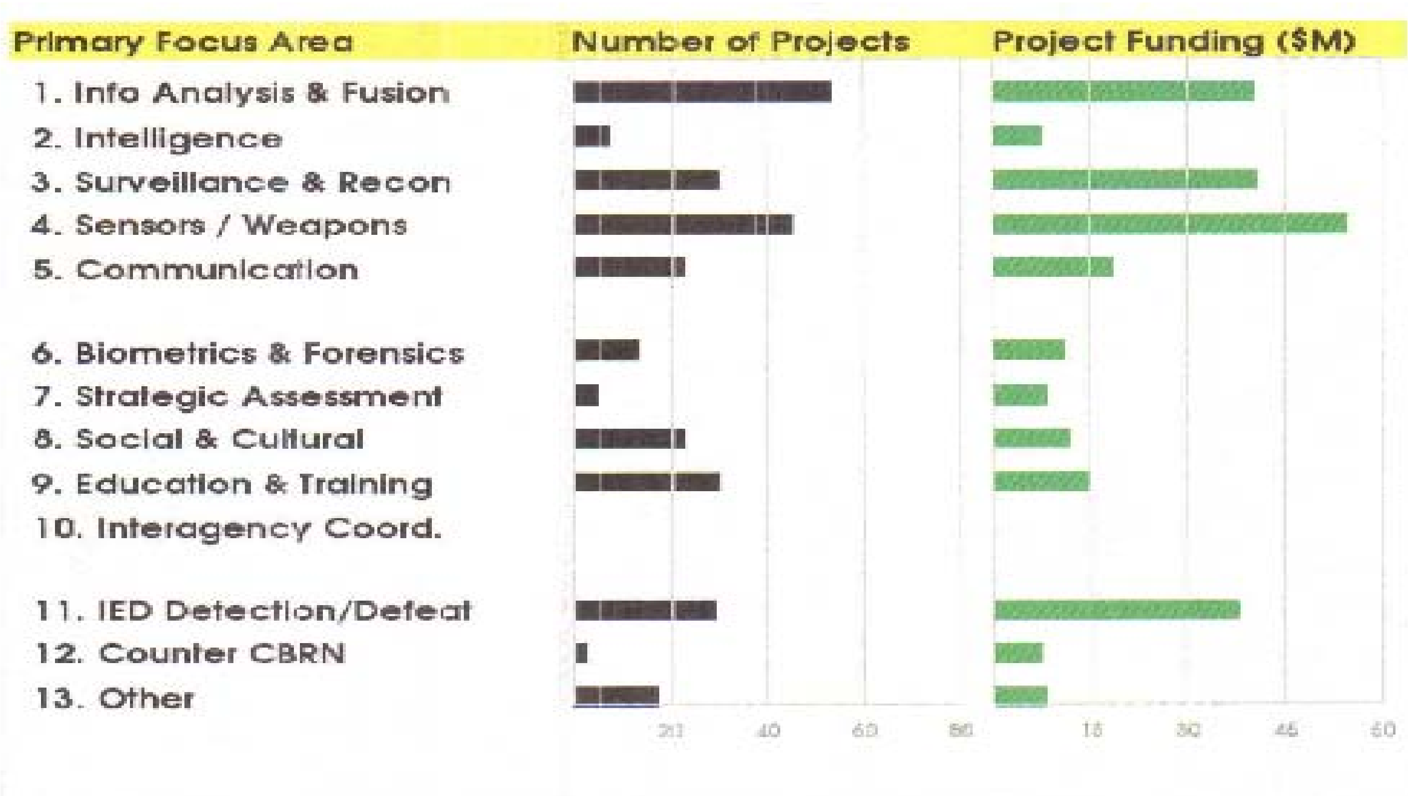
RRTO Fiscal Year 2009 and Beyond

- Identify critical focus areas
- Mitigating factors
  - Potential drawdown / refocus from current areas of emphasis
  - Services recapitalization challenges
  - Future levels of defense spending
  - Re-examination of Irregular Warfare strategy
  - Global insurgency / terrorist challenges
  - Competition for resources: energy, food and water
  - Geographic access
  - Smaller but networked terrorist groups
  - Terrorist and criminal groups and organizations affiliations
- Actions
  - Expand Irregular Warfare focus beyond Afghanistan / Iraq
  - Examine terrorist / criminal interfaces
  - Develop non-kinetic capabilities including support for strategic communications
  - Increase interagency coordination

RRTO Fiscal Year 2009 Focus Areas

- Thunderstorm and surveillance system testing
- The interface of law enforcement and military operations
- Strategic Communication and Influence Operations
- Interagency coordination
- Biometrics and forensics capability development
- Establish an open business cell
- Capabilities to support denied area operations
- Small dispersed unit operations
- Autonomous system operations
- Strategic Multi-Layer Assessment

RRTO Portfolio Overview



306 Projects from FY 04 to FY09

Rapid Reaction Technology Office

Link 16 Multi-role Adaptable Xceiver (MAX) (RRF)

Technology / Key Deliverables

- **Dual Channel Link 16 Radio Terminal (Link 16, UHF or SATCOM)**
- **SCA compliant waveform with JANUS Crypto Chip**
- **Falconview software integration for SOF applications**
- **Targeting capability**
- **Watertight Pelican Case configuration for harsh environment portability**
- **Multiple power source adaptability (including 5590 battery operation)**
- **Integration of weather, AIS and FAA traffic software applications**
- **Integrated GPS feature and multiple display option capability**
- **Chat and mission execution features**
- **Small form factor for**
    - **SPECWAR and Riverine watercraft**
    - **Disadvantaged aircraft (MV-22, OH-6, MH-60, AV-8, CH-53)**
    - **UAV and non-traditional ISR platforms**
    - **AFSB (Amphibs & LCU/RHIB watercraft)**

Description

Link 16 is currently fielded with a variety of USAF, USMC and USN platforms and provides unprecedented data and Situational Awareness (SA) to platforms capable of hosting the relatively large MIDS or JTIDS terminals needed to join the Link 16 net. MAX provides Link 16 capability in a small form factor thus enabling platforms and units heretofore unable to have access to the Link 16 and its robust ability to provide a jam resistant reliable situational awareness and Data exchange capability to disadvantaged warfighters. MAX L16 provides capability to operate in ground, air and sea applications as a standalone configuration or integrated into existing displays. Addresses standing ODR from SOF Community and leverages USAF single channel WDL L16 terminal ATD and Rockwell Collins IR&D investments.

Schedule/Phases

Phase I

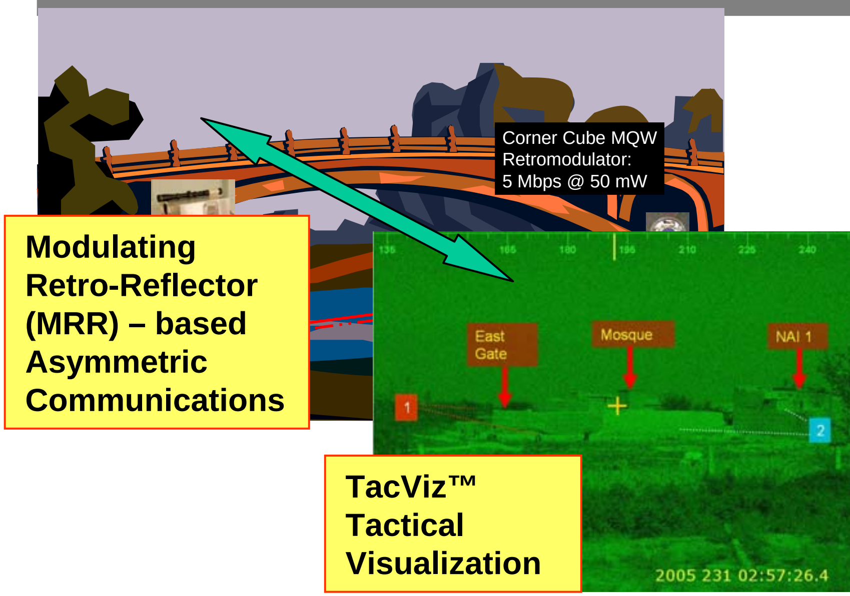
- **JANUS Chip certification**
- **Dual Channel terminal development**
- **SW additions (AIS, FAA traffic, targeting, WX)**
- **Combat Validation Using "Time to Kill" Metric in SOF CAS scenario**

Phase II

- **Dual Channel terminal configuration demo**
- **Software integration**
- **Man portable configuration development**

Rapid Reaction Technology Office

TINA: Tactical Infra-red Networked Awareness (RRF)



Objectives:

- Improve situational awareness for operators

- Enables covert, compact, high bandwidth means to harvest

data quickly

Payoff:

A fieldable means to quickly and covertly acquire and understand data from remotely placed sensors where the information is enhanced by location, orientation, and other relevant metadata; units now can quickly locate and harvest

Description: TINA takes advantage of significant DOD investment in communications and visualization technologies to integrate the MRR long-range asymmetric communication technology with the TacViz™ tactical data visualization tool. The new system will provide an advanced reconnaissance asset that will allow operators to access, collect, and understand data from various remote sensors.

Key Participants: OSD, NRL, SOCOM

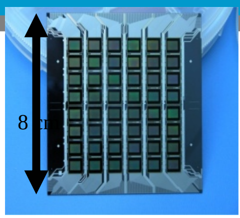
Milestones / Deliverables

- Define Interface Requirements: TACVIZ & MRR System (MRR terminal & Interrogator)
- Interface TACVIZ w/sensor
- Drive MRR with enhanced data
- Integration tests at CBD (iterative)
- Two Demonstrations at CBD
- Develop integration plan for TENCAP experiment if TENCAP proposal is awarded

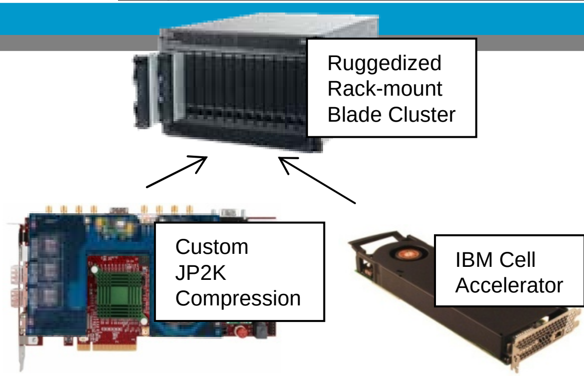
MASIVS: Giga-pixel Video Onboard Processing (RRF)

Rapid Reaction Technology Office

MASIVS Sensor



Giga-pixel Video Processor



Enabling wide area electro-optical persistent surveillance

Technology

- **Novel Giga-pixel-scale processing:**
  - **MASIVS - 880 Mpixel, 2fps, color**
  - **Onboard stabilization, detection, compression utilizing IBM Cell processor**

Capability:

- **FY08: 220 Mpixel color - compression & stabilization**
- **FY09: 880 Mpixel color - compression, stabilization and detection**

Key Participants

- **MIT/LL: Development of Hardware, Algorithms & Software**
- **ARMY / Air Force: Operational deployment**

Key Deliverables

- **Flight demonstration**

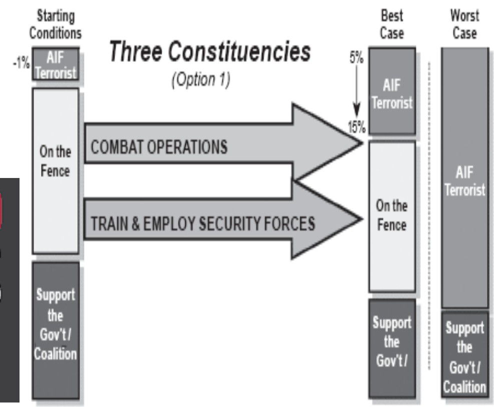
Key Deliverables

880 mega-pixel camera system
Documentation on integration and calibration test results
Ruggedized for field deployment

Milestones Leading to Fielded Capability

• February / June engineering flights	FY08
• First quarter full capability test flight	FY09
• Ruggedization and deployment	FY09

MEASURING PROGRESS IN CONFLICT ENVIRONMENTS (MPICE) (RRF)



(From Chiarelli, “Winning the Peace,” July/Aug 2005)

<u>Objectives</u>

- **Develop a comprehensive measures and metrics framework**
- **Provide conflict transformation baseline capability**
- **Support policymakers and planners at the Joint Task Force and Country Team level**
- **Develop an understanding of illicit power structures in SRO situations to strengthen strategy development**

<u>Description</u>: Develop an integrated system and definitive guidelines for baseline assessment, measurement and monitoring of conflict transformation. Define an application methodology and test against relevant and critical case studies.

<u>Key Participants</u>: USAID, S/CRS, JCS J5, PKSOI, OUSD(I)

<u>Key Deliverables</u>: Conflict Transformation Measurement Tool and Methodology; Illicit Power Structure Taxonomy

<u>Milestones / Steps Leading to Fielding Capability</u>

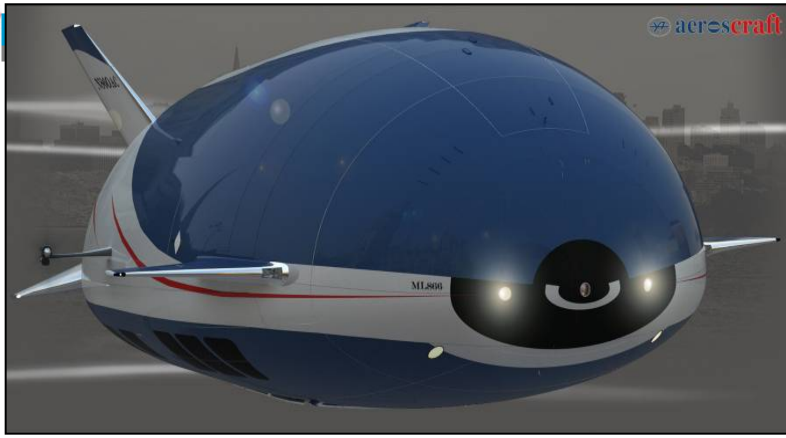
- **Initial metric framework report**
- **Preliminary conflict transformation measurement tool**
- **CONUS-based analysis report for Iraq & Afghanistan**
- **Conflict baseline report**
- **Data fusion methodology, results**
- **Integrated conflict transformation measurement tool**

Emerging Capabilities Fund

- Purpose: Anticipate and inform the JCIDS and acquisition processes through risk-reducing prototypes and advanced capability development activities with emphasis on inter-agency cooperation
- Goals:
  - Increase visibility into inter-agency capability gaps of concern to DOD with leveraged funding to stimulate cooperation and develop capabilities
  - COCOMs, Services, and Defense Agencies benefit from risk-reduction prototyping and experimentation in advance of (or in conjunction with) formal acquisition programs
  - Increase access to inter-agency S&T programs
  - Prototypes with military utility provided to COCOM, Service, or Defense Agency for further development or experiments

Project Pelican
Rigid Aeroshell Variable-Buoyancy (RAVB)

Rapid Reaction Technology Office



Energy-Efficient, High-Capacity, Direct Delivery Airlift

Technology / Product

- Rigid structure, ballast-independent vertical takeoff/landing air vehicle with vastly improved energy efficiency
- Capable of unimproved surface/water operations

The So What

- Will reduce airlift energy use per ton-mile to commercial trucking levels
- Will enable heavy-lift air access to austere regions with little infrastructure
- Will enable direct delivery, cutting in-transit times from point-of-origin to point-of-need

Key Participants

- Gov't Contributors: NASA, Aerospace Corp
- Industry: Aeros Aeronautical Systems Corporation
- Operational Advocate: USEUCOM

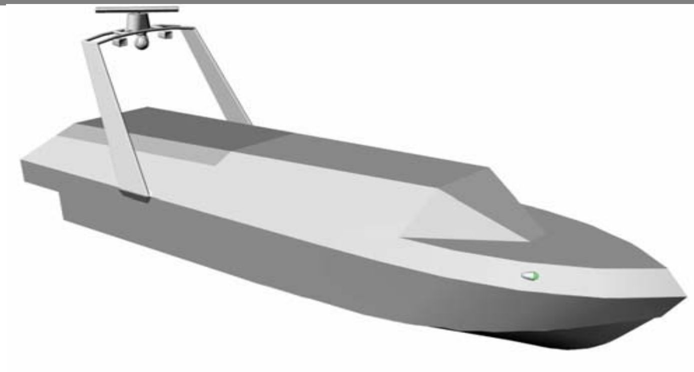
Key Deliverables

- Scaleable prototype RAVB air vehicle
- Ground and flight test data
- Evaluation of scaleability and technical risks for full-scale articles

Milestones Leading to Prototype Delivery

- Program milestones (FY09 increment)
  - Subsystem component demos — ongoing
  - Conceptual design — 1 Aug 09

Griffin USV



Multiple autonomous USVs cooperating to complete a basic MDA patrol

Technology / Product

- Software supporting autonomous 24 hour patrol under controlled conditions
- Extensible Mission Package implementation software
- Capable of cooperative operation between USVs

The So What

- Autonomy remains critical missing piece in unmanned systems
- Reduced manning for unmanned systems, currently approx 2x manned requirements

Project description: Develop and install autonomous C2 system on two current USVs which will permit the unmanned systems to execute a MDA task cooperatively

Key Participants

Sponsor(s): OSD/RRTO, NSWC Carderock
Gov't Contributors: NSWC Dahlgren
Industry: PSU's Applied Research Lab, TSI

Key Deliverables:

Software and hardware installed on 2 USV Demonstrators
Extensible Mission Package software
Training / CONOPS manuals
Safety release for UAS, SSSTRP accreditation

Milestones Leading to Fielded Capability

- Intelligent Controller Framework S/W
- Extensible Mission Package S/W
- Safety Release/Software Reliability
- Underway Testing

Open Business Cell

- Established in February 2009
- Pilot project that seeks to engage nontraditional performers to solve some of DoD's needs
- “Technology Brokers” are facilitators and guides to shepherd non-traditional performers through prototype development and testing
- Contracting cell using Other Transaction Authorities (OTAs) to establish prototype/proof of concept programs
- www.DefenseSolutions.gov provides background and clear instruction on how to submit a proposal.
- Current focus is on Battlefield Forensics.
  - Large data analysis
  - Autonomous control of UAVs / USVs

RRTO "Testing History"
Joint Experimental Range Complex

- October 2003. The IED challenge emerges.
  - The first thing we need is a "representative" test site in which to examine systems.
- 23 Dec 2003: Construction on the Joint Experimental Range Complex (JERC) begins in Yuma.
  - ATEC Yuma
  - Naval Air Systems Command Special Projects
  - CTTTF
- 15 Jan 2004: First testing at new JERC facility in Yuma.
- Aug 2004: 'What are you doing to test systems?'
  - Commander CENTCOM to the Joint IED Task Force
- Nov 2005: Idea of National Counter Insurgency/Counter Terrorism Test Facility
  - CTTTF cedes Yuma to Joint IED Task Force and Joint IED Defeat Organization
- 2005-Present. CTTTF/RRTO maintains test windows at Yuma for testing.
  - Support to industry, labs and academia with an emphasis on small vendors.
  - RRTO provides test director, facility use, testing support and archives test reports.
  - Testing status reviewed at regular Force Protection VTCs
  - To date 250 systems have been tested at the JERC under CTTTF/RRTO sponsorship

RRTO "Testing History" IED Blitz

- Sixty day proof of concept that focused ISR assets on a 20 km road segment to detect IEDs and IED emplacement activities
- Employed a "persistent surveillance" approach with multiple sensors including:
  - EO / IR
  - SAR
- Manually fused numerous ISR inputs and developed capabilities to move large amounts of data from theater to CONUS.
- Identified numerous items of interest, none of which were confirmed as IEDs.
- IED Blitz assessed as a failure.
- The IED Blitz identified challenges associated with conducting persistent surveillance and led to development of numerous effective capabilities.
  - GMTI
  - Sonoma / Constant Hawk
  - FOPEN
  - SIGINT TIVO
  - FADE
  - LIDAR
  - COIC
  - SAR CCD
  - Bluegrass
  - Thunderstorm

Does the department need a venue to conduct high risk enterprises/experiments to capture constructive lessons learned?

RRTO "Testing History" Stiletto

- Dec 2006: S&T Division of the former Office of Force Transformation assigned to RRTO
  - Tactical Relay Mirror System
  - Operationally Responsive Space
  - Project Wolf Pack
  - Stiletto
- Stiletto proposed as an operational demonstration platform with potential application to future Navy missions. Not embraced by the Navy.
- Under RRTO sponsorship:
  - Avoid trying to force the Navy to embrace Stiletto
  - Focus on establishing Stiletto as a "test platform" with outreach to laboratories and industry. A maritime environment test bed (at no cost to users) without the paperwork associated with traditional test venues.
- Summer 2008: Deploys to Cartegena, Columbia with 10 vendor and "test" systems aboard.
  - OPCON – SOUTHCOM TACON – JIATF-South
- Jun 2009: Incorporate into Project Thunderstorm and redeploy to SOUTHCOM AOR.

RRTO "Testing History" Bluegrass

- RRTO has been the initial funder / fielder of a number of surveillance capabilities.
  - Derived from the IED Blitz in the fall of 2004
  - GMTI backtracking with JSTARS and P-3 LSRS
  - Sonoma, Mohawk Stare, Constant Hawk wide area electro-optic surveillance
- We continue to develop systems to enhance the base surveillance capabilities.
- There is no "organized" investment to improve the analytic capabilities of GMTI and wide area EO. Most analysis is manual and time consuming
- Project Bluegrass: Develop a data set, with ground truth of GMTI and EO to facilitate future tool and capability development to exploit wide area surveillance systems.
  - Participants included: RRTO, CIA (OCS), NSA and DTRA.
  - MIT/LL functioned as Test Director
  - Data available at no charge to government laboratories and industry for capability development.
  - RRTO and CIA approve each data release.
- 7 Oct 2008: BAA released through TSWG with a series of Bluegrass "Challenge Problems."

RRTO "Testing History" Project Wolf Pack

- **Support Service / Coalition / Interagency efforts to enhance <u>small unit</u> ground force operations across a spectrum of mission profiles and environments.**
- **Identify, integrate and assess emerging but relatively mature concepts and technologies that are sustainable and deployable.**
  - **Focus on communications**
  - **Produce prototype support equipment for field experimetation**
- **Partners include:**
  - **USMC**
  - **US Army**
  - **JFCOM**
  - **USNORTHCOM**
  - **DHS S&T**
  - **Joint Non-Lethal Weapons Office**
  - **Technical Support Working Group**
  - **Australian Army**
  - **Israeli Ministry of Defense**

RRTO "Testing History" Thunderstorm

- Operational outgrowth of Project Bluegrass
- Goal is to establish an enduring multi-int ISR test bed focused on the JIATF-S AOR to exercise evolving architectures, emerging capabilities and transformational concepts
  - Demo new capabilities
  - Provide relevant intelligence
  - Encourage greater cooperation
  - Identify ISR CONOP improvements
  - Make data available
- Exercise with a series of ongoing spirals
- MIT/LL acting as test director
- Participants in initial spirals include:
  - JIATF-S
  - CIA
  - NSA
  - NRO
  - DHS
  - Industry partners

Submission Routes

- **Quick Reaction Fund**
  - DDRE@dtic.mil
- **Rapid Reaction Fund**
  - RRTO@dtic.mil
- **Emerging Capabilities Fund**
  - RRTO@dtic.mil
- **Open Business Cell**
  - www.DefenseSolutions.gov
- **JERC / Stiletto / Bluegrass Data / Wolf Pack / Thunderstorm**
  - Glenn.Fogg@osd.mil

Naval Open Architecture

AIR

C4I

SPACE

SUBS

SURFACE

MARINES

28 April 2009

Distribution Statement A: Distribution is unlimited

Nick Guertin
PEO-IWS
Deputy Director for Open Architecture

To execute this strategy, we must change how we build systems - the adoption of Open Architecture is critical to our Navy

***Naval Open Architecture** is the confluence of business and technical practices yielding modular, interoperable systems that adhere to open standards with published interfaces. OA delivers increased warfighting capabilities in a shorter time at reduced cost.*

OA CORE PRINCIPLES

- ***Modular design and design disclosure***
- ***Reusable application software***
- ***Interoperable joint warfighting applications and secure information exchange***
- ***Life cycle affordability***
- ***Encouraging competition and collaboration***

Source: OPNAV ltr Ser N6N7/5U916276 dtd 23 Dec 05

Our focus has been on addressing business, technical, and cultural changes

OA GOALS

1. Change the Naval processes and **business** practices to "utilize open systems architectures in order to rapidly field affordable, interoperable systems."

2. Provide OA **Technical Systems Engineering** leadership to field common, interoperable capabilities more rapidly at reduced costs

3. Change the Naval and Marine Corps **Cultures** to Institutionalize OA Principles

OA PRACTICES

Disclose design artifacts
Negotiate appropriate data rights
Foster enterprise collaboration
Institute Peer Reviews of solutions
Develop new open business models
Change contracts / increase competition
Software Process Improvement Initiative

Publish interfaces
Isolate proprietary components
Use widely adopted standards
Modularize systems
Reuse software products
Build interoperable applications

OA Training
Outreach - Symposias & Industry Days
Research

Implementing *Open Architecture* yields many benefits

Reduction in Time to Field	▪ Decreased development and acquisition cycle times to field new warfighting capabilities ▪ Faster integration of open standards based systems
Increased Performance	▪ Improved operator performance thru delivery of cutting edge technologies and increased bandwidth capabilities from spiral developments and technology insertions
Improved Interoperability	▪ Use of common services (e.g. common time reference) ▪ Use of common warfighting applications (e.g. track mgr) ▪ Use of published interfaces to standardize collaboration
More Competition	▪ Modular architectures enable competition at the component level ▪ Sharing data rights allows third parties to compete
Cost Avoidance	▪ Cost avoidance from software reuse and use of commodity COTS products at optimum prices ▪ Reduced training and streamlined lifecycle support

Implementing OA requires the commitment and participation of all stakeholders across the Naval Enterprise

Chief of Naval Operations

- N6
- N8
- OA CROSS FUNCTIONAL BOARD

- Provide Naval requirements and POM/PR guidance to acquisition community
- Identify requirements for rapid, cost-effective, interoperable warfighting improvements with the objectives of supporting OA

Assistant Secretary of Navy (Research, Development & Acquisition)

OA Enterprise Team Lead Council

OA Enterprise Team (OAET)

- AIR
- C4I
- SPACE
- SURFACE
- SUB
- MARINE CORPS

- Lead the enterprise to OA implementation
- Oversee the development and implementation of the processes, business strategies, and technical solutions for implementing OA
- Provide OA Systems Engineering Leadership to PEOs, Warfare Centers, Industry, etc.

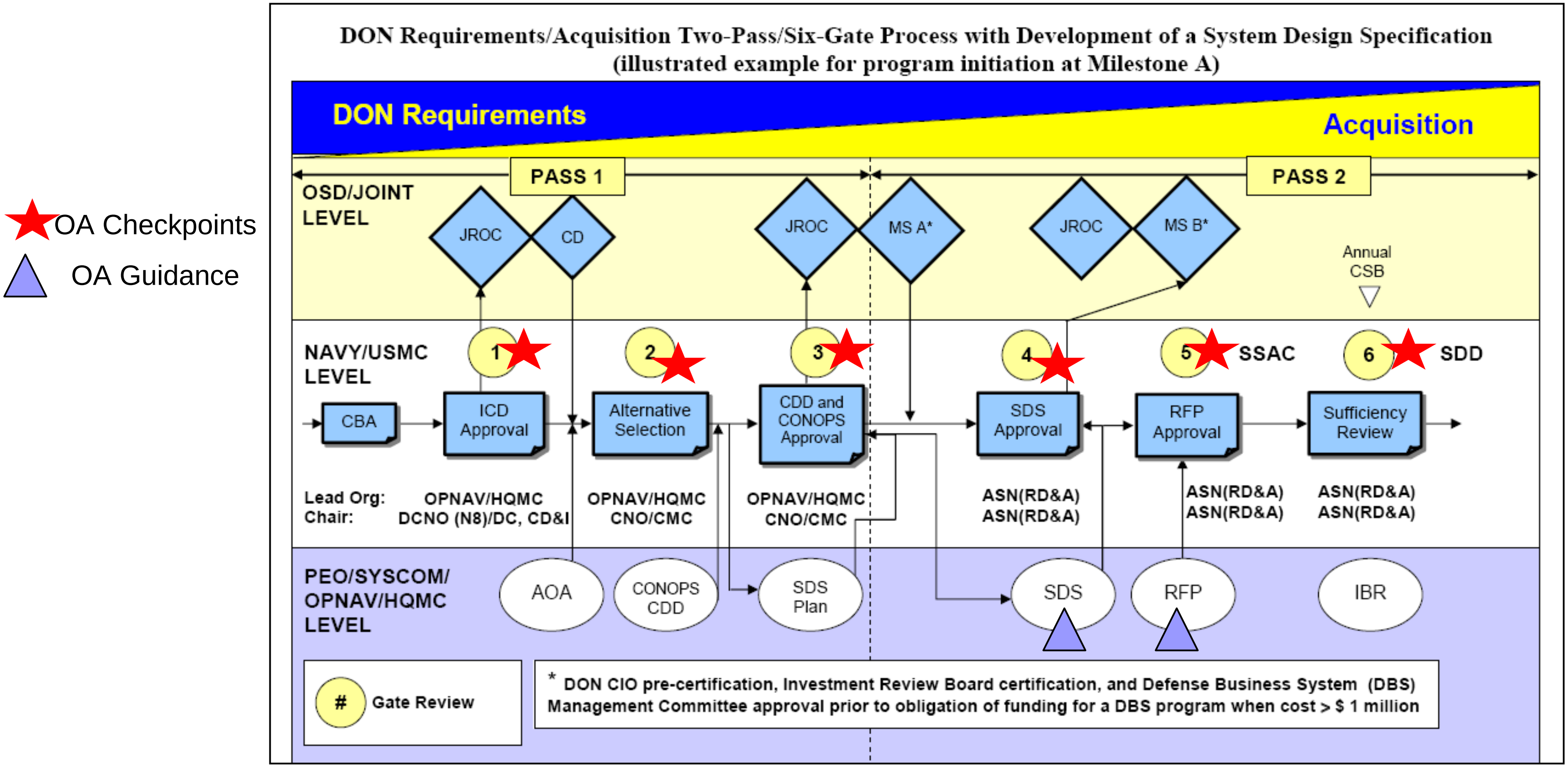
PEOs

- Identify architectures unique to domains and implement a process to ensure OA compliance

SYSCOMS

- Provide technical, financial management and contracting support to PEOs
- Establish OA technical processes
- Monitor and assess compliance with OA standards and processes

OA checkpoints are being built into the Department of Navy's Six Gate Review Process to ensure compliance



SECNAV introduced the six-gate, two-pass process to more effectively integrate the Naval requirements and acquisition decision processes. This process improves visibility and insight into the development, establishment and execution of programs.

A key part of OA is the proper exercise of the Navy's Intellectual Property Rights …

- A key aspect to implementing OA is for the Government to ***exercise*** the intellectual property rights (IPR) it acquires

- Under the Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulation Supplement (DFARS):
  - The Government gets **Unlimited Rights** in both Technical Data (TD) and Computer Software (CS) for noncommercial items **developed exclusively at the Government's expense**.
  - For noncommercial items developed with **mixed funding**, the Government gets **Government Purpose Rights (GPR)** in TD and CS.

- If a contractor asserts more restrictive rights over a system/component's IP and the Government fails to challenge such an assertion by exercising its rights, the contractor obtains the asserted rights

- It is imperative that the Government assert and exercise the IPR it acquires because it may lose the right to challenge after a period of time

Coalition Warfare Program

Briefing to: Science & Engineering Technology Conference

Col Kathy Hithe, USAF
Deputy Director,
Coalition Warfare Program
OUSD(AT&L)/International Cooperation

April 2009

Purpose of the Coalition Warfare Program

- Coalition Warfare Program provides funds on a competitive basis to projects that conduct collaborative RDT&E with foreign government partners.
- Why?
  - Global Security requires strong partners and partnerships
  - Effective coalitions require a high degree of interoperability
  - Solutions to warfighter problems can be developed better, cheaper, and faster by leveraging partner expertise and resources.

  - …and yet, COCOMs, Services, and Agencies do not always program for international partnerships and interoperability

Coalition Warfare Team

Under Secretary of Defense for Acquisition, Technology and Logistics
Hon. John Young

Director, International Cooperation
Mr. Al Volkman

Director, International Negotiations
Mr. Frank Kenlon

Director, Planning & Analysis
Mr. Steve Austin

Director, Pacific Armaments Cooperation
Mr. Bruce Bade

Director, Armaments Cooperation Atlantic
Col Mark Price (Acting)

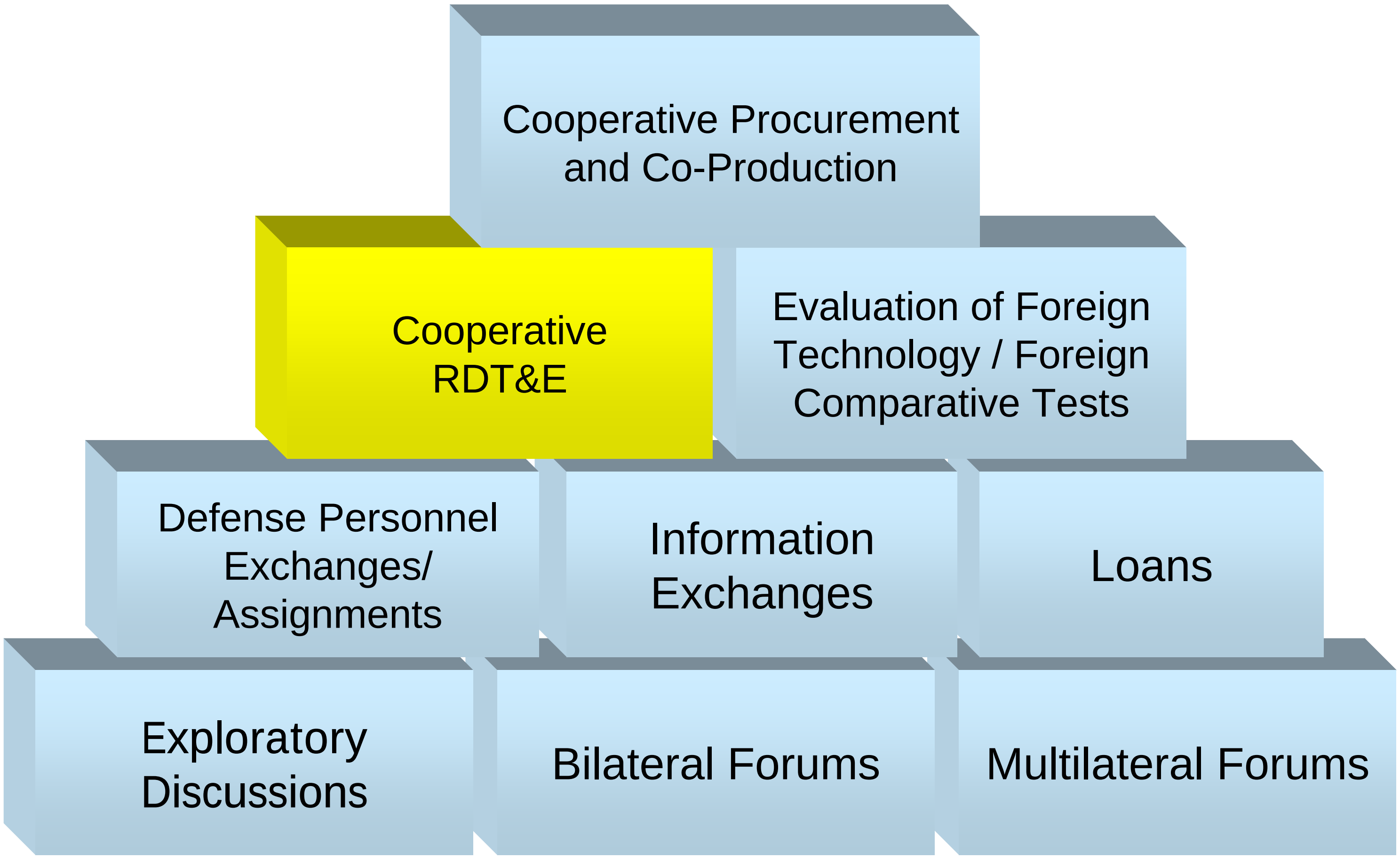
Deputy Director, Coalition Warfare Program
Col Kathy Hithe

Ms. Merry Lutz (Contractor)
Army, PACOM, SOUTHCOM, TRANSCOM

Ms. Christa Cochran (Contractor)
Air Force, EUCOM, NORTHCOM, STRATCOM

Mr. John Noulis (Contractor)
Navy, Marine Corps, AFRICOM, CENTCOM, JFCOM, SOCOM

Building Blocks of Armaments Cooperation



CWP Responds to DoD Acquisition and Policy Imperatives

Armaments Cooperation Goals:

- Build partnerships; strengthen alliances and influence adversaries
- Reduce cost by sharing costs or avoiding duplication of development efforts
- Increase military effectiveness through interoperability; share global security responsibilities
- Bolster domestic and allied defense industrial bases
- Access the best defense technology and expertise; help minimize the capabilities gaps

Building Partnerships Goals:

- Build capabilities and capacities of partners and institutions
- Leverage capacities and capabilities of security establishments
- Influence adversaries and competitors
- Strengthen global defense posture
- Partner with government and institutions
- Inform domestic and foreign audiences

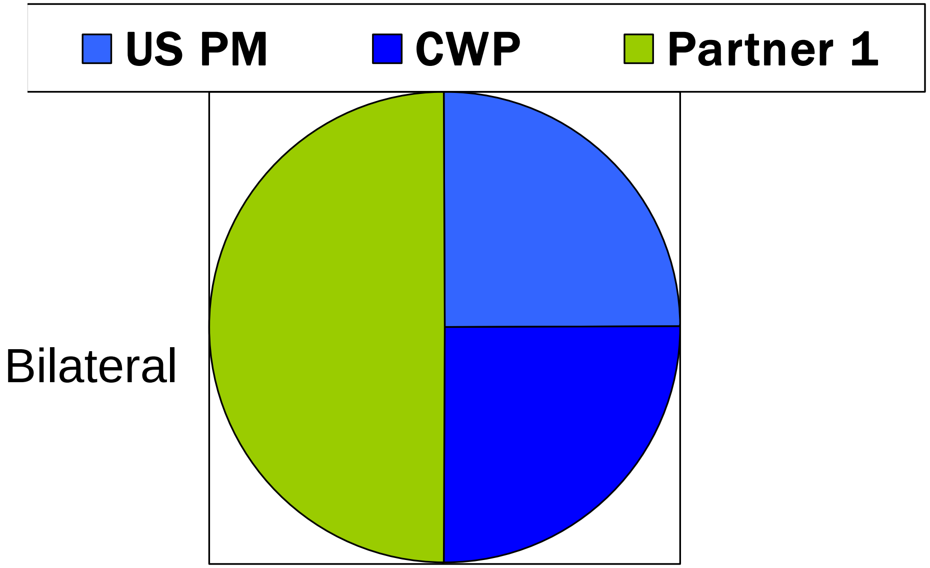
Global Partnerships through CWP Projects

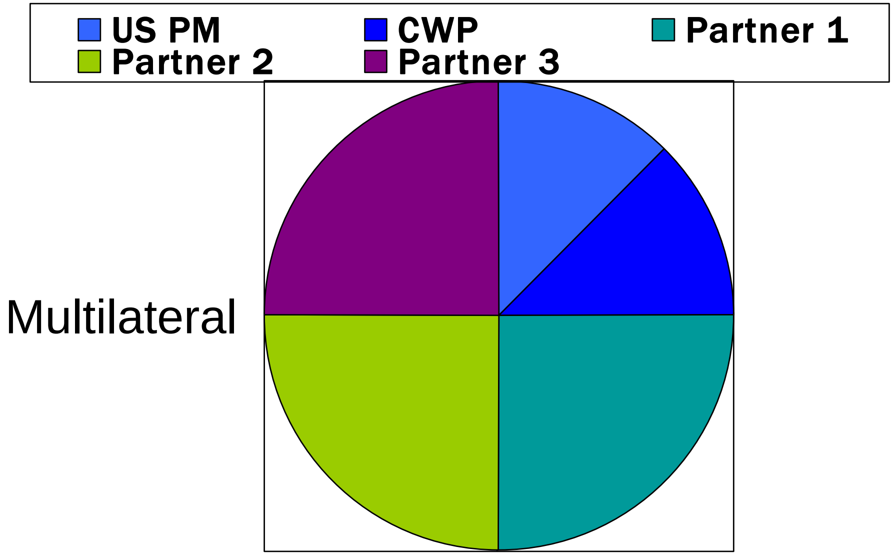
CWP Proposal Basic Requirements

- CWP selects projects through an annual, competitive, nomination process.
  - CWP will provide "seed" funding of up to $1,000,000 per year for 2 years.
- Basic Criteria:
  - RDT&E content
  - Nominations accepted from COCOMs, Services, Defense Agencies, or OSD staff
  - Projects must have committed foreign government partners

Coalition Warfare Program Contributions

- Sponsor and foreign partner expected to contribute resources to project
- Equitable contributions from foreign partner could entail:
  - Traditional "equal" contributions
  - Could also be benefit related

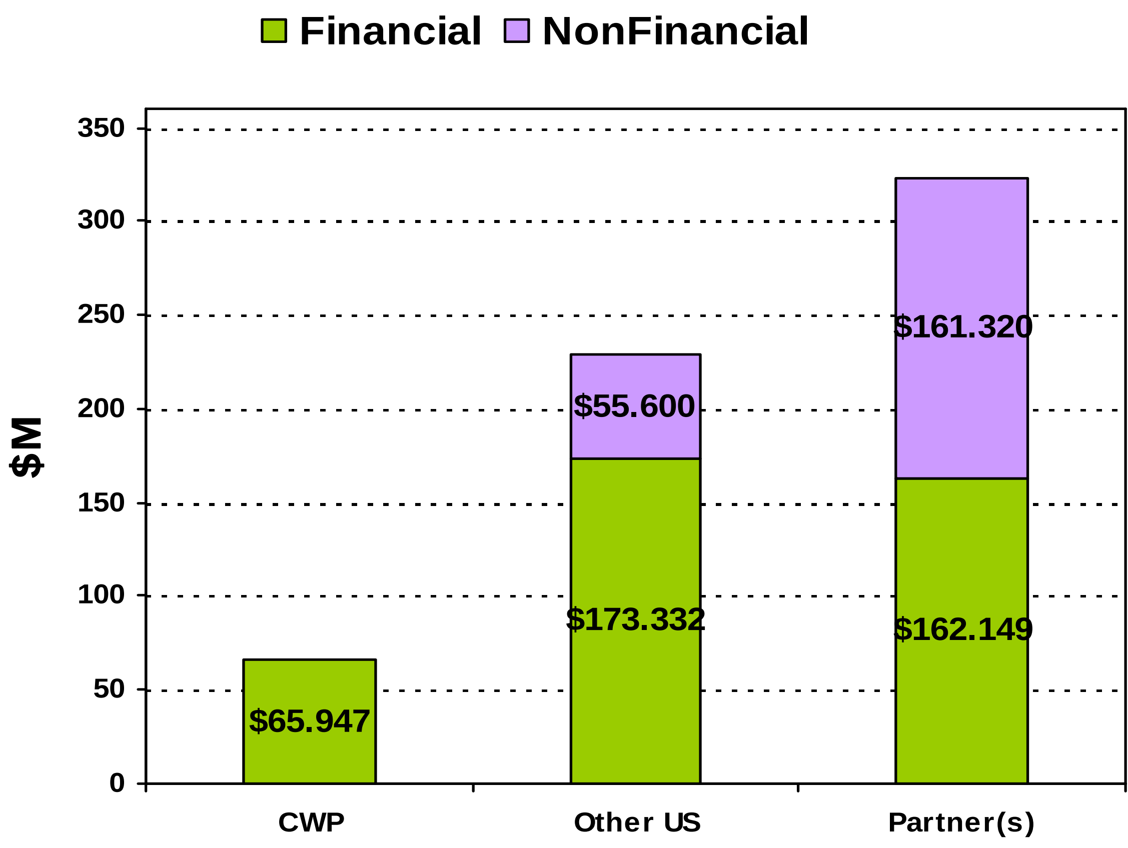




CWP History

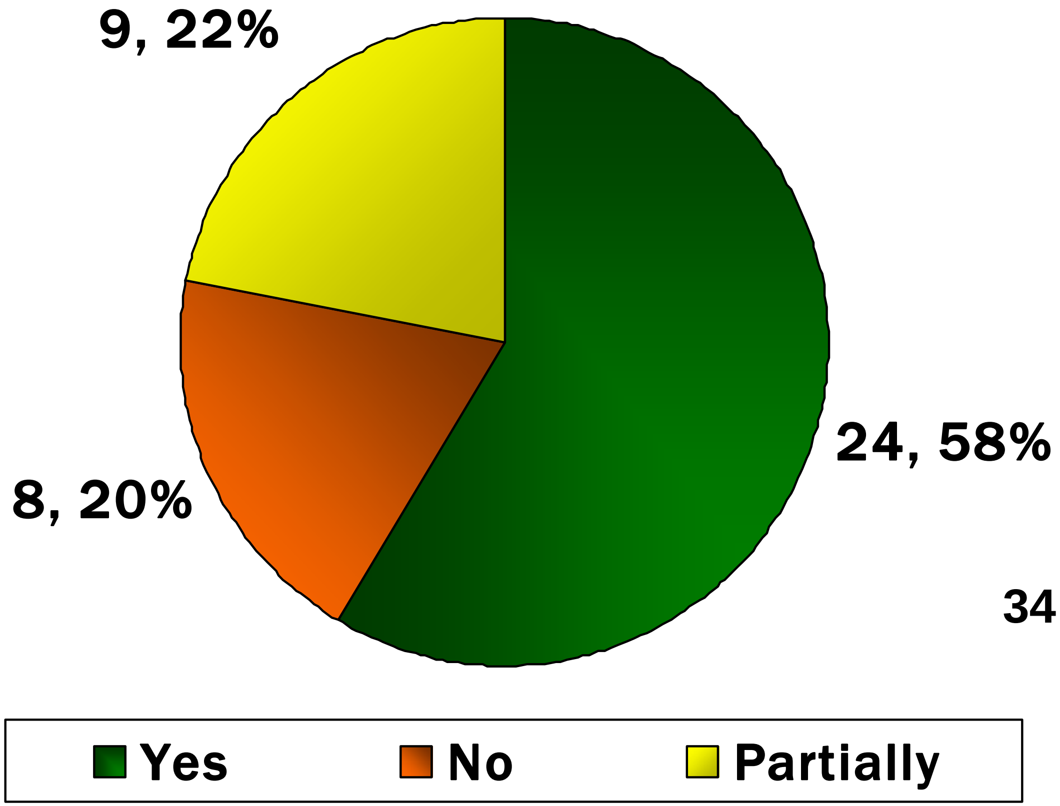
- Established in 2000; funding began in FY01
- 75 projects
  - CWP - $65.75M
  - Other US - $224.17M (1:3)
  - Partners - $319.27M (1:5)

Total Funding Leveraged : $543.44M (1:8)



Project Transitions

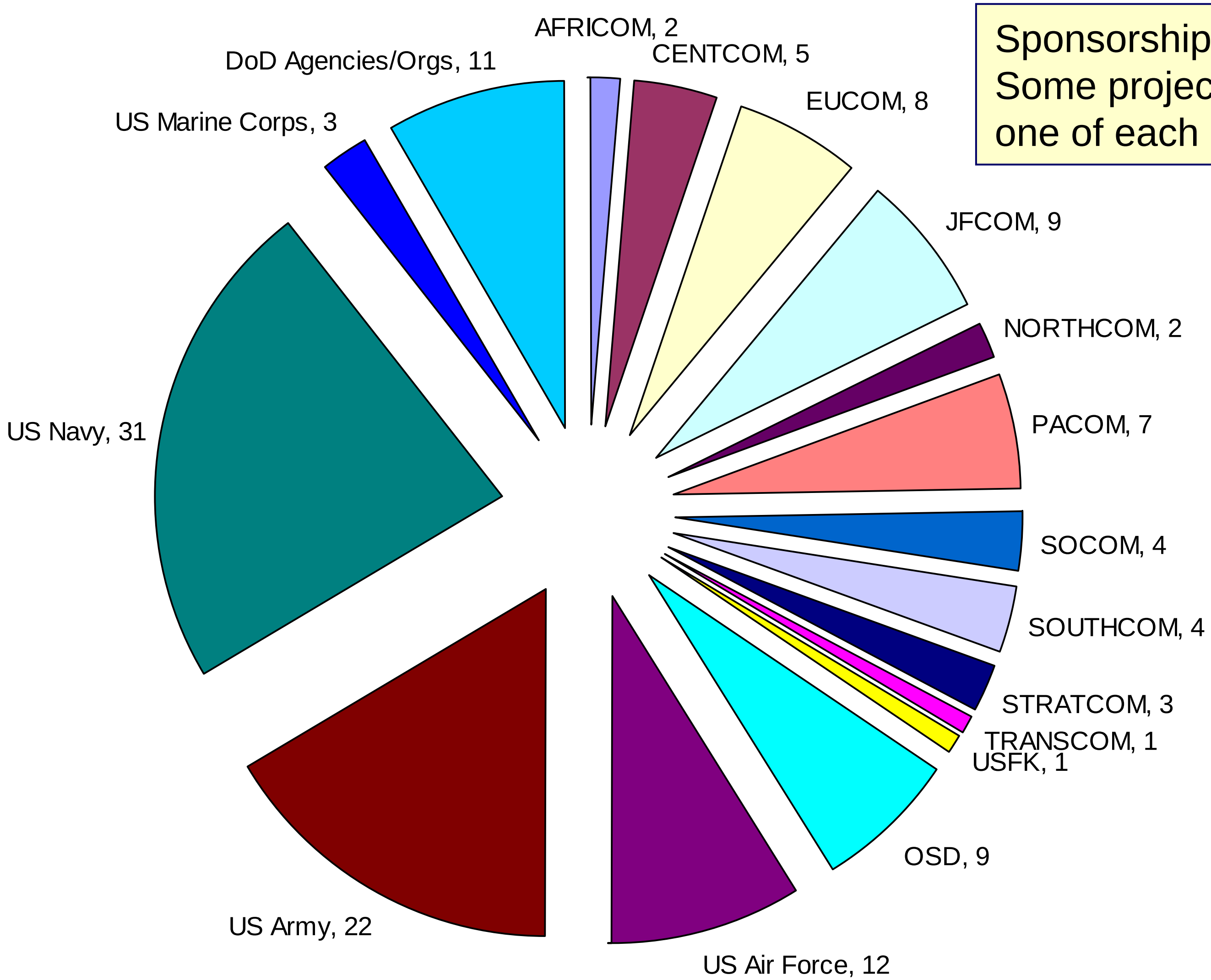
Technical PM is responsible for working transition to next phase



34 Projects still underway

Participation in CWP Projects FY01-FY09

Sponsorship and Partnership. Some projects have more than one of each



Important Dates

- FY10
  - Closed to new submissions
  - Preliminary decisions on selections will be announced in June.
  - Projects will be notified of availability of CWP funding after passage of FY10 DoD Authorization and Appropriations Bills.
  - Selected projects will be able begin work after CWP receives its FY10 budget (plan for January 2010.)
- FY11
  - Offices interested in submitting a proposal for FY11 cycle should start ground work by:
    - Identifying foreign partner and understanding international agreement requirements of project.
    - Identifying internal resources that can be committed.
  - First drafts will be due in January 2010.

Evaluating a CWP Proposal

	Basic	Acceptable Basic Elements +	Strong Previous Elements +	Excellent Previous Elements +
Product	RDT&E Content	Tangible outcome and clear objectives	Not duplicative of other efforts	Unique solution to a complex problem
Sponsor-ship	U.S. government sponsor	Sponsor financial contribution & COCOM endorsement	Equitable financial contribution	Multiple endorsements
Foreign Partner	Identified	Financial or non-financial support	Foreign POCs identified & equitable contributions	High-level interest
Benefit	Clear benefit to warfighter	Meets an identified need	Meets identified need of multiple COCOMs/ Services/Agencies	Will quickly be able to respond to identified need
Legal	Reviewed for international agreement/ disclosure/export control issues	Sponsor and Service IPO have a plan of action to get agreements in place/issues resolved	Can get necessary international agreements in place in time to start/other issues in work	Has necessary international agreements in place /other issues resolved
Project Mgmt	Funds requested commensurate with scope	Practical metrics for success	Identified transition aim	Programmed to transition

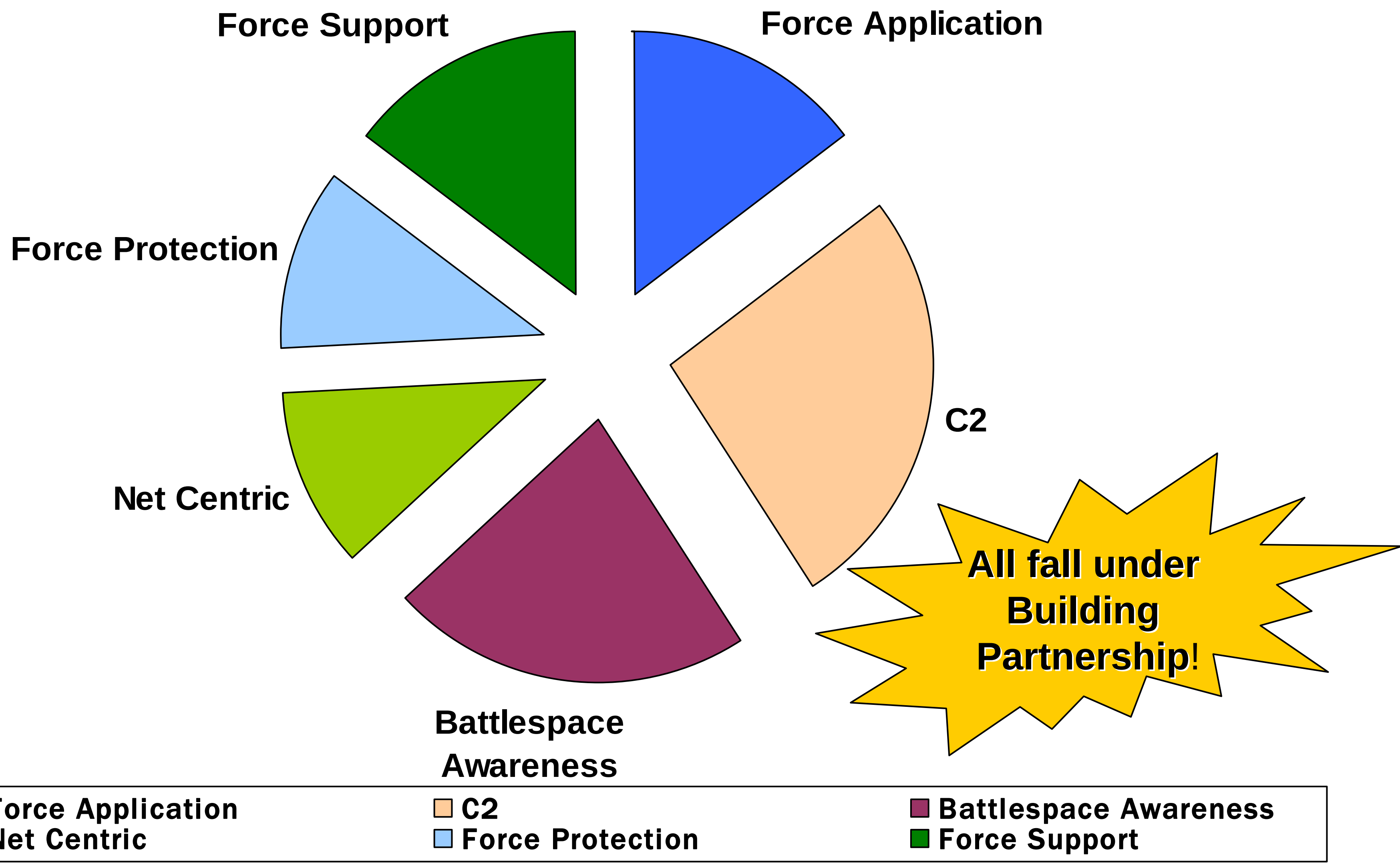
Sources for CWP Project Ideas

- Current relationships
  - Bilateral and Multilateral Forums
  - Ongoing development programs
  - Existing international agreements
  - Information Exchange Agreements
- Networking
  - International conferences
  - Joint Capability Technology Demonstrations
  - CWPs can add an international element to an existing JCTD or jump start a new effort

Paths for Getting Involved

- After generating project idea:
  - U.S. government offices should engage:
    - CWP Office
    - COCOM/Agency S&T Offices
    - Service International Program Offices
  - U.S. industry should engage:
    - Service or COCOM POC with interest in project and funding to contribute
  - Foreign government offices should engage:
    - U.S. Embassy Office of Defense Cooperation/Office of Security Assistance
    - Appropriate OUSD(AT&L)/International Cooperation Desk Officer

Current portfolio by Joint Capability Area (JCA)

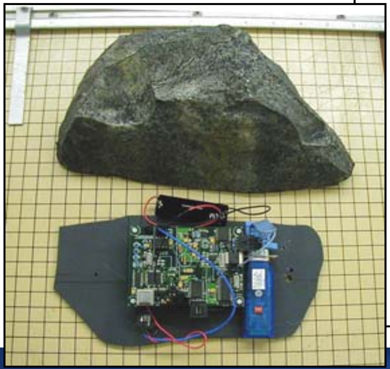


Project Examples

Force Protection

Passive and Active Detection of Special Nuclear Material(09-10)

Demonstrate near-term passive detection systems for stand-off detection of kilogram quantities of special nuclear material and interdiction team capabilities to locate and identify materials



Battlespace Awareness

Tactile Situational Awareness System (08-09)

Garment containing tactile stimulators that intuitively provides SA to pilots (useful for brownouts). Developing an extended torso application to provide pitch and roll and hover SA.

Advanced Dynamic Magnetometer for Static and Moving Applications (08-09)

Develop an advanced, low cost, rugged, easily disguised networked magnetometer for persistent battlefield surveillance and detection of moving magnetic signatures. Capability to “see” through walls, harbor and littoral protection

Command and Control

US JTRS Bowman VHF Waveform (02-03, 08-09)

Waveform to allow communication with UK Bowman system. Successfully demonstrated, currently in JTRS waveform library; porting testing in FY09. Requirement in next phase of JTRS program

FBCB2/SIR Interoperability Solution (08-09)

Cooperative project with France to exchange C2 data and information between two coalition battle command systems

Project Examples

Combat Identification

International Recognition of Combat Vehicles (09-10)

Collect and process imagery (visual and thermal, ground and air to ground) of coalition platforms for improvements to ROC-V training system

Mode 5 Identification Friend or Foe (IFF) (04-08)

Cooperative development and testing. Includes development and integration testing on AWACS and coalition platforms

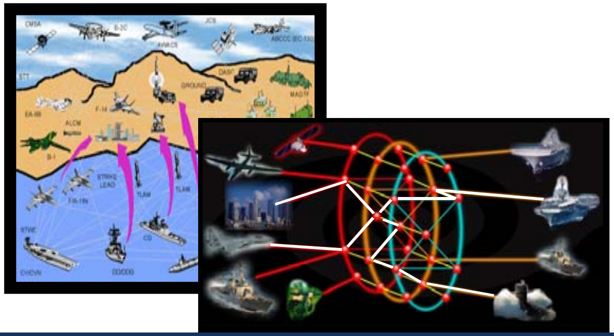
Maritime Domain Awareness

Multinational Information Exchange (FY06-07)

Secure architecture and certified rule sets for exchange of COP data with Singapore

Virtual Regional Maritime Traffic Center (FY08-09)

Maritime security project to share unclassified date with SOUTHCOM partners



Planning and Application

Multinational Turnkey C2 (FY08-09)

Support to NATO ACT to develop coalition C2 architectures and mission templates to improve JTF formations. Focused on NRF, specifically in ISAF

Leadership and Commanders Intent (FY06-07) and Optimizing Coalition Leaders (08-09)

Human Behavior studies on working with coalition partners in a net centric environment. Results will populate databases for acquisition and operational planning

Achieving Coalition Interoperability

- Warfighters need effective coalition partners
  - 2006 QDR Report: Building Partnership Capacity
  - COCOM Theater Security Cooperation Annexes
  - USD(AT&L) aims to increase interoperability with allies and partners
- Interoperability gaps have compromised operational effectiveness and jeopardized force protection (e.g., fratricidal incidents)
- R&D cooperation with coalition partners helps close capability gaps
- Small investments early in the R&D process can yield large dividends (e.g., Joint Strike Fighter)

Desire for strategy driven cooperation
Services focus on Service-unique issues first
Combatant Commanders lack discretionary funding

→ **Need for Coalition Warfare Funding**

Contact Information

Obtain more information at:

www.acq.osd.mil/ic/cwp.html

Contacts:

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Mr. John Noulis
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703-602-5817

CWP Project Timeline: Nomination/Selection Phase

	Project Manager	Partners	Sponsors	CWP Team
Jul				
Aug	Conduct Groundwork:			Release Call Memo
Sep	• Develop ideas		Distribute Call Memo	Kickoff Conf.
Oct	• Identify sponsor, funding			
Nov	• Work with international programs offices for any agreements required			
Dec				
Jan	Submit Executive Summary			Provide Feedback
Feb	Submit Final Nomination Packages			
Mar				Conduct Evaluation:
Apr				• Get feedback from SMEs, Embassies
May				• Compare nominations to needs/gaps
Jun				Announce Decisions
Jul	Submit Statement of Work, Updated Project Spend Plan, Quad Chart	Negotiate and Sign Agreements		
Aug				
Sep				

CWP Project Timeline: Execution Phase

Month	Project Manager	Sponsor	CWP Team
Oct			
Nov			
Dec			Disburse Funding (Timing dependent on congressional action on defense budget)
Jan			
Feb	Obligate Funding ASAP		
Mar			
Apr			
May			
Jun			
Jul			
Aug	Submit Updated SOW, Spend Plan, Quad Chart	Track Project's Status	
Sep			
Oct			
Nov			
Dec	Submit Monthly Expenditure Reports		Disburse Funding (Timing dependent on congressional action on defense budget)
Jan			
Feb	Submit Quarterly Status and Expenditure Reports		
Mar			
Apr			
May			
Jun			
Jul			
Aug	Submit Final Project Report		
Sep			

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Robotic Systems

Jeff Jaster
Deputy Associate Director for Autonomous Systems
US Army TARDEC – Intelligent Ground Systems

Robotics Life Cycle

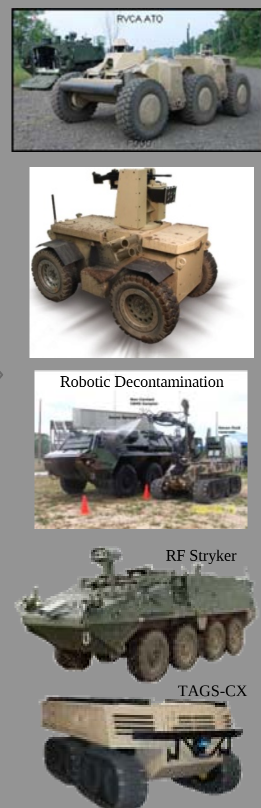
Mission

Integrate, Explore, and Develop Robotics, Network and Control Components with a Focus on Customer Driven Requirements to Provide Full System Solutions to the War Fighter

Technology Components

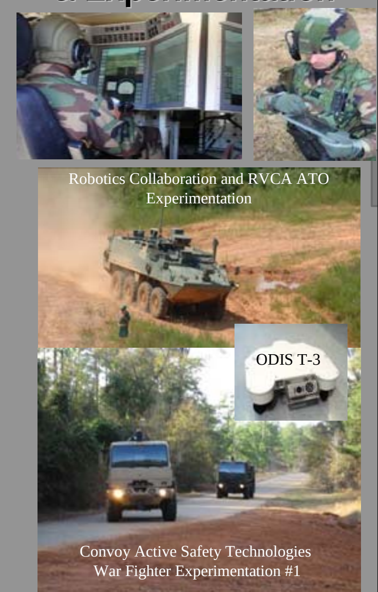
Integration

Demonstrators



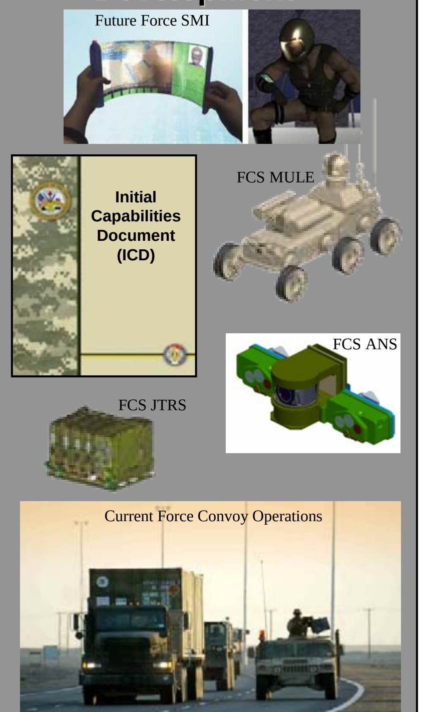
SME Defined Scenarios

Military Relevant Test & Experimentation



Tech Transfer

Transition and Requirements Development



Integration Technology Development Lessons Learned to Enable Early Technology Insertion

Hard On-Road Problems

Very busy environments

Other vehicles

Pedestrians

Poor lane markings

Animals

Potholes

Traffic signals

Road work

Hard Off-Road Problems

Very cluttered environments

Mud, ice, snow, gravel and other traction problems

Deep water

Sharp rocks, rebar, curbs

Tank traps

Wire, posts, and fences

Hidden hazards: rocks and holes

Fog, dust, smoke, rain

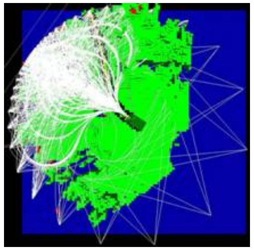
RDECOM

Robotics Research Areas

TARDEC

Safe Operations and 360° SA

Tactical behaviors

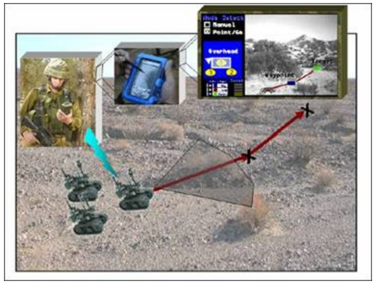


Platform Mobility

High-Speed Tele-operation

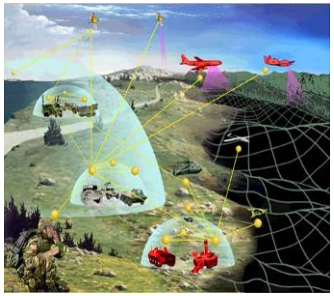
UGV – Soldier Interfaces

Autonomous Control

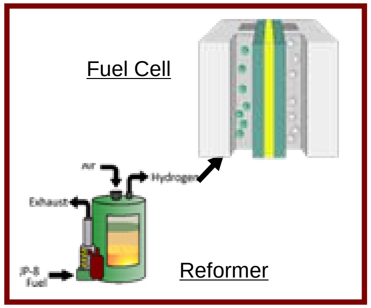


Arm and Manipulator Articulation

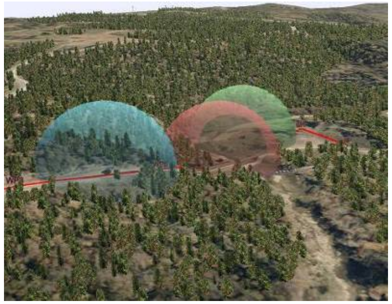
Communications



Power Management



Non-LOS SA



From Basic Research to Advanced Development

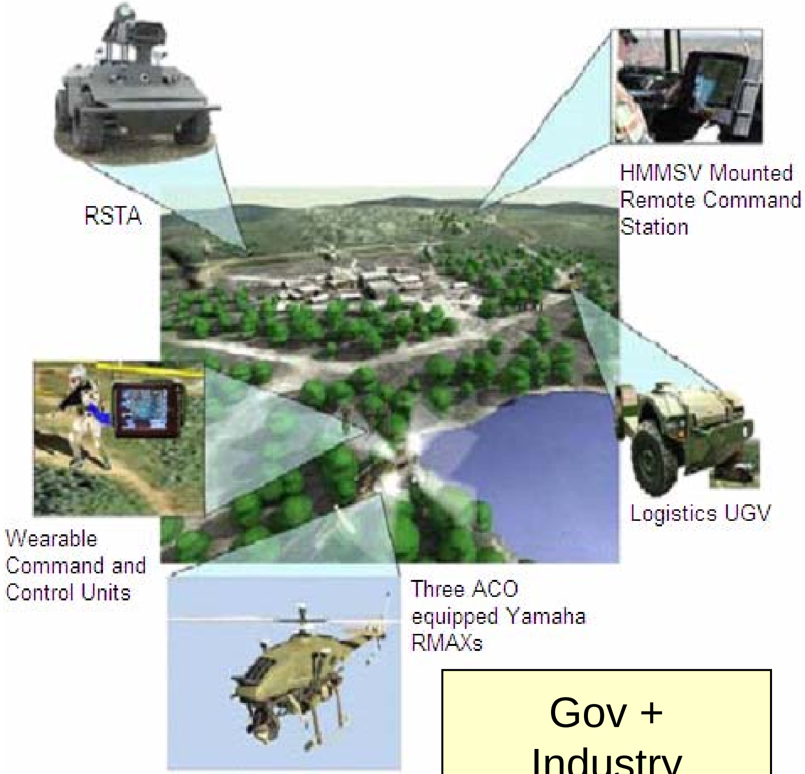
Basic Research	*Applied Research*	**Advanced Development**

Adaptive Coordinated Control of Intelligent Muti-Agent Teams MURI
Army Research Office

Univ + Gov

Robotics CTA
Army Research Lab

Univ + Gov + Industry



Gov + Industry

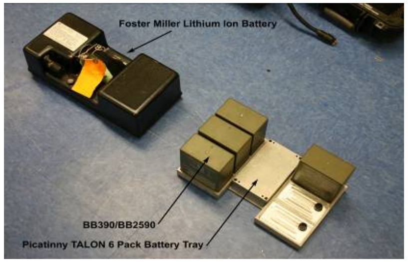
Unmanned Autonomous Collaborative Operations
Research Development & Engineering Centers

Science & Technology to Meet Soldier Needs

Support for Current Operations

Man Transportable Robot Systems (MTRS) Upgrades

W̲ide A̲ngle R̲emote V̲iew camera
180 degrees x 360 degrees.
standard camera is: 54 degrees

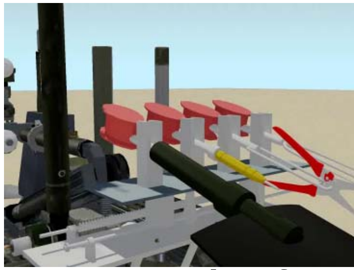


TALON BB-390/BB-2590
Battery Upgrade"6-PACK"
-increase run time by 2 hrs

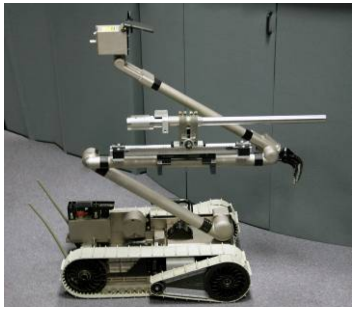
Head Aimed Remote Viewer for EOD robot

Improving MTRS to Aid Soldier

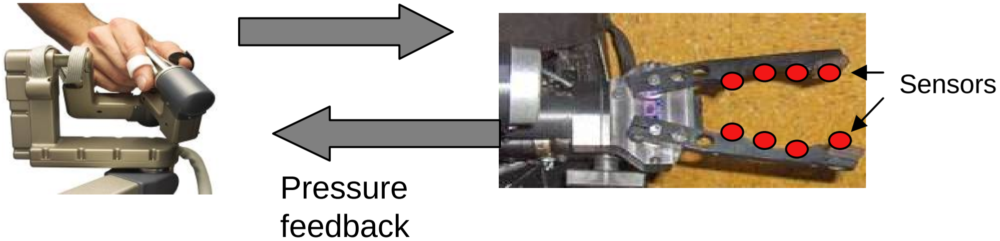
- Dexterous manipulation
- Advanced control capabilities
- Extended time on station



Autonomous Grasping for Talon Robot: Tool Retrieval



EOD Disrupter Integration onto MTRS Robots



Haptic Feedback for Talon Robot Gripper

Support for Current Operations

Construction Engineering Robotic Kit (CERK)

Under-vehicle Inspections

Remote Mine Detection System

Convoy Active Safety Technologies

Robotic Decontamination

LTG Lynch and III Corp Developments

Unmanned Systems Technology Transfer

Rapid, Precise, Supportable Technology Development and Refinement to Meet Soldier's Needs.

- **Sense of urgency**
- **Communicate the vision**
- **Empower action**
- **Create short-term wins**
- **Persistence**

- Autonomous Detection Vehicle (Husky)
  - Capability for Supervised Autonomous Husky
- Autonomous VOIED Defeat Robotic Capability
  - Capability for Agnostic Autonomous Wheeled Vehicles
- Convoy logistics
  - Capability for Robotic Convoy Vehicles
- Persistent Stare
  - Capability for Autonomous ISR
- Robotic Wingman
  - Capability for any Tactical Vehicle to Become a UGV

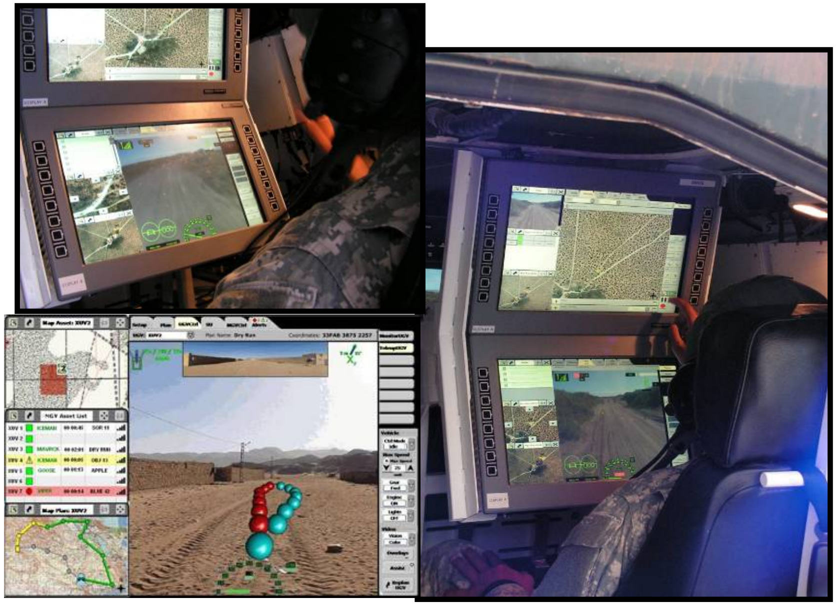
LTG Lynch's Vision: **ONS/Requirements, Implementation Plan, Maximize Modeling and Simulation**

Recent Warfighter Experiments

Near Autonomous Unmanned Systems
ATO Capstone

Robotic Vehicle Control Architecture

Convoy Active Safety Technologies (CAST)



Robotics Collaboration ATO Capstone

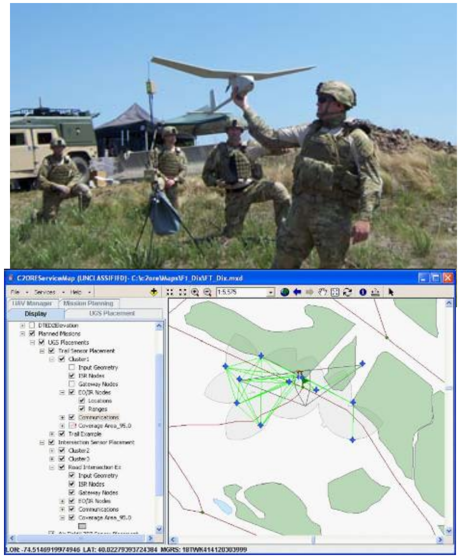
Future Force Technologies

Robotics CTA – Technology for Near Autonomous Systems

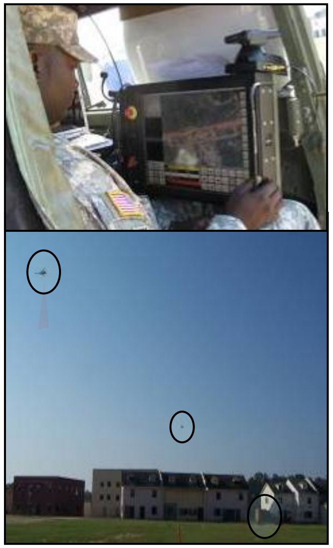
Robotic Platform for Engineer Missions

MAST CTA - Small “Creatures for Urban Terrain”

Robotic Vehicle Safe Operations



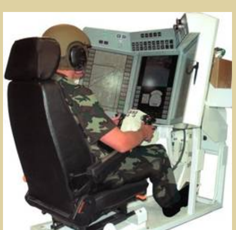
Command & Control of Robotic Entities



Air-Ground Collaboration

Crewstation Advancements

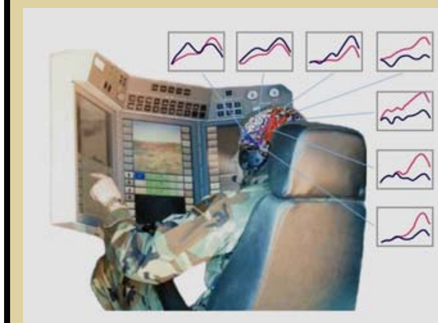
PAST
•Workload reduction
•Embedded crewstation



PRESENT
•Robotic control (mounted, dismounted)
•Driving aids (Soldier assist)
•Scalable, portable Interface

Dismounted Controller

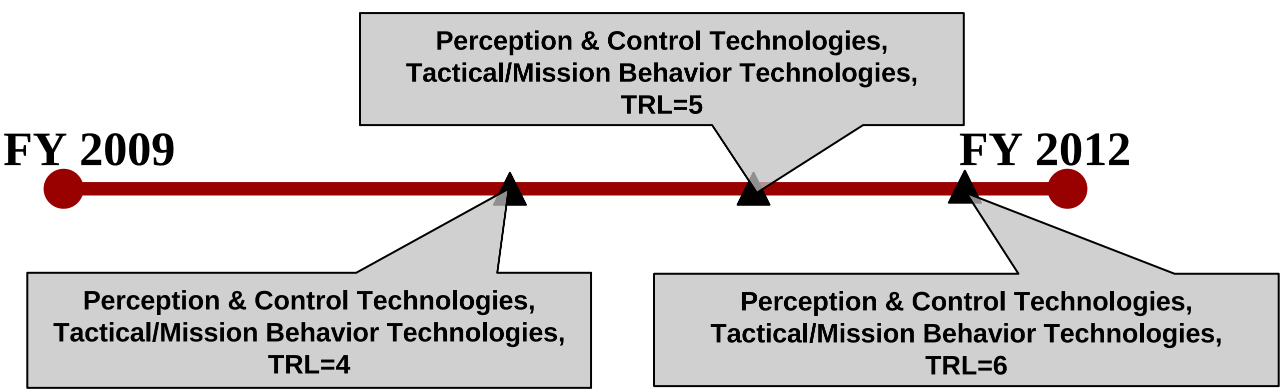
FUTURE
•Soldier monitoring and task assist
•Intelligent agents
•360 degree situational awareness



Safe Operations of Unmanned systems for Reconnaissance in Complex Environments (SOURCE) ATO

ERDC TARDEC ARL

- Safer operations of UGVs in proximity to pedestrians and vehicles
- Increase in vehicle autonomy to enable less supervisory burden
- Increased UGV situational awareness
- Robust Soldier/robot and robot/robot teaming behaviors
- Robust UGV performance in all environments/conditions
- Simulation of platform, payload and algorithms in relevant operational environment



Improved Mobility and Operational Performance through Autonomous Technologies (IMOPAT) ATO

360/90 Day/Night
Near-field Sensor Coverage

Soldier Monitoring
& State Classification

Advanced
Crew Stations

Enhance, Integrate and Demonstrate 360/90 LSA/Assisted Mobility/Human Dimension to Maximize Indirect Vision 360/90 LSA and Mobility Capabilities (Secure Mobility)

- **Focus on closed-hatch operations, indirect vision**
- **360/90 degree local area awareness**
- **Improved mobility via non-LADAR and LADAR based solutions**
- **Improved assessment and integration of operator performance in real-time**
- **Increase situational awareness for all crew members**

FY 2009 — **FY 2012**

TRL 4 — **Integrate Threat Detection & Cueing**

TRL 5 — **Integrate High Resolution Imager**

TRL 6 — **Interface Crewstation Warfighter Interface**

LSA sensor system

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

unclassified

Robotics Way Ahead – Current to Future

- Affordable common robotic kit for manned/unmanned operations of current force vehicles
  - Incremental insertion of safety and automation capabilities
- Manned-unmanned and UAV-UGV collaboration for enhanced company operations
- Open systems architecture and joint interoperability
- Multi-mission capable family of robotic platforms
- Safe semi-autonomous operations in complex/dynamic environments
- Scaleable autonomy based on terrain and mission understanding
- Robotic security for maneuver elements

- **Focused on the Soldier**
- **Applying Today's Technology for Immediate Results**
- **Developing Technology for the Future to provide U.S. Forces a Vital Edge**
- **Partnering with Others to Insure the Best Available Materiel for Our Troops**

RDECOM

Questions

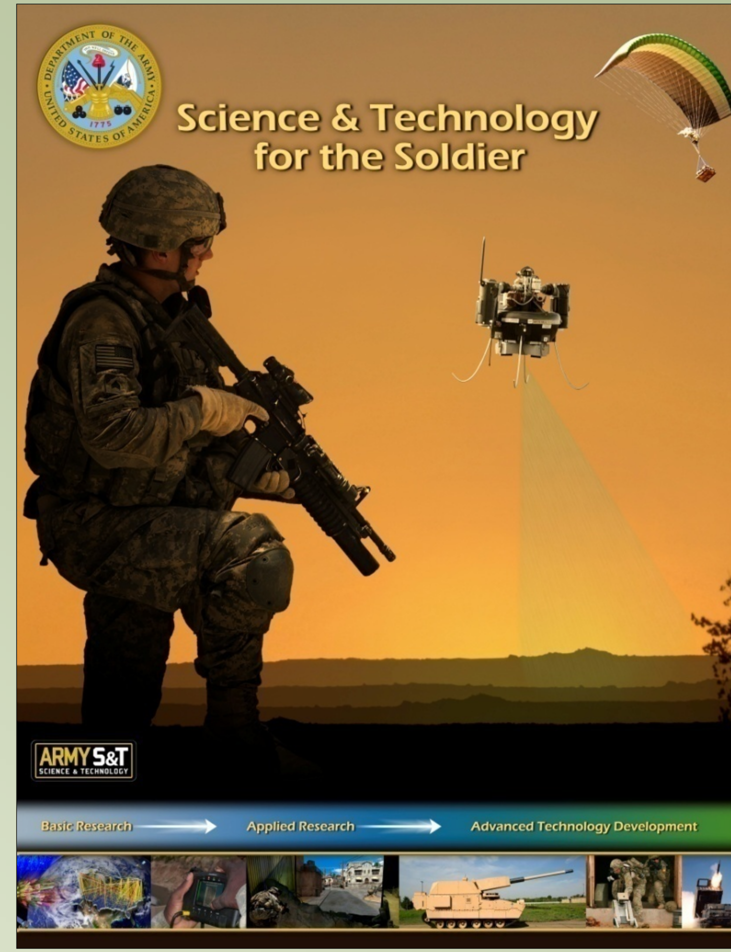
TARDEC

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Army
Science & Technology

NDIA

10th Annual Science & Engineering Technology Conference



Empowering Soldiers through High Technology

21 April 2009

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Deputy Assistant Secretary of the Army for Research and Technology/ Chief Scientist

Overview

- *Army Science and Technology (S&T) strategy*
- *Army S&T Priorities*
- *Science for Disruptive Technology*

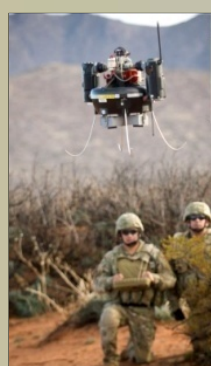
Strategy—what is Army S&T working to achieve

Foster innovation and accelerate/mature technology to enable Future Force capabilities while exploiting opportunities to rapidly transition technology to the Current Force

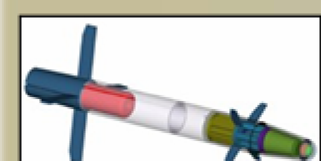
Current Force

Modular Protective Systems

Add on Armor for Tactical Vehicles



Micro Air Vehicle

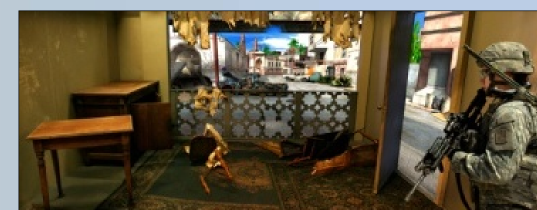


120mm Mid-Range Munition

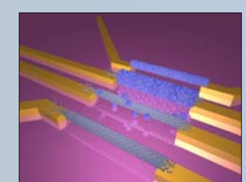
Enabling the Future Force

Enhancing the Current Force

Future Force



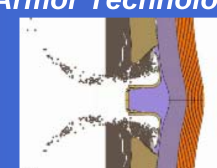
Immersive Training



Virus-based Self-Assembling Electrodes—Advanced Batteries

Wearable Flexible Displays

Armor Technology

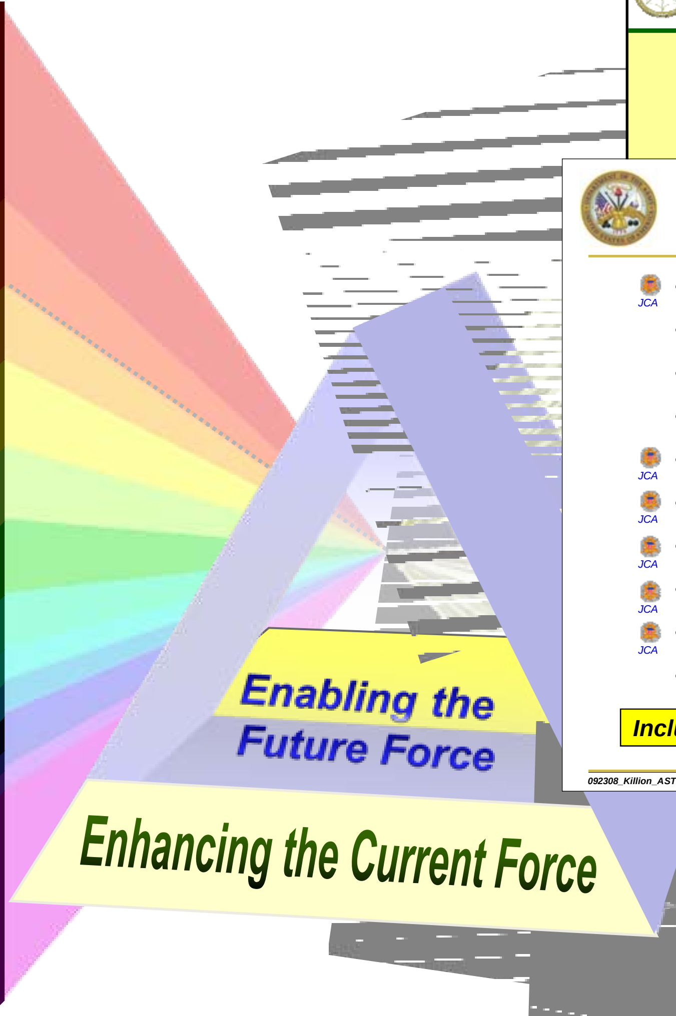


Armor Kit

Technology Area Investments

FY09 $1.8B

- *Force Protection $370M*
- *ISR $149M*
- *C4 $144M*
- *Lethality $161M*
- *Medical $140M*
- *Soldier $135M*
- *Logistics $92M*
- *Rotorcraft $72M*
- *Classified $62M*
- *Unmanned Vehicle $54M*
- *Mil Eng & Environment $47M*
- *Advanced Simulation $37M*
- *Basic Research $379M*



List of 37 Tier One Warfighter S&T Outcomes (1 of 2)

- Battle Command Network*
- Counter IED and Mine*
- Power & Energy*
- Human Dimension*
- Training*

"Big 5" Integrated Warfighter S&T Outcomes

- Force Health Protection Initiative
- Increase control of unmanned systems
- Future Force Multi modal Human Computer Interface
- Increase Future Force Soldier Cognitive Functions While Under Stress
- Language and cultural awareness
- Dismounted soldier virtual training environment
- Adaptive training system

6

10 Comprehensive Warfighter Outcomes— includes "Big 5"

- JCA • Battle Command Network
- • Counter IED and Mine
- • Power and Energy
- • Human Dimension
- JCA • Training
- JCA • Force Protection
- JCA • Battlespace Awareness
- JCA • Force Application
- JCA • Logistics
- • Unmanned Systems Operations

Includes all Army Tier I Outcomes—aligned with S&T portfolio

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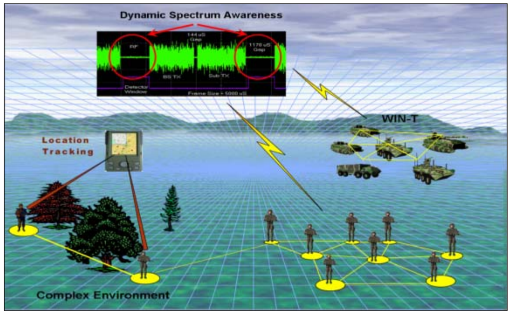
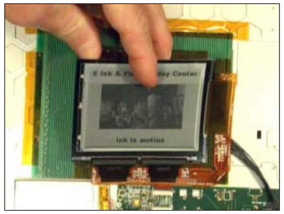
S&T Strategy for Battle Command Network

- ***Robust communications systems***

  - *Dynamic spectrum management*
  - *Antennas (e.g., Directional, SATCOM, Multifunctional)*
- ***Information assurance***



  - *Network and Data security*
  - *Intrusion detection/mitigation*
- ***Timely geospatial awareness***
- ***Knowledge Management***



  - *Decision aids*
  - *Intelligent agents that extract data for critical combat functions*

Enabling Command and Control On-the-Move

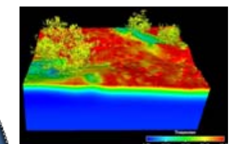
Technology for Counter-IED

RKG-3 EFP Grenade Trainer

Dynamic Mine Clearing - SBIR Program

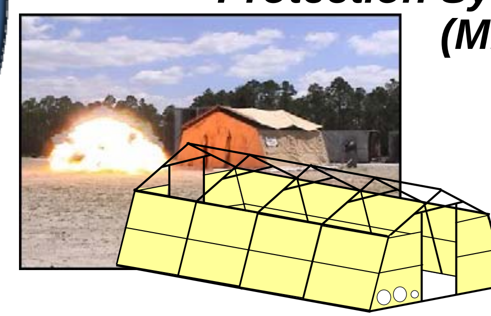
IED/Mine Detection for In Road Threats

Recognition of Combatants - IED



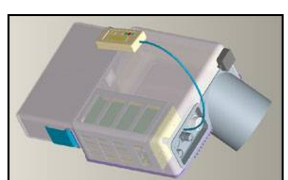
Near-Surface & Countermine Phenomenology

Modular Ballistic Protection System (MBPS)

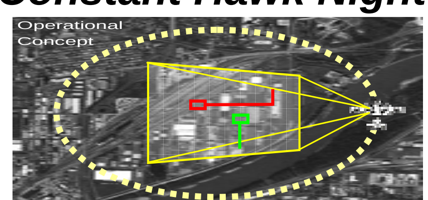


Ghost

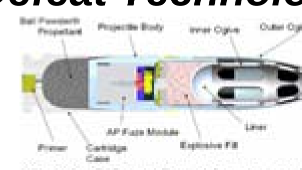
Wizard Dismounted CREW System



Constant Hawk Night

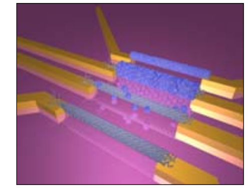


Standoff Mine/IED Defeat Technology



S&T Strategy for Power and Energy

- ***Reduce platform energy consumption***
  - ***Lightweight materials***
  - ***Lower power electronics***
  - ***Unmanned vs. manned platforms***
- ***More efficient power sources***
  - ***Batteries with higher energy/power density***
  - ***Fuel cells***
  - ***Hybrid power sources***
- ***Smart energy management***
- ***Proactive thermal management***
  - ***Higher temperature materials***
  - ***Harvesting of thermal energy***
- ***Provide energy options (e.g., alternative fuels, solar)***

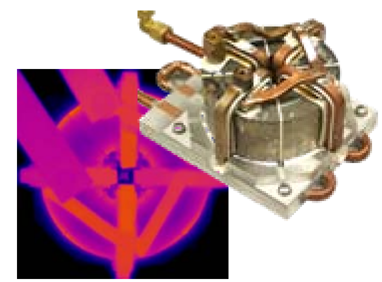


Virus-based Self-Assembling Electrodes

Low Power Color Helmet-mounted Display

Direct Methanol Soldier Fuel Cell

Vehicle Power Distribution



Vehicle Thermal Management

Reduce Fossil Fuel and Battery Demand

S&T Strategy for Human Dimension

- ***Comprehensive Soldier fitness***
  - ***Physiological (e.g., trauma treatments, prediction tools for physical damage assessment, vaccines and diagnostic systems for infectious diseases)***
  - ***Psychological (e.g., psychological well-being—Post Traumatic Stress Disorder and mild Traumatic Brain Injury)***
- ***Optimize Soldier cognitive functions—under battlefield stress and multitasking environments (e.g., Soldier system interface design – neuro-ergonomics)***
- ***Enhance recruitment and retention—develop tools/methods***
- ***Develop network-centric automated prediction, reasoning and decision-support tools***

Biomedical Research to Treat Traumatic Brain Injury

Spatial Cognition Experiment

Enhance Soldier Effectiveness

S&T Strategy for Training

- ***Accelerate Soldier learning***
  - ***Develop innovative tools and methods (e.g., intelligent tutoring/coaching, platform-scalable, culturally realistic, automated performance assessment)***
  - ***Tailorable training packages that are easily modified to address current events and mission needs***

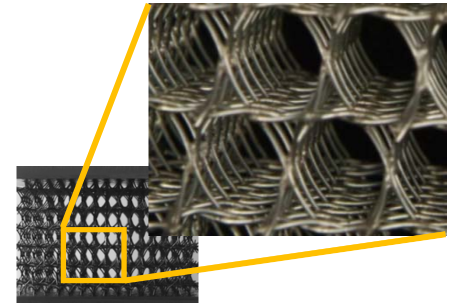
- ***Embedded training (mounted and dismounted)***

- ***Improve leader skills***
  - ***Investigate techniques that accelerate the development of skills to enhance decision making, build teams, lead complex organizations***
  - ***Identify leader skills, abilities, and effective behaviors in complex environments (e.g., culturally diverse scenarios)***

Efficient Soldier Need-based Training

S&T Strategy for Force Protection

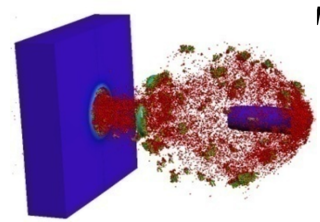
- *Soldier protection*
  - *Body armor*
    - *Flexible armor for extremities*
    - *Advanced helmet designs*
    - *Ballistic/blast thoracic protection*
  - *Ballistic and laser vision protection*
- *Platform protection*
  - *Armor (e.g., composite, reactive, electromagnetic)*
  - *Active protection (e.g., counter-munition, EW)*
  - *Platform design for crew/vehicle survivability (e.g., V-shaped hulls, blast resistant seats)*
- *Facility/area protection*
  - *Hardened structures*
  - *Entry control point protection*
  - *Defense against rockets, artillery, and mortars (RAM), UAVs, and missiles (e.g., high energy laser)*



Bio-Inspired Energy-Dispersive Materials

MRAP

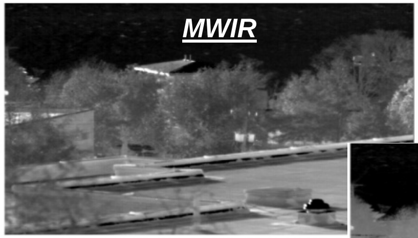
HMMWV Improvement Program



Macro/Meso-Scale, Mesh-Free Simulations of Protective Materials

S&T Strategy for Battlespace Awareness

- ***Persistent sensing***
  - ***Detecting (e.g., Electro-optic/Infrared, acoustic)***
  - ***Tracking (e.g., radars)***
  - ***Identifying (e.g., 3rd GEN FLIR)***
- ***Network exploitation and data fusion***
- ***Locate persons/items of interest***
  - ***Tactical biometrics (e.g., facial recognition)***
  - ***Tag, track, and locate (TTL)***
  - ***Combat Identification***
- ***Information operations***
  - ***Security/warfare***
- ***Signal detection***
  - ***Mapping and geo-location***

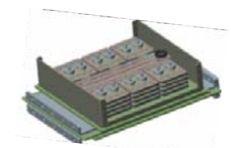


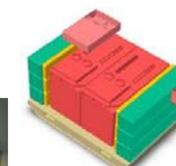
Reliable, Real-time Knowledge of the Battlespace

S&T Strategy for Force Application

- ***Multifunction precision lethality***
  - ***Precision munitions***
  - ***Warheads/energetics/insensitive munitions***
  - ***Scalable lethality***

- ***Pursue novel mechanisms***
  - ***Non-lethal weapons (e.g., high-power microwaves, directed energy)***



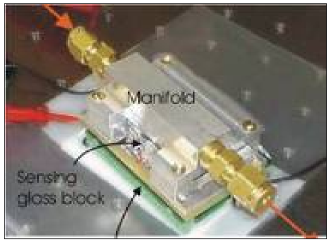


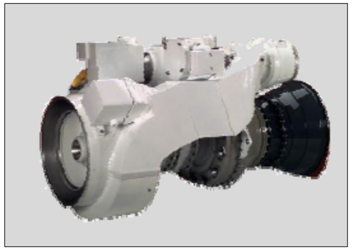
- ***Soldier weapons***
  - ***Lightweight weapon components/ammunition***
  - ***Wall breaching munitions***
  - ***Advanced Soldier targeting/sighting systems***

Scalable Precision Lethality—Minimize Collateral Damage

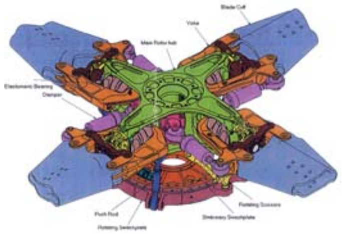
S&T Strategy for Logistics

- Reduce fuel and water battlefield delivery
  - Alternative energy sources
    - Diesel fuel reforming
    - Waste-to-energy conversion
    - Hybrid power sources
  - Water generation and purification





- Develop efficient turbine, hybrid engines and propulsion systems
- Comprehensive condition-based maintenance
  - Embedded prognostics/diagnostics
- Pursue lightweight materials technologies (e.g., composites, lightweight track)



- Improve precision delivery of Soldiers/equipment (e.g., air drop)

Reduced Fully Burdened Cost of Logistics

S&T Strategy for Unmanned Systems Operations

- ***Remove the Soldier from dangerous and "dirty" work through development of autonomous ground and air platforms***
  - ***Autonomous perception with high resolution, long range, 360 degree ability to detect and respond appropriately***
  - ***Autonomous/near-autonomous maneuvers and tactics in relevant environments and complex terrain (manned-unmanned collaboration)***
- ***Micro-autonomous Systems***

MAV

UGV

Packbot

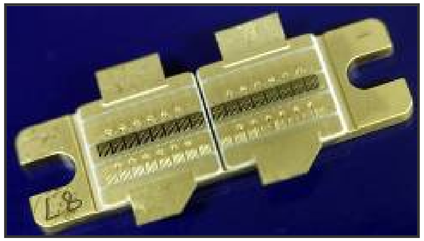
Nanoflyer

Micro Autonomous Systems Technology CTA

New Capabilities With Reduced Manpower

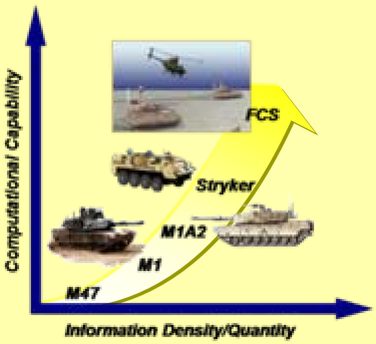
S&T Enabling Affordable Manufacturing

- ***Addressing concepts for manufacturing processes in fundamental research on materials—nanotechnology, biotechnology***
- ***Integrating technology development with manufacturing processes—flexible displays, MEMS IMU***
- ***Designing technology to facilitate affordable production—smaller, lighter, cheaper munition components***
- ***Aligning manufacturing technology investments with key technologies for future systems—armor, SiC switch technologies, IR focal plane arrays, batteries and RF electronics for FCS***
- ***Addressing manufacturing issues in support of programs of record—PAX-41(SPIDER Mine), UH-60 composite tailcone***



Complexity Demands Disruptive Technology

Ground Combat Vehicle Evolution

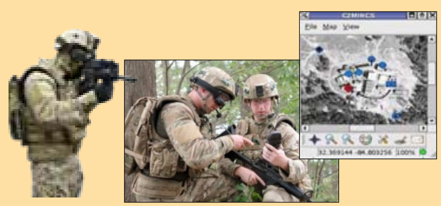


M47 Patton
- FM Radio
- Direct View Optics
- Engine Gauges
- Ballistic Periscopes

M1A2 Abrams
- Secure data/voice radio
- Thermal Viewer
- FBCB2 Digital Battle Command
- Digital Fire Control
- 1 Color/3 Monochromatic Displays

Soldier as System Evolution

Late 1960s Soldier
- FM radio
- Early I2 devices
- Binoculars
- M-16 with daylight scope

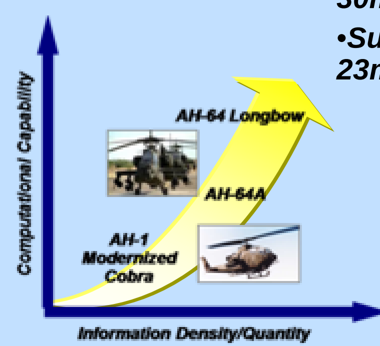


Future Force Warrior (FFW)
- Integrated body armor & equipment carriage suite
- Helmet mounted thermal imaging
- Radio digitally linked to unit communications network displaying individual locations
- Laser aided weapon precision fire control
- Embedded training

Helicopter Evolution

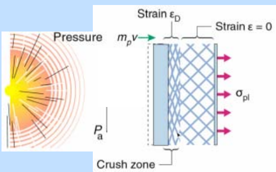
AH-1 G Cobra
- FM Radio
- Direct View Optics
- 2.75 inch rockets and 7.62mm machine gun

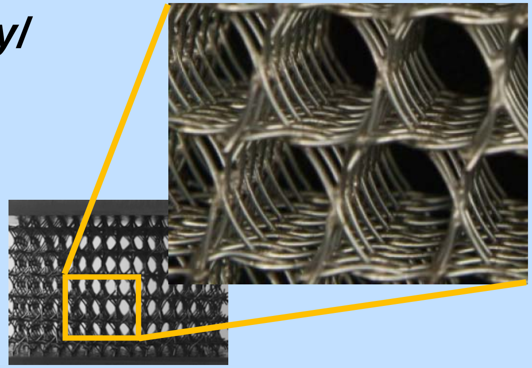
AH-64 Apache Longbow
- Secure data/voice radio
- Integrated pilot night vision system
- Digital fire control linking gunners view & weapons systems
- Longbow MMW radar
- Hellfire missiles and 30mm cannon
- Survivable rotors—up to 23mm AA



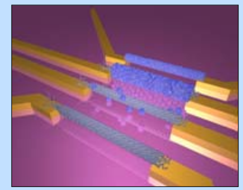
Science for Disruptive Technology

Nanotechnology/ Biotechnology





Bio-Inspired Energy-Dispersive Materials



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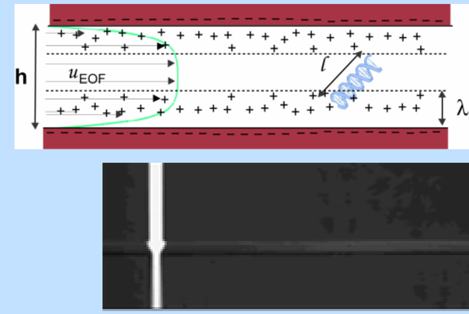
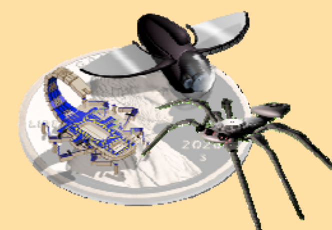


Nanofluidics

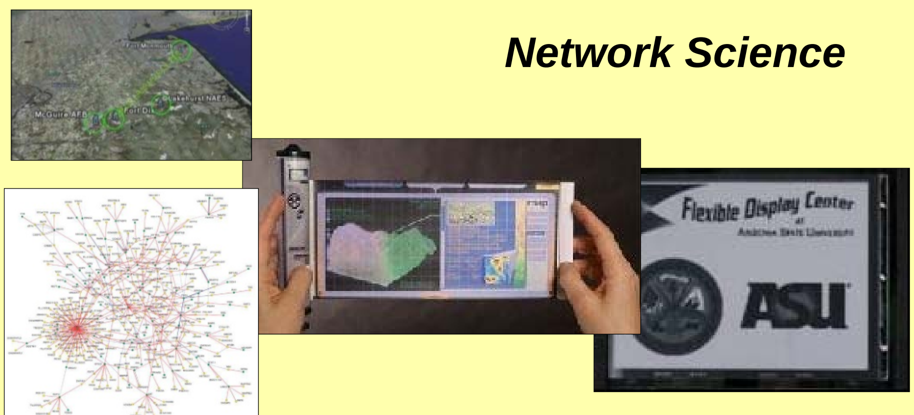
Autonomous Systems

Nanoflyer



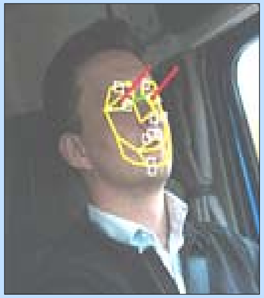
Micro Autonomous Systems Technology CTA

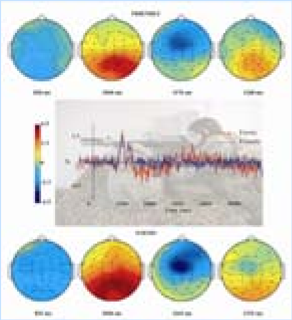
Network Science

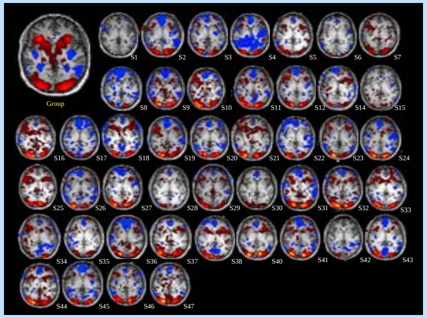


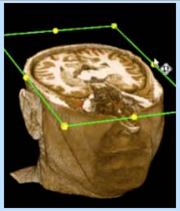
Science for Disruptive Technology

Neuroscience



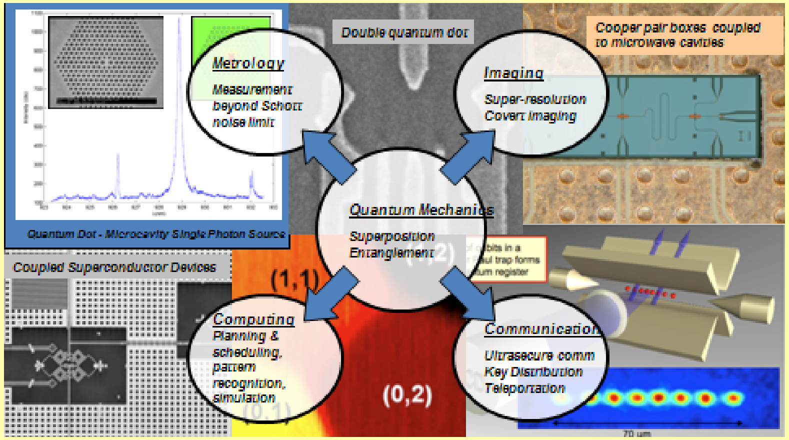






fMRI

Quantum Information Science



Immersive Technology

Basic Research Thrusts

Research in human engineered and biologically evolved networks to enhance network-centric operations

Research in learning, decision models and the functional brain to improve training techniques, human-machine interface design, and to more fully understand the decision-making process

Discover, develop and exploit robotic devices and systems to dramatically enhance Soldier survivability

Research to understand biological construction of novel materials, structures and processes to develop biologically-derived materials, sensing systems, information processing and power and energy

Revolutionize military training and mission rehearsal through the development of technology and art for simulation experiences and the development of virtual human technology

Generate advances in quantum sciences that will enable revolutionary approaches to information processing, cryptography, information assurance, and communication

Partnering—leveraging other Services, Agencies, Academia, Industry & International

Other Services
- *Air Force*
- *Navy/USMC*

Versatile, Affordable, Advanced Turbine Engine

PTSD treatment

Agencies
- *DARPA*
- *DTRA*
- *DoE labs*
- *DHS*
- *NIH*
- *NASA*

Micro Air Vehicle

NLOS-LS

Academia
- *Georgia Tech*
- *MIT*
- *Penn State*
- *USC*
- *UMd*
- *UC System*
- *Delaware*
- *Michigan*
- *Arizona State*

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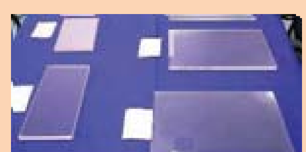
Industry
- *Primarily technology development to create options for PMs*
- *Small Business Innovation Research—solutions from non-traditional sources*
- *Army Venture Capital Initiative—dismounted Soldier power*

Transparent Armor–Technology Assessment & Transfer, Inc.



International
- *The Technical Cooperation Program (US, UK, CA, AUS, NZ)*
- *NATO Research & Technology Organization*
- *Bilateral Agreements (UK, CA, IS, FR, GE…)*

Co-investment with UK to advance state-of-the-art in network science

Fostering Science and Engineering Careers

Students participating in bridge building exercise at George Washington University

Student in bio-suit at Walter Reed Army Institute for Research

Junior Solar Sprint

Tomorrow's Technology is in the Minds of Today's Youth

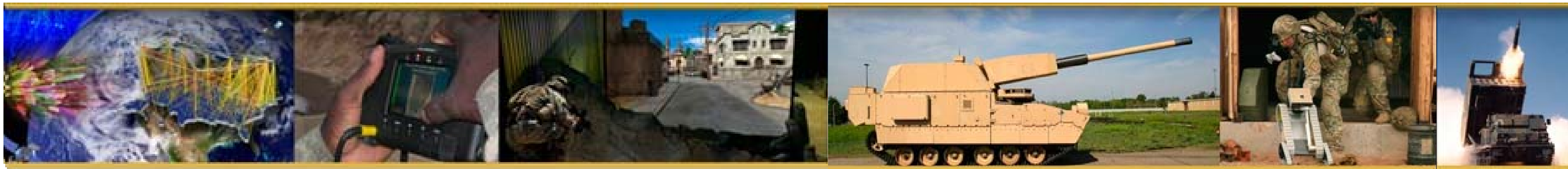
Summary

- *Investments are aligned to Army needs—emphasis on the future with an "eye" on the present*
- *S&T funding competes with other Army and DOD priorities*
- *The Army S&T enterprise includes—Army laboratories, other Services and Agencies academia, industry and international partnerships*
- *America's economic survival requires more students to seek science and engineering careers*

S&T strategic investments provide options for an uncertain future—inventing the possible

Army S&T…

Engine of Transformation



U.S. Army Armament Research, Development and Engineering Center 2007 Malcolm Baldrige National Quality Award

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Office of the Secretary of Defense

Acquisition, Technology & Logistics

Defense Research & Engineering
Plans & Program Office

Conceptual Framework

for

Military Capability Development

Mike Knollmann
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Kurt Kratz
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Defense Capabilities Enterprise:

Diversified Force Generation Roles, Diversified Force Employment Needs

Organize, Train & Equip

Operationally Employ

…and increasingly, complex operational partners: NGB, inter-agency, coalition, NGO

Combatant Commander Science &Technology Staff: Diversified Roles, Diversified Needs

Variety of roles/titles

- Science &Techology (S&T) Advisor
- Research, Development, Test & Evaluation (RDT&E) Programs Liaison
- Concept Development Lead
- Capability Development Lead

Variety of organizational structures

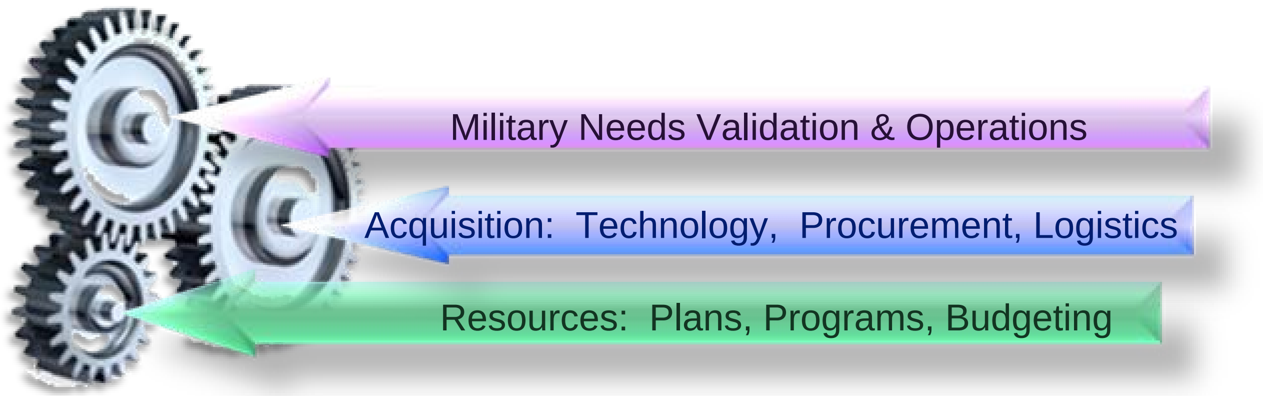
- Reporting to Deputy Commander, Chief of Staff, J8/Resources, J9/Experimentation
- Single/multiple science advisors on HQ staff

Variety of resource support

- Executive agency Service / parent service support
- Experimentation support
- Working capital fund support
- Rapid reaction acquisition programs support
- Operational needs processes

Aligning the Domains: Defense Engine for Capabilities

All three domains must be aligned & engaged to deliver capabilities



The challenge for Combatant Commanders:

- They exist in the authority domain of Military Needs & Operations
  - Joint force needs are predominantly expressed through CJCS
  - Only US Special Operations Command has force development acquisition authorities
- They rely on Services for preponderance of force capabilities
  - "Force Integration" / "Force Provider" services performed by USJFCOM
  - USJFCOM translates joint force needs into force fill requirements for Services
- They rely on Services for HQ resources through legacy Executive Agency provisions
- They have limited manpower to participate in needs, acquisition & funding processes

Needs to Solutions: Processes & Roles

PPBES:Program – Budget Process

Needs Process

1. Develop & specify needs
2. Review & comment on budget-based programming and acquisition solutions
3. Allocate resources to joint/combatant commanders

Needs Roles

CJCS/JCS

CoComs – Including USJFCOM

Joint Staff

Military Staffs

CoCom/Component Cdr Staffs

Acquisition Solutions Process

1. Consult with needs authorities in development of acqusition solutions
2. Acquire material solutions based on validated needs and budget-based programming
3. Deliver resources (acquisition products) for allocation to joint/combatant commanders

Solution Roles

USD (AT&L)/DAE

Service Secretaries/SAEs

OSD (AT&L) Staff

Service Secretariat Staffs

Systems/Materiel Commands

Military Agencies

USSOCOM [special authorities]

Joint Capability Development Strategy – Framing Remedies

Identifying Military Requirements

Analyze capability gaps
- Lessons Learned / Warfighting Analyses

Characterize improvements: What is really required?
- Experiment…what DOTMLPF elements are needed?

Define in actionable terms
- Specify DOTMLPF elements or options

Understand DoD roles

Respect & leverage authorities

Needs ⇨ Requirements ⇨ Solutions

Framing the Solution Set

Headquarters enhancement
- Engage Executive Agency (military Service)?

Specific Component Force Development
- Specify Service partnership / component roles

Joint Force Capability Gap
- Pursue Functional CoCom partnerships

Use diversity of tools

Employ gapfillers

Remain flexible

Developing Specific Strategies

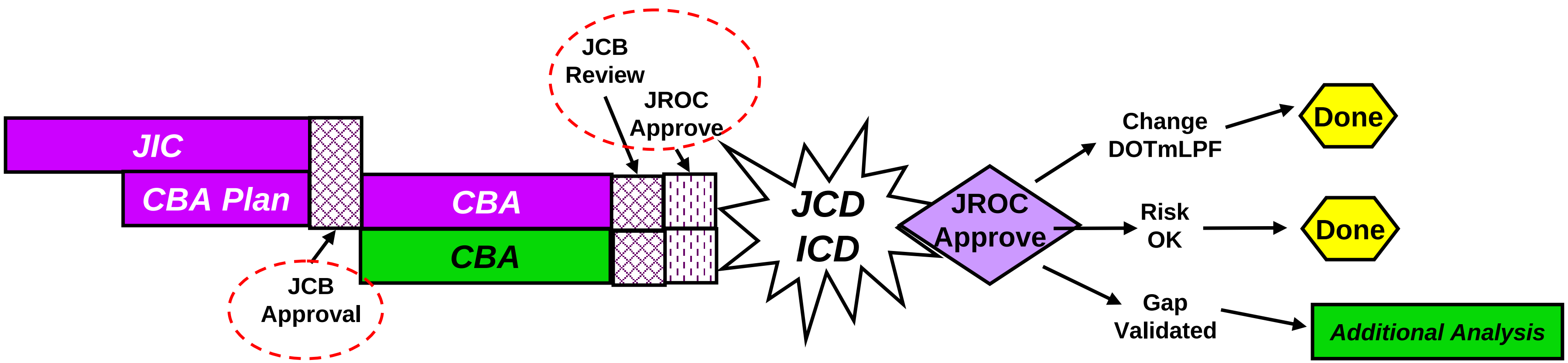
Address key gap-closing capability segments

Forge partnerships with strategy development
- Key element of resourcing & transition

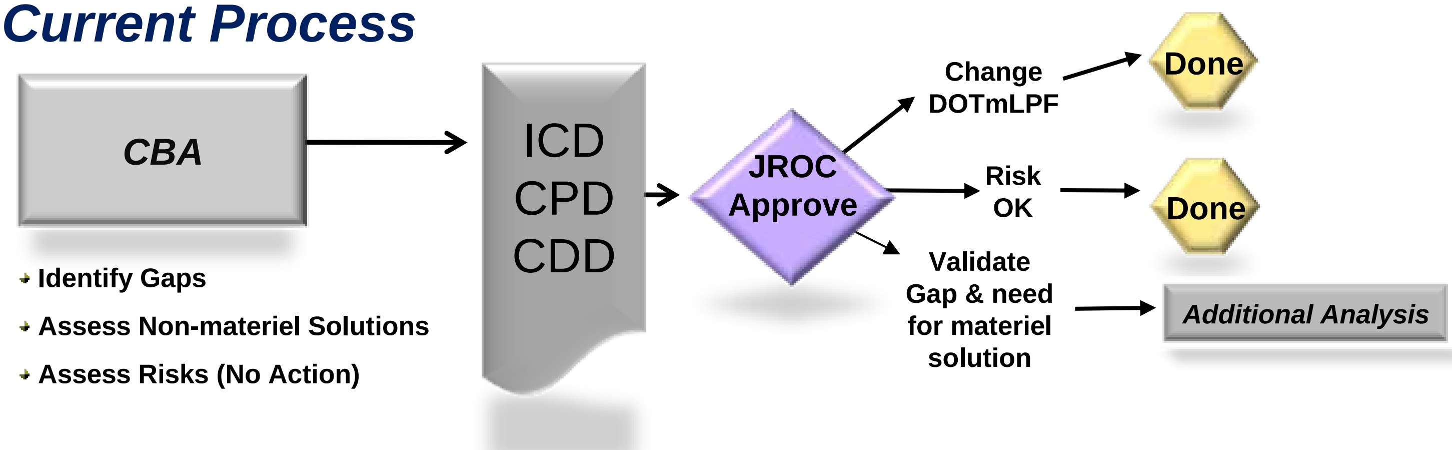
Stipulate timeline and phasing of deliverables
- Cite operational imperative for timelines

Restructure Capabilities Based Analyses (CBAs)

Former Process

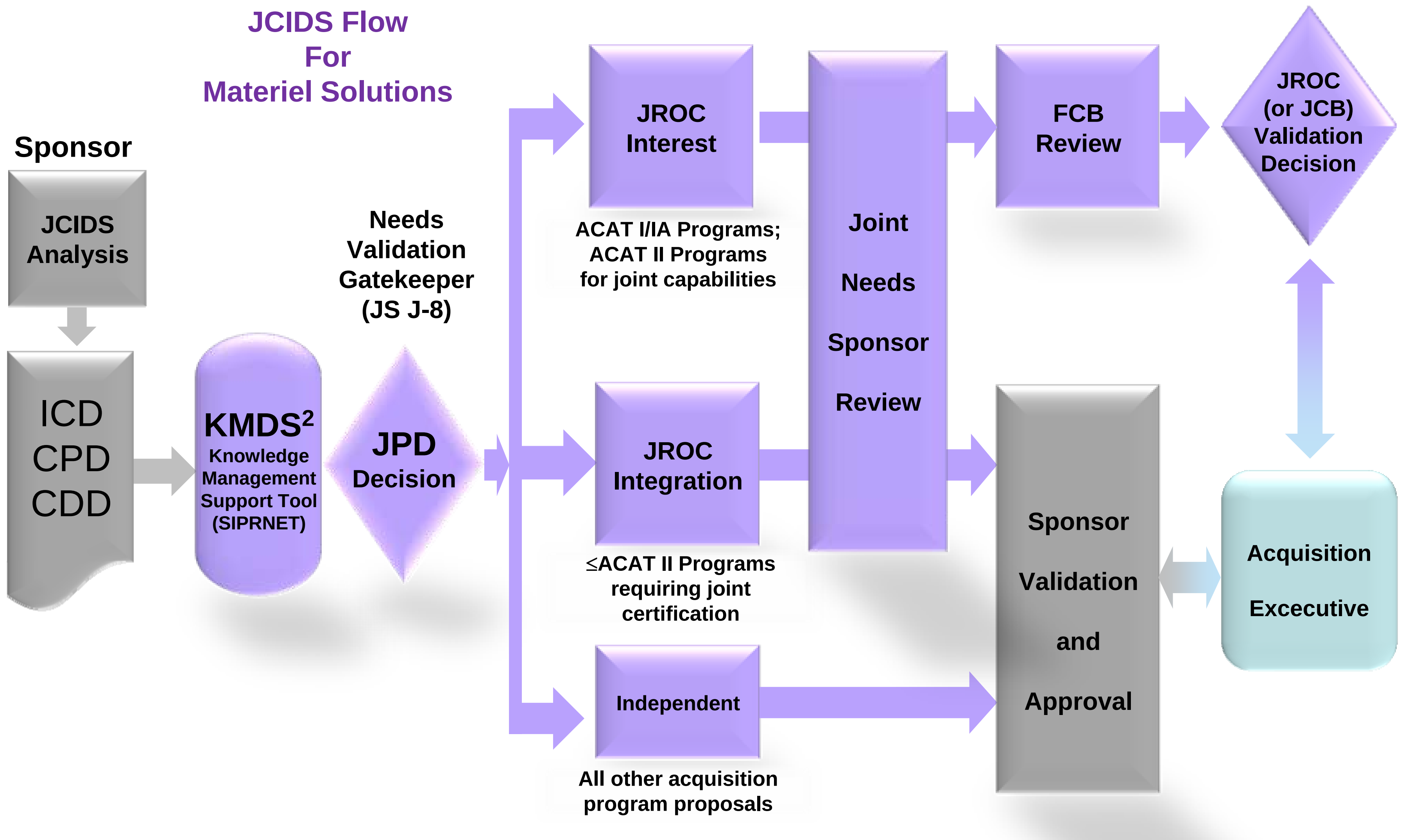


Current Process

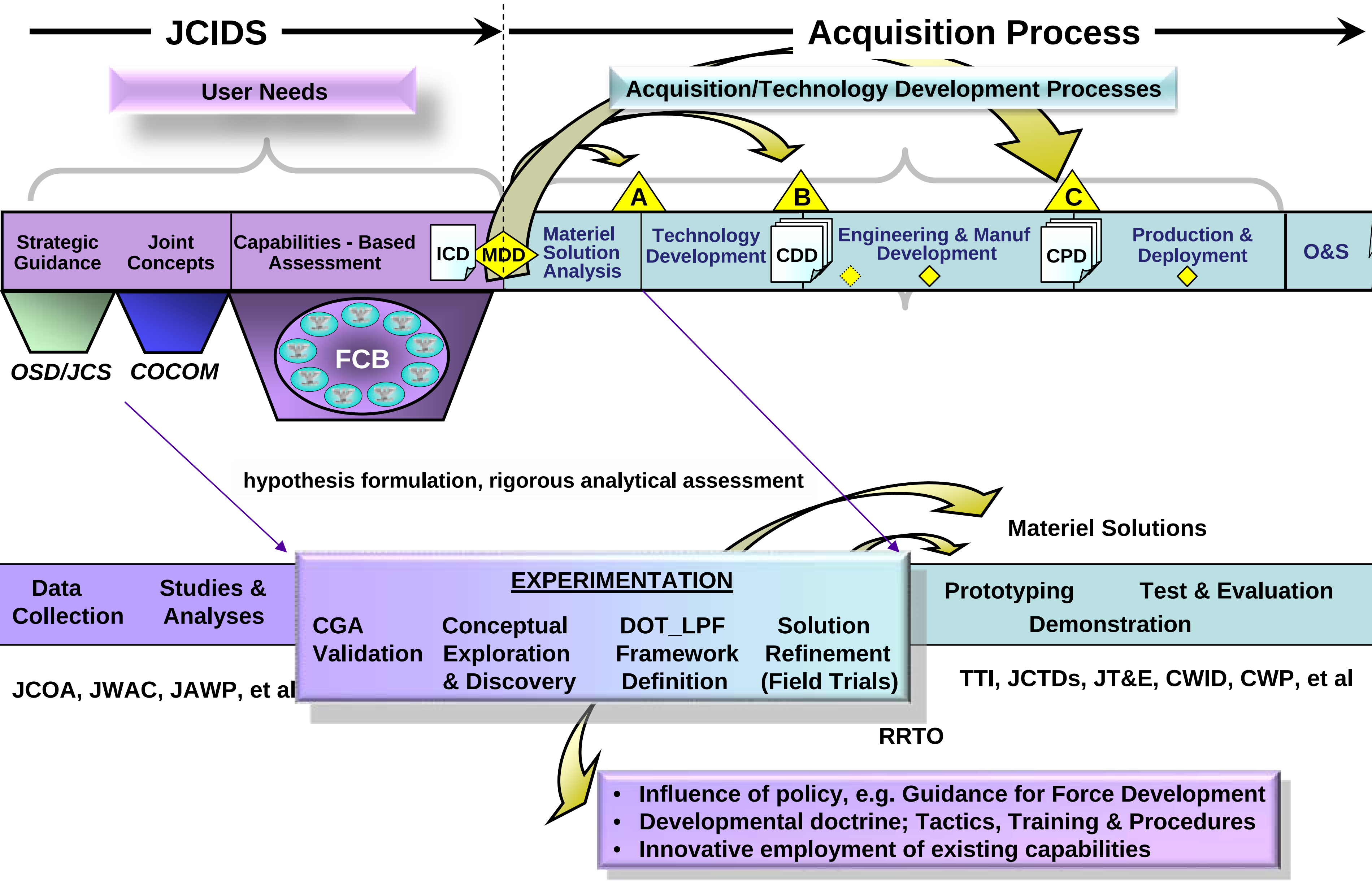


Streamline analysis and focus JROC decisions

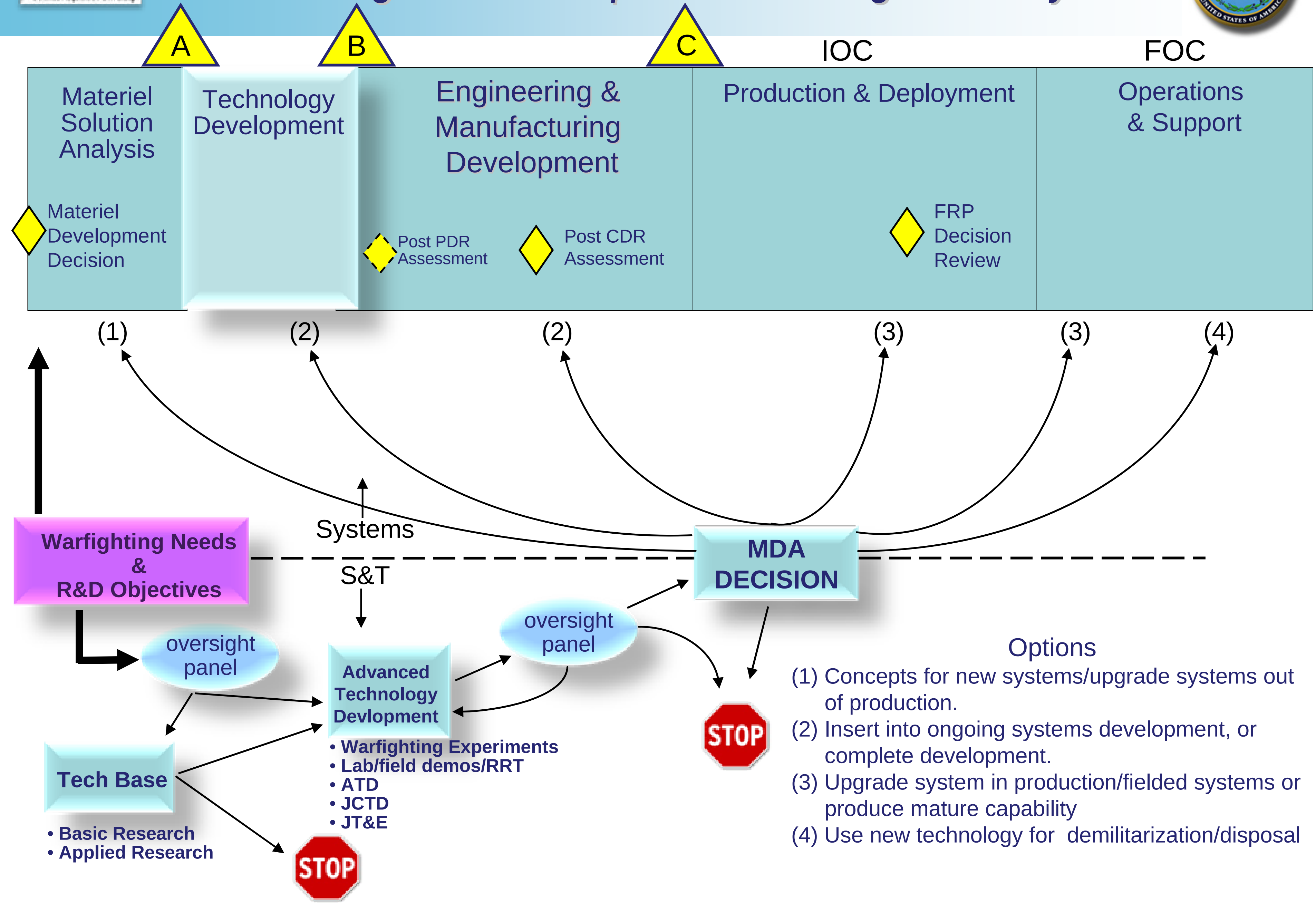
Military Needs/Operations Domain:
JCIDS Joint Operational Needs Process Overview



Defining Defense Experimentation



S&T Linkage to the Acquisition Management System



Development Model for Acquisition Solutions

more

Maturity of Operational Concept and Technology

less

Transition to Procurement & Sustainment

- Joint Training

Readiness & Suitability Confirmation

- Test & Evaluation
- Military assessment of utility

Functional Validation; Tailored Form/Fit/Function

- DOTMLPF construct development and confirmation
- Demonstration

Technical Concept Design & Development

- Prototyping

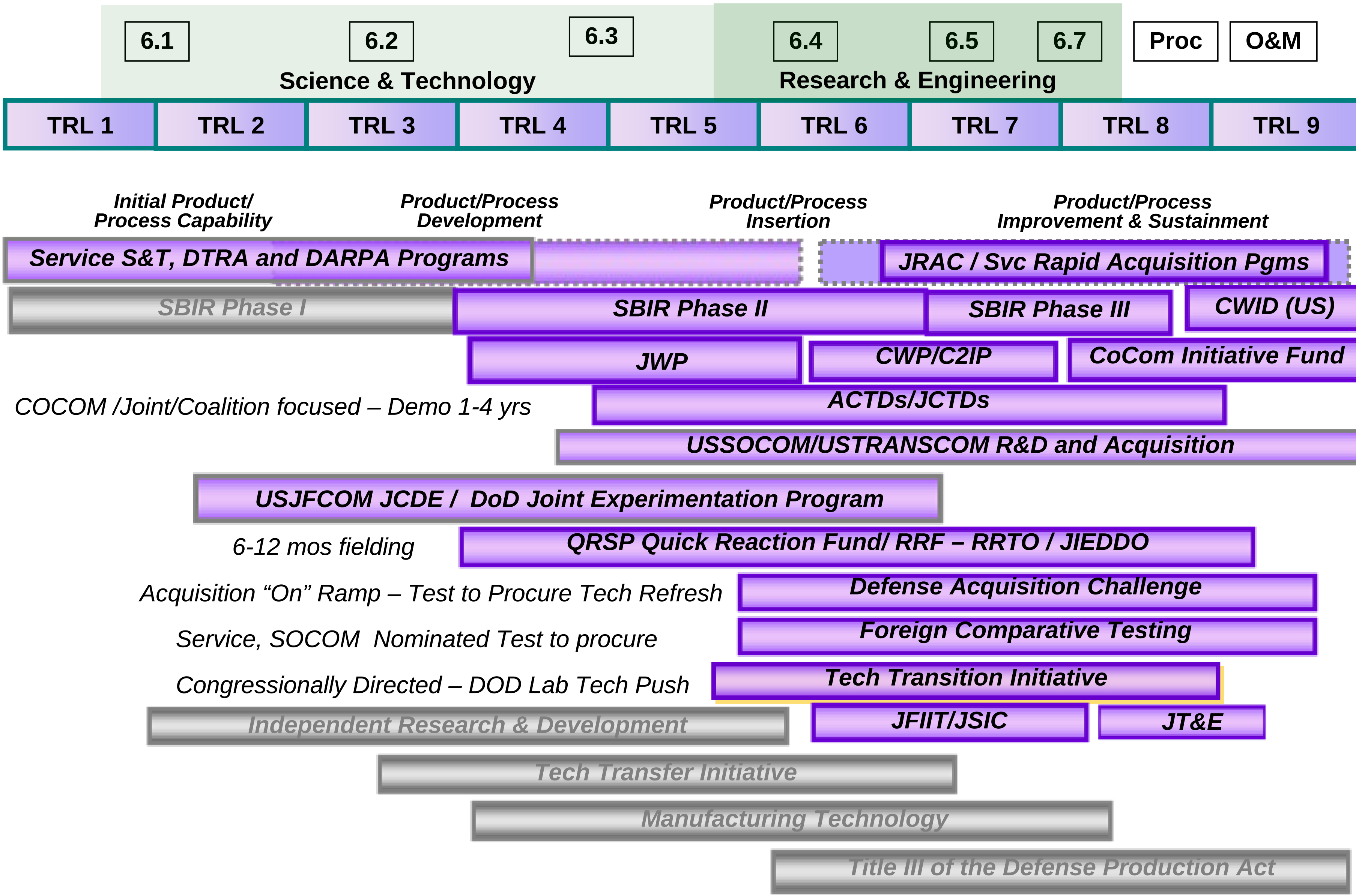
Alternatives Development & Assessment

- Experimentation
- Red Teaming Analysis

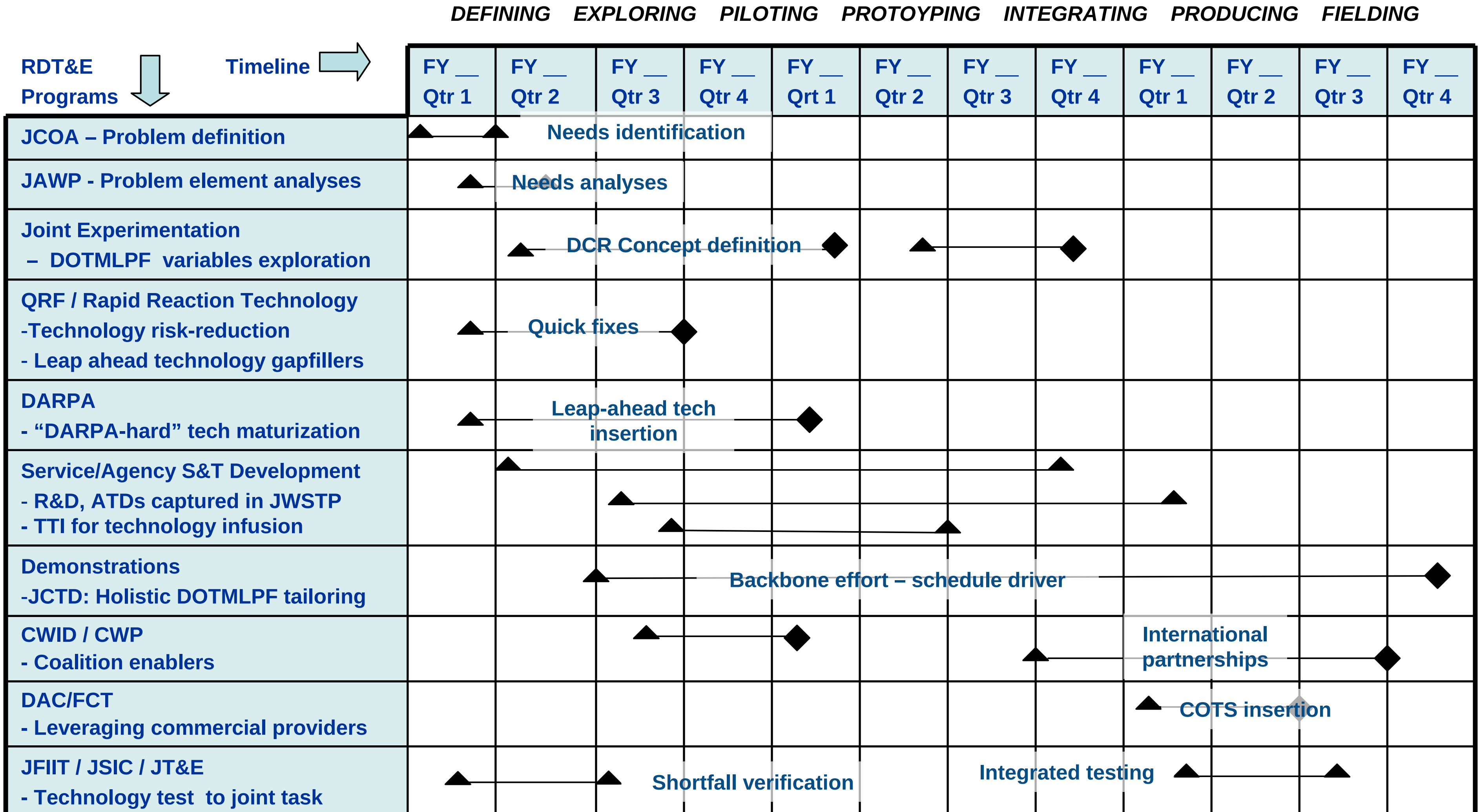
Conceptualization

- Needs identification/lessons learned/assessment
- Tech push exploitation

Range of Current Technology Transition Programs



Capability Development Strategy – Template Example



Point of Departure: Capability Gap Assessment ***Output: Fielded Capability***

A coherent strategy sets bar for solution providers & expectations for joint customers

UNCLASSIFIED

Office of the Secretary of Defense

Acquisition, Technology & Logistics

Defense Research & Engineering
Plans & Program Office

Conceptual Framework for Military Capability Development

UNCLASSIFIED

CoCom S&T Advisor Support Initiatives

Coordinated S&T Conferences

- Deconflicted CoCom conference schedule
- Consolidated RDT&E Program coverage / attendance

CoCom S&T Advisor Input into DoD S&T Efforts

- Marquee Component S&T efforts linked to desired operational capabilities
- Strategy and decision making bodies informed of CoCom S&T needs/potential

Combatant Commands Science and Technology Community (CSTC) Portal – CoCom Homepages

- DTIC-designed S&T Advisor tool
- Posting site for needs, on-going projects, hot keys to reference sites

Tailored Joint Capability Development Strategies

- To assist S&T advisors in formulating proposals from concept to transition
- Aims to involve Component Command S&T Advisors in gap remediation

COCOM S&T Advisor Input into DoD S&T Efforts

Science & Technology Integrated Priority List

- Collect S&T needs that support CoCom IPLs
- Provide expertise to FCBs
- Inform JSJ8 of possible capability solutions
- Inform DoD S&T organizations of priority CoCom needs
- Stimulate information exchange among the CoCom S&T Advisors

CSTAIG: CoCom S&T Advisor Integration Group

- To stimulate information exchange between CoCom HQ S&T Advisors
- Potential adjunct to DSTAG
- Collect, disseminate S&T needs to FCBs, CPMs, and OSD S&T strategy producing bodies

CoCom Staff Data/Information Enablers

Multiple domain visibility
- Military needs, Defense resources, DOTMLPF development processes
- Joint Capability Area (JCA) portfolio assignments
- Capability Portfolio Management (CPM) activities
- Optimized for technical services

Joint Warfighting Science & Technology Plan
- Inter-Service, inter-Agency R&D effort transparency
- Project-level detail

Adaptive capability programs: consolidated view
- Searchable queries across diverse web sites
- Cross-cutting capability development effort checks
- Application cycles, project proposals, approval status
- Application/proposal clearing house services

CoCom/Component Command S&T efforts
- CoCom / CompCom S&T community listing
- Joint capability gap identification efforts
- Capability gap solution development efforts

Master S&T Events Schedule
- S&T Conferences, Technical SAGs, SWARFs
- Key developmental/adaptive acquisition program conferences
- Experimentation program events & conferences
- Experimentation/adaptive acquisition program application milestones

Research services
- Quick-response technical research services

Technology Readiness Levels

System Test, Flight and Operations

FRP

System/Subsystem Development

MS C

Technology Demonstration

MS B

Technology Development

Research to Prove Feasibility

MS A

Basic Technology Research

9 Actual system "flight proven" through successful mission operations

8 Actual system completed and "flight qualified" through test and demonstration

7 System prototype demonstration in an operational environment

6 System/subsystem model or prototype demonstration in a relevant environment

5 Component and/or breadboard validation in relevant environment

4 Component and/or breadboard validation in laboratory environment

3 Analytical and experimental critical function and/or characteristic proof-of-concept

2 Technology concept and/or application formulated

1 Basic principles observed and reported

U.S. Army Research, Development and Engineering Command

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

10th Annual Science & Engineering Technology Conference
April 2009

COL Craig G. Langhauser
Director, Simulation & Training Technology Center
RDECOM

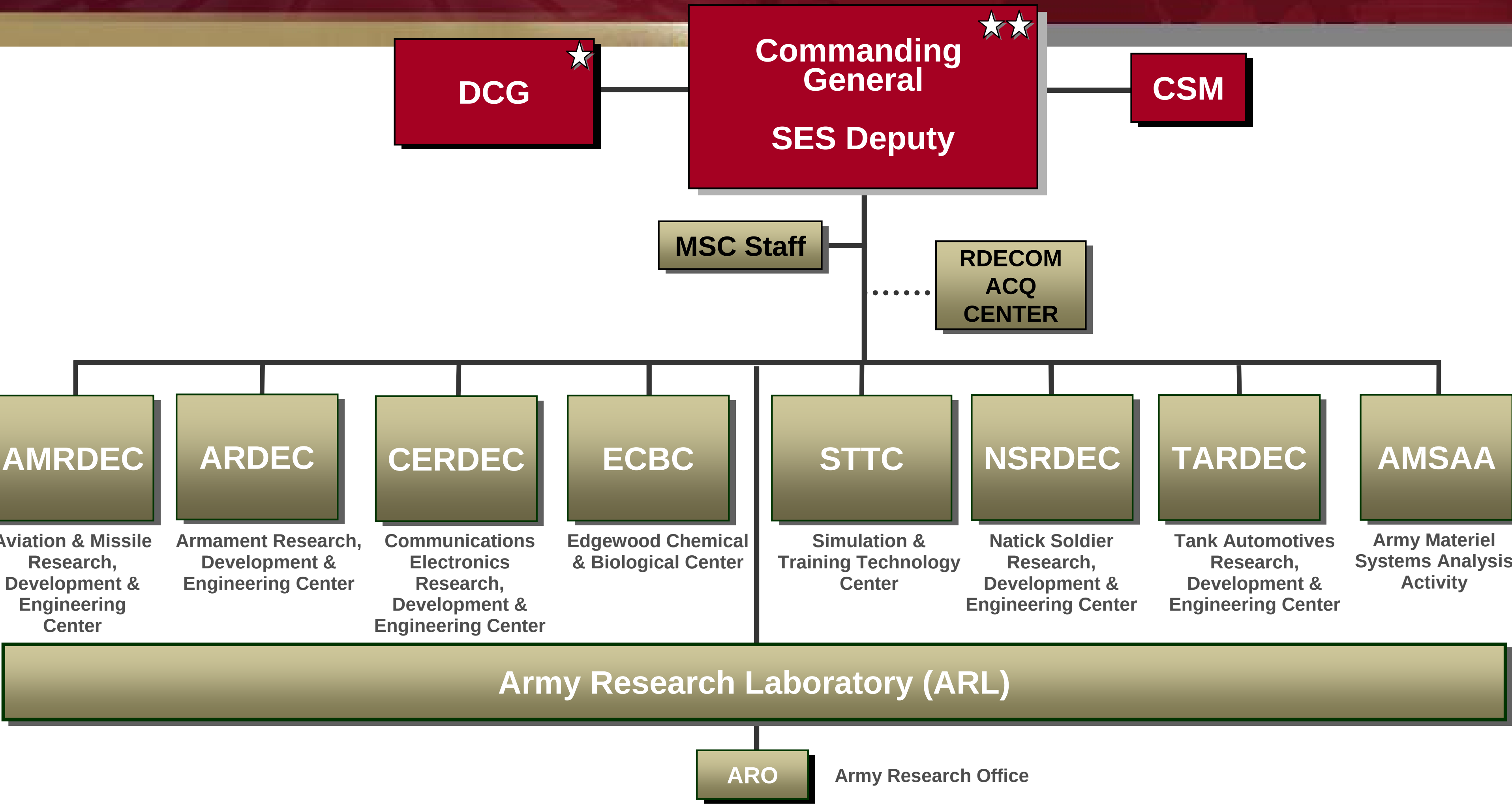
What We Do

***RDECOM** develops, integrate*
decisive technology-enabled
ensure the dominance of our
today and in the future.

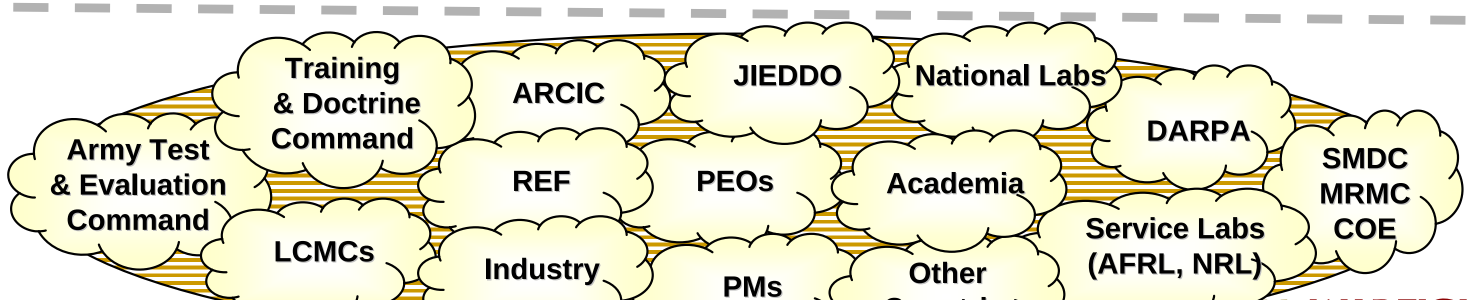
ESSENTIAL TASKS:

- Provide superior technology and solutions in response to Warfigh
- Provide acquisition and enginee support across the force
- Develop and execute comprehe leader and skill development pro
- Develop and maintain a quality focused on the Command's Con
- Integrate safety and risk manag all operations and activities
- Develop and execute obsolete w demilitarization and provide sure for the nation

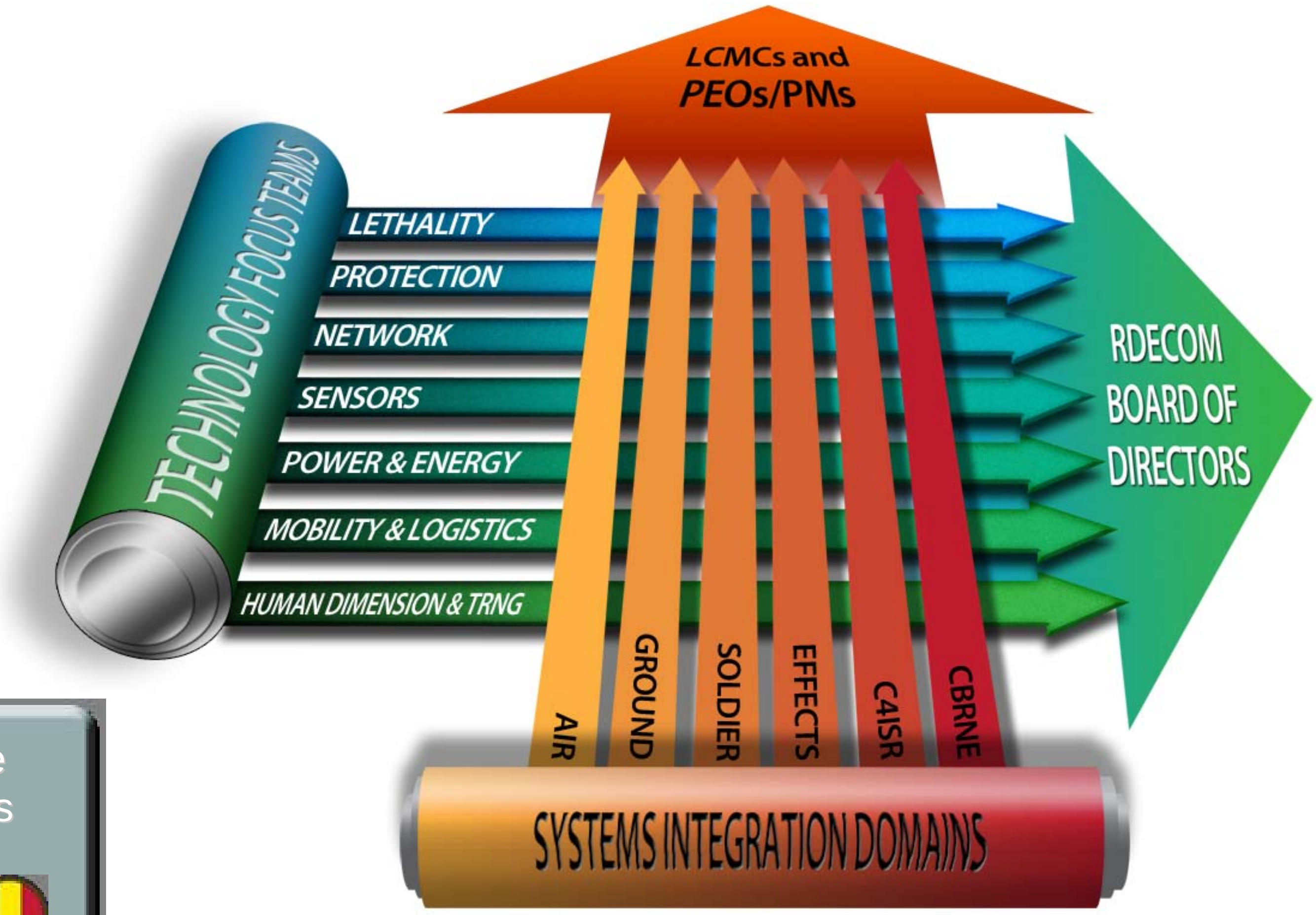
Organization



artners



RDECOM Technology Integration Concept



Synchronized and Aligned Command Technology Solutions

S&T Guidance & Requirements

SYSTEM OF SYSTEMS OVERLAY

- Systems Engineering Across Domains
- Cost & Performance Effectiveness Analysis
  (Army Materiel Systems Analysis Agency and Army Research Lab's Survivability/Lethality Analysis Directorate)
- Capability gaps

Develop, integrate, and sustain decisive technology-enabled capabilities to ensure the dominance of our Warfighters

Technology Focus Teams and Systems Integration Domains perform a critical function for RDECOM

- Leverage RD&E capacity and knowledge across the command
- Ensure maximum utilization of S&T investments

Continued effective interactions with PEO/PMs is essential to achieve successful technology transitions.

HQ RDECOM Role in ATO process

Manage RDECOM ATO review process

Trace S&T programs to Warfighter Outcomes (Coordinate w/AMSAA)

Monitor S&T portfolio execution *(NEW Process)*

- Current Program Tracking:
  - Developed low impact reporting process for Cost, Schedule, Performance, and Transition
- Track Technology Transition Agreements (TTAs)
  - Existing process for ATO-Ms
  - Extending to ATO-Ds
  - Will track ATO-Rs on case by case at program completion
- Coordinate Technology Demonstration opportunities with TRADOC Operational Experimentation
  - Coordinating all ATO-D Technology Demonstration Plans with ARCIC


US ARMY
RDECOM
TECHNOLOGY DRIVEN.
WARFIGHTER FOCUSED

Creating Capability Surprise

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MIT Lincoln Laboratory

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21 April 2009

*This work was sponsored by the Department of the Air Force under contract FA8721-05-C-0002. "Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the United States Government"

The Surprise Exemplar: 4 October 1957

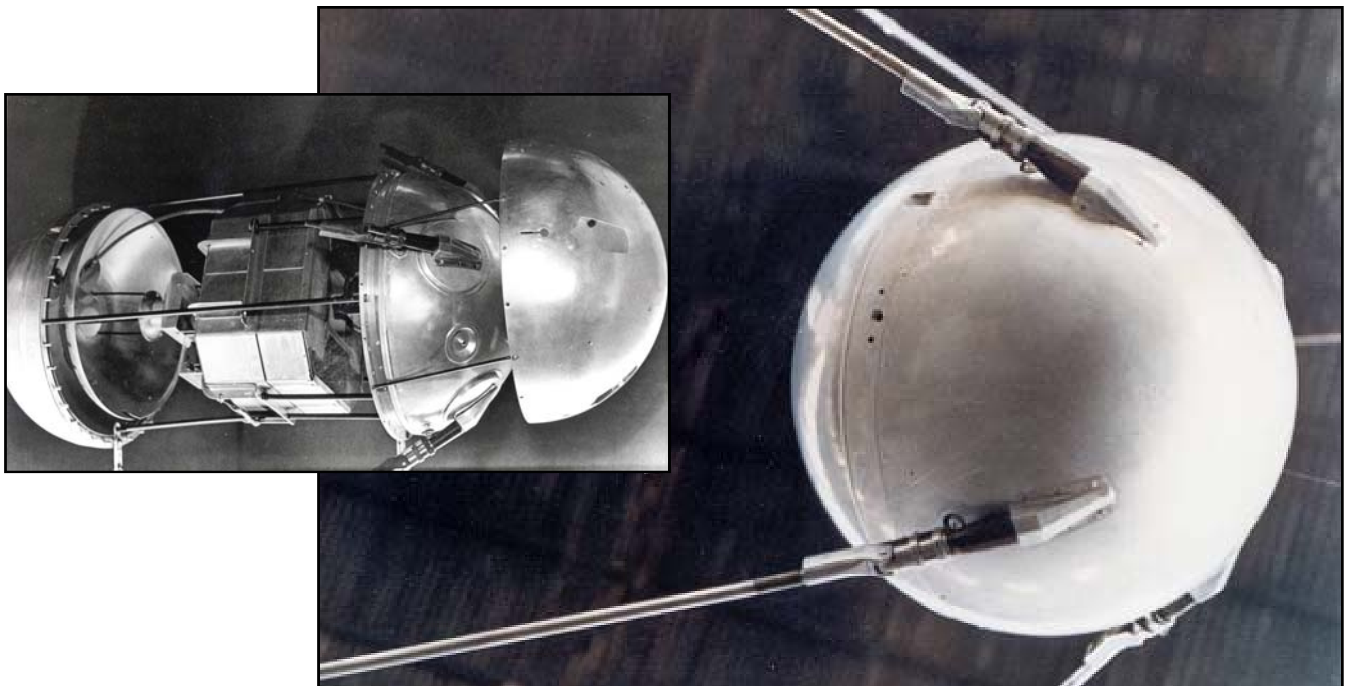
"All the News That's Fit to Print"

The New York Times.

LATE CITY EDITION

NEW YORK, SATURDAY, OCTOBER 5, 1957. FIVE CENTS

SOVIET FIRES EARTH SATELLITE INTO SPACE; IT IS CIRCLING THE GLOBE AT 18,000 M. P. H.; SPHERE TRACKED IN 4 CROSSINGS OVER U. S.



—Dallas News Staff Photo.

SIGNALS FROM THE SATELLITE

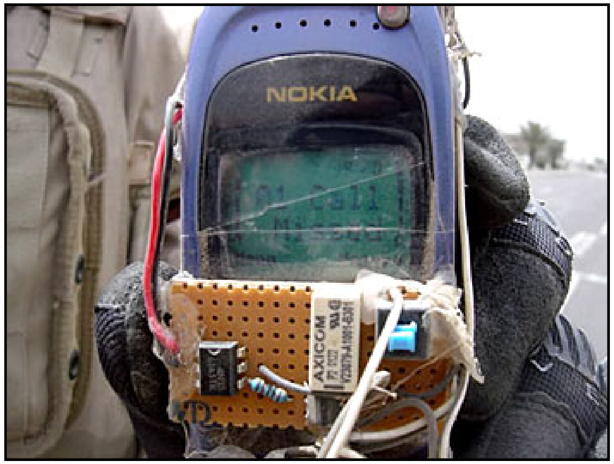
Ham operator Roy Welch of Dallas, seated, plays a tape-recorded signal from the Russian space satellite for fellow hams at the State Fair of Texas. Welch recorded the signals on a receiver at his home.

The Extension of Asymmetric Surprise

Terrorist Attack

Suicide Vest

Explosive Cell Phone



Vehicle-Borne IED

Using existing systems in radically new and asymmetrical ways can have enormous impact

Examples Abound

Pearl Harbor
Kamikazes
China enters Korea
Bay of Pigs
Sputnik
Cuban Missile Crisis
Iran Hostages
Tet Offensive
Victor 3/Akula Quieting
Beirut Barracks Bombing
Soviet Bio-weapons Program
Khobar, Cole, Nairobi
Kuwait Invasion
’93 WTC
9/11
PRC ASAT
IEDs in OIF
PRC Force-down of EP-3

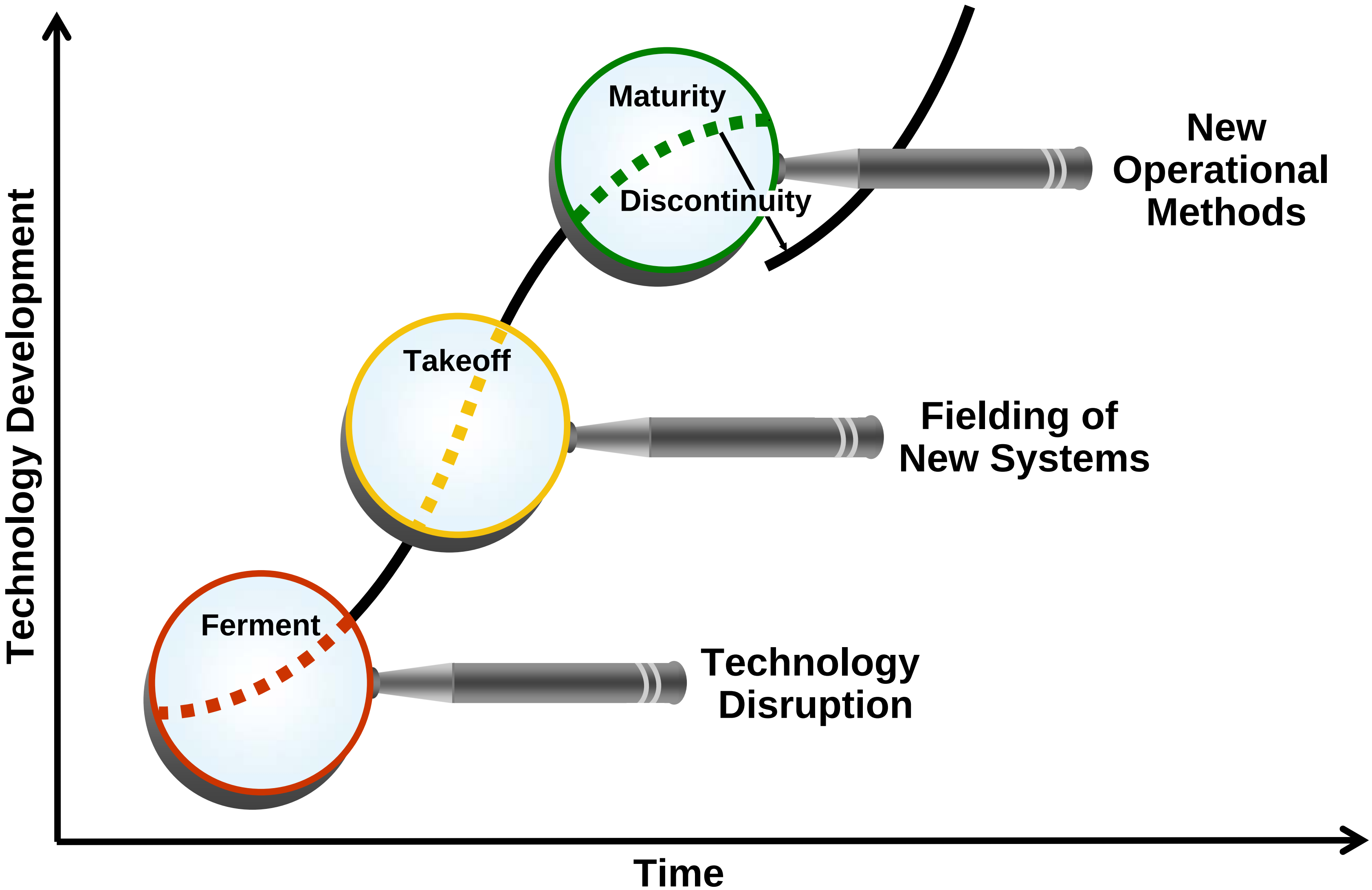
...and happened for a variety of reasons

- **Thought we could respond without doing anything new**
- **Knew it was likely, understood the magnitude of the implications, but didn't pursue it appropriately**
- **Believed they were not up to it**
- **Believed they wouldn't dare**
- **Knew it might happen, but were trapped in our own paradigms**
- **Didn't imagine or anticipate the strategic impact**
- **Lost in the "signal to noise" of other possibilities**
- **Imagined it, but thought it was years away**
- **Were willing to take the risk that it wouldn't happen**

In most cases the indications were there, but with nothing to differentiate a given possibility from others and compel a decision to act

Adapted from 2008 Defense Science Board Study on Capability Surprise

Three Tiers of Technology Innovation



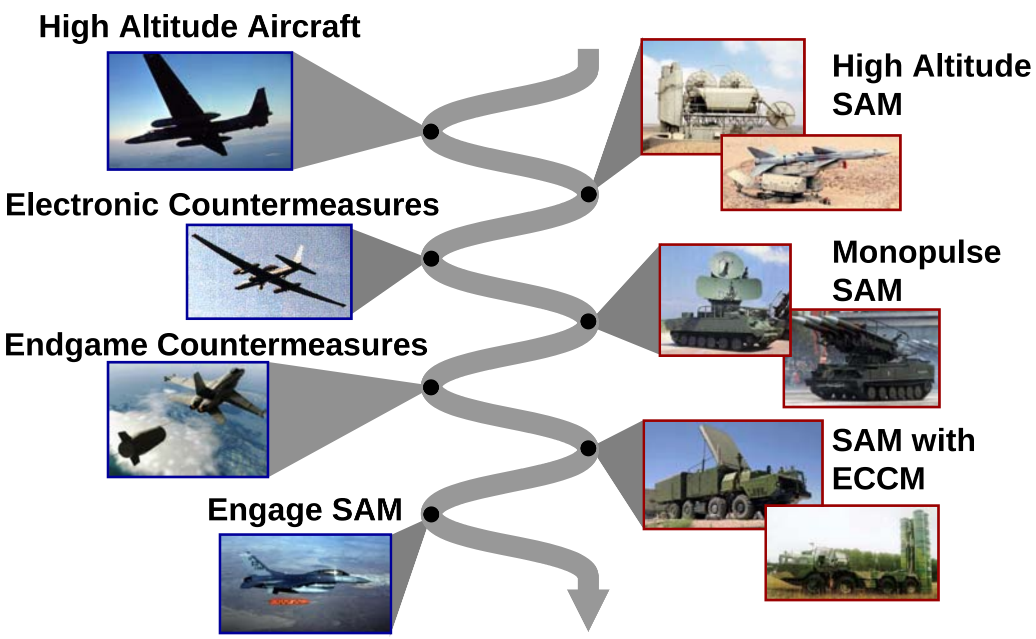
Outline

- Introduction
- Sources of Technology Capability Surprise
  – New operational methods
  – Transition and fielding
  – Adaption of new technologies
- Summary

The Symmetric Timeline

Conventional Warfare
SEAD / DEAD Example

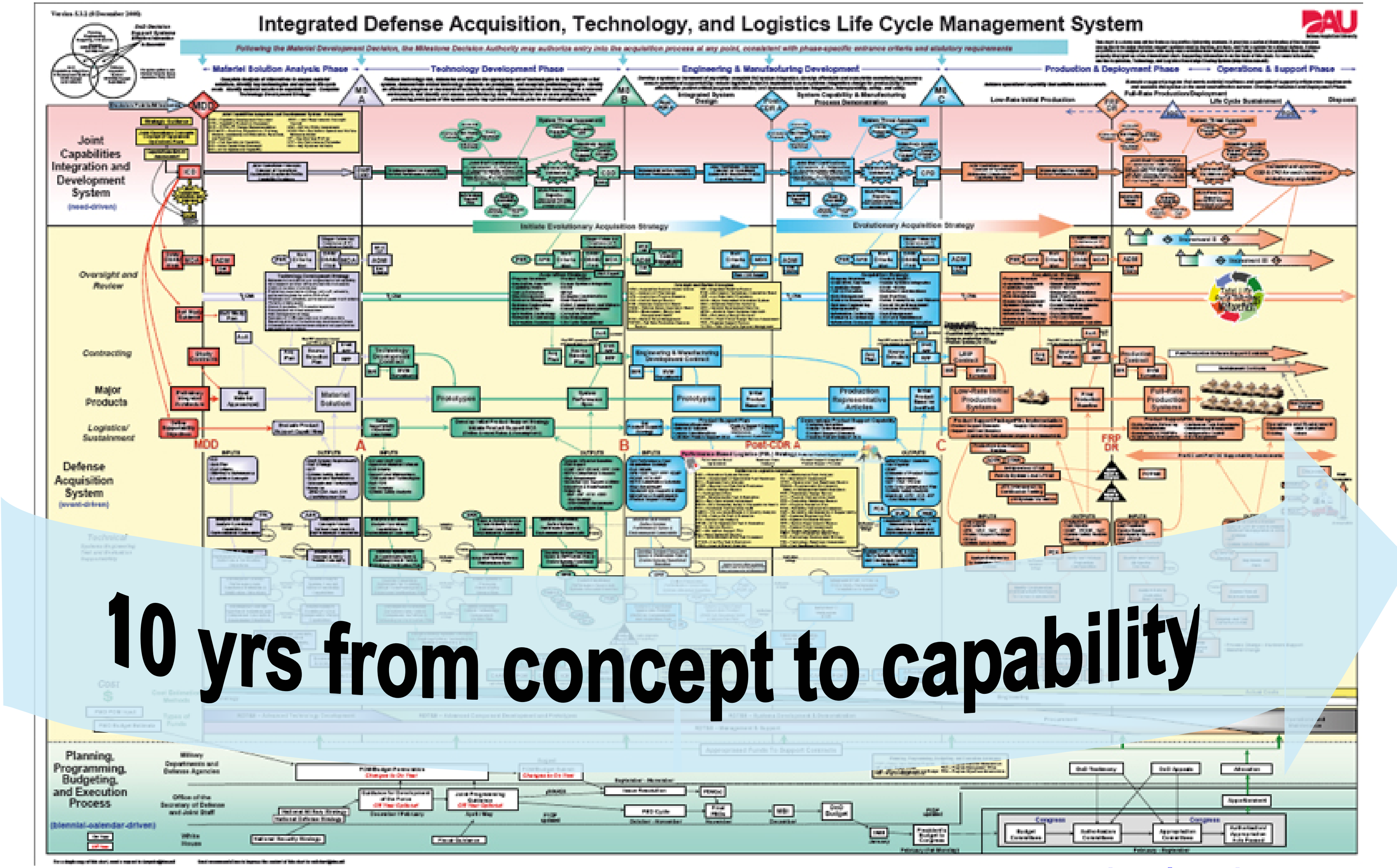
USAF Capability | **Adversary Capability**



Response loop measured in years

- Suppression of enemy air defense (SEAD)
- Destruction of enemy air defense (DEAD)

The DoD 5000 Integrated Defense Acquisition, Technology and Logistics Life Cycle Management Process



Changing Political and Economic Landscape

- Emergence of US as sole superpower

- Connectivity growth (CNN, internet)
- Ease of global transportation

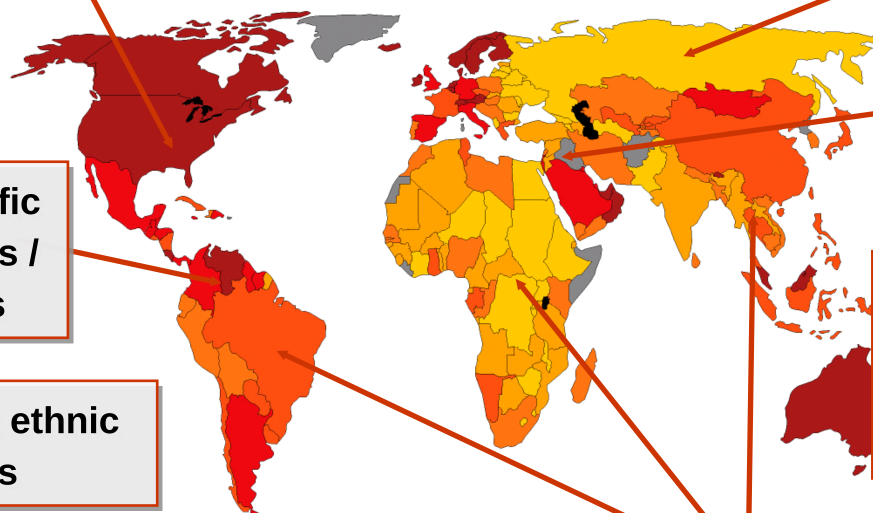
- Disintegration of Soviet Union

- Insertion / maintenance of US military in Middle East

- Explosion of drug traffic
- Partnering of narcotics / terrorist organizations

- Worsening income inequity
- Declining standard of living
- Clash over religious influence in third world

- Resurgence of violent ethnic and ideological groups



Demographic Stress

Moderate — Severe

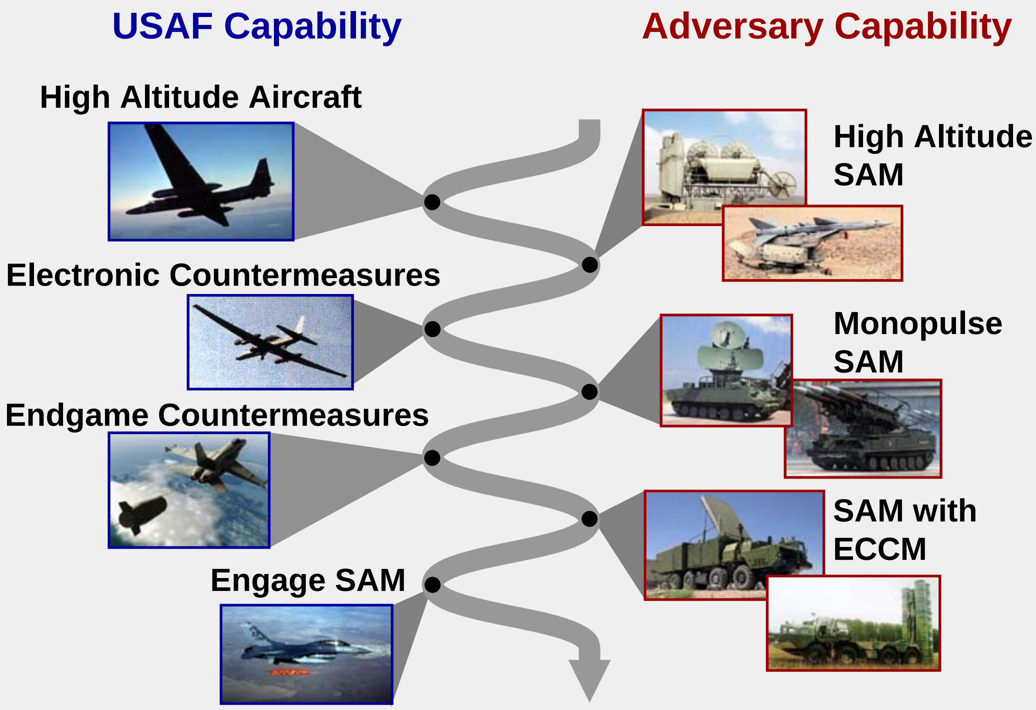
- Safe havens in Africa, Asia, South America
- Readily available small arms & weapons

Variety of socio-economic and political conditions providing "kindling" for likely explosion of 4th generation warfare

† Map by Adrian White, University of Leicester (2006)

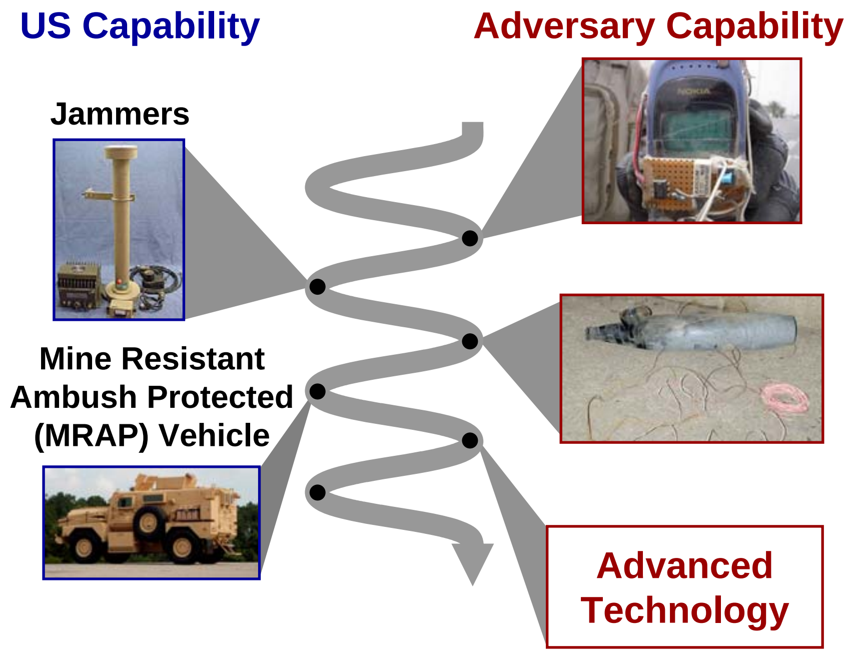
The Timeline Has Collapsed!

Conventional Warfare
SEAD / DEAD Example



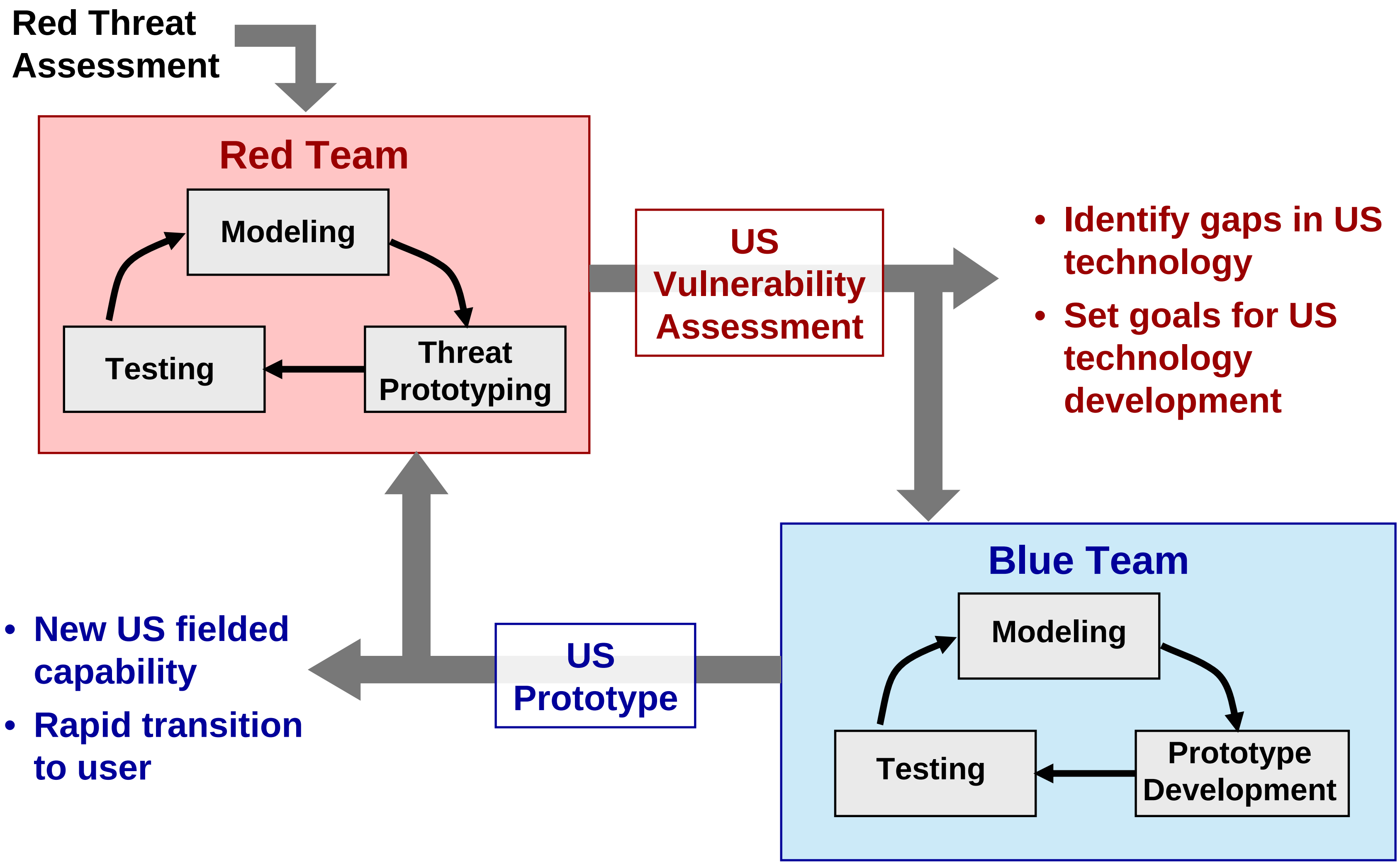
Response loop measured in years

Counter-Insurgency Warfare
Iraq Example

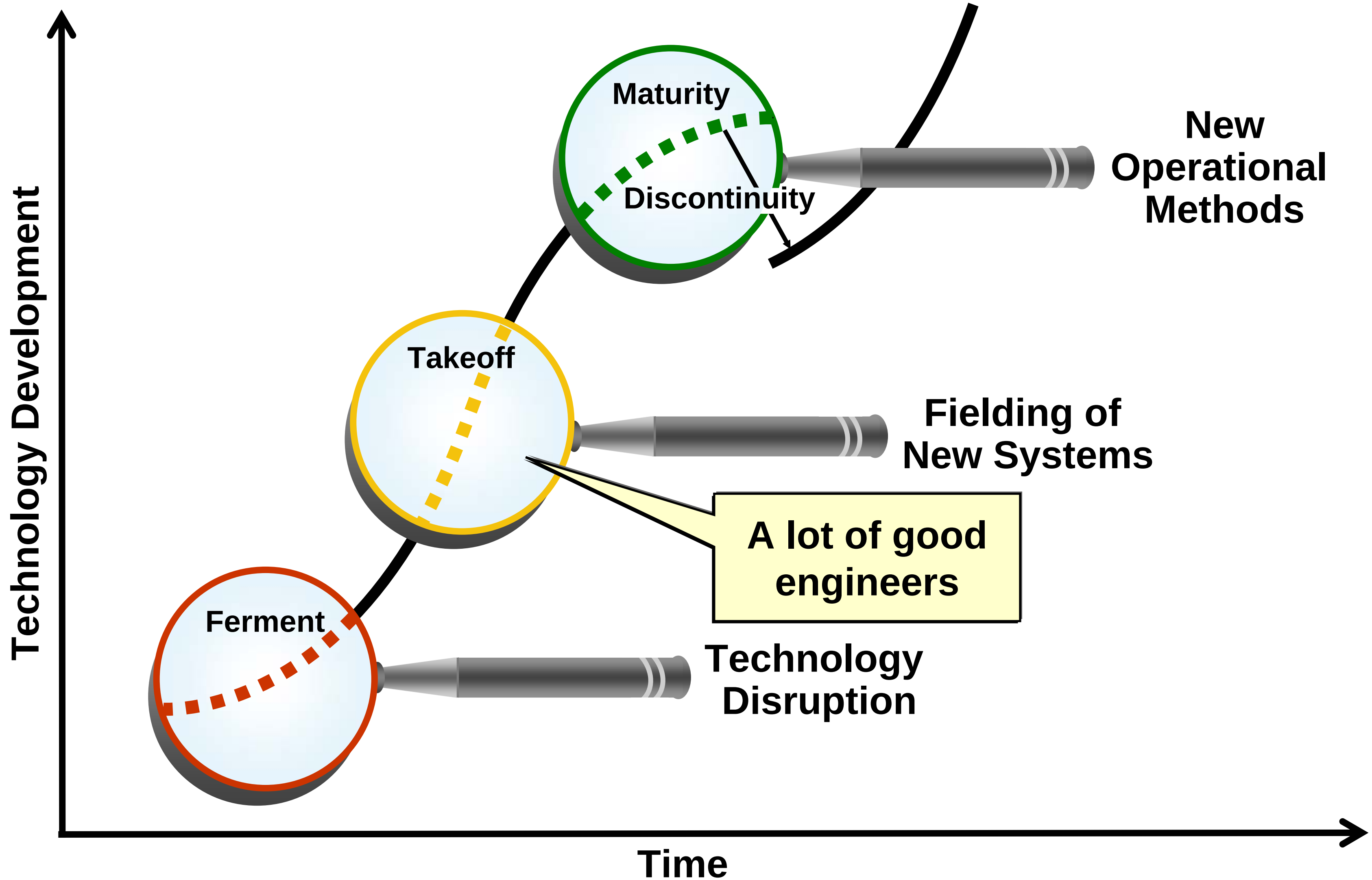


Response loop measured in months or weeks

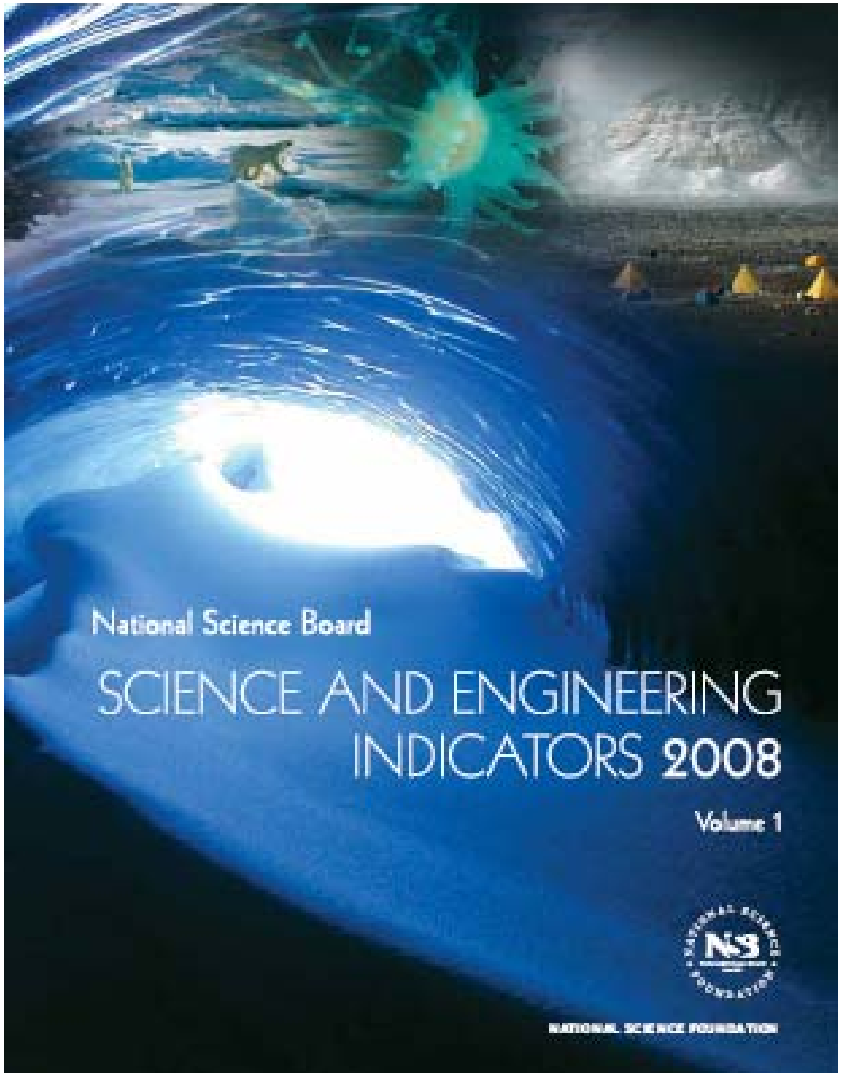
Red Team / Blue Team Process



Three Tiers of Technology Innovation



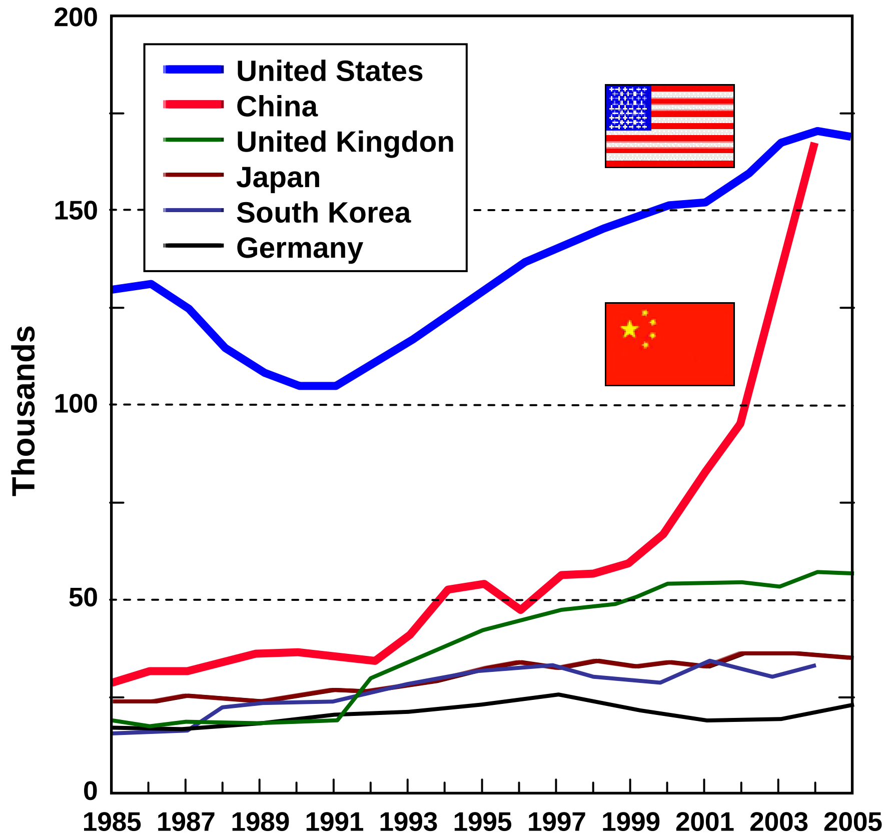
Concerning Trends



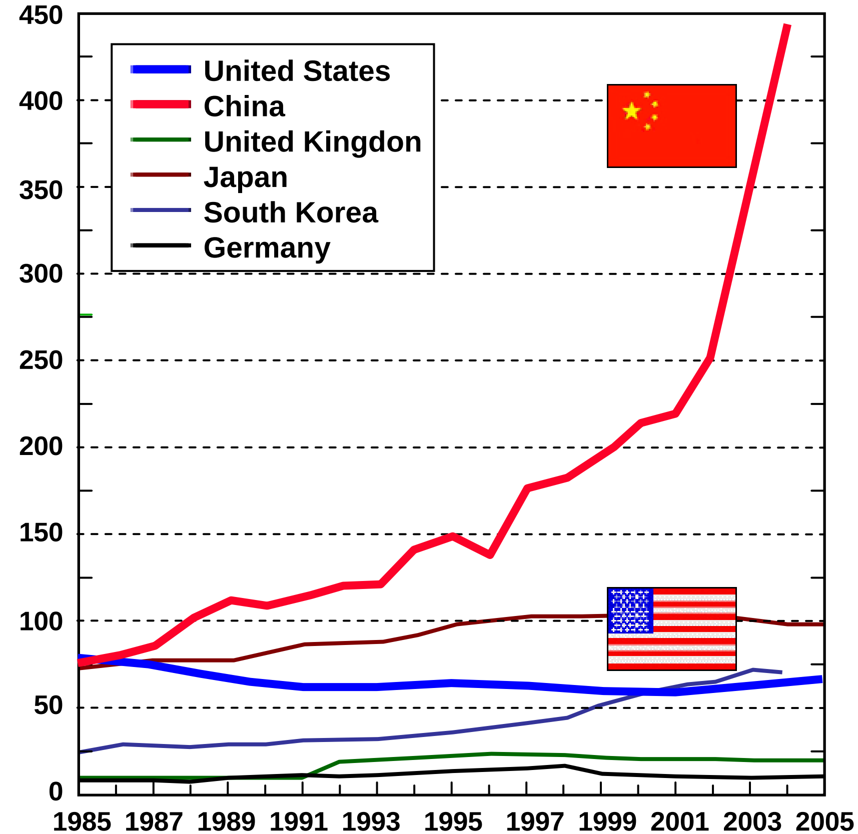
- Knowledge-intensive industries are reshaping the world economy
- Industry R&D in manufacturing and services is expanding and increasingly crossing borders
- R&D in the United States is robust and dominated by industry
- Advanced training in natural sciences and engineering is becoming widespread, eroding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

First University Degrees, by Selected Country: 1985–2005

Natural Sciences



Engineering



Notes: Natural sciences include physical, biological, earth, atmospheric, ocean, agricultural, and computer sciences and mathematics. German degrees include only long university degrees required for further study.

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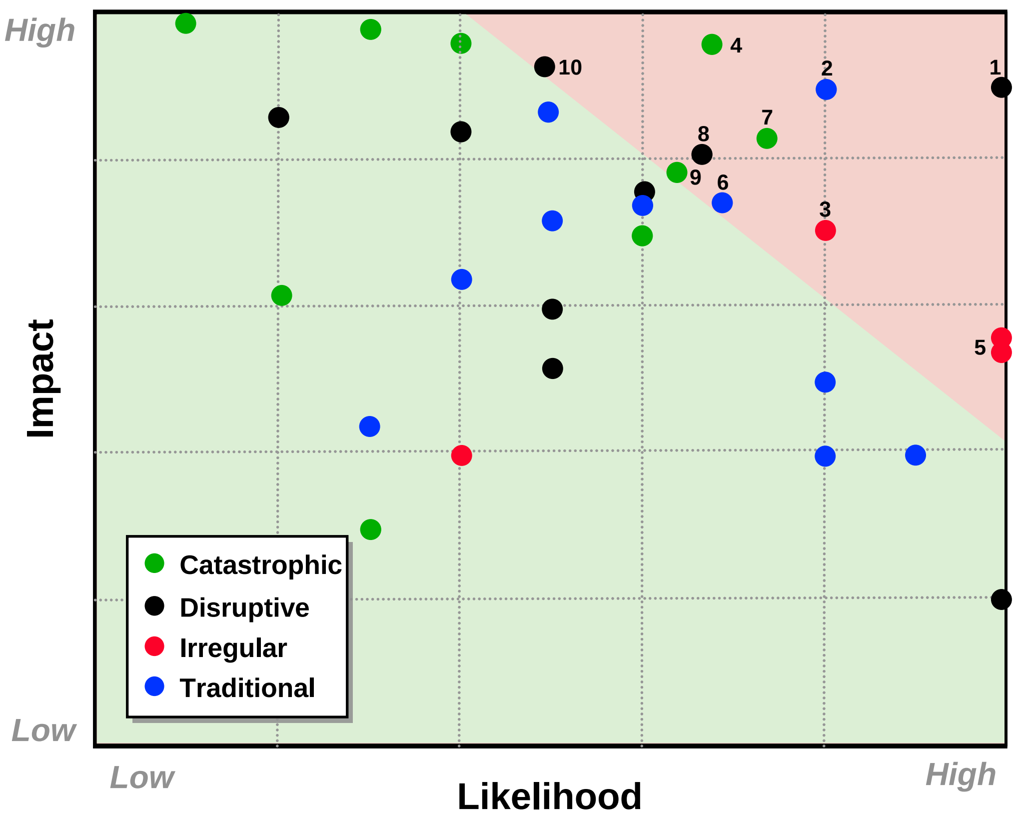
Source: National Science Board, Science and Engineering Indicators 2008

MIT LL National Security Technology Study
Threat Ranking



Critical National Security Threats

(1) Computer Network Attack/Exploit

(2) Quiet Submarines

(3) Unguided Battlefield Rockets

(4) Chemical/Biological Attack

(5) IED/Insurgents

(6) Maneuvering Ballistic Missile (MaRV) Against Carrier Battle Group (CBG)

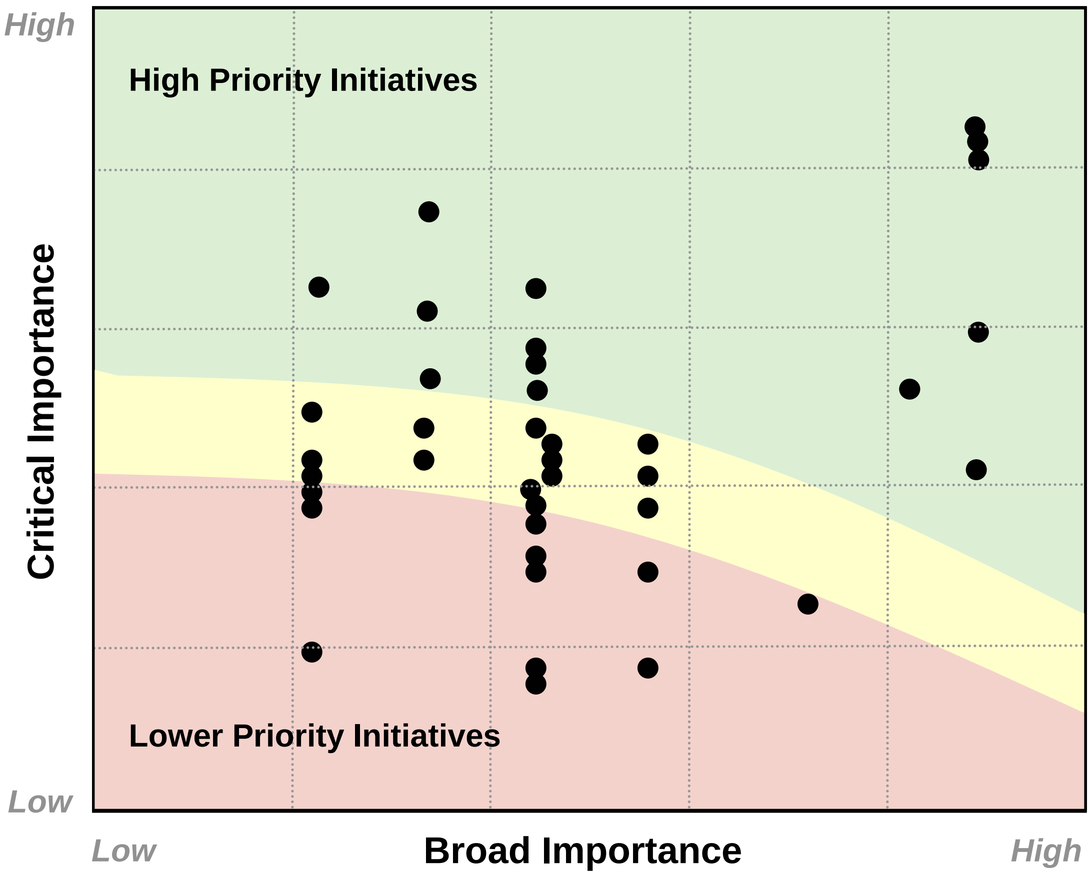
(7) Containerized Nuclear Weapon

(8) Anti-Satellite (ASAT)

(9) Cruise or Short-Range Ballistic Missile Launch off Barge

(10) Anti-cryptography (QC)

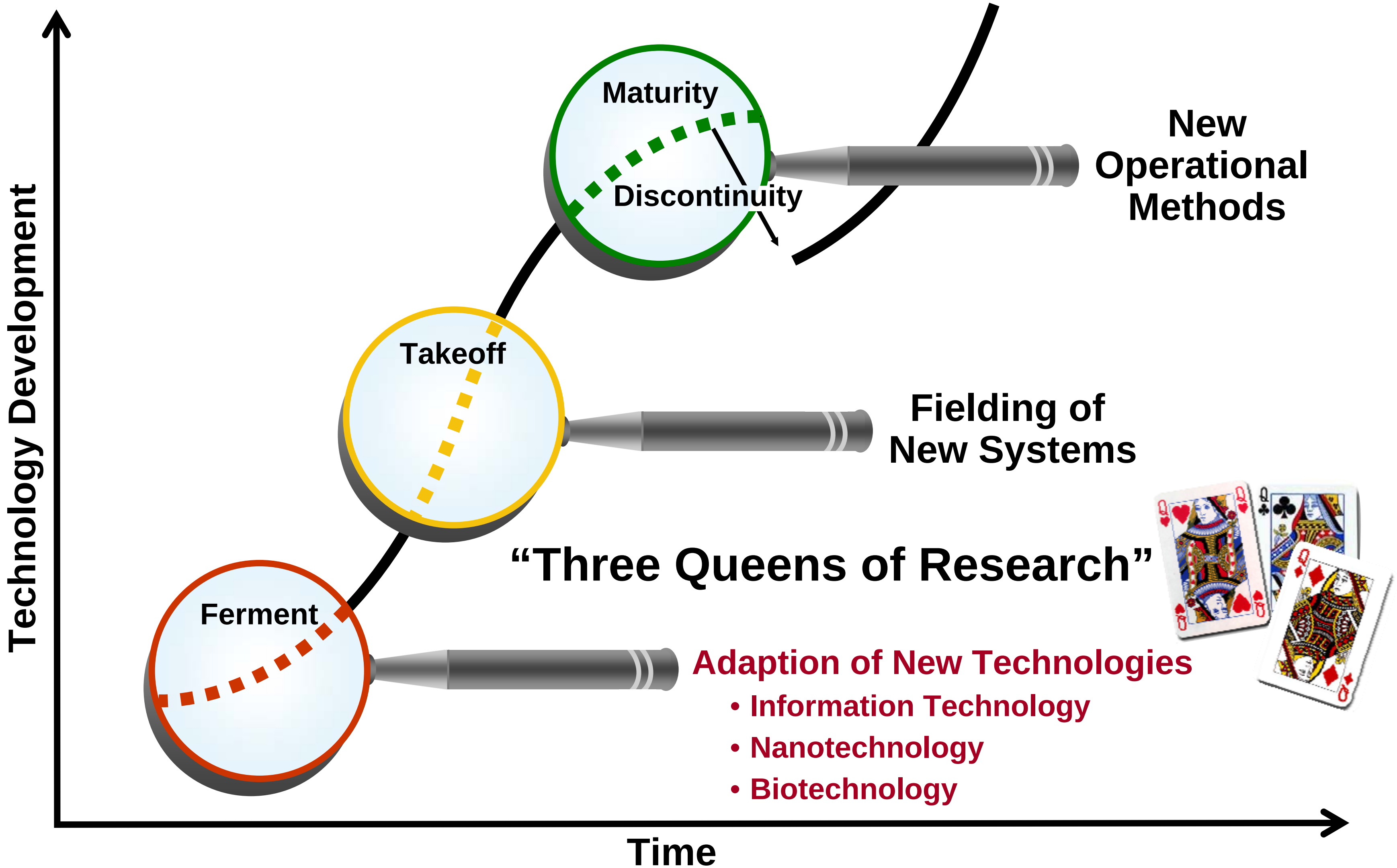
S&T Initiatives to Address Top National Security Threats



High Priority Initiatives

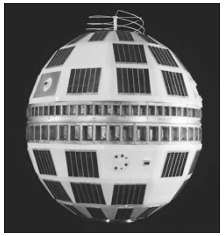
- Early Warning
- Medical Treatments
- Speed-of-Light Weapons
- Container Monitoring/Tracking
- Active Radiological Detection
- Pre-detonation
- Cultural Training
- Persistent Surveillance
- Counter-media
- Authentication, Trust, Access
- Network Attack
- Attack Detection & Response
- Network Hardening
- Platform Hardening

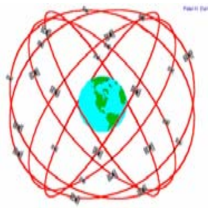
Three Tiers of Technology Innovation

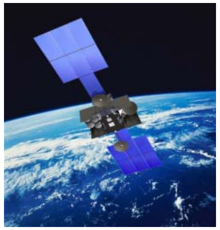


Defense Technology Timeline





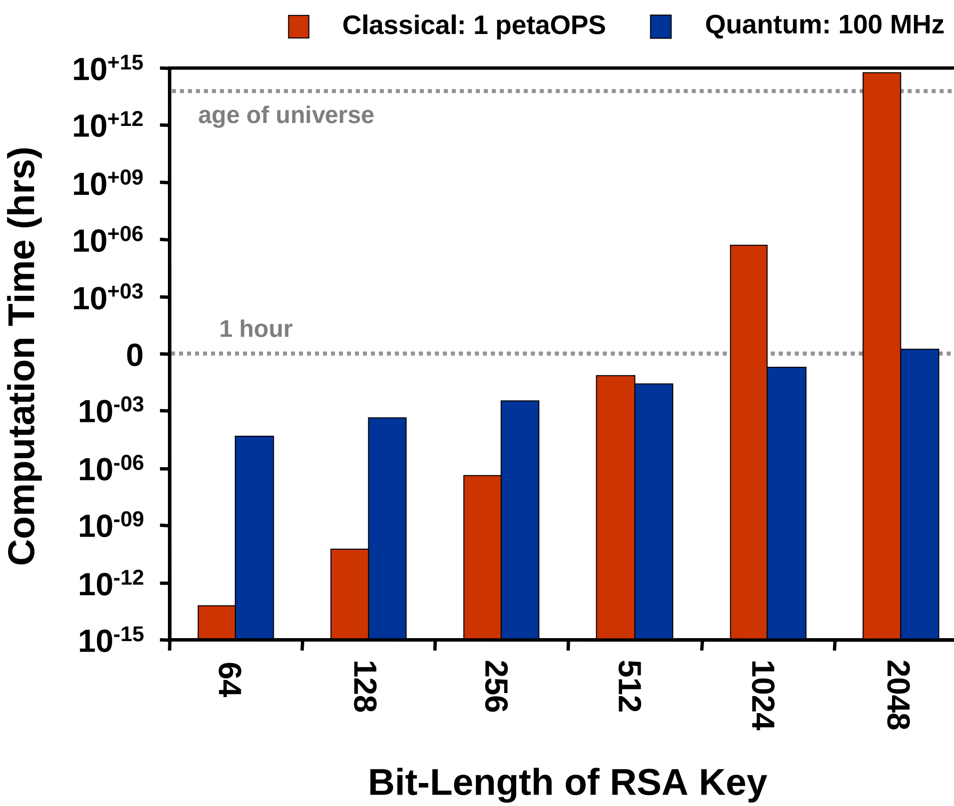




40s	50s	60s	70s	80s	90s	00s
• Nuclear weapons	• Digital computer	• Satellite comm.	• Airborne GMTI/SAR	• GPS	• Wideband networks	• GIG
• Radar	• ICBM	• Integrated circuits	• Stealth	• UAVs	• Web protocols	• Armed UAVs
• Proximity fuze	• Transistor	• Phased-array radar	• Strategic CMs	• Night vision	• Precision munitions	• Optical SATCOM
• Sonar	• Laser technology	• Defense networks	• IR search and track	• Personal computing	• Solid state radar	• Data mining
• Jet engine	• Nuclear propulsion	• Airborne surv.	• Space track network	• Counter-stealth	• Advanced robotics	• Advanced seekers
• LORAN	• Digital comm.	• MIRV	• C2 networks	• BMD hit-to-kill	• Speech recognition	• Decision support

- Quantum
- Nanoscale
- Engineered Bio

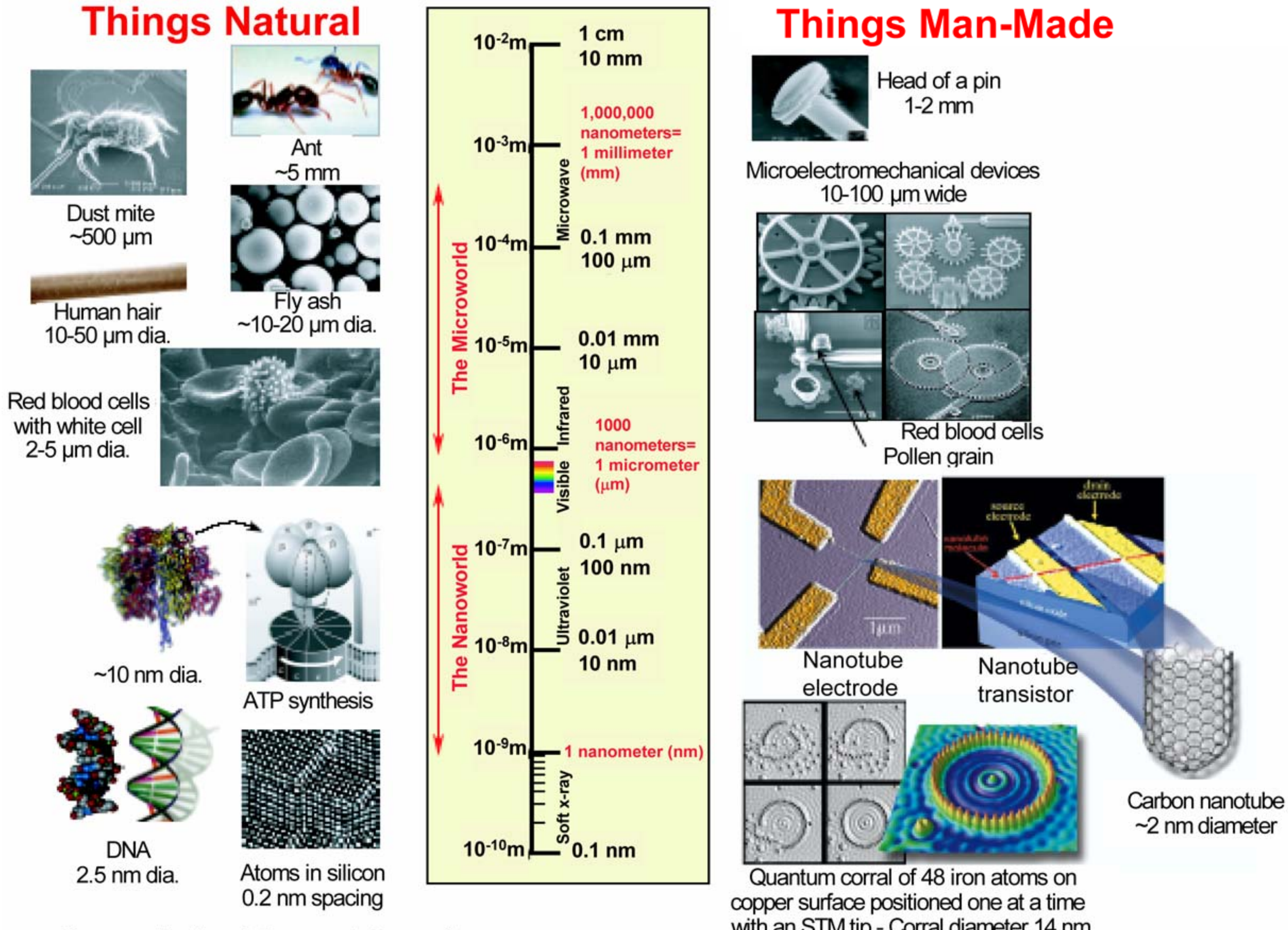
Quantum Computing



- Cryptanalysis
  - Factorization of prime numbers
  - Unsorted database searches
- Simulation
  - Fluid flow problems
  - Atomic interactions
  - Material Sciences
  - Modeling quantum systems
- Nobody knows whether we can build one big enough to be useful

Quantum computers are significantly faster than classical computers for certain classes of problems

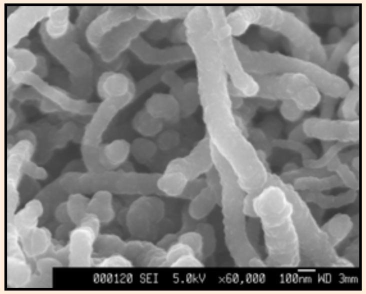
The Nanometer Scale

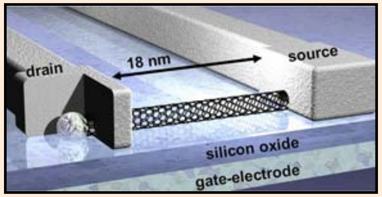


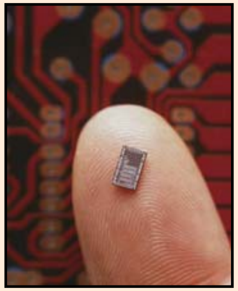
Source: National Research Council

Nanotechnology Classes

Nano-Structures	Nano-Devices	Nano-Enabled Systems







	Nano-Structures	Nano-Devices	Nano-Enabled Systems
Sensors	Functionalized plasmonic structures	Chemical nanosensors	Distributed nanosensor arrays
Computing	Graphene films	Graphene transistors	Ultrafast computers
Electronics	Carbon nanotubes	Field emitting devices	High-efficiency displays
Energy	Semiconductor nanodots	Thermoelectric materials	Efficient thermoelectric generators
Biotechnology	Protein nanotubes	Drug-containing nanotubes	Drug delivery systems
Materials	Metallic-dielectric nanostructures	Negative-index metamaterials	Cloaking coatings

Explosion of Biological Capability*

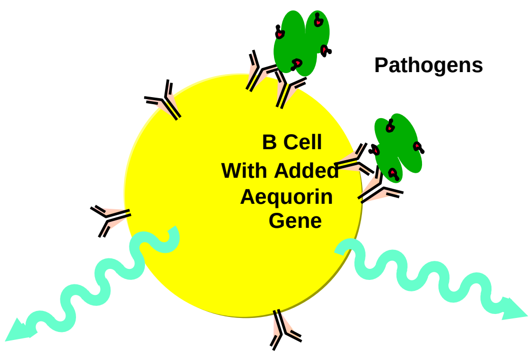
- *E. Coli* was the first bacterial genome sequenced, in 1997
- The Human Genome was sequenced in 2003; it took 10 years and $3 billion
- In 2007 the genome of James Watson (co-discoverer of DNA) was sequenced; it took 2 months and $1 million
- The $1000 genome is imminent, and it is projected to become a common diagnostic procedure.
- In 2006, a patent application was filed for the first synthetic organism
- In 2007 recombinant genetic methods were used to alter the species of a bacterial strain

There are many "Moore's Law" equivalencies for DNA and synthetic biology, and we are just at the beginning of the curves

*Courtesy D. Galloway, DTRA JSTO

Enabling Technology: Engineered Organisms

- **A range of organisms (bacteria, fungi, yeast, eukaryotic cells) have been engineered in a variety of ways**
  - **Biosensors (ex. CANARY)**
  - **Protein production (ex. insulin from yeast and bacteria)**
- **How is this done?**
  - **Selection under stringent conditions (predominantly used for bioremediation applications)**
  - **Genetic engineering – insert desired genes into genome of organism (ex. CANARY)**



(1) Pathogens crosslink antibodies

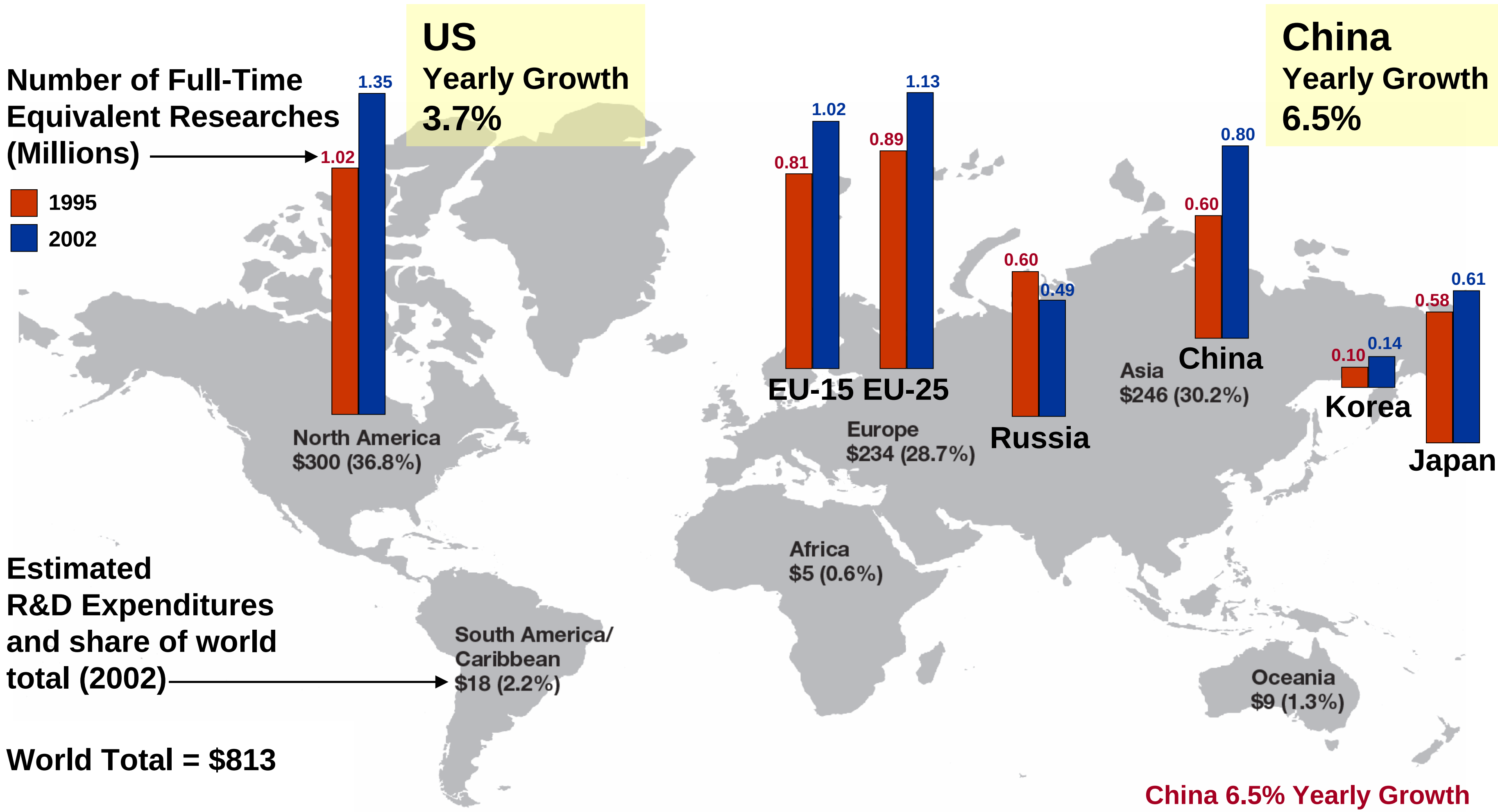
(2) Biochemical signal amplification releases Ca^{2+}

(3) Ca^{2+} makes aequorin emit photons

(4) Detect photons

As we learn more about cellular systems and "-omics", we can engineer more elaborate systems

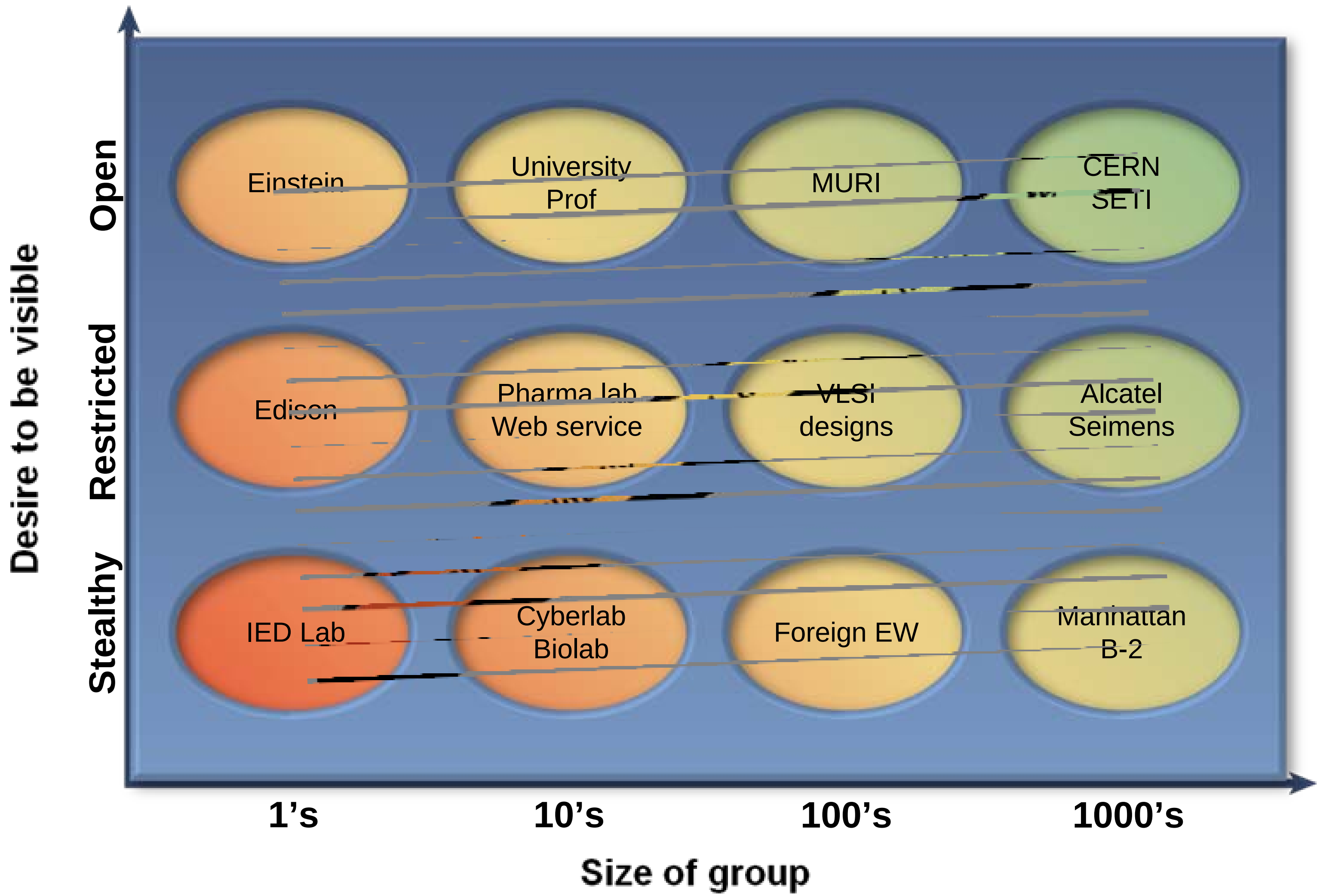
The Shifting Research Base



Notes: R&D estimates from 91 countries in billions of purchasing power parity dollars. Percentages may not add to 100 because of rounding.

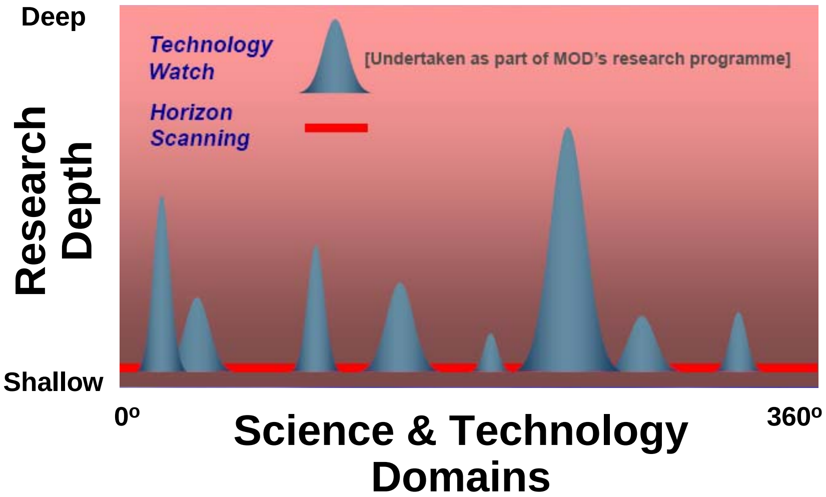
Sources: OECD Science, Technology and Industry Outlook (2006)
National Science Board, Science and Engineering Indicators 2008

Monitoring People in Research Communities is Also Important



Adapted from 2008 Defense Science Board Study on Capability Surprise

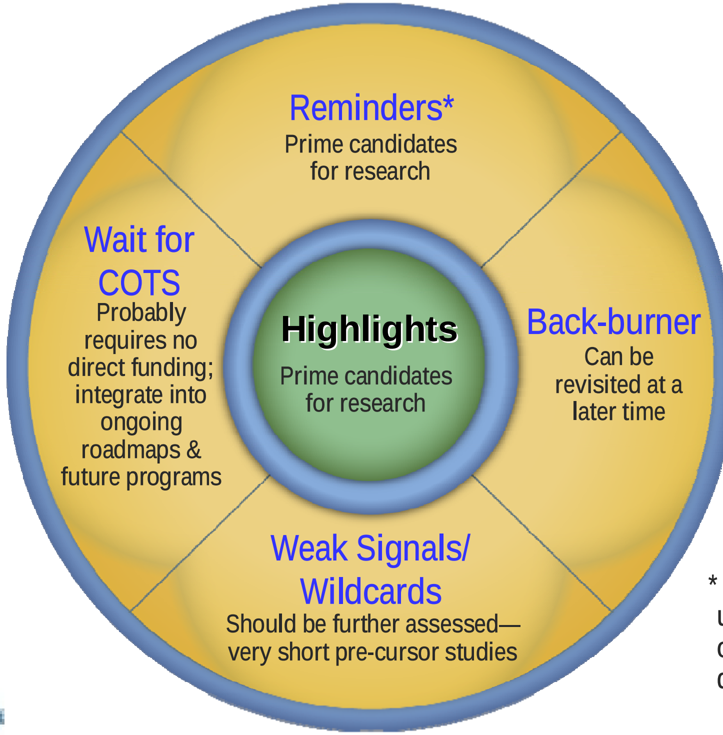
Tech Watch / Horizon Scan



- Scientometric analysis of published work
- Identify emerging technical communities
- Identify movement of authors
- Detect new technical concepts

DOD Techipedia

UK Office of Science and Innovation (OSI)



* May already be under consideration or have been discounted

Adapted from 2008 Defense Science Board Study on Capability Surprise

Summary

- **Capability surprise results from both “known surprises” and “surprising surprises”**
- **The changing landscape is likely to result in more capability surprises**
  - **Growing strength of foreign S&T enterprise**
  - **Global diffusion of technology**
  - **Global pull on US S&T ideas and workforce**
  - **Changing nature of innovation**
- **Sources, examples, and methods for countering each of the technology surprise categories were presented**

Naval Open Architecture

Avoiding Cost Growth through Open System Architecture

AIR

C4I

SPACE

SUBS

SURFACE

MARINES

22 April 2009

Dr. A. Wayne Meeks
Executive Director, Ships/Submarine, Integrated Warfare Systems

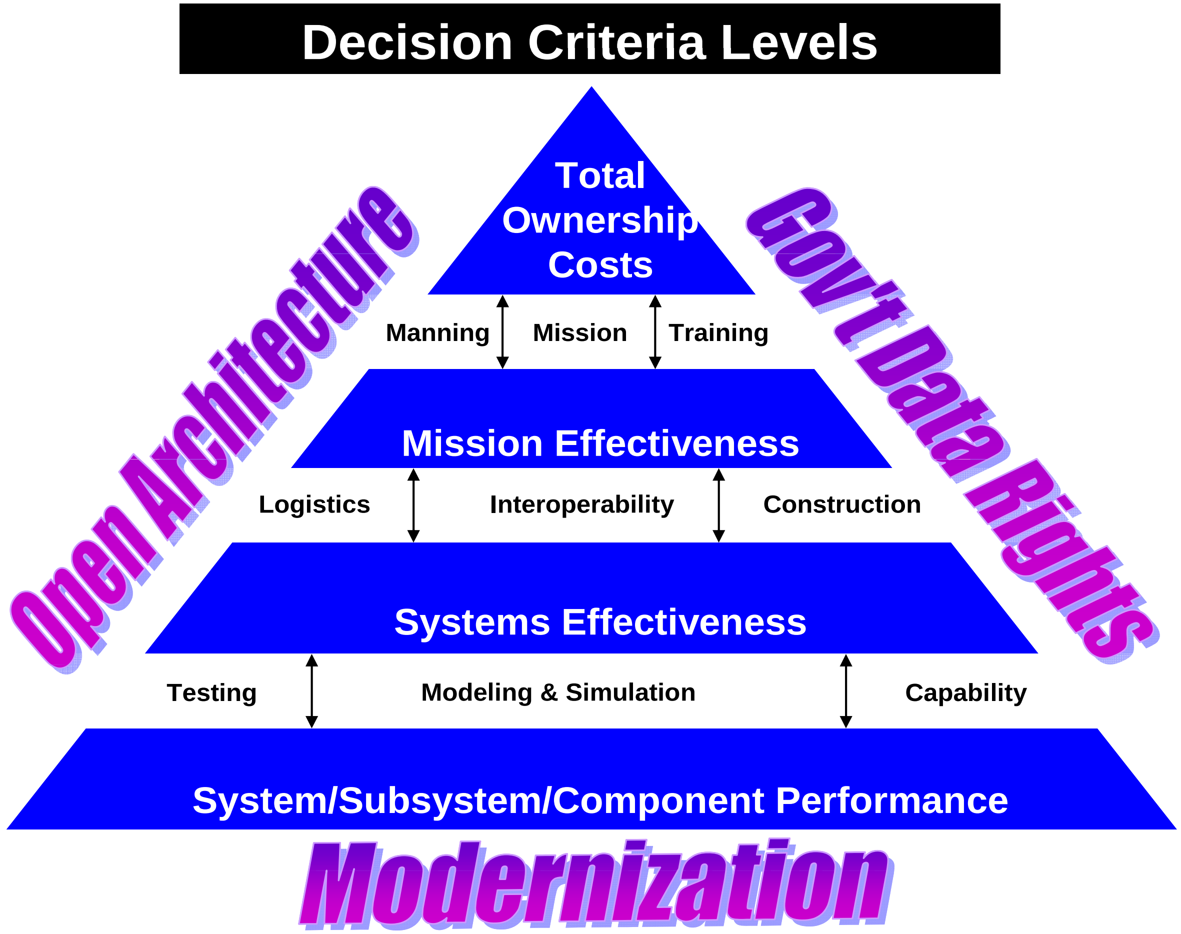
New Threats…Changing Requirements—Demands A Different Approach

"We must rebalance this department's programs in order to 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, while at the same time providing a hedge against other risks and contingencies. In order to do this, ***we must reform how and what we buy, meaning a fundamental overhaul of our approach to procurement, acquisition, and contracting.***

—Secretary Gates, "Gates Unveil Overhaul of Weapon's Programs, Wall Street Journal, April 6, 2009

Rising Costs…Requires Focus on Total Ownership Costs

The System Engineering focus is on Total Ownership Costs



Source: Surface Warfare Enterprise Chief Technology Officer, RDML Shannon

How do we do it? We change how we build systems by adopting OA Principles

***Naval Open Architecture** is the confluence of business and technical practices yielding modular, interoperable systems that adhere to open standards with published interfaces. OA delivers increased warfighting capabilities in a shorter time at reduced cost.*

OA CORE PRINCIPLES

- *Modular design and design disclosure*
- *Reusable application software*
- *Interoperable joint warfighting applications and secure information exchange*
- *Life cycle affordability*
- *Encouraging competition and collaboration*

Source: OPNAV ltr Ser N6N7/5U916276 dtd 23 Dec 05

Everyone has a role in Open Architecture

Chief of Naval Operations

- N43
- N6
- N8
- OA CROSS FUNCTIONAL BOARD

- Provide Naval requirements and POM/PR guidance to acquisition community
- Identify requirements for rapid, cost-effective, interoperable warfighting improvements with the objectives of supporting OA

Assistant Secretary of Navy (Research, Development & Acquisition)

OA Enterprise Team Lead Council

OA Enterprise Team (OAET)

- Air
- IWS
- C4I
- USMC
- LMW
- Carriers
- Subs
- Space
- ASW COI
- MIW COI
- Ships

- Lead the enterprise to OA implementation
- Oversee the development and implementation of the processes, business strategies, and technical solutions for implementing OA
- Provide OA Systems Engineering Leadership to PEOs, Warfare Centers, Industry, etc.

PEOs

- Implement OA business & technical practices

SYSCOMS

- Provide technical, financial management and contracting support to PEOs
- Establish OA technical processes
- Monitor and assess compliance with OA standards and processes

OA policy progression since 2004

Apr 2004 USD (AT&L) issues Modular Open Systems Approach Implementation Memo

OSD OA Policy

Aug 2004 Navy issues Open Architecture policy

Naval OA Policy

Dec 2005 OPNAV issues OA Requirements

Navy OA Requirements

Oct 2006 ASN RDA issues DDG Mod Funds to Support OA

Navy OA Alignment

May 2007 ASN RDA issues Memo to CNO on OA progress

Navy OA Progress

Feb 2008 – Present OA Reports to Congress

FIFTH QUARTERLY REPORT TO CONGRESS ON NAVAL OPEN ARCHITECTURE (NOA)

Prepared by: Open Architecture Enterprise Team, Program Executive Office, Integrated Warfare Systems (PEO IWS), Washington, DC 20376

February 2009

Navy OA Reporting

OA progress and results

DOMAIN	RESULTS
	**E-2D** ■ OA approach **reduced computer acquisition timeline from 7 to 2.5 years**. Employs **70% software reuse** from the E2-C mission/display computers
	**Electronic Warfare Self-Protection Systems Program Office** ■ Provide Interface Control Documents as Government Furnished Information (GFI) in all new Request for Proposal packages. The defined interfaces enable an environment where a **variety of material solutions can be incorporated (plug'n protect) in Light Aircraft survivability suites** without modification to the existing CIs.
	**EA-18G** ■ Mission computer software is approximately **90% common with the F/A-18 E/F and 82% common with the EA-6B ICAP III ALQ-218**
	**F/A-18 E/F** ■ Since incorporating High Order Language (HOL) mission computer software has provided a significant ROI with a **75% reduction in man hours and a 50-90% improvement in defect closure rate** when compared to Legacy mission computer software development

OA progress and results

DOMAIN	OA Progress / Results
C4I	**CANES:** Continued ISNS–to–CANES migration efforts, which is **reducing four separate shipboard networks down to one.** Migration efforts focused on risk reduction, CANES early adopter process, and early installations in operational strike group ships
	**Communications at Speed & Depth S&T Program:** Identified areas through an OA Assessment where **openly available interface standards can be more extensively used**
	ADNS Program: **Reused 128k lines of Navy-owned code & 25k lines of U.S. Army-owned code** to deliver new capabilities.
	Multiple C4I Programs: **Incorporated OA Language in several contracts** including Future Command & Control System; ADNS; Global Positioning System Based Positioning, Navigation & Timing Services; Naval Integrated Tactical Environmental Subsystem Next Generation (NITESNext); Distributed Information Operations (DIOS); Distributed Common Ground System ((DCGS) Info Backbone (DIB); Digital Modular Radio (DMR); Submarine High Data Rate Program; and Net Enabled Command Capability (NECC)
	Contracts: Developing logical decision tree to **determine requirements for inserting OA language into solicitations and standard CDRLs**.

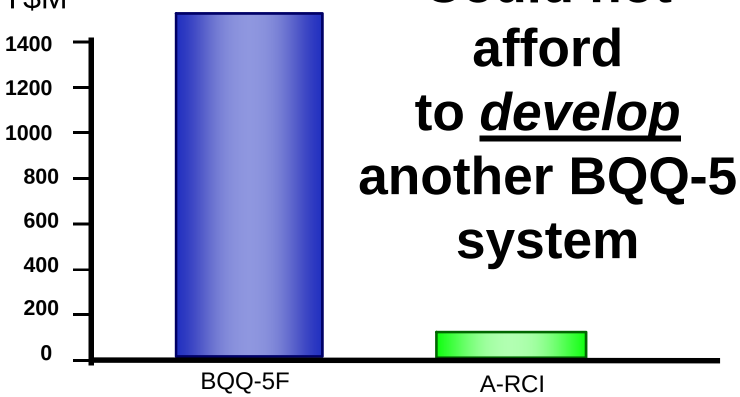
OA progress and results

DOMAIN	OA Progress / Results
	**Submarine Sensor Systems Program Office (PMS – 435)** □ Joined PMS 401 and PMS 425 in adoption of the submarine ARCI model to **open up the system both technically and programmatically**
	■ **Changing contracts** □ Adapting a common business strategy by participating in a **joint contracting approach across two program offices** (PMS 401 and PMS 425).
	■ **Increasing Lifecycle Affordability** □ Implemented capability insertion processes which in turn is limiting cost growth. Developed the acoustic rapid costs insertion process (ARCI) and the advanced processing build process (APB). A key element of this process is the **competitive software development guided by an open and collaborative peer review** that includes industry, academia, warfare centers, and government labs.

PEO Subs has demonstrated significant results by adopting OA —COTS/OA vs. Legacy Cost Efficiencies

TY$M

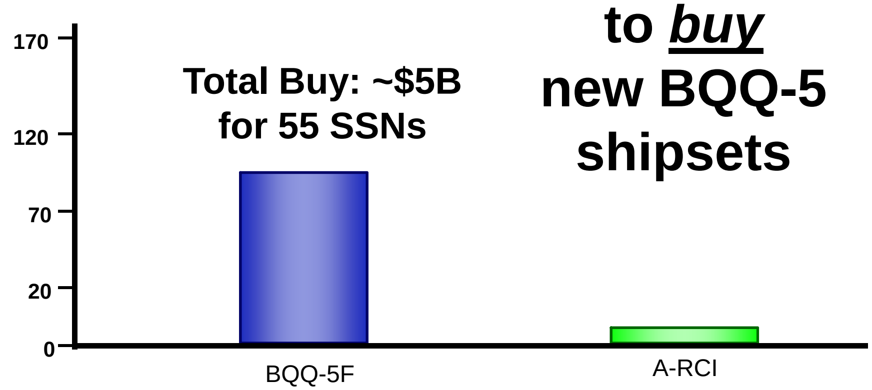
Could not afford to ***develop*** another BQQ-5 system



Development Cost

FY98$M

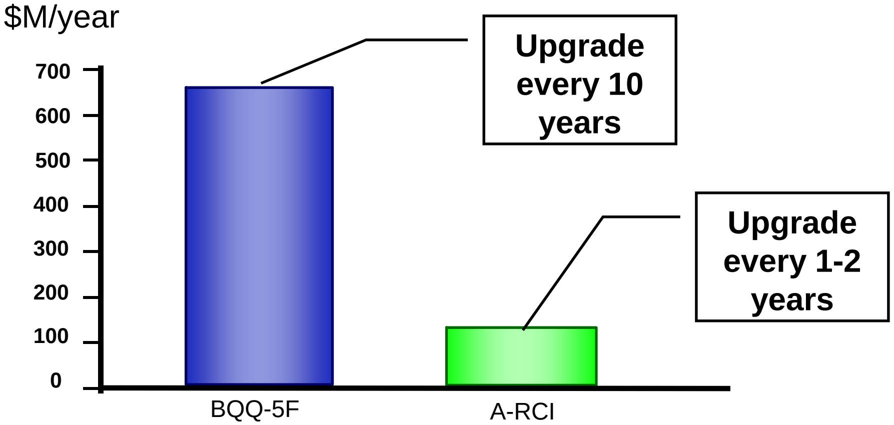
Could not afford to ***buy*** new BQQ-5 shipsets



Shipset Cost

Ten Year Comparison Development, Installation & Support Cost

$M/year



OA progress and results

DOMAIN	OA Progress / Results
	**Aegis Modernization** ▪ USS BUNKER HILL (CG 52) – **<u>separated hardware and software and introduced a Commercial Off-The-Shelf (COTS) based hardware</u>** infrastructure in Advanced Capability Build 08 / Technology Insertion 08
	**Common Display Systems (CDS)** ▪ Held a **<u>full and open competition for CDS in support of the DDG 1000 and Aegis Modernization</u>**. The CDS is a family of displays that will be implemented across platform systems on Navy surface ships, submarines, and aircraft.
	**Ship Self Defense System Mk2** ▪ Use a **<u>distributed, open system design and employ COTS electronics</u>** in rugged cabinets; POSIX Compliant Operating Systems; distributed processing using COTS devices and commercial standards; and modularized software. Introduction to the fleet of SSDS Mk 2 began with USS NIMITZ (CVN 68) in FY 2008. The software for all ship classes employing SSDS comes from a **<u>single source library that allows reuse</u>** across all SSDS ships.

OA progress and results

Program	OA Progress / Results
	**LCS Mission Module Program Office** ▪ **<u>Reused several subsystems</u>** across the Navy to build the 3 Mission Modules ▪ **<u>Assessed openness</u>** of the Mission Package Computing Environment, Multi-Vehicle Communication System, and Mission Modules (Surface Warfare, Anti-Submarine Warfare, Mine Counter Measures MM) ▪ **<u>Provided components to Aegis and DDG</u>** from MPCE for reuse ▪ **<u>Identified key interfaces</u>** to enable "plug and play" at lower level ▪ Developed **<u>Technology Transition Development Plan</u>**
	**Space Mobile User Objective System Program** ▪ Deposited MUOS Common Air Interface (CAI) Waveform in the JTRS Information Repository and **<u>provided assets to Nine (9) developers for possible integration</u>** into their terminal product lines ▪ CAI Waveform and Satellite Bus are Based on **<u>Commercial Standards</u>** resulting in over **<u>85% Reused or Modified Software</u>**
	**Marine Corps** ▪ Incorporated components from eight other programs developed by two other domains into Marine Air Ground Task Force Command and Control (MAGTF C2)

OA progress and results

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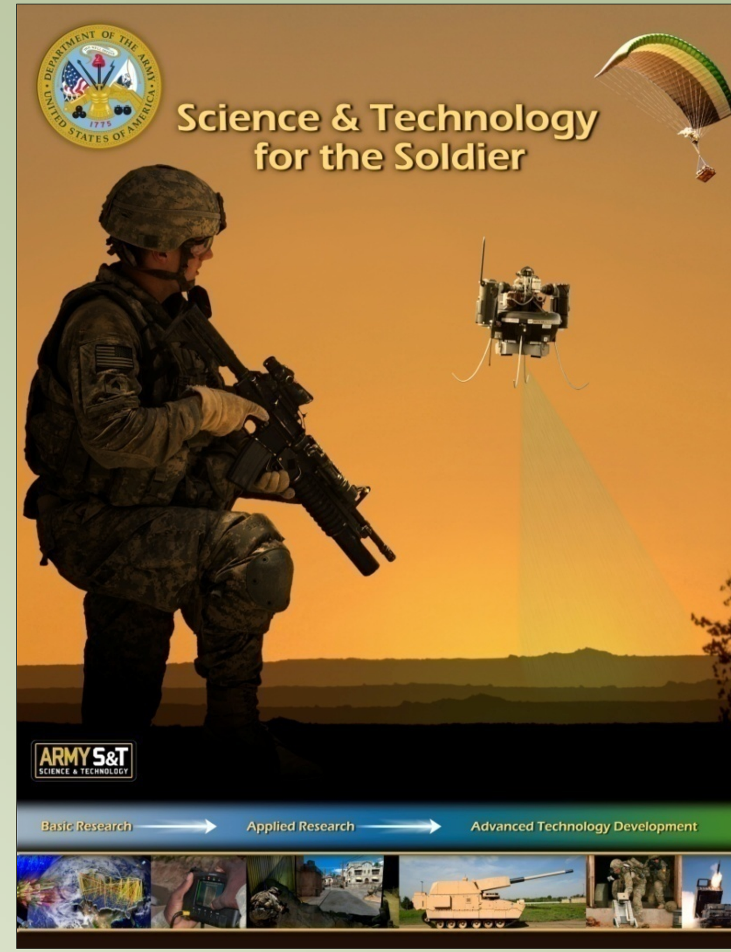
	**Marine Corps** ▪ Incorporated components from eight other programs developed by two other domains into Marine Air Ground Task Force Command and Control (MAGTF C2)

“We have to be prepared for the wars we are most likely to fight -- not just the wars we're best suited to fight, or threats we conjure up from potential adversaries with unlimited time and resources.”

—Secretary Gates, 15 Apr 09

Army and Independent Research and Development

NDIA
10th Annual Science & Engineering Technology Conference



Empowering Soldiers through High Technology

Dr. Jagadeesh Pamulapati
Deputy Director for Laboratory Management

23 April 2009

Introduction

- *Army Science and Technology (S&T) Priorities*
- *The Next Generation of Revolutionary Technologies*
- *Independent Research and Development (IR&D)*

Strategy—what is Army S&T working to achieve

Foster innovation and accelerate/mature technology to enable Future Force capabilities while exploiting opportunities to rapidly transition technology to the Current Force

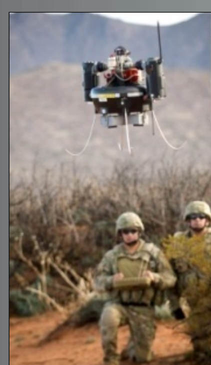
Current Force

Enabling the Future Force →

Future Force

Modular Protective Systems

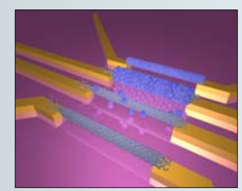
Add on Armor for Tactical Vehicles



Micro Air Vehicle

120mm Mid-Range Munition

Immersive Training



Virus-based Self-Assembling Electrodes—Advanced Batteries

Wearable Flexible Displays

Armor Kit

Mounted Combat System (MCS)

← **Enhancing the Current Force**

echnology Area Investments to Achieve Wa

FY09 $1.8B

- Force Protection $370M
- ISR $149M
- C4 $144M
- Lethality $161M
- Medical $140M
- Soldier $135M
- Logistics $92M
- Rotorcraft $72M
- Classified $62M
- Unmanned Vehicle $54M
- Mil Eng & Environment $47M
- Advanced Simulation $37M
- Basic Research $379M

Shaping the FY09/10 Portfolio

Enabling the Future Force

Enhancing the Current Force

List of 37 Tier One Warfighter S&T Outcomes (1 of 2)

- Battle Command Network*
- Counter IED and Mine*
- Power & Energy*
- Human Dimension*
- Training*

"Big 5" Warfighter S&T Outcomes

- Prognostics & Diagnostics
- Alternative Energy Sources
- Force Health Protection Initiative
- Increase control of unmanned systems
- Future Force Multi modal Human Computer Interface
- Increase Future Force Soldier Cognitive Functions While Under Stress
- Language and cultural awareness
- Dismounted soldier virtual training environment
- Adaptive training system

6

10 Comprehensive Warfighter Outcomes— includes "Big 5"

- JCA • Battle Command Network
- • Counter IED and Mine
- • Power and Energy
- • Human Dimension
- JCA • Training
- JCA • Force Protection
- JCA • Battlespace Awareness
- JCA • Force Application
- JCA • Logistics
- • Unmanned Systems Operations

Includes all Army Tier I Outcomes—aligned with S&T portfolio

092308_Killion_ASTWG_Final High Technology Army ARMY S&T 20

Big-Five Warfighter Outcomes that Guide S&T Investment

Battle Command Network

- Beyond-line-of-sight
- Optimized for mobile operations
- Increase access to the individual Soldier

Counter IED and Mine

- Detect, identify and neutralize CBRNE obstacles
- Safe standoff distance
- Maintains maneuver force momentum while protecting Soldiers and platforms

Power & Energy

- Enhanced agility to operate worldwide, reducing weight and volume
- Sufficient pulsed power enabling advanced lethality options
- Increased continuous power and fuel economy
- Dismounted Soldiers to possess twice available power, at half the tactical weight

Human Dimension

- Enhance & restore cognitive and physical performance
- Soldiers incorporated into highly trained and competent small units
- Access on potential vs. high school performance
- Mitigate the increase in physiological and psychological tress
- Improving mental, moral and physical capacity and performance

Training

- Live, virtual, constructive and mixed venues
- Impart more skills, faster, at lower cost, with greater retention than currently achievable
- Use non-traditional home station training techniques; train prior to employment
- Enhance and account for individual proficiencies and learning rates (outcome based)

Army S&T Priorities

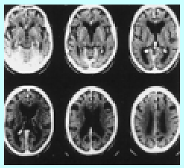
- Battle Command Network
- Counter IED and Mine
- Power and Energy
- Human Dimension
- Training
- Force Protection
- Battlespace Awareness
- Force Application
- Logistics
- Unmanned Systems Operations

S&T portfolio aligned with Warfighter needs

The Next Generation of Revolutionary Technologies

Decade of the 1970's

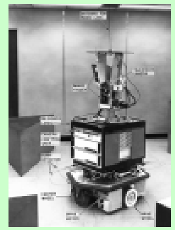
Structural Imaging



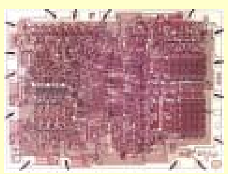
1971 – First Practical X-ray Computed Tomography Image

Artificial Intelligence

1970- Shakey the robot



Micro-processors



1971 – First 4-Bit Micro-Processor in Production

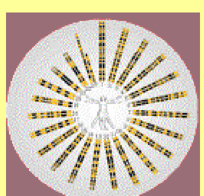
Schematic of Early ARPANET

ARPANET

Super-computing

1975 – Cray I Supercomputer

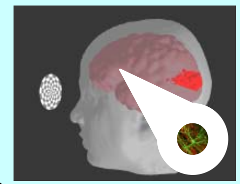
Arcade Games



Genetic Engineering

Today for 2020 and beyond…

Functional Brain Imaging & Beyond

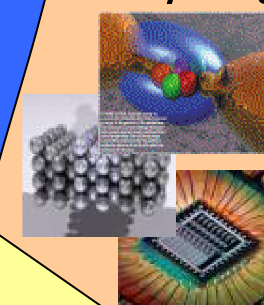


Robotics

Nano-technology

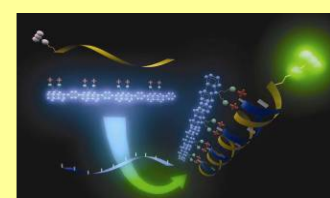
Network Science

Quantum Computing



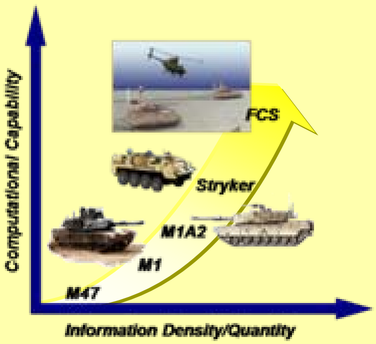
Immersive Environments

Bio-technology



Complexity Demands Disruptive Technology

Ground Combat Vehicle Evolution



M47 Patton
- •FM Radio
- •Direct View Optics
- •Engine Gauges
- •Ballistic Periscopes

M1A2 Abrams
- •Secure data/voice radio
- •Thermal Viewer
- •FBCB2 Digital Battle Command
- •Digital Fire Control
- •1 Color/3 Monochromatic Displays

Soldier as System Evolution

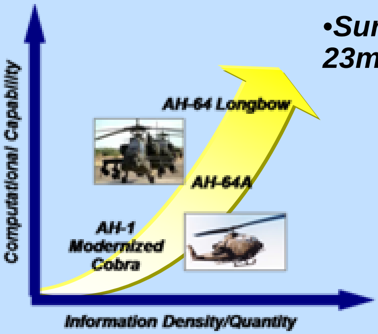
Late 1960s Soldier
- •FM radio
- •Early I2 devices
- •Binoculars
- •M-16 with daylight scope

Future Force Warrior (FFW)
- •Integrated body armor & equipment carriage suite
- •Helmet mounted thermal imaging
- •Radio digitally linked to unit communications network displaying individual locations
- •Laser aided weapon precision fire control
- •Embedded training

Helicopter Evolution

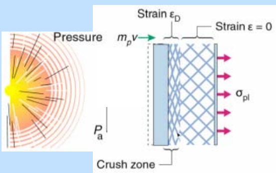
AH-1 G Cobra
- •FM Radio
- •Direct View Optics
- •2.75 inch rockets and 7.62mm machine gun

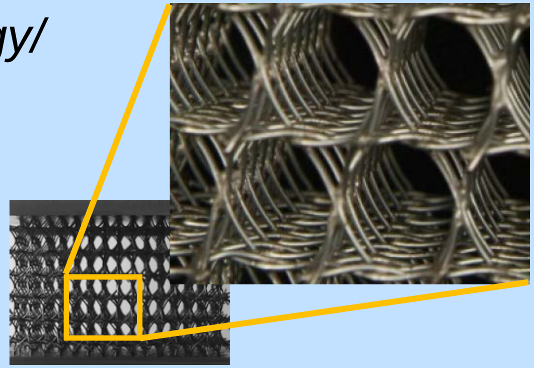
AH-64 Apache Longbow
- •Secure data/voice radio
- •Integrated pilot night vision system
- •Digital fire control linking gunners view & weapons systems
- •Longbow MMW radar
- •Hellfire missiles and 30mm cannon
- •Survivable rotors—up to 23mm AA



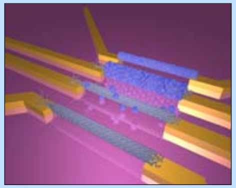
Revolutionary Technologies

Nanotechnology/ Biotechnology

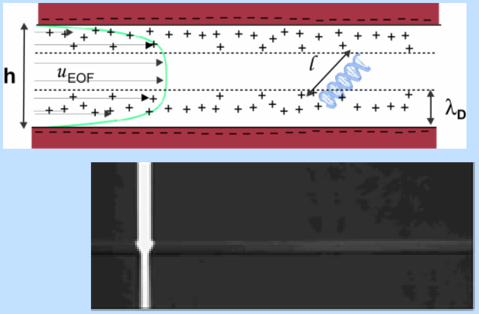




Bio-Inspired Energy-Dispersive Materials

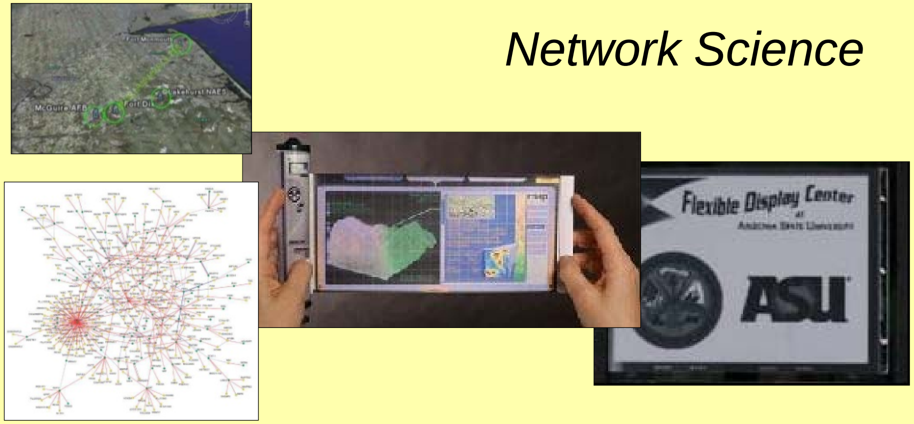


Virus-based Self- Assembling Electrodes



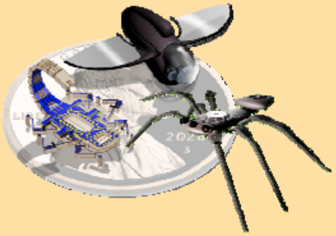
Nanofluidics

Network Science



Autonomous Systems

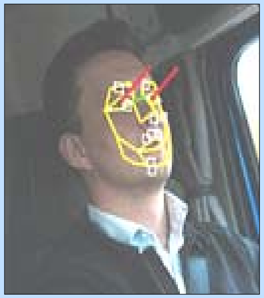
Nanoflyer

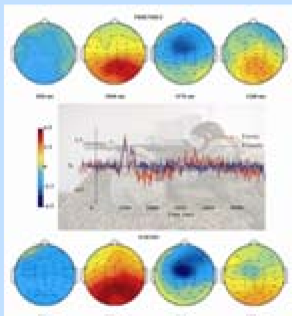


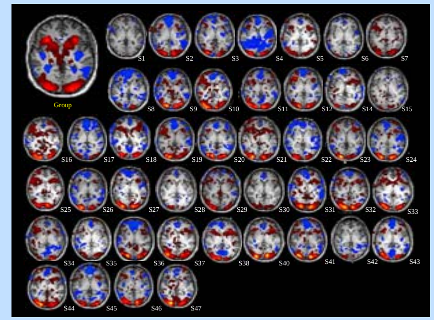
Micro Autonomous Systems Technology CTA

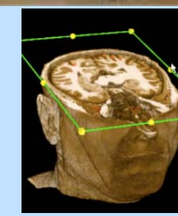
Revolutionary Technologies

Neuroscience



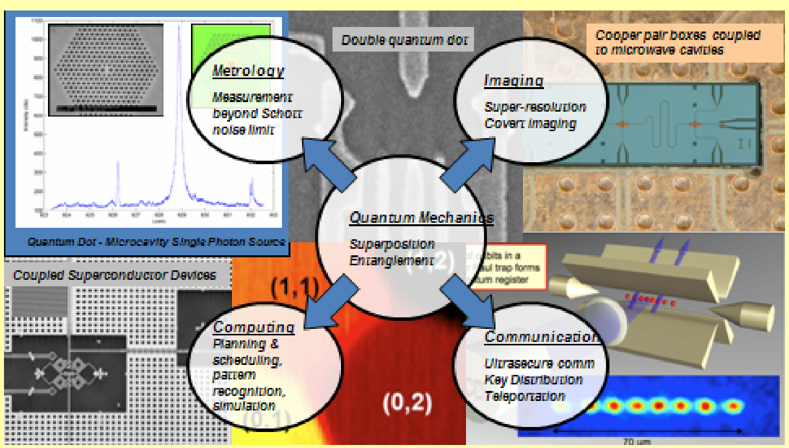






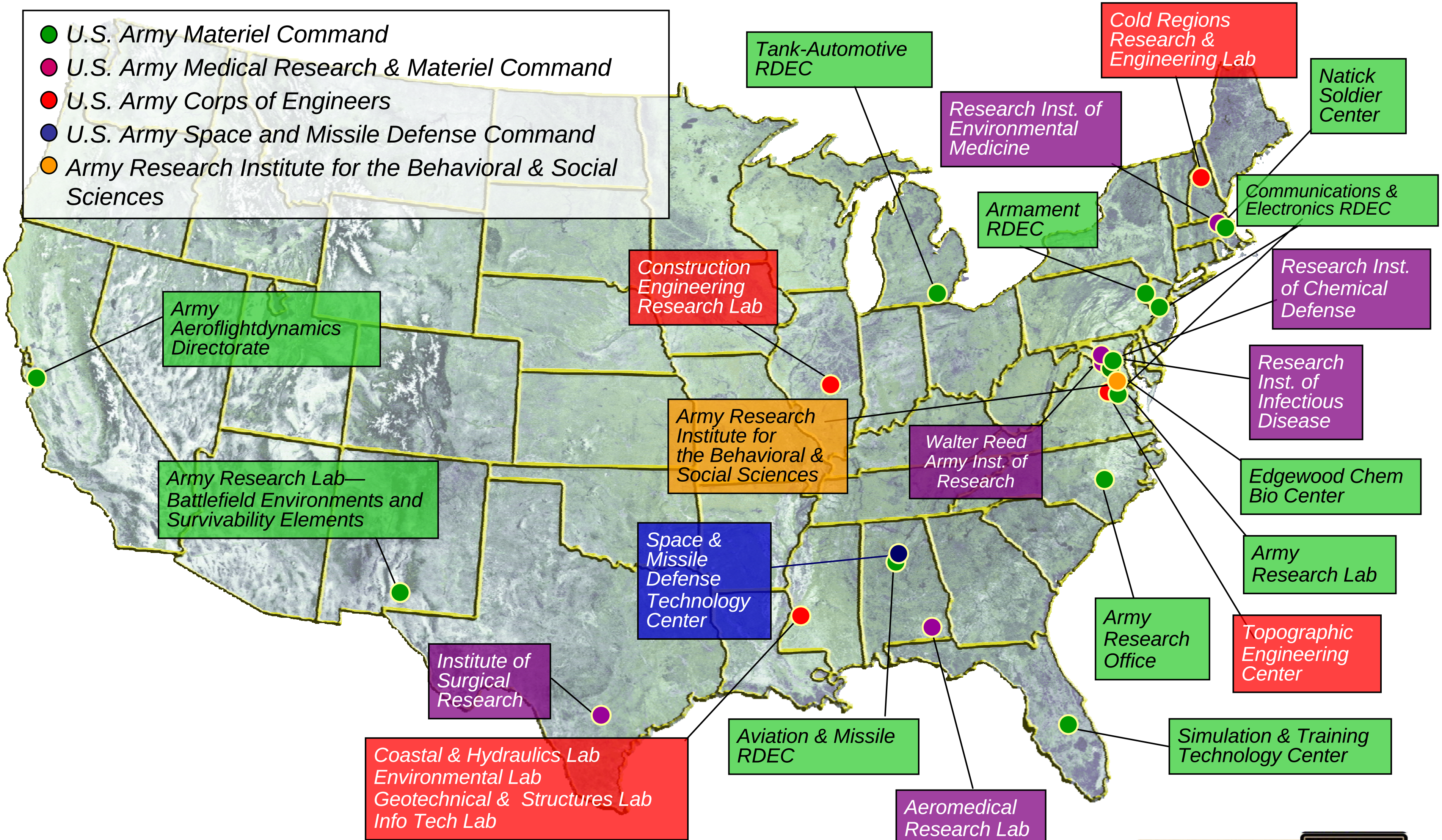
fMRI

Quantum Information Science



Immersive Technology

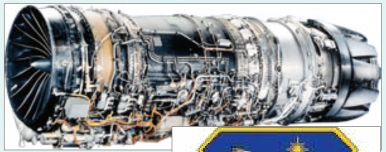
Army S&T Enterprise—Research, Development & Engineering Centers & Labs



Partnering—leveraging other Services, Agencies, Academia, Industry & International

<u>Other Services</u>
•Air Force
•Navy/USMC

Versatile, Affordable, Advanced Turbine Engine



PTSD treatment

<u>Agencies</u>
•DARPA
•DTRA
•DoE labs
•DHS
•NIH
•NASA

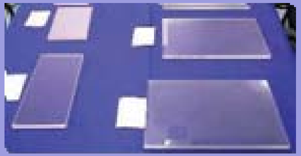
Micro Air Vehicle

NLOS-LS

<u>Academia</u>
•Georgia Tech
•MIT
•Penn State
•USC
•UMd
•UC System
•Delaware
•Michigan
•Arizona State
.
.
.

<u>Industry</u>
•Primarily technology development to create options for PMs
•Small Business Innovation Research—solutions from non-traditional sources
•Army Venture Capital Initiative—dismounted Soldier power

Transparent Armor–Technology Assessment & Transfer, Inc.



<u>International</u>
- The Technical Cooperation Program (US, UK, CA, AUS, NZ)
- NATO Research & Technology Organization
- Bilateral Agreements (UK, CA, IS, FR, GE…)

Co-investment with UK to advance stat of-the-art in networ science

Upcoming Events/Opportunities

- *TRADOC Information Information Exchange Program*
  - *http://www.arcic.army.mil/res_briefings.html*
- *AMRDEC*
  - *http://www.redstone.army.mil/amrdec/News/events.html*
- *CERDEC Technology Interchange Meetings*
  - *http://www.cerdec.army.mil/business/ird.asp*
- *TARDEC*
  - *http://tardec.army.mil/events.asp*
- *ARDEC*
  - *https://www.pica.army.mil/TechTran/policy/index.asp#4*
- *AUSA (Winter/Spring)*
- *Army Science Conference*

For More Information

- ***Links to pertinent websites***
  - ***RDECOM***
    - ***http://www.army.mil/institution/organization/unitsandcommands/commandstructure/rdecom/***
  - ***US Army Corps of Engineers***
    - ***http://www.usace.army.mil/Pages/Default.aspx***
  - ***US Army Medical Research and Materiel Command***
    - ***https://mrmc-www.army.mil/***
- ***Service IR&D Lead***
  - ***Contact info:***
    - ***Dr. Jagadeesh Pamulapati***
    - ***703.601.1515***
    - ***Jagadeesh.Pamulapati@us.army.mil***

Harvesting Technology for Warfighters

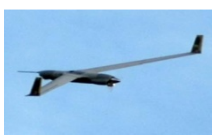
Dr Chuck Perkins
Acting DUSD (Advanced Systems & Concepts)

“There is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things …Whenever his enemies have the abilities to attack the innovator, they do so with the passion of partisans, while others defend him sluggishly, so that the innovator and his party alike are vulnerable” --

Nicco Machiavelli, *The Prince*

UAVs since 1994

Before 1994, DoD cancelled nine UAV programs. By 1 Oct 2008, DoD had fielded over 6,000 unmanned aerial systems, the following aided by AS&C initiatives:

	**High Altitude Endurance UAV ACTD produced *Global Hawk***	**9**
	**Medium Altitude Endurance UAV ACTD produced *Predator* (109) and *Reaper* (26)**	**135**
	**Tactical UAV ACTD led to *Shadow***	**288**
	**Scan Eagle**	**13**
	**Expendable UAV ACTD produced *TigerShark***	**12**
	**Micro Air Vehicle ACTD**	**54**
	**Small UAV ACTD produced *Raven***	**4,995**

Our Job

Harvesting Technology for Warfighters

Our Goals

Find mature technology for warfighting needs

Get to warfighters within the budget cycle

Overcome obstacles and gaps

Minimize risks in acquisition

Ensure sustainable technologies

Deep bleeding control enabled by
Office of Technology Transition

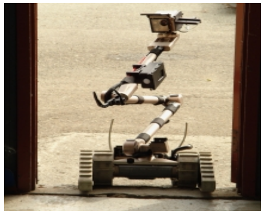
We Don’t Do it Alone

Tools Brought to Bear -- Sustainable Technologies

Residuals

Thermobarics ACTD – 20 warheads provided to combatant commander

Program of Record



CUGR ACTD -- CBRN unmanned ground vehicle transitioned to Joint NBC Reconnaissance System Increment 2 Program

GSA Schedule

JMIDS ACTD and Technology Transfer – Joint Modular Intermodal Container in GSA catalog

Concepts

CAESAR ACTD – Standard NATO Agreement on mobile targeting

Spin offs

Counter Sniper ACTD – Bullet Ears forerunner of Boomerang gunfire detection system

Their Value-Added

New Capabilities

US maritime domain awareness enabled by MASTER JCTD

Coalition Capabilities

Coastal surveillance network for African nations enabled by RMAC JCTD

Improved Capabilities

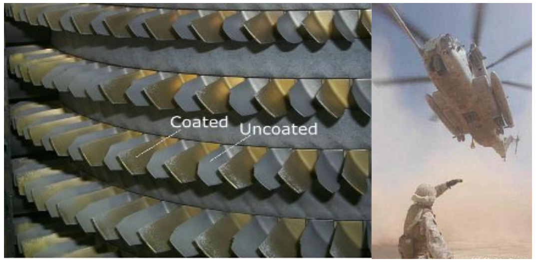
Distant warfighters get faster access to large amounts of map data, with Large Data JCTD

Faster Warfighting

Communications planned in 20 minutes, vice 24 hours, with software enabled by DAC

Improved Systems

UH-60 helicopter range/payload increased with lighter materials enabled by ManTech and DAC



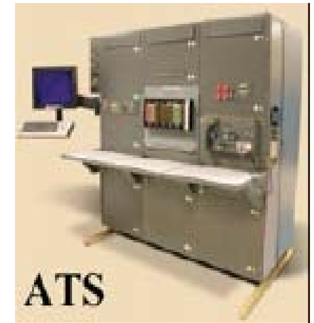
Extended System Use

helicopter use extended in desert with TiN coated turbine blades, enabled by FCT and TTI

Their Value Added

Reduced Maintenance

Air generator eliminated removal of nitrogen cooling bottles in Sidewinder missiles, saving $50M in life cycle costs, with FCT

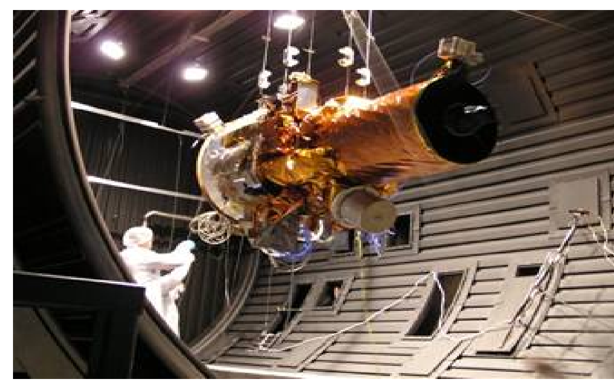


Smaller Logistics Footprint

Number of electronic testers reduced and faster diagnostics achieved, with ARGCS ACTD

Affordable Systems

Cost of uncooled focal plane arrays in vision systems was cut from $16,000 each, to under $2,000 with ManTech



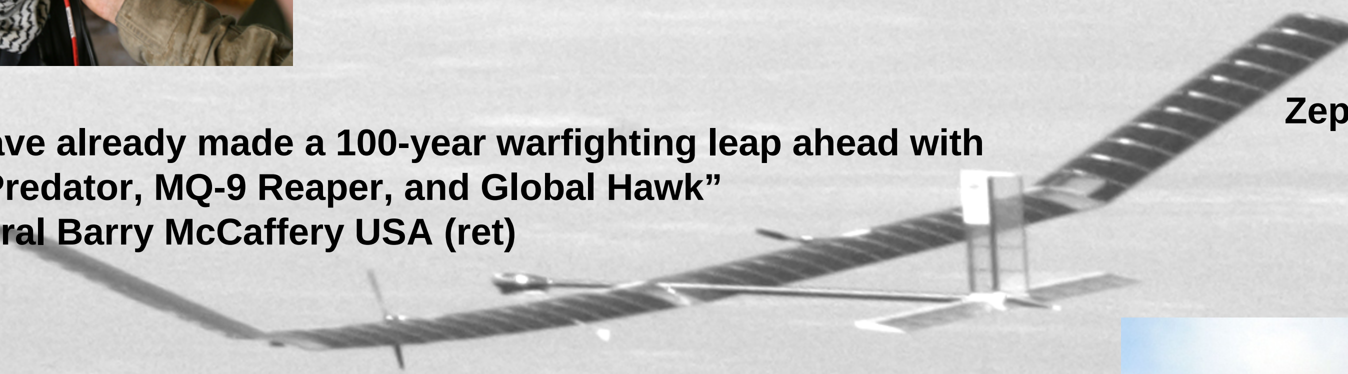
Assured Future Systems

Radiation-hardened processors produced for advanced spacecraft with help from DPA Title III

Game Changers and Life Savers

"We've revolutionized the way we resupply the Warfighter" -- Maj Gen Scott Gray, Commander, Air Mobility Warfare Center (Joint Precision Air Drop System ACTD)

"The Marines own Fallujah with biometrics" – US Central Command Assistant Chief of Staff for Intelligence, (Human Intelligence and Counterintelligence Support Tools ACTD)



Zephyr JCTD

"We have already made a 100-year warfighting leap ahead with MQ-1 Predator, MQ-9 Reaper, and Global Hawk" – General Barry McCaffery USA (ret)

"What's great is that you can send the Raven out ahead of a convoy and check for activity …It can really save lives" -- Army Staff Sergeant Company D, 5th Squadron, 73rd Calvary Regiment (Small UAV ACTD)

Use Beyond Defense

Non-DoD organizations using energy-efficient LED lights, enabled by DPA III

New York and Ohio power grids using YBCO tape enabled by DPA III

NASA conducting earth research with Global Hawk from ACTD

NASA's Mars Orbiter using Hardened Microprocessors aided by DPA III

Center for Disease Control using ACTD diagnostic system in Africa

Miami-Dade County Police Department testing Micro Air Vehicle from ACTD

Health Care industry benefiting from:

- Hearing Pill enabled by OTT CRADA and TTI
- SAM Sling for pelvic fractures enabled by MilTech
- Medical devices using tough, rigid rod polymers enabled by DPA III
- Rescue Wraps enabled by MilTech


NASA's Mars orbiter with hardened processors


Miami police testing Micro Air Vehicle


Medical devices with rigid rod polymers

Invention is not enough --

Getting technology used requires processes

"Successful innovation often demands an innovative business model"

-- John Seely Brown , Director Emeritus, Xerox Palo Alto Research Center

- Estimate: 3-5 percent of government inventions reach commercial success

- Time between invention and use is at least 10 years

- Many inventions often have perilous paths to use

- The inventor is often not the one who gets a technology used

AS&C provides processes for innovation

-- they get product solutions used in defense

The Core of Our Processes – Knowing User Needs

We spend our time

- Listening to warfighters
- Listening to technology providers
- Overseeing initiatives
- Ensuring sustainable solutions

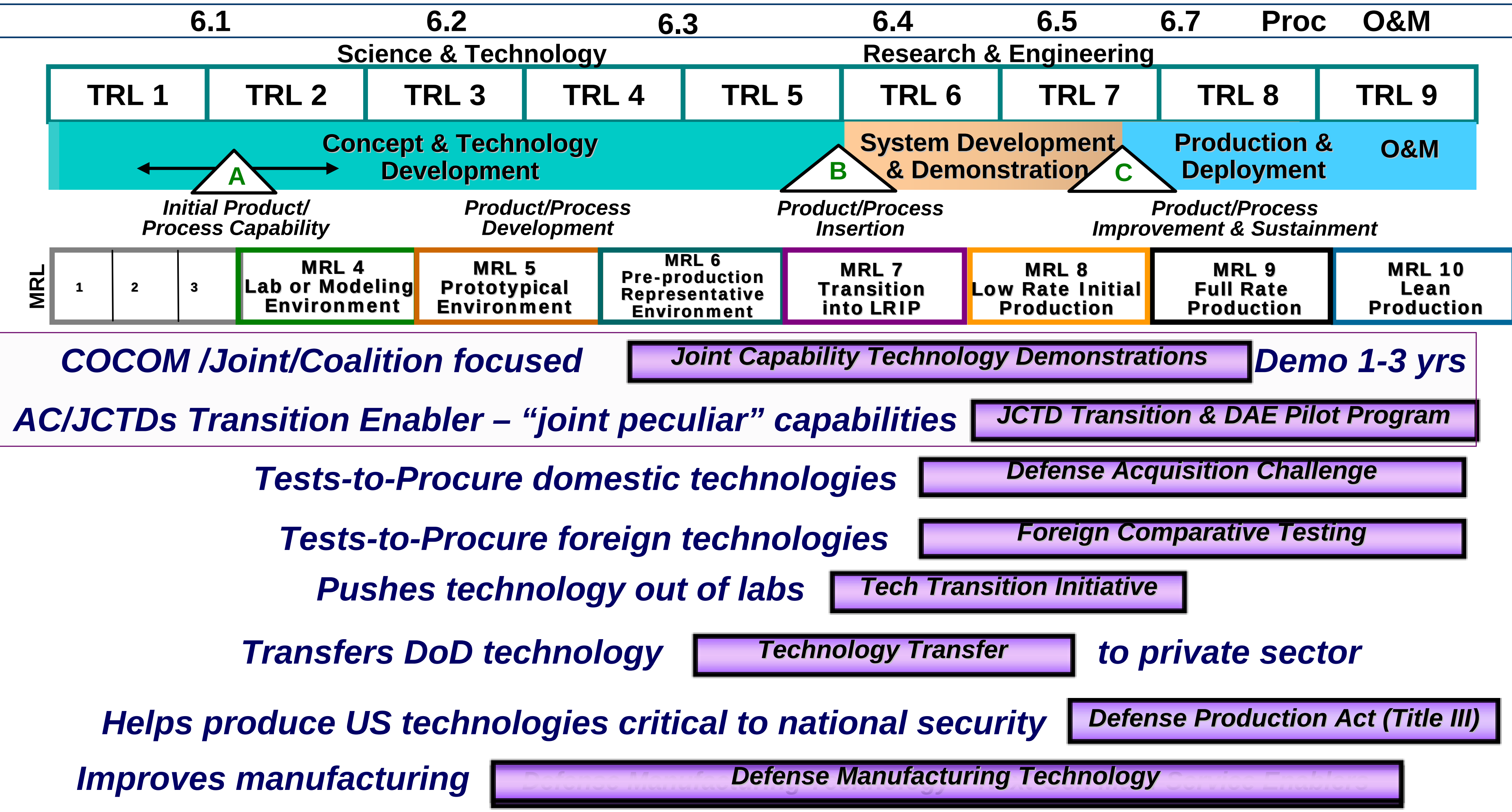
AS&C bridges S&T and Warfighting

S&T Sources

- DoD Labs
- Other Government Labs
- Universities
- Industry
- Other Nations

Lightweight Modular Causeway System
from Joint Enable Theater Access – Seaports of Debarkation ACTD

AS&C Processes Rapidly Insert Technology into Acquisition Process



Joint Capability Technology Demonstrations

Rapidly addresses joint, coalition, and interagency capability gaps

Validates JCTD need via JCS process and military utility assessment

Partners with service/agency and warfighters to address gaps

Provides rapid prototypes and concepts for capability gaps

Demonstrates solutions in 1-3 years

Provides business case analysis for solution's cost and support

Transitions solution to enduring capability via service/agency partnership

Stand Off Precision Guided Munition JCTD meets need for stand-off strikes

CORSOM ACTD provides overview of coalition forces deployment

CHAMPION JCTD meets HUMINT Teams need for communications

The JCTD Record

"The JCTD program has been an important tool in developing technology solutions, to validate COCOM warfighting shortfalls, and then transitioning these solutions to enduring, sustainable capabilities" -- General Bantz J. Craddock US Army, Commander, US European Command, March 5, 2008

185 ACTD/JCTDs have been selected for initiation

80 percent of 127 completed transitioned products to warfighters

Over 45 ACTD/JCTDs deployed to OEF, OIF and other operations

35 percent involve coalition/partner nations

Awards and recognitions:

- Link 16 -- Windows World Wide Open Product Award, presented by Bill Gates
- Airbase/Port Biological Detection ACTD – David Packard Excellence in Acquisition Award, 1998
- High Altitude Endurance ACTD -- Robert J. Collier Trophy, National Aeronautic Association, 2000
- CAESAR ACTD -- AFMC International Armaments Cooperation Team Award, 2002
- Thermobaric ACTD **--** Special Achievement Award from International Test & Evaluation Association, 2004
- MANPACK ACTD – Tibbetts Award, for innovation involving Federal SBIR program, 2006
- Hunter Standoff Killer team ACTD – Shepard Group's Integrator of the Year Award 2007
- Stand Off Precision Guided Munition JCTD **--** David Packard Excellence in Acquisition Award, 2008
- Focused Lethality Munition JCTD – William J. Perry Award
- Stand Off Precision Guided Munition JCTD – William J. Perry Award, 2009
- JETA– SPOD JCTD -- Defense Logistics award for "Technology Implementation of the Year," 2008

Comparative Testing Office – 80 percent transitioned over last eight years

Defense Acquisition Challenge Program

Searches for and “tests-to-procure” US technologies meeting warfighting needs

Allows anyone to propose improved system performance, production or affordability.

Annually solicits and selects proposals

Funds testing of proposed technology

Successfully tested items have procurement path

Items tested in about two years, some finishing faster

Avoided $9 in R&D and other costs for every $1 spent on testing

Last 3 years, over 25% of tested proposals came from “first time” DoD companies

Medical personnel train with patient simulator, enabled by DAC

Marines use 3-in-1 unit to power, cool and heat field facilities, enabled by DAC

Special operators use fly-away SatCom, enabled by DAC

Comparative Testing Office – 80 percent transitioned over last eight years

Foreign Comparative Testing Program

Searches for and "tests-to-procure" foreign technologies meeting warfighting needs


Swedish-developed anti-armor weapon for Rangers


Belgian-developed high-rate-of fire .50 cal for Marine helicopters

Annually solicits and selects proposals

Funds testing of proposed technology

Successful items have procurement path

Items tested in two years, some sooner

On average, cut fielding by 5-7 years

Avoided $7 in R&D and other costs for every $1 spent on testing

Since 1980, DoD has avoided estimated $7.6 billion in RDT&E costs

29 nations have participated in program

Resulted in US jobs in 33 states


South African-developed Buffalo


French-developed Mobi-mat for fast set-up helipads

-- Transitioned 75 percent of technologies aided

Technology Transition Initiative

Helps new technologies bridge “Valley of Death”

Identifies promising technologies meeting DoD goals and requirements

Helps fund technologies’ transition from labs

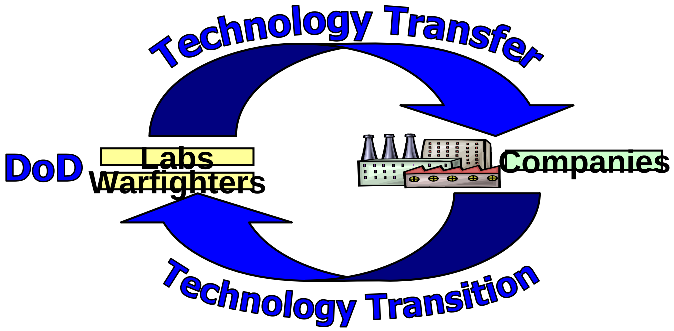
Demonstrates technologies in relevant environment

Accelerates new technologies to operational capabilities by 24 months

Navy-developed Hearing Pill, fighting hear loss, undergoing clinical trials with help from TTI

Unmanned Sea Surface Vehicle delivered two years ahead schedule with help from TTI

Safer, insensitive 155 munitions being accelerated to warfighters with TTI help



Technology Transfer

Moves DoD technology to industry for production for warfighters

DoD TechMatch identified an AFRL technology, helped create a capability and delivered 2,300 Bombots for EOD in Iraq

Links DoD labs and industry via intermediaries

- ***DoD TechMatch* – Makes known DoD technologies available for transfer**
- ***FirstLink* – Links companies to first-responder technologies**
- ***TechLink* – Helps labs and industry with technology transfer agreements**

Alternative fuel for USAF aircraft developed with CRADA

Enables direct exchanges between DoD labs and industry

- **Collaboration -- Cooperative Research and Development Agreements**
- **Intellectual property use – Patent Licensing Agreements**

Aids small innovative companies' production via MilTech

MilTech helped company expand its application of camouflage military wraps

Defense Production Act, Title III

Ensures production of technologies essential to national security

DoD's one tool for addressing production shortfalls

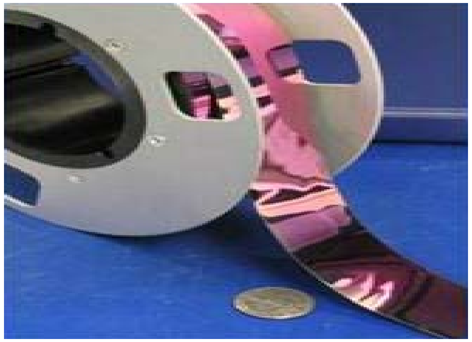
Provides incentives to create/expand production
- Purchases or commitments to purchase
- Installs equipment in government or private facilities

Bridges gap between R&D and acquisition

Addresses shortfalls across programs

Strengthens competitiveness of US industrial base


DPA III aided production of Silicon Carbide Substrates for next generation radar, also used in energy efficient LED lighting in Pentagon and other government buildings




DPA III aided production of YBCO Tape for more efficient electrical transmission in defense systems, also used in cities' power grids

Defense Manufacturing Technology Program

Enables fast, affordable and efficient manufacturing

Improves fabrication of metals, composites and electronics

Enables advanced and affordable manufacturing, maintenance and repair processes

Pursues manufacturing processes optimizing development

60 ManTech projects are expected to provide $30 million savings in construction of each Virginia-class submarine.

ManTech cut weight and parts in the M777 howitzer and avoided $40 million in manufacturing costs

Constant innovation is the new defense demand

10th Annual NDIA Conference

Air Force STEM Workforce Today and Tomorrow

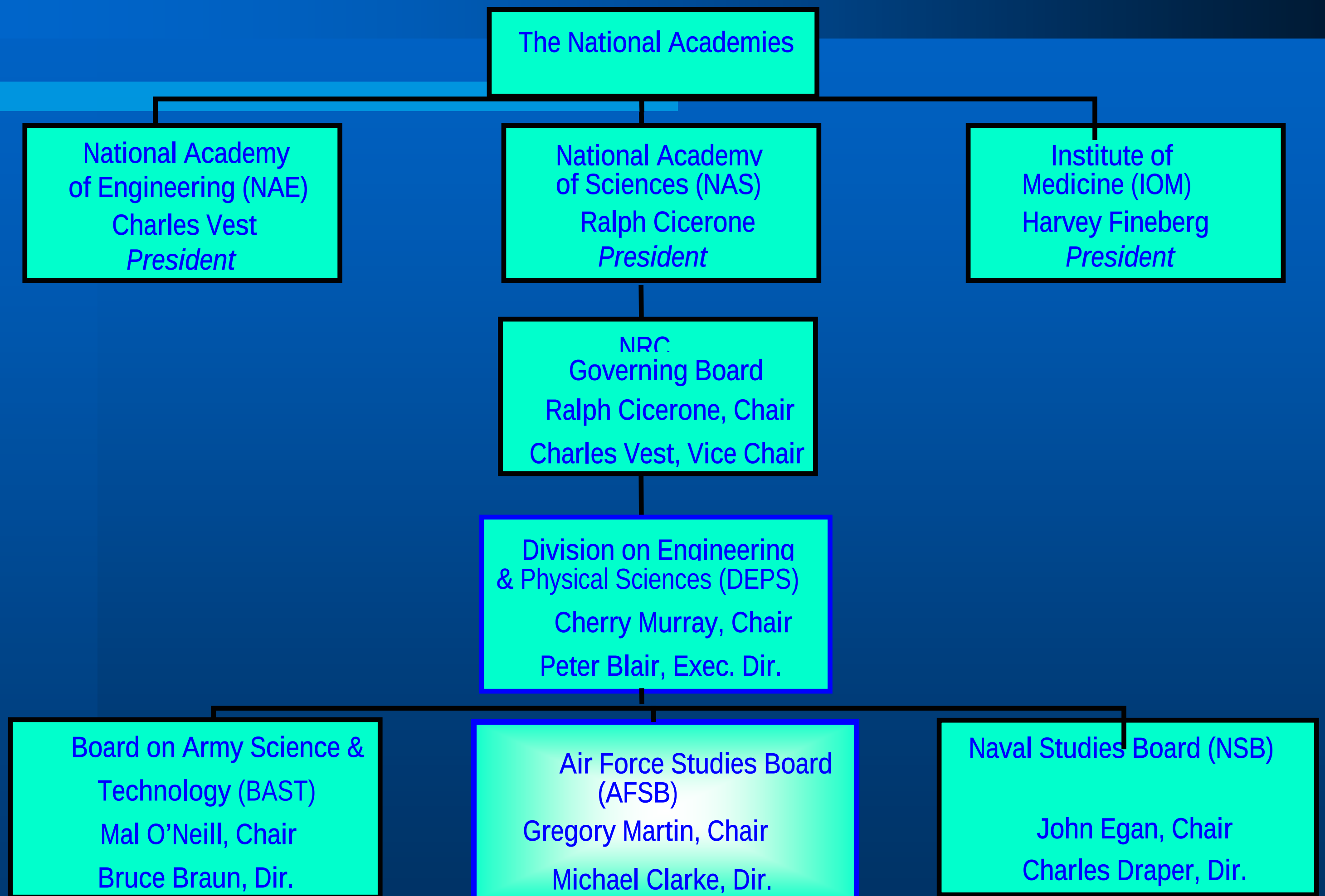
Leif E. Peterson
Member, NRC Committee on USAF STEM Workforce Needs and Strategy

The National Academies

- National Academy of Sciences
- National Academy of Engineering
- Institute of Medicine
- and National Research Council (NRC)

Not-for-profit corporation –
Executive Order 2859
Non-competitive contracting
http://www.nationalacademies.org

The National Academies



RULES OF THE ROAD

- Section 15 of Federal Advisory Committee Act (FACA) governs activities of ad hoc committees
- NRC speaks only through peer-reviewed written reports. Any other advice is the opinion of the individual committee member and should not be considered “official”
- NRC Governing Board approves studies, boards and committee members - not the sponsor

Study Roadmap

DEFINING THE STUDY	COMMITTEE SELECTIONS AND APPROVAL		
NRC Governing Board reviews and approves study scope and plan	Project Starts when funding is received	Provisional slate approved by NAS president	Provisional committee posted for public comment via Current Projects System
STAGE 1	STAGE 2		

Committee balance and expertise evaluated; any conflicts of interests are investigated

Final committee formally approved

Monitoring for potential conflicts of interest continues

Reviewers comment on report

National Academies sign off on report

COMMITTEE SELECTION AND APPROVAL

REPORT REVIEW

COMMITTEE MEETINGS, GATHERING, DELIBERATIONS, AND DRAFTING REPORT

Committee's first meeting

Full Committee signs off on draft report

STAGE 3

STAGE 4

Lastly the report is released to the sponsor and the public

NRC STEM Study

Examination of the U.S. Air Force's Science, Technology, Engineering, and Mathematics (STEM) Workforce Needs in the Future and Its Strategy to Meet Those Needs

Study Origin

- Requested by Terry Jaggers, SAF/AQR
- Co-sponsored by Joseph McDade, HAF/A1D

Statement of Task

- Assess the STEM capabilities the U.S. Air Force
- Determine whether those capabilities will meet AF needs
- Identify and evaluate strategy options
- Address STEM capability in terms of functional mgt areas
- Identify and evaluate options re organization and management of Air Force STEM workforce
- Recommend strategies to meet STEM needs in the future

Members

Natalie W. Crawford, *Co-Chair*

George K. Muellner, *Co-Chair*

William P. Ard
James B. Armor, Jr.
Earl H. Dowell
Richard P. Hallion
Michael A. Hamel
Ray M. Haynes
Leon A. Johnson
Lester McFawn

Michael C. McMahan
Donald L. Peterson
Leif E. Peterson
Albert A. Robbert
Paula E. Stephan
Todd I. Stewart
Ronald W. Yates

NRC STEM Study

- Five Meetings – Aug 2008   Jan 2009
- 25+ speakers & presentations
- SAF/AQR & X, A1, A8, A9, HQ AFMC & Centers, ACC, AMC, AFSPC, AFIT, USAFA, AETC, AFRS, Toffler Assoc., SAIC, Battelle
- Numerous studies & reports

  (i.e., AF, NRC, NDIA, National Science Foundation)

Status

- Pending peer review
- Final edits
- Approval & release – late June, early July

Norm Augustine – Jan 2009

Congressional Testimony

Competing in the New World Economy

Past 50 years – 50-85% GNP growth rooted in S&E
4 % of workforce in S&E

"Gathering Storm"

K-12 education in US – one of worlds worst, spend more per capita than all nations but two

Engineering & physical sciences grads - down 20%

US citizens achieving PhD's – down 34%

Engineering PhD's in US – 2/3 are non-US citizens

Interventions elsewhere…..

NASA – 50% new hires – ‘fresh outs’

Navy – CNO, 65% Academy 2013 grads in science, engineering, or math majors

Something to Think About…

"If you don't solve (the K-12 education problem), nothing else is going to matter all that much."

Alan Greenspan

"The only sustainable competitive advantage is the ability to be able to learn faster than your competition."

Peter Senge

"You are today where your thoughts have brought you, you will be tomorrow where your thoughts take you."

James Allen

Professor Robert Clark
Chief Defence Scientist &
Chief Executive Officer

Defence Science & Technology Organisation
Department of Defence
Australia

10th Annual SET Conference

21 April 2009

The Australian Perspective

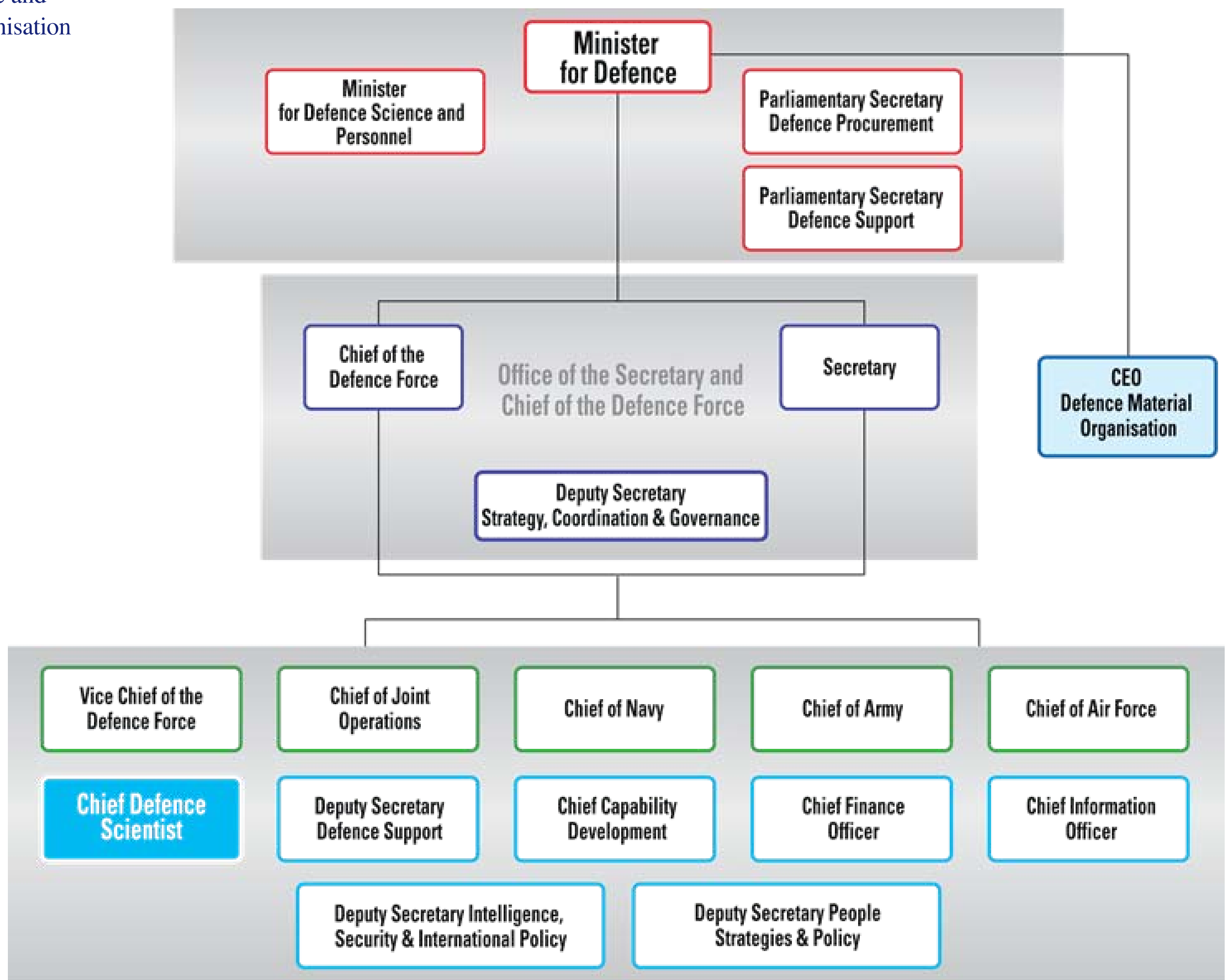
Unclassified

Australian Government
Department of Defence
Defence Science and Technology Organisation

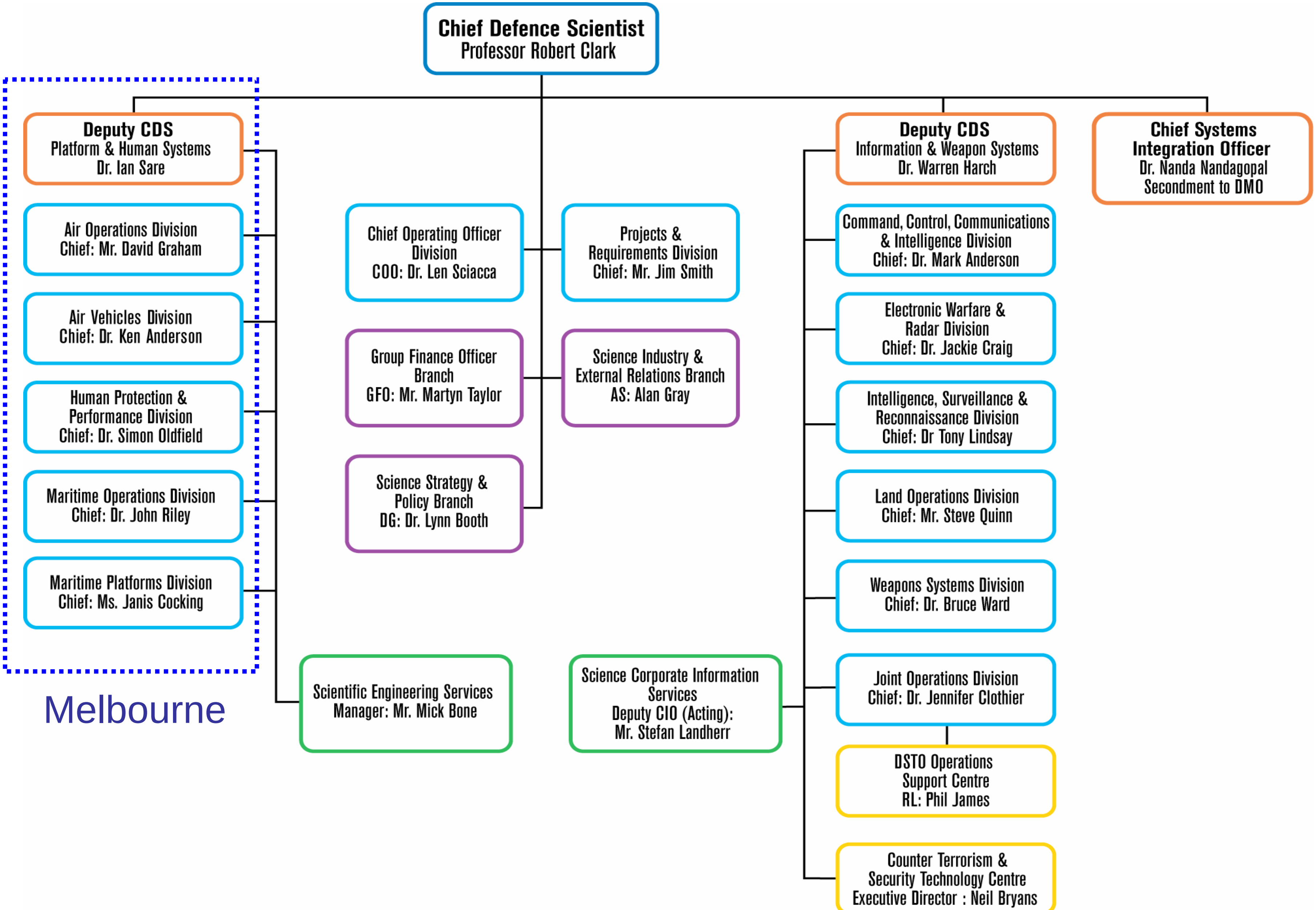
DSTO at a Glance

Australian Government
Department of Defence
Defence Science and
Technology Organisation

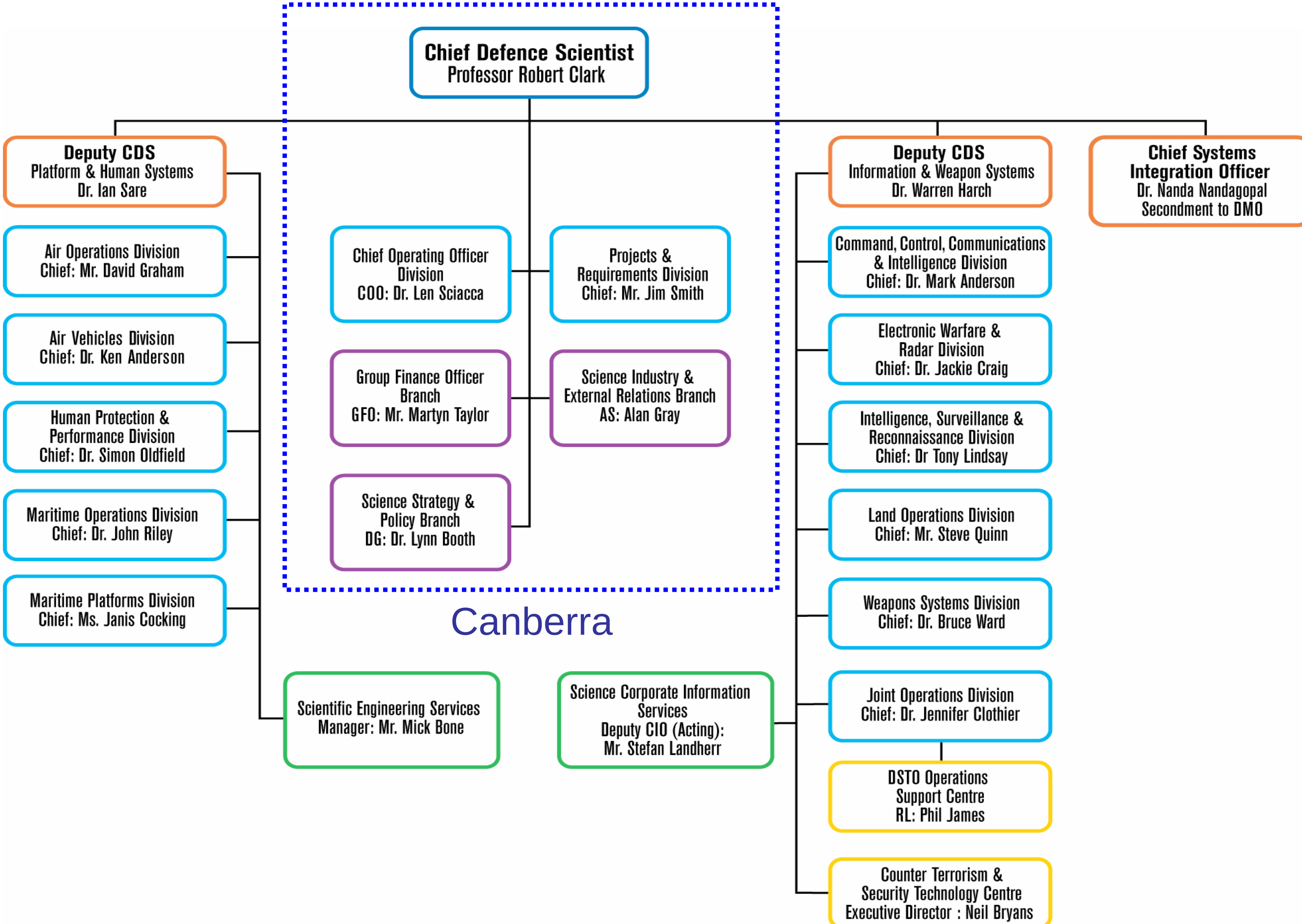
DSTO in Defence



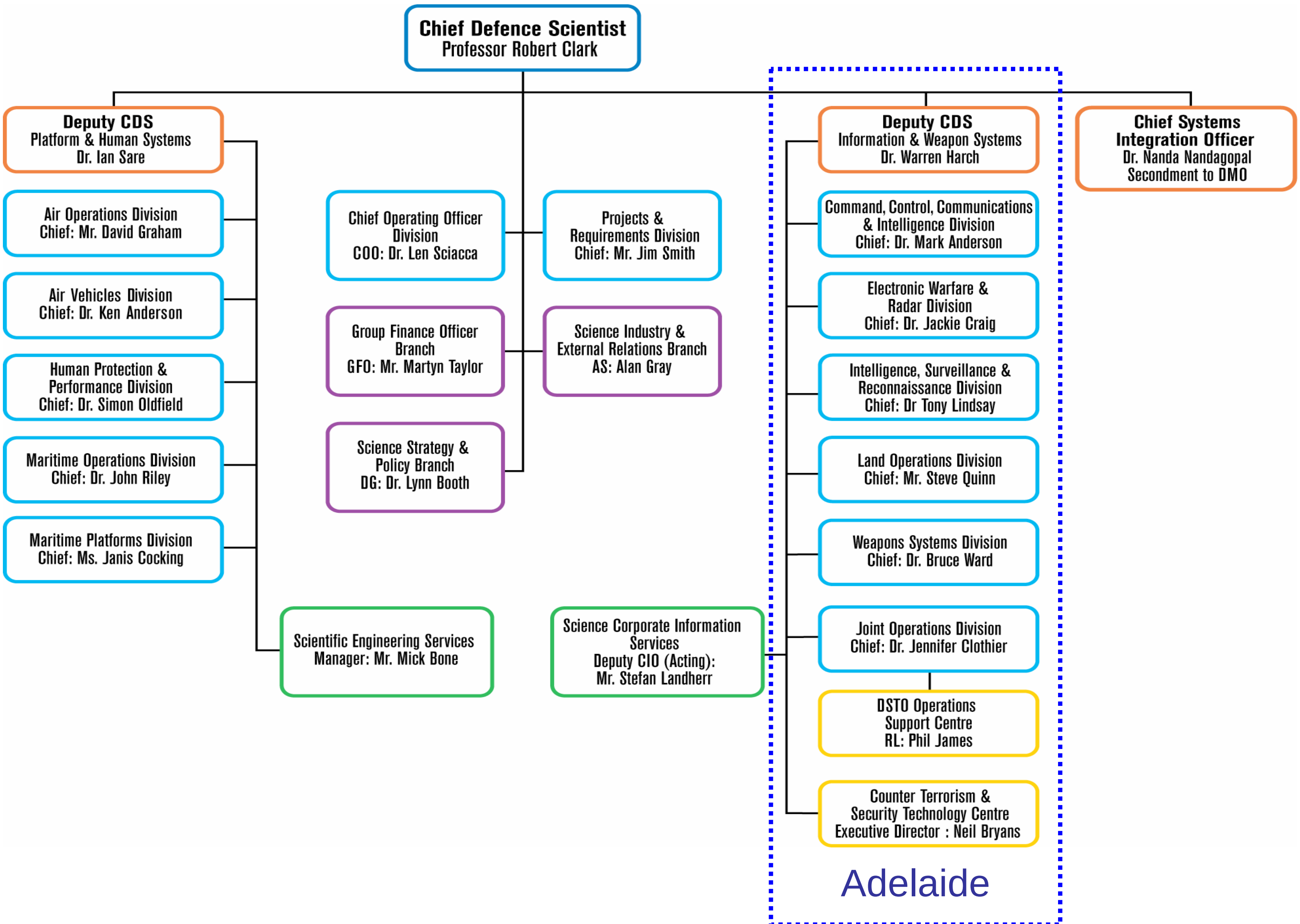
DSTO Structure



DSTO Structure



DSTO Structure



Australian Government
Department of Defence
Defence Science and Technology Organisation

DSTO Major Facilities

Adelaide

Melbourne

Australian Government
Department of Defence
Defence Science and
Technology Organisation

Selected DSTO Achievements /1

- JORN Phase 5 Enhancement Program

- F/A-18 Hornet Structural Testing

Selected DSTO Achievements /2

- “Shapes Vector” Network Security

- Nulka

Australian Government
Department of Defence
Defence Science and
Technology Organisation

DSTO Role

- Enhance Australian Defence and national security operations

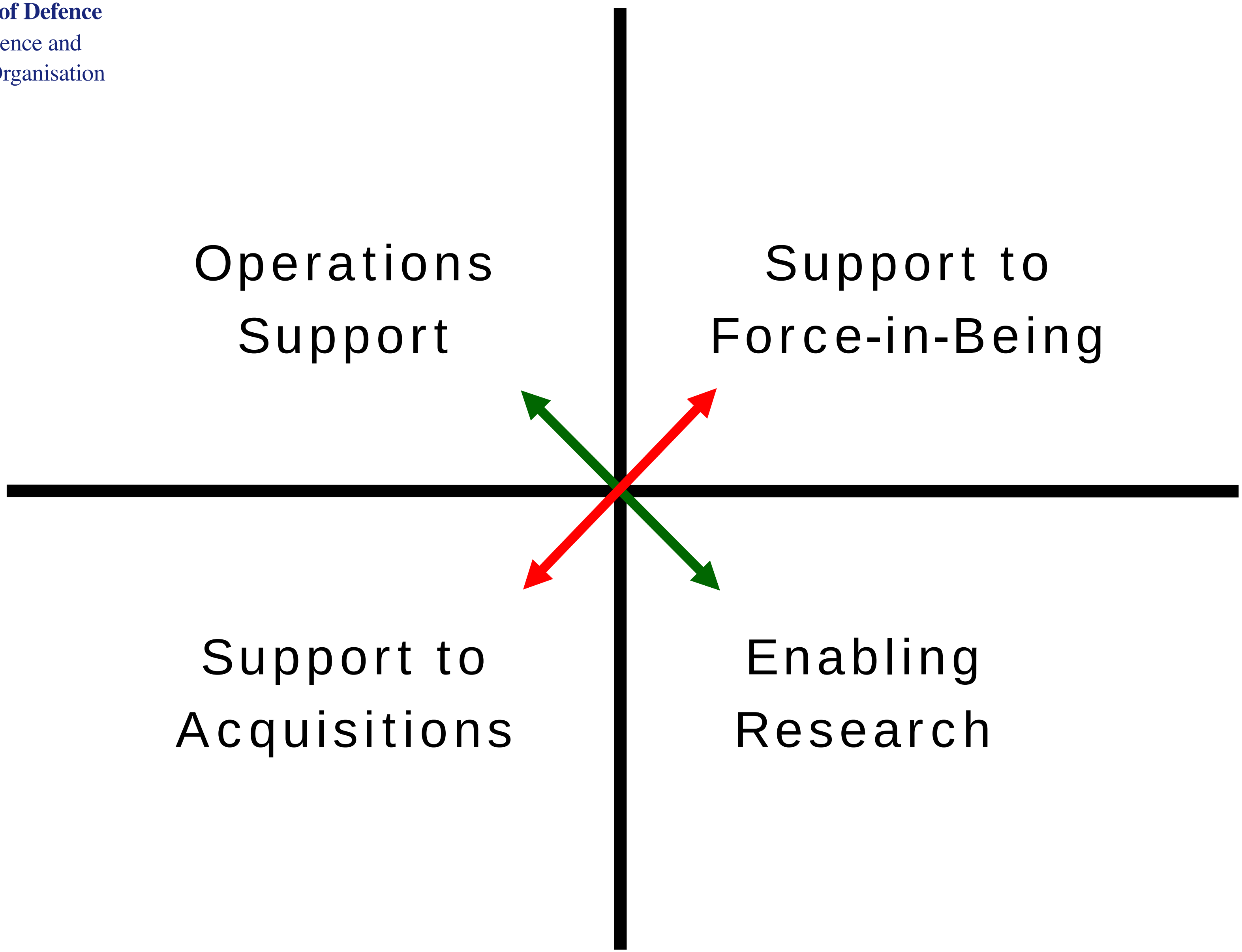
- Support the sustainment of in-service capabilities

- Deliver key advice and technology solutions for future capability

- Build Defence capacity through partnerships with industry

Australian Government
Department of Defence
Defence Science and Technology Organisation

DSTO Focus



I: Support to Operations /1

- Deployed Operations Analysts (OA)
  - DSTO responsible for raising, training and deploying two-person OA teams on ADF operations
  - > 60 personnel deployed to 7 countries since 2005
  - Currently maintain 4 teams around the globe

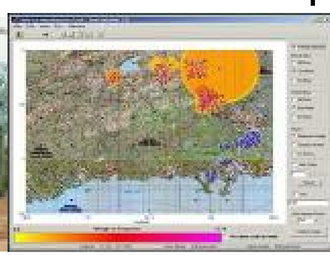
- Operational Reachback Program
  - Link between deployed analysts and broader defence science community
  - Set of dedicated and committed staff available to respond to requests for science and technology assistance

Australian Government
Department of Defence
Defence Science and
Technology Organisation

I: Support to Operations /2

Headquarters Joint Operations Command (HQJOC)

Joint Task Force Headquarters



Fighting Elements

DSTO Contributions

Battlelabs

Deployed scientists

Technology insertion

Australian Government
Department of Defence
Defence Science and Technology Organisation

II: Operational Support for ADF Platforms

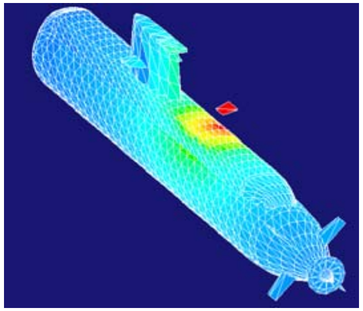
- Maximising operational effectiveness
- Support to capability enhancements
- Position for the future

Australian Government
Department of Defence
Defence Science and
Technology Organisation

II: Shock Trial of HMAS Rankin

Outcomes: Validated static & dynamic structural performance

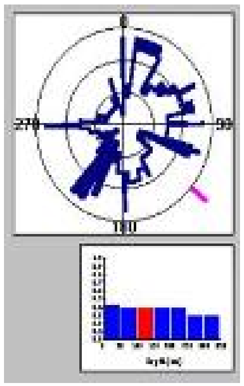
R&D advice to support safety, reliability & functionality



Australian Government
Department of Defence
Defence Science and Technology Organisation

II: Signature Management

Threat Analyses

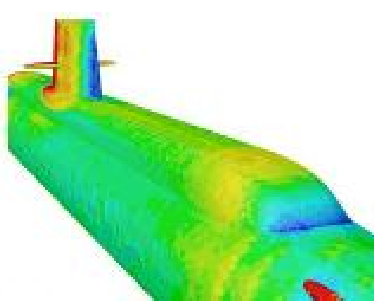


Measurement

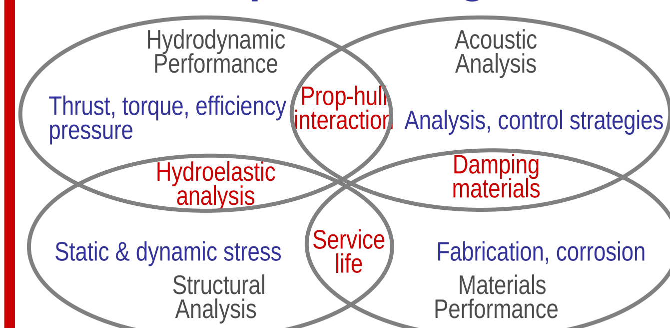
Analysis

Provides essential information for complete signature awareness and management

Modelling



Propeller design



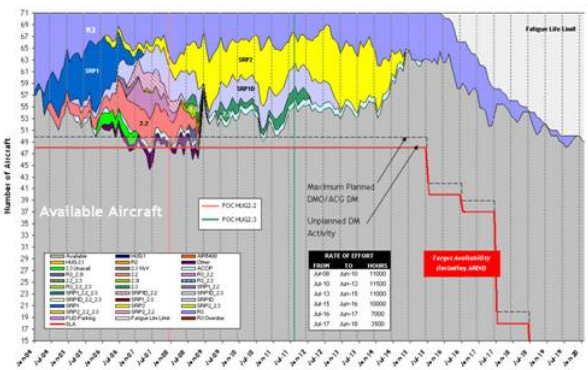
Control

Australian Government
Department of Defence
Defence Science and Technology Organisation

II: Support of F/A-18 Structure

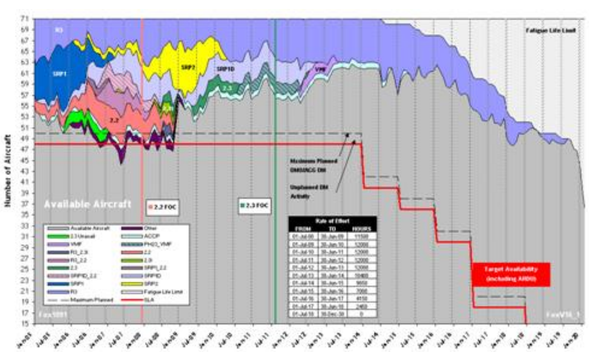
- Improve fatigue crack growth modelling
- Combined with fleet management

Outcomes:
- Improved operational flexibility
- Improved availability
- Large cost savings

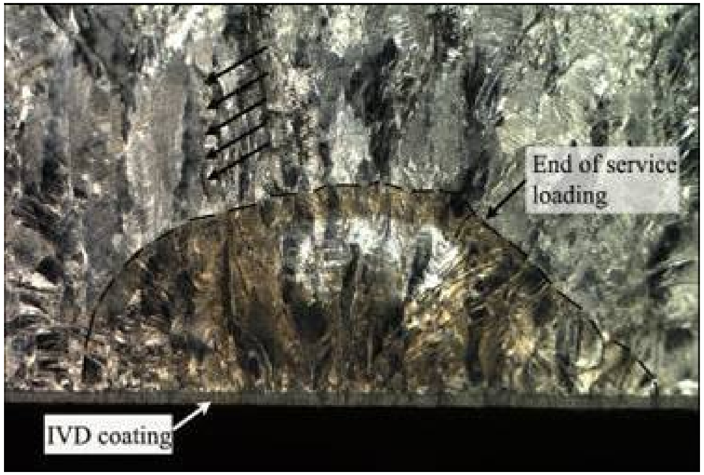


Prior to program 41- 45 Centre Barrels due to be replaced

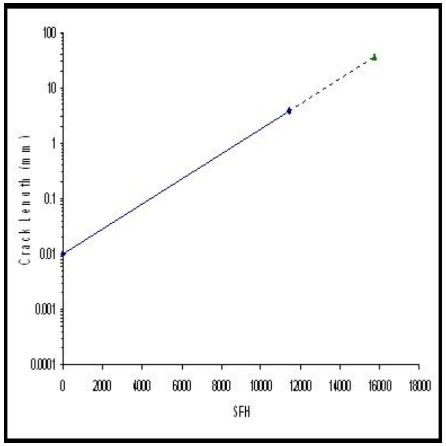
Centre Barrel in test rig



After program 10 - 15 due to be replaced



Fracture surface of bulkhead



Crack growth

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III: Support to Acquisitions

SEA 1000 Future Submarine	SEA 4000 Air Warfare Destroyer
AIR 6000 New Air Combat Capability	LAND 400 Combat Vehicles

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IV: Enabling Research

- Cyber
- Electronic Warfare
- OTHR
- Hypersonics
- CIED – Force Protection
- Signature, Power and Energy
- USW
- UAS
- Systems Integration

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Collaborating to Innovate

- Rapid Prototyping, Development and Evaluation Program (RPDE) – collaborating with Australian Industry.
- Defence Future Capability Technology Centre (DFCTC) – linking government, research agencies and industry to develop Defence capability.
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DMTC
DEFENCE MATERIALS TECHNOLOGY CENTRE

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Centres of Expertise

- DSTO Centres of Expertise in 7 universities.
- Focus on specific research and technology areas

  - energetic materials
  - systems integration
  - autonomous vehicle systems
  - photonics
  - helicopter structures and diagnostics
  - aerodynamic loading
  - structural mechanics.

- Some COEs (photonics, AVS) already making significant advances.

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International Collaboration

- DSTO participates in the following multilateral agreements
  - American, British, Canadian, Australian and New Zealand Multilateral Master Information Exchange MOU (ABCANZ)
  - The Technical Cooperation Program (TTCP)
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THE TECHNICAL COOPERATION PROGRAM
TTCP

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- DSTO and industry have common goal – to enhance Defence capability.
- DSTO enables industry to better support Defence.
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DSTO Support to National Security

- Threat anticipation
- Public safety and border security
- Crisis management & command systems
- Critical infrastructure protection, including information infrastructure
- Chemical, biological, radiological and nuclear defence
- Explosives and improvised explosive devices
- Intelligence support tools
- Exercise command and control and operations research

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DSTO Advisory Board

- Strong team of experts will advise on strategic directions and S&T delivery to Defence.
- A change to welcome fresh ideas and perspectives from industry and the science/innovation community.






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Questions

Australian Government
Department of Defence
Defence Science and Technology Organisation

Professor Robert Clark
Chief Defence Scientist &
Chief Executive Officer

Defence Science & Technology Organisation
Department of Defence
Australia

10th Annual SET Conference

21 April 2009

The Australian Perspective

Unclassified

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DSTO at a Glance

- Budget 08/09 ~$400m
- 11 research divisions
- 2300 staff
- 8 sites across Australia

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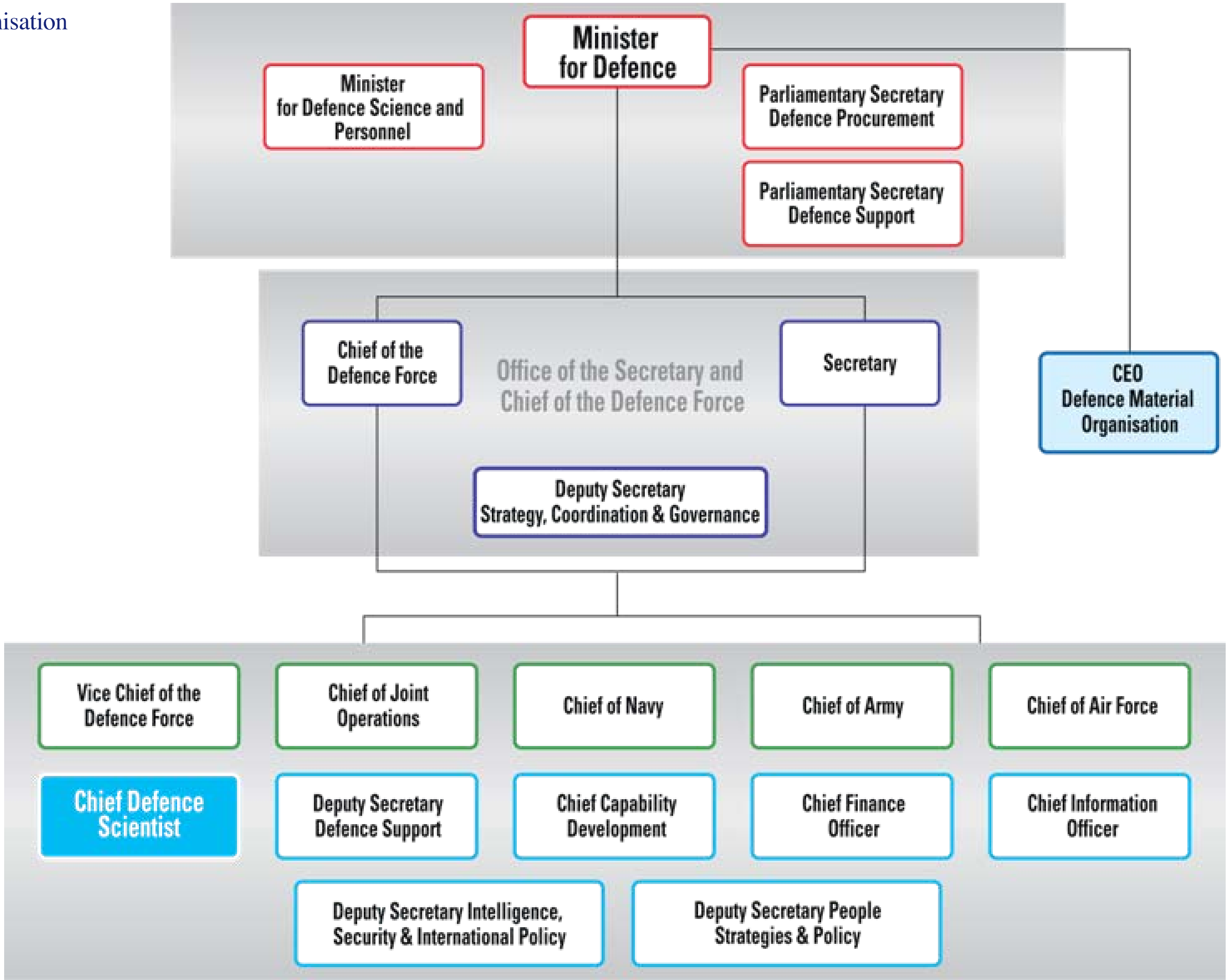
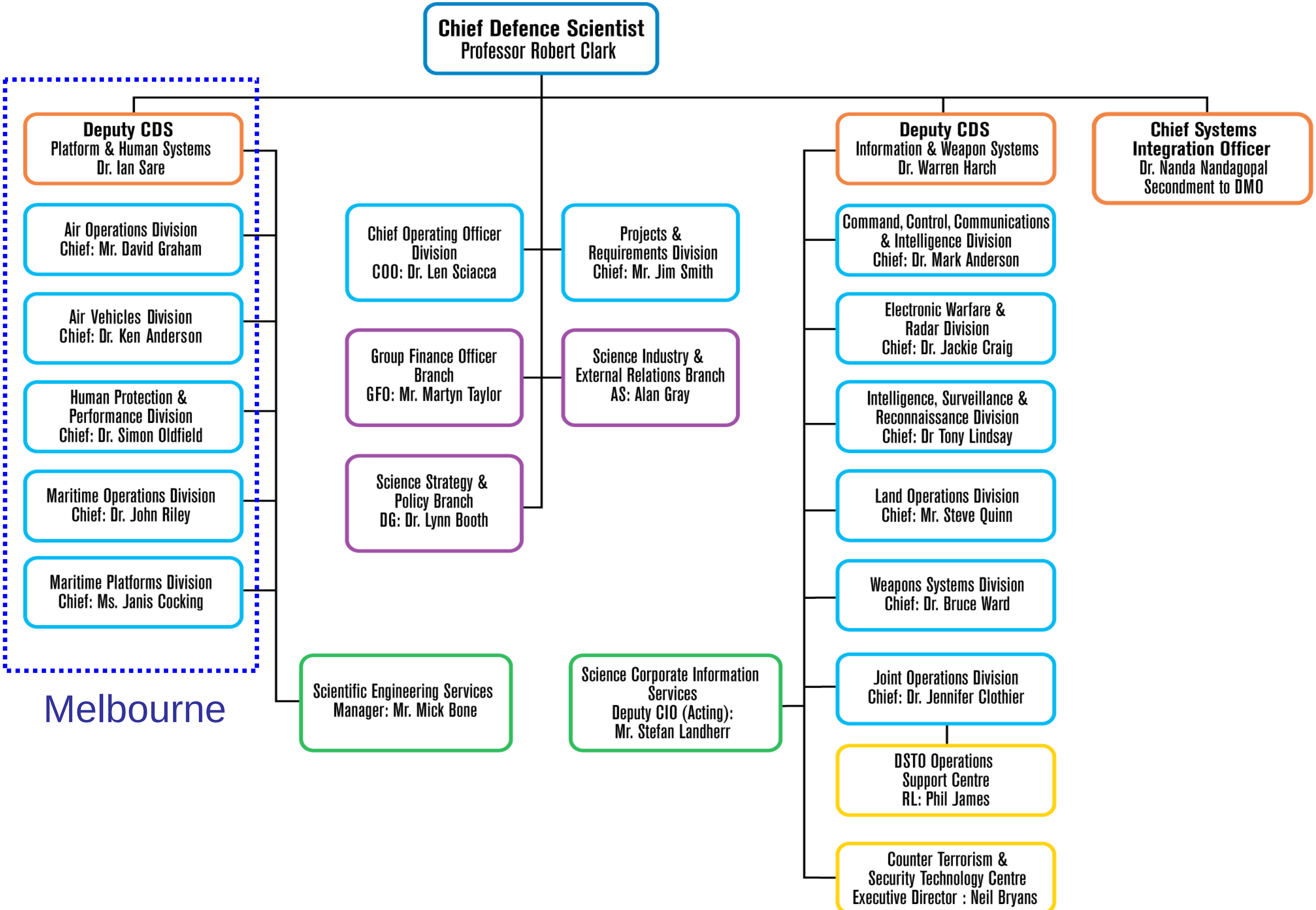
Technology Organisation

DSTO in Defence



DSTO Structure



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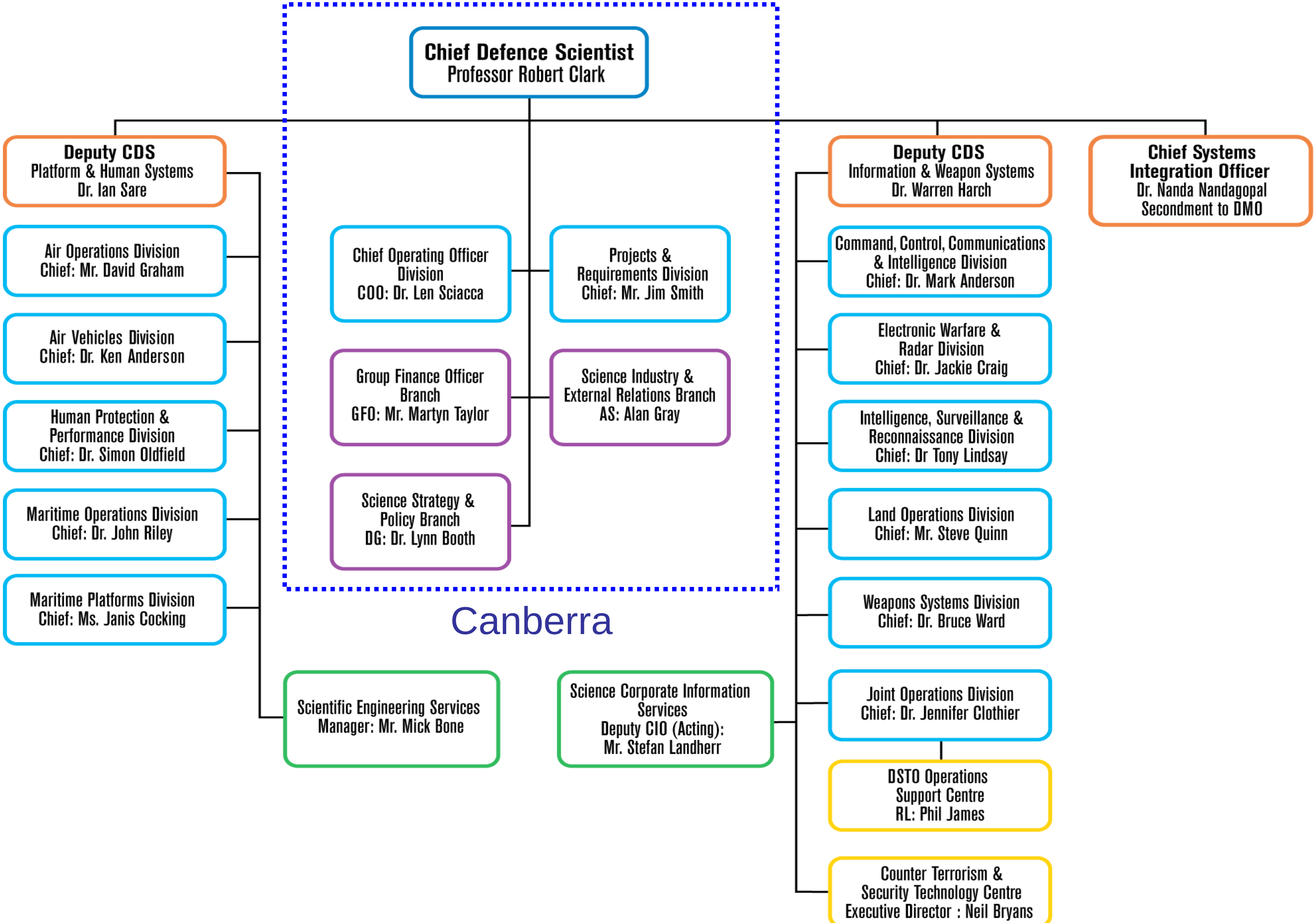

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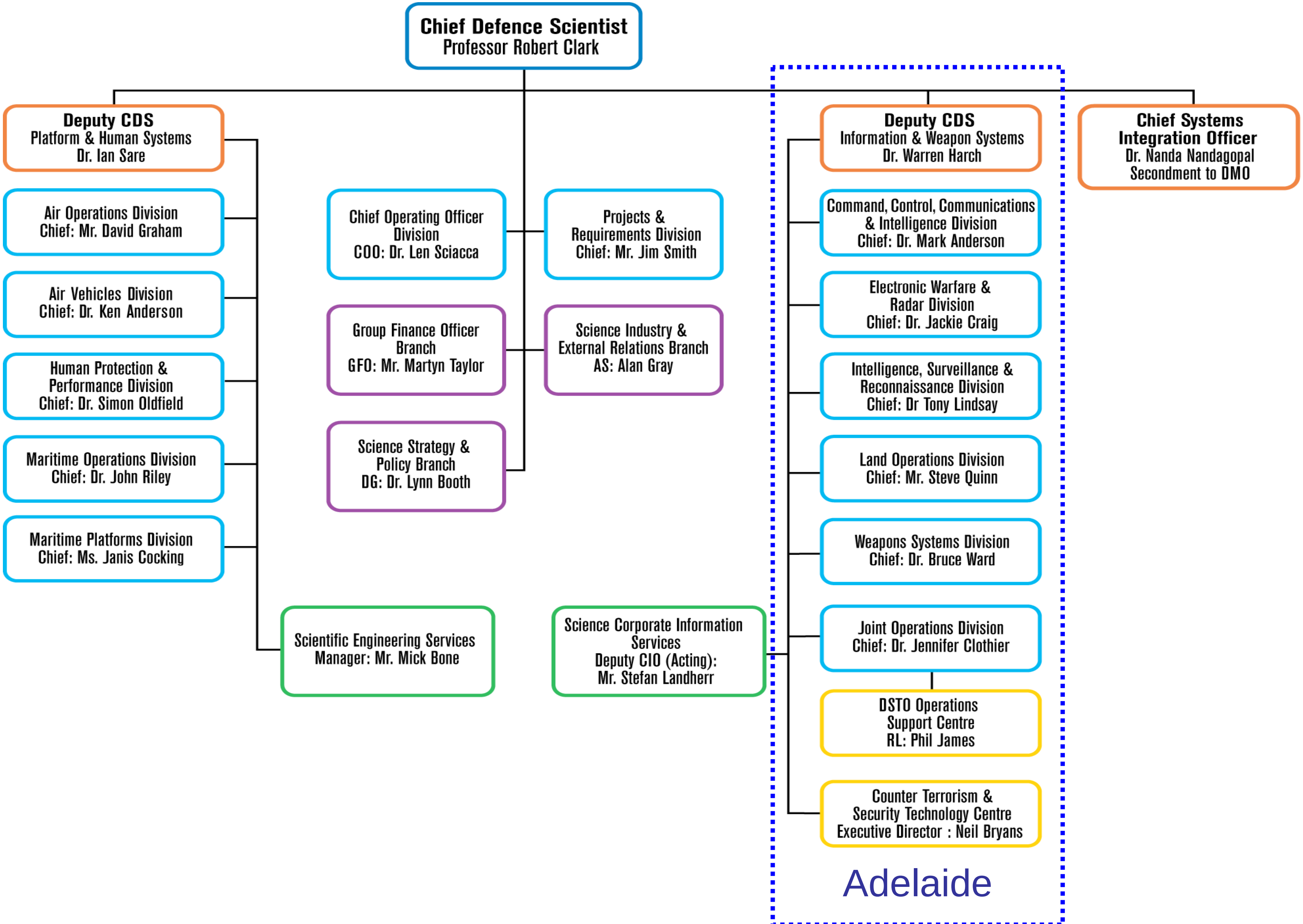

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DSTO Major Facilities

Adelaide

Melbourne

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Selected DSTO Achievements /1

- JORN Phase 5 Enhancement Program

- F/A-18 Hornet Structural Testing

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Selected DSTO Achievements /2

- "Shapes Vector" Network Security

- Nulka

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DSTO Role

- Enhance Australian Defence and national security operations

- Support the sustainment of in-service capabilities

- Deliver key advice and technology solutions for future capability

- Build Defence capacity through partnerships with industry

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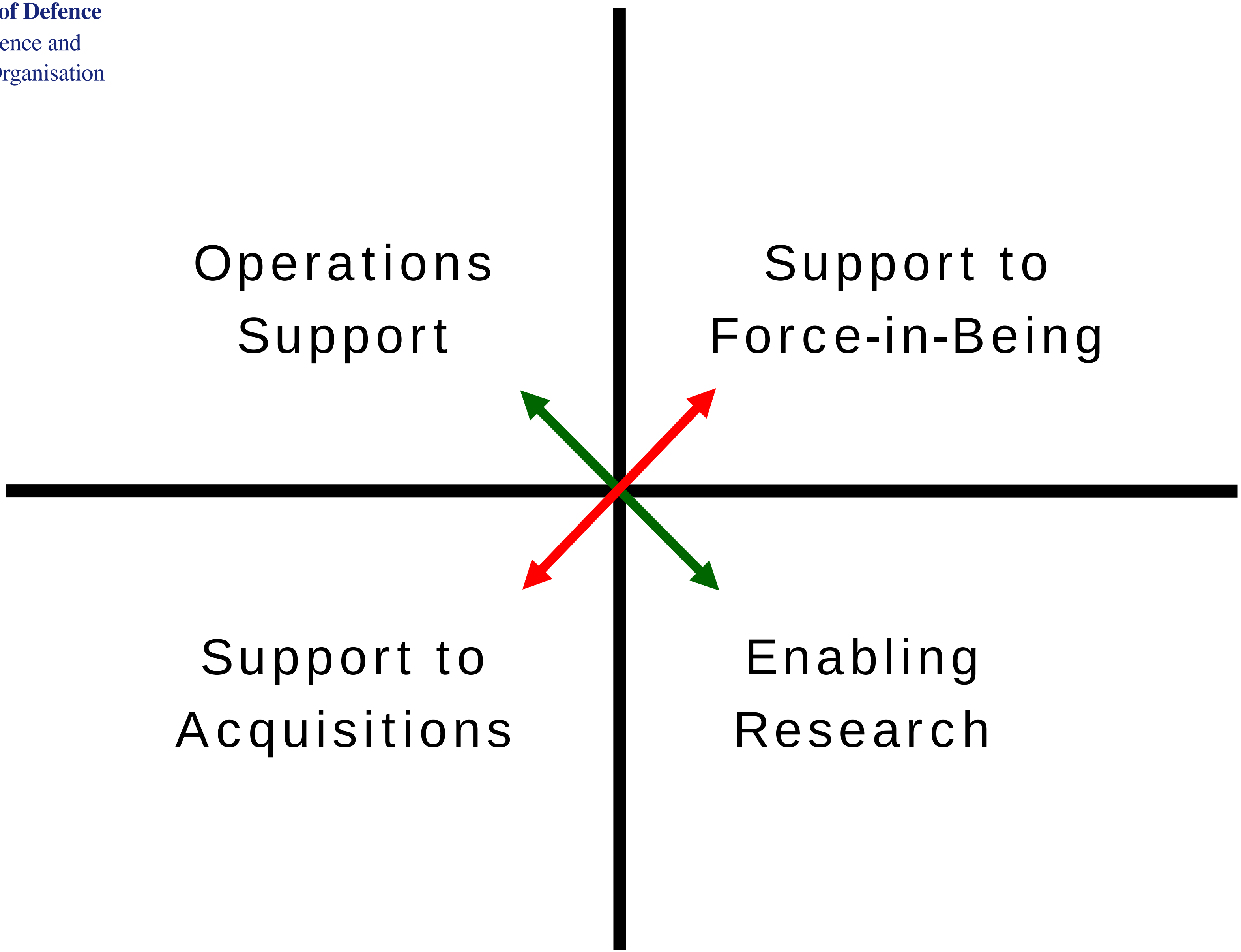
Technology Organisation

DSTO Focus



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I: Support to Operations /1

- Deployed Operations Analysts (OA)
  - DSTO responsible for raising, training and deploying two-person OA teams on ADF operations
  - > 60 personnel deployed to 7 countries since 2005
  - Currently maintain 4 teams around the globe

- Operational Reachback Program
  - Link between deployed analysts and broader defence science community
  - Set of dedicated and committed staff available to respond to requests for science and technology assistance

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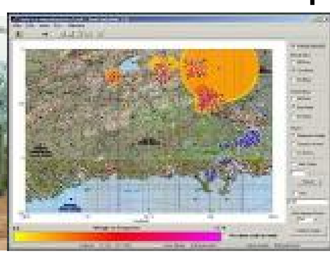
Defence Science and
Technology Organisation

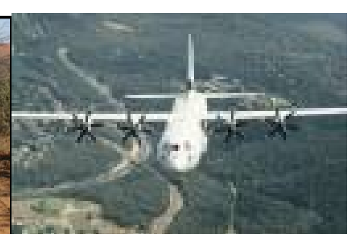
I: Support to Operations /2

Headquarters Joint Operations Command (HQJOC)

Joint Task Force Headquarters



Fighting Elements



DSTO Contributions

Battlelabs

Deployed scientists

Technology insertion

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Technology Organisation

II: Operational Support for ADF Platforms

- Maximising operational effectiveness
- Support to capability enhancements
- Position for the future

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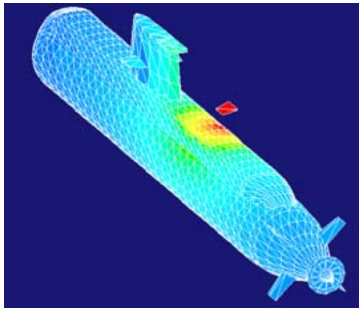
II: Shock Trial of HMAS Rankin

Outcomes: Validated static & dynamic structural performance



R&D advice to support safety, reliability & functionality

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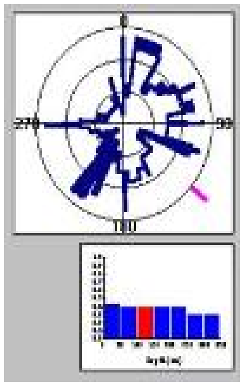
II: Signature Management

Threat Analyses

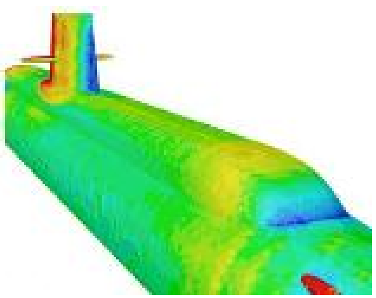


Measurement

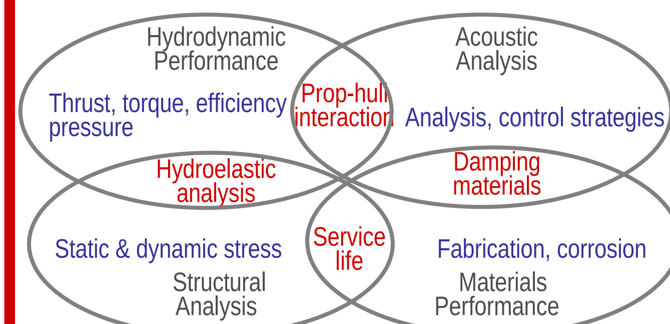
Analysis

**Provides essential information for
complete signature awareness and management**

Modelling



Propeller design



Control

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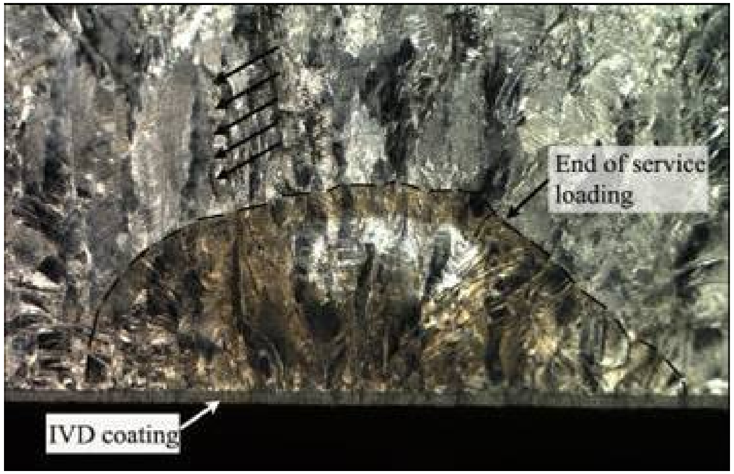
II: Support of F/A-18 Structure

Flaw IdentificatioN though
Application of Loads

- Risk Mitigation program supporting RAAF fleet late in life.
- Damage enhancement testing, and teardown, of retired centre barrels.
- Assesses potential for wide spread fatigue damage and environmental degradation.
- Build confidence by comparing FINAL locations to known Damage Item Locations (DILs).
- Re-Assess safe life limits at DILs

- Improve fatigue crack growth modelling
- Combined with fleet management

Outcomes:
- Improved operational flexibility
- Improved availability
- Large cost savings - less centre barrels replaced



Fracture surface of bulkhead

FINAL Test
Centre Barrel in test rig

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SEA 1000
Future
Submarine

SEA 4000
Air Warfare
Destroyer

AIR 6000
New Air
Combat
Capability

LAND 400
Combat
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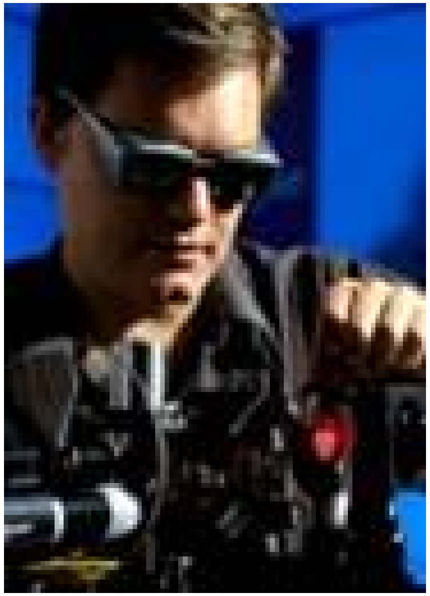

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Questions

U.S. European Command

… security and stability through technology

Forrest G. Ruble

EUCOM Science Advisor, ECJ8-Q

23 Apr 2009

The overall classification of this briefing is **UNCLASSIFIED**

Mission

- **Defend the Homeland forward and support U.S. strategic interests**
  - **Maintain ready forces for global operations**
  - **Secure strategic access and enable global freedom of action**
  - **Enhance trans-Atlantic security through support of NATO**
  - **Promote regional stability**
  - **Counter terrorism**

Building Partnership Capacity is essential to all our efforts

Technologies of Interest (1 of 2)

- **Building Partner Capacity**
  - **Low-cost, low-power computers leveraging open-source technologies and advanced security**
  - **Portable, renewable power generation, storage, and distribution to self-configuring grids**
  - **Portable, low-power water purification**

- **Situational Awareness**
  - **Low-cost, configurable, multi-purpose micro-satellites**
  - **Low-cost micro-satellite launch platforms**
  - **Long-life, high-density power storage and management**
  - **Precision location and navigation independent of GPS**

Technologies of Interest (2 of 2)

- **Area Protection**
  - **Projected, holographic visualization with focused, projected audio**
  - **Vehicle specific electronics neutralizer**

- **General**
  - **Sub-orbital, extremely long-endurance platforms as regional routers and repeaters**
  - **Direct-delivery of heavy-lift platforms with low carbon-footprint**

Questions?

Ask the EUCOM Science & Technology Team

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Innovating for the Future

Larry Schuette
Office of Naval Research
larry.schuette@navy.mil
703.696.7118

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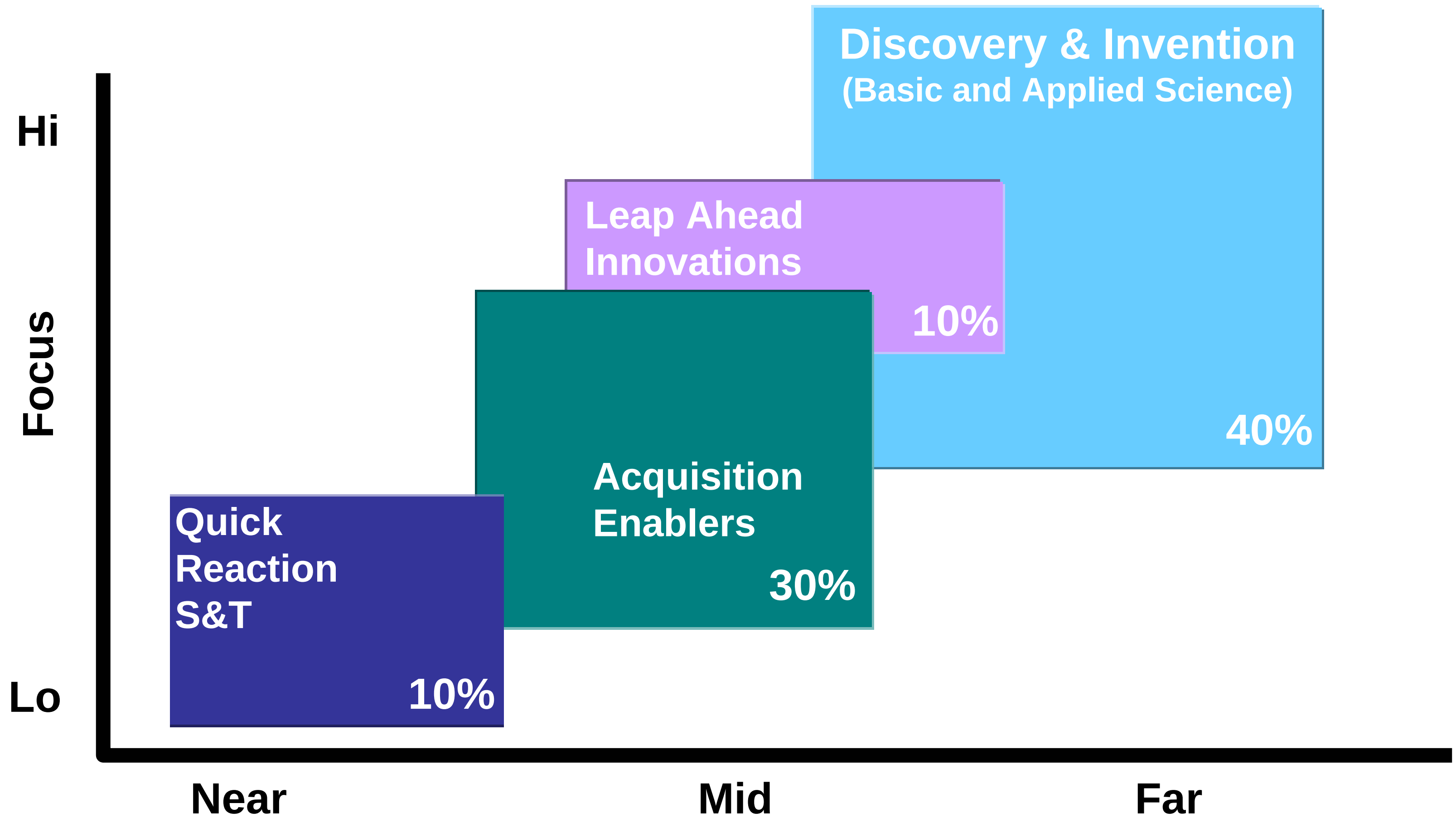
DoN Investment Portfolio



S&T occurs across the Time Horizon. DOI focuses on Quick Reaction and Leap Ahead.

Current Innovative Naval Prototypes

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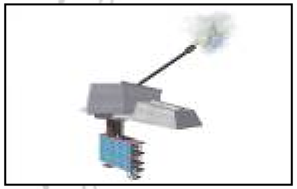
ONR

- High risk, high payoff
- Mix of weapons, platforms and sensors
- $10-$50M/yr, 4-8 year efforts

Current INPs



EMRG

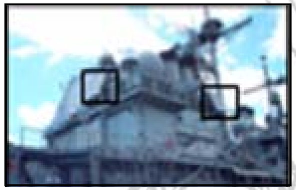
SBE

TACSAT

PLUS

FY-10 INPs

FEL



INT TOPSIDE

- What alternate futures can these INPs enable?
- What disruptive guidance should we adopt for future INPs?

Integrated Topside INP

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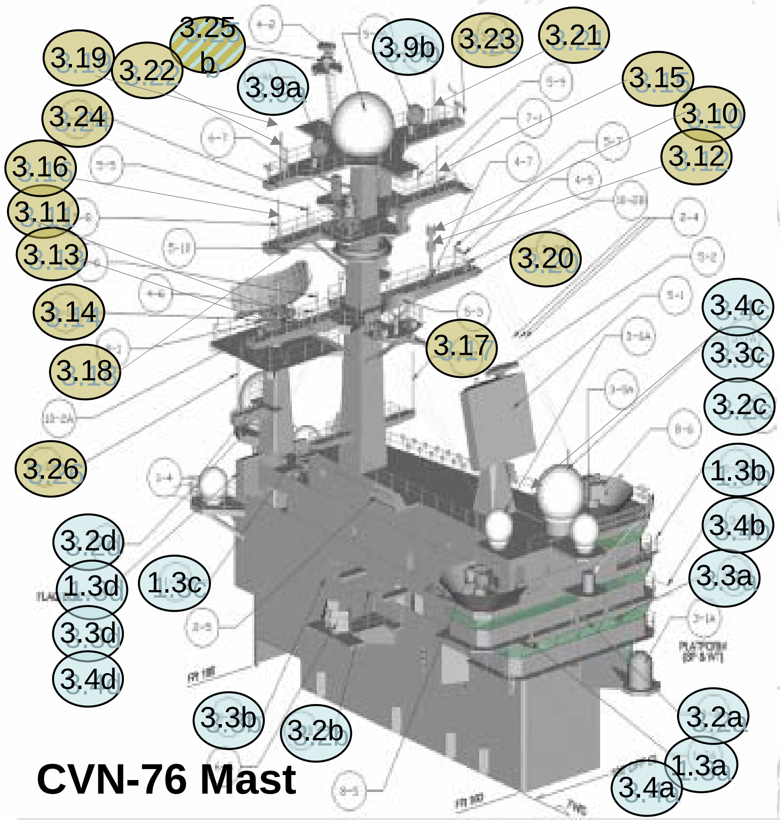
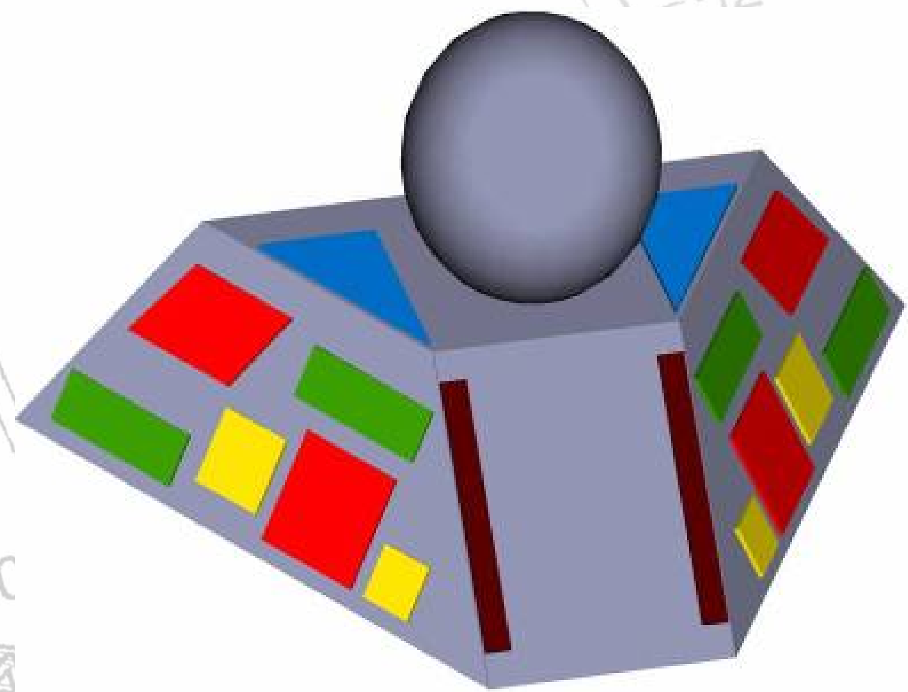


CVN-76 Mast

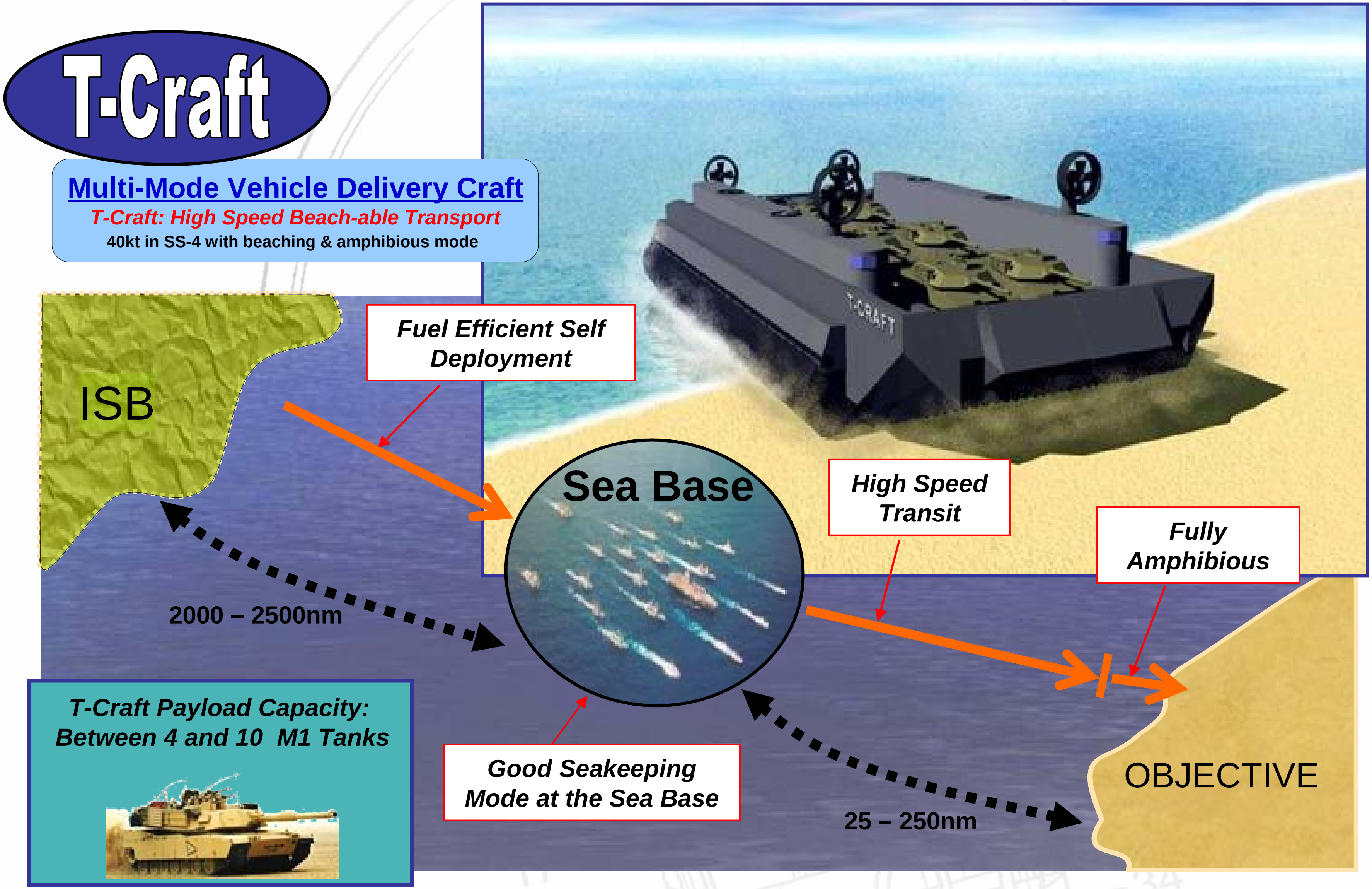


46 to 51 antennas
> 3500 pounds (Ant. Only)

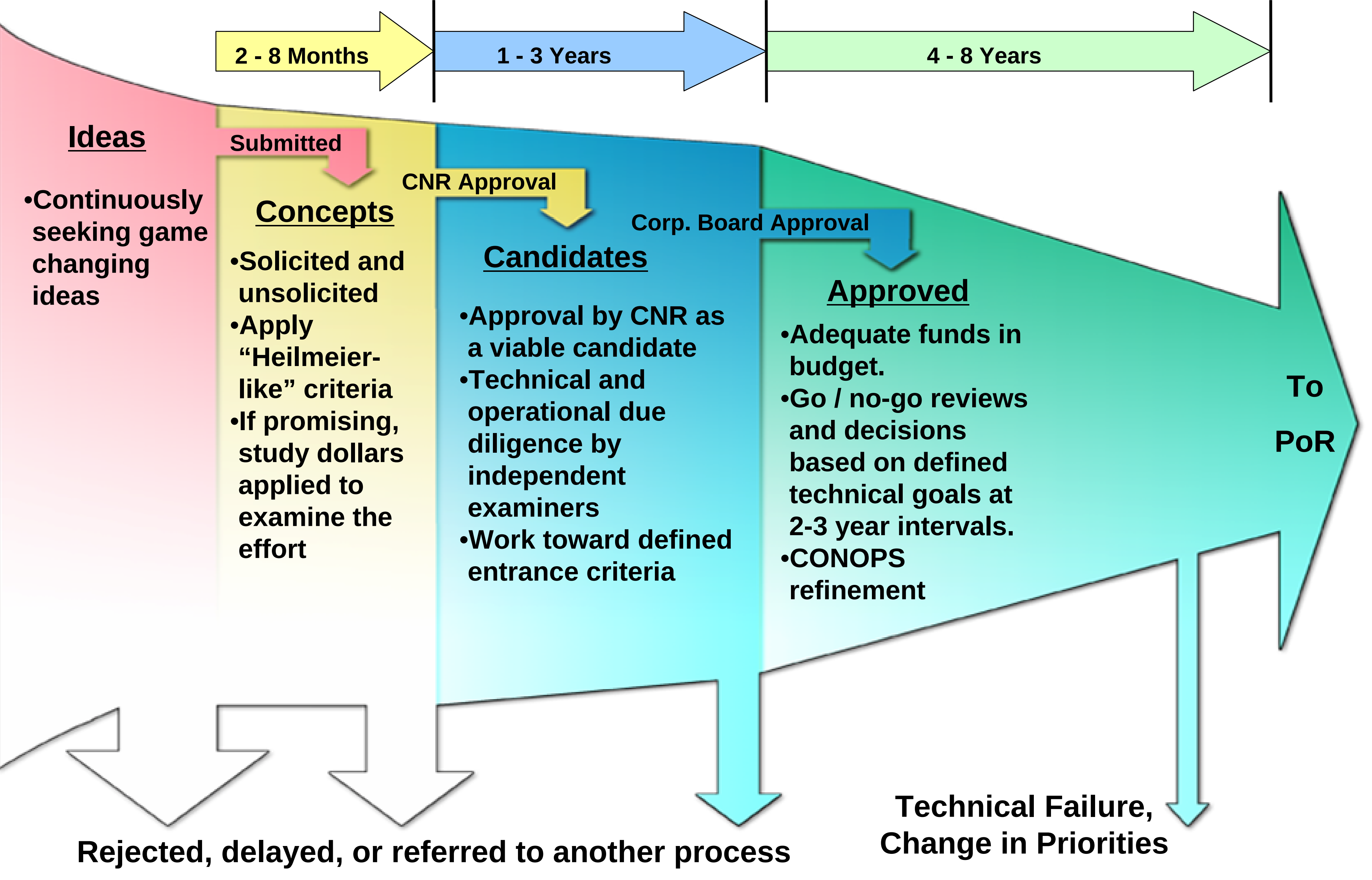
NEW

4 panels , 20 meters ^{2}
< 1800 pounds

Seabasing Enablers INP



Going From Idea to INP



What's the Next Big Bet? Potential FY-12 INP Candidates

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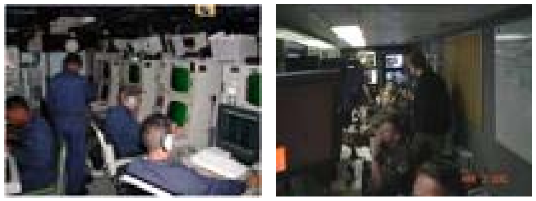
ONR

- Autonomous & distributed electronic warfare capabilities
- Autonomous cargo/medevac UAV
- Autonomous Damage Control Technologies
- Maintenance-free ship/aircraft
- Electric ship/submarine
- High bandwidth communications with submerged submarines and UUVs
- Intense/Immersive simulation training
- Unmanned Vehicle Sentry System
- Land, air, surface and sub-surface vehicles
- UUV for ASW training
- Ship-board Autonomous Logistics Enablers

Most are Autonomous in nature, which is the most game changing?
Which will change how we fight?

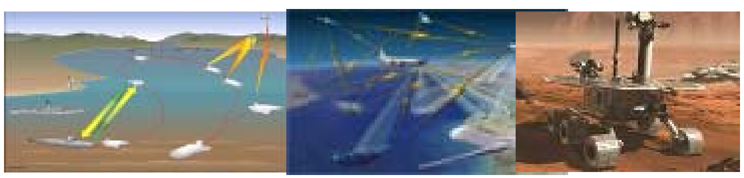
What's Holding Us Back?
Limitations of Current Autonomous Systems



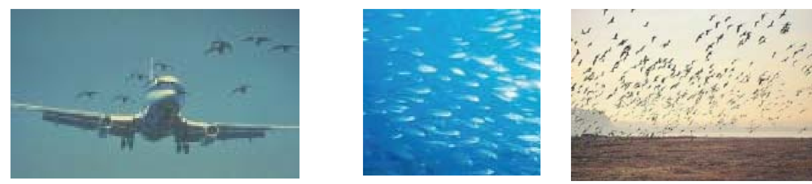
-Require multiple operators
-Cannot easily share assets or collaborate

-Forward units need dedicated operators (require protection)
-Data hard to disseminate

-Require human intervention to maintain performance



-Autonomy tailored for specific missions, users, and environments
-Reliance on pre-programmed plans
-Tough to adapt



-Not as smart as animals
-Limitations in challenging weather
-Cannot exploit environmental conditions
-Cannot navigate without GPS & reliable maps
-Cannot collaborate in close proximity to others

What should we fix? In what order?

Ultimately, where are we going?

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- Distributed system relying on decentralized control that is flexible in its level of autonomy
- Hybrid force with manned systems and platforms
- Automated image/scene understanding, data gathering, purposeful sensing/seeking, information analysis and distributed information management
- Cooperation to perform a mission or task
- Automated distribution of tasks
- Autonomous determination of the best way to accomplish each task, with appropriate human guidance

Why Autonomous Behavior is a Hard Problem

Constrained by size, weight, power, money

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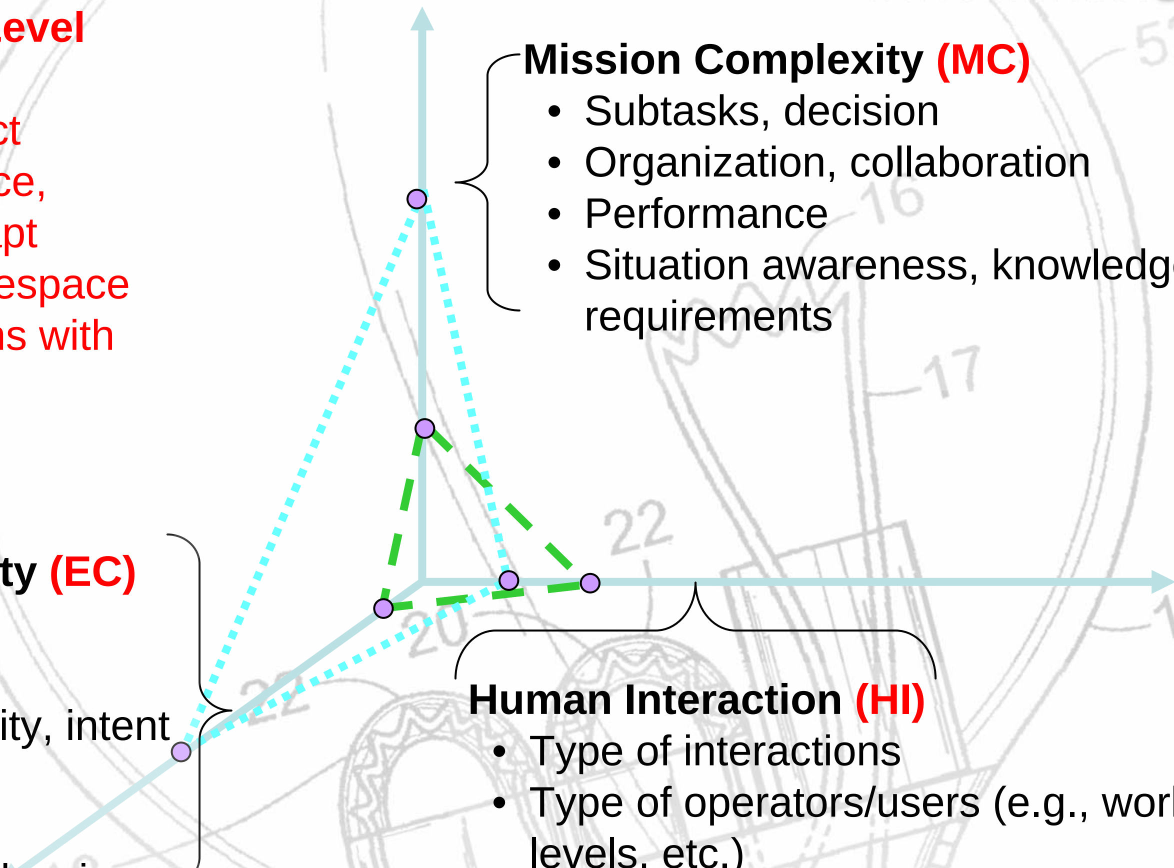
Machine Intelligence Level
Ability to:
- Reason, Plan, Predict
- Learn from experience, instructions, and adapt
  Understand the battlespace
- High-level interactions with humans



Mission Complexity (MC)
- Subtasks, decision
- Organization, collaboration
- Performance
- Situation awareness, knowledge requirements

Environmental Complexity (EC)
Solution ratios on:
- Terrain variation
- Object frequency, density, intent
- Weather
- Mobility constraints
- Communication dependencies

Human Interaction (HI)
- Type of interactions
- Type of operators/users (e.g., workload, skill levels, etc.)
- Frequency, duration, robot initiated interactions

Autonomy Level required is driven by EC, MC, HI

Benchmark for Autonomous Systems? Assembly Line Robotics

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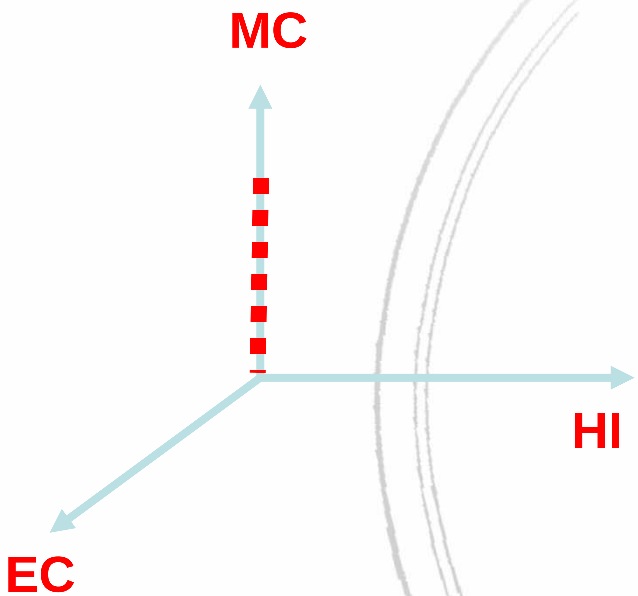
ONR



- **Complex mission**
- **Well known environment**
- **No Human interaction**
- **Better than a human at the task**
- **Thousands of iterations to get it right**

DARPA Grand Challenge - UGV

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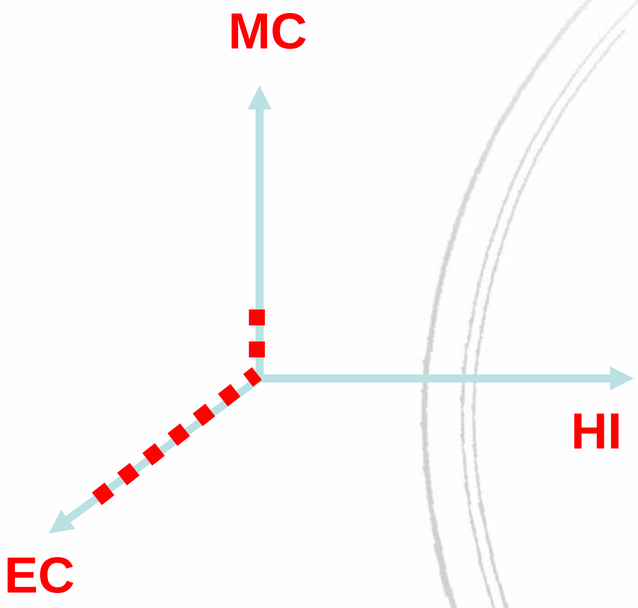

- **Tougher Environment than underwater or air**
- **No Human Interaction**
- **Controlled Mission Complexity by reducing speed**
  - **About 15% as effective as a human**
- **In use on Mars – where no man has been**

UAV Mission: Find, observe, kill

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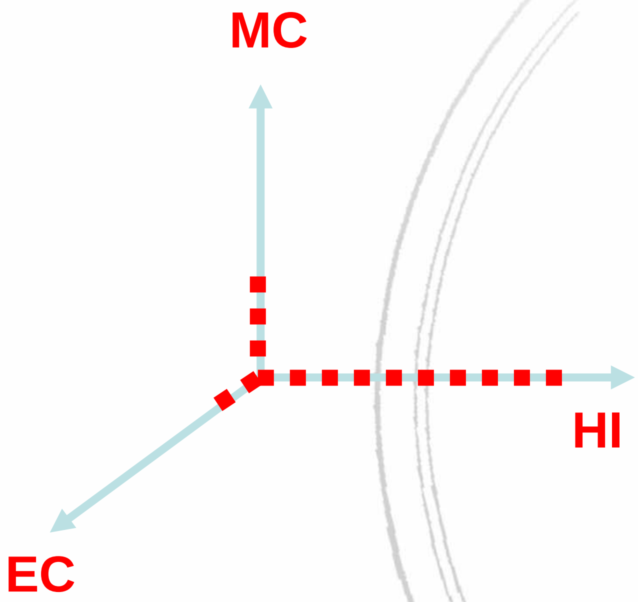
ONR



- Obvious crawl, walk, run road ahead
- Complex mission driven by high human interaction
- Lots of other missions ripe for unmanned air vehicle

UAV Focus To Date Has Been on Large Systems

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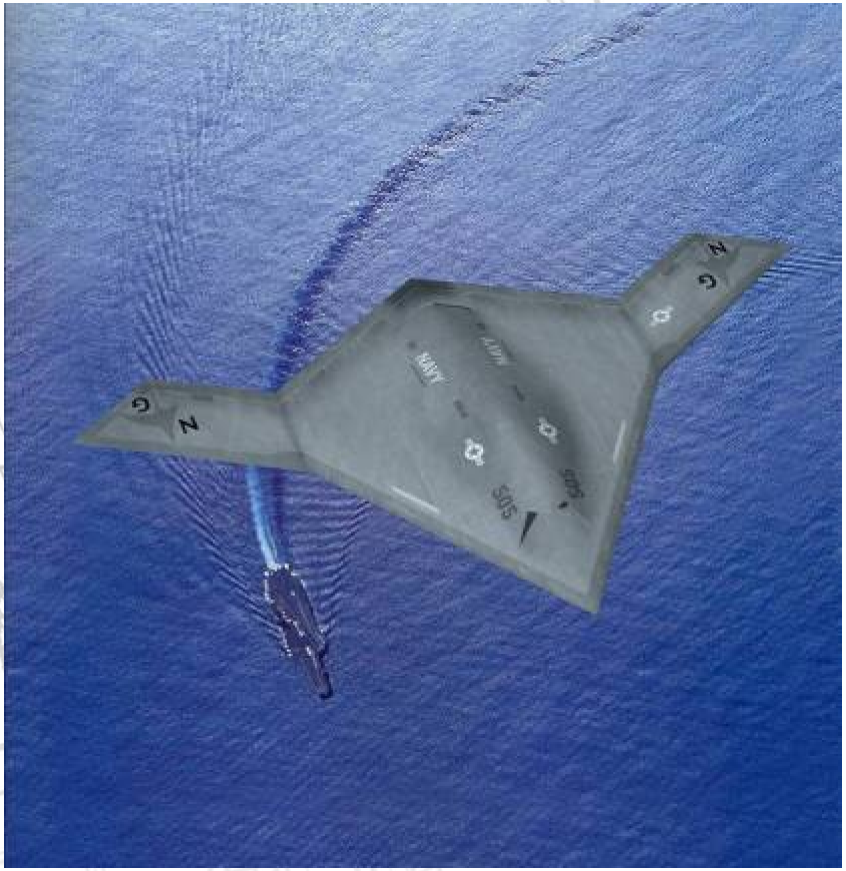
- Consider future of small UAVs (<50lb)
  - Missions these systems are uniquely qualified to address
  - Cheaper
  - Decoy cost, expendable

Global Hawk

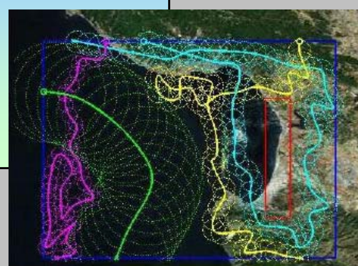


N-UCAS

UAV S&T Autonomy Roadmap & Goals

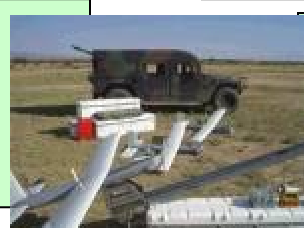
Guidance & Control
- Shipboard Landing
- Autonomous Maneuvering

Automated Tasking
- Search Planning
- Convoy Protection
- Reconnaissance
- Small numbers of multiple systems

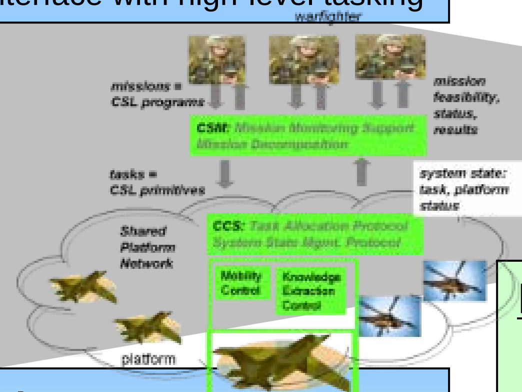


Maritime Video
- Automated capability to detect and track multiple targets
- Address small boat threat

Silver Fox
- Small UAV with traditional auto-pilot for control
- Limited operational eval



Support of Small Expeditionary Units
- Distributed control of multiple air systems
- Simplified interface with high-level tasking



Airspace Management
- Planning & human interface technologies

Shipboard Operations
- Control & human interaction approaches for autonomous deck operations

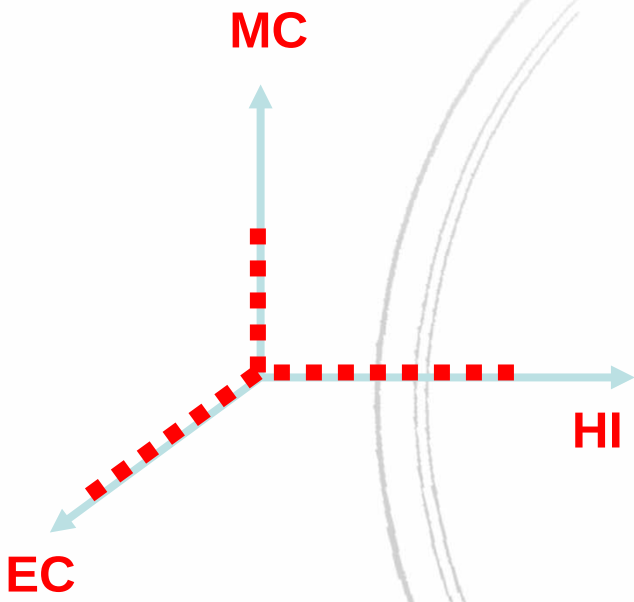
Robustness to Weather
- Small UAS control in Challenging weather conditions
- Increase endurance taking advantage of atmospheric effects

Safe Operations
- More like manned aircraft ops for naval missions & environments

Distributed Control of Large Numbers of Small Systems
- Control of Expendable UAS Systems that can be Mass Produced & Deployed in Great Numbers

Past 10 Years | **Current Efforts** | **2025**

USV Mission

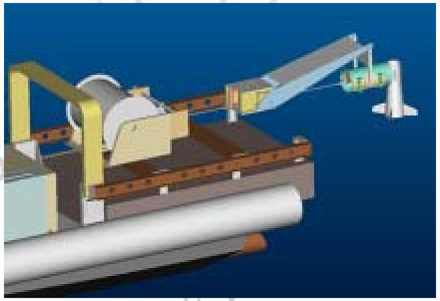


- **Tough environment**
  - **Sea state**
  - **Obstacle avoidance**
- **Range of missions to mitigate need for human interaction**

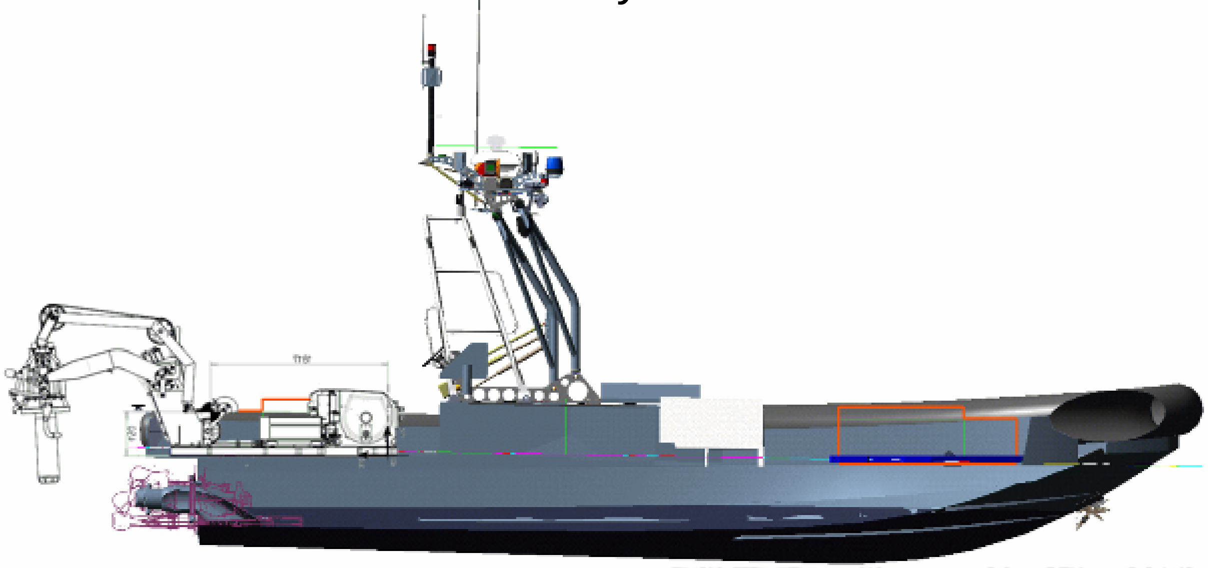
Unmanned Surface Vehicle

- Mine Warfare Mission Module
  - Mine Neutralization using Electromagnetic and Acoustic Sweep
- Antisubmarine Warfare Mission Module
  - Detection and Localization using
    - Airborne Low Frequency Sonar (ALFS)
    - Multifunctional Towed Array

DIRECTOR OF INNOVATION



Deploy & Retrieve:
Automated Handling of Influence Sweep



Acoustic Sweep:
Generates Subsurface Acoustic Influence Field

ALFS

USV Autonomy

Adapted Autonomy

- Adapt submarine periscope sensing & image processing

Adapt Jet Propulsion Lab Autonomy technology to USVs

Perception-Based Navigation

- Stereo camera-based, autonomous avoidance of fixed obstacles at boat speeds up to 25 kts
- Perception-based Navigation through bridge abutments

Multi-Vehicle Collaboration

- Multi-mission
- Multi-domain
- Persistent
- Scaleable
- Adaptable
- Affordable

USSV

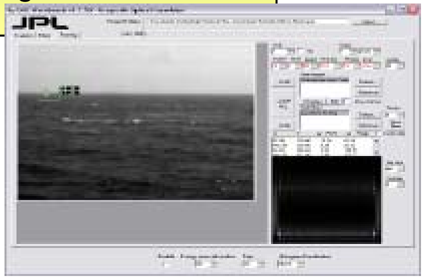
- On-board auto-route generation via nav charts and GPS

Transitioned to LCS

- Part of the ONR-developed "MCM-USV"
- Part of MIW mission package #1 – USS FREEDOM

Tracking

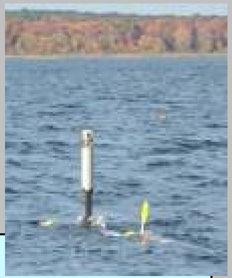
- Recognition & tracking of a sailboat



Past 10 Years **Current Efforts** **2025**

UUV Autonomy

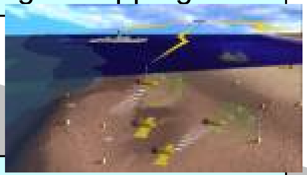
Maritime Reconnaissance
- Perform autonomous surveillance in littoral regions
- Torpedo-size underwater vehicle with ISR payload



MCM
- Area search, classify & map rates for mines in littoral regions
- Cooperative autonomous underwater vehicles with high resolution sonars

Ocean Surveillance
- Networks of undersea gliders with oceanographic and acoustic sensors

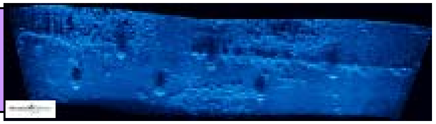
Unmanned Cooperative Cueing and Intervention
- Rapid (< 5 days)
- Standoff MCM target mapping



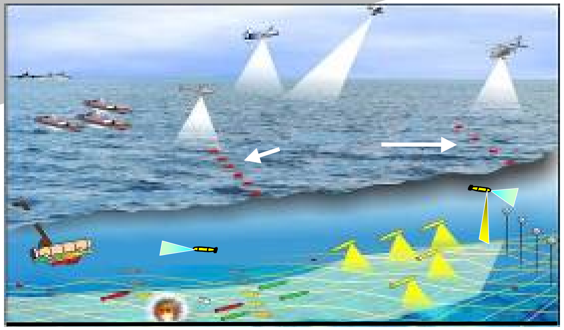
Undersea Surveillance
- Large area surveillance using autonomous unmanned vehicles to achieve undersea superiority of the designated battle space

Littoral ASW
- Use autonomous Unmanned Undersea Vehicles to support tactical anti submarine warfare

Harbor & Port Security
-Hull Inspection



Multi-Platform, Multi-Static, Distributed UUV
- Autonomous, self-deployable, heterogeneous, multi-platform, system capable of rapidly detecting, identifying mines, subs over wide areas
- Goal-oriented collaborative/ adaptive autonomy, multi-objective optimization & distributed control of large teams.



Past 10 Years | **Current Efforts** | **2025**

Takeaway Challenge

- What are the missions that Autonomous systems will be better suited for?
  - Only extraterrestrial?
  - Only shop floor?

- What are the capabilities we would need?

- What manned platforms could we stop using?
  - 5 year plan
  - 10 year objective
  - 30 year ambition

- I look forward to your thoughts
  - larry.schuette@navy.mil

RDECOM

Army Network Science

NDIA

10th Annual Science and Engineering Technology Conference/DoD Tech Exposition

21 April 2009

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

David Skatrud
Director, Army Research Office
Deputy Director for Basic Science,
Army Research Laboratory

Outline

- **The power, promise, and ubiquitous nature of networks**
- **The science of networks is a key to Army transformation**
- **Army Network Science**
  - **- Key Initiative**
  - **- Supporting Programs**

Network Science

Networks

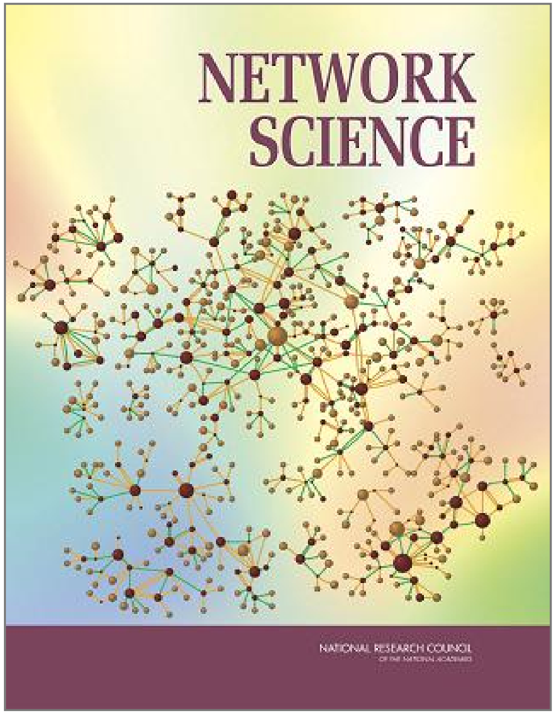
The fundamental components of a network are its structure (nodes and links) and its dynamics, which together specify the network's properties (functions and behaviors).

Science

Core research principles which enable predictions of behaviors, given structure and dynamics as inputs.

Networks Science

The study of network representations of physical, biological, and social phenomena leading to predictive models of these phenomena



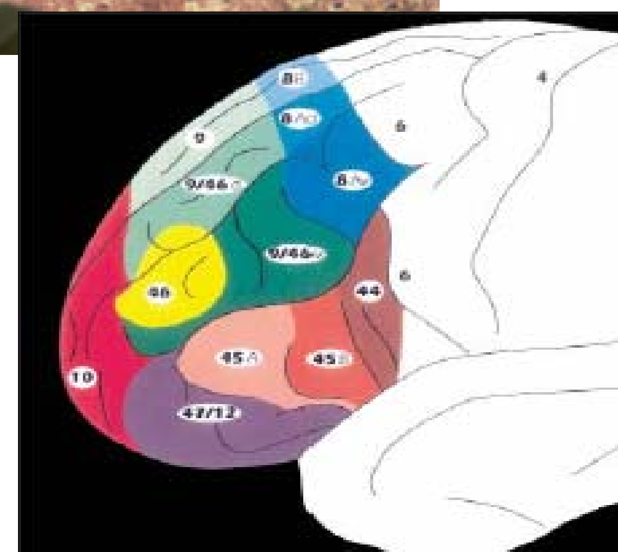
http://fermat.nap.edu/catalog/11516.html

ASA(ALT) commissioned

-- NRC Report on Network Science (2005) --

Examples of Complex Networks

- *Internet*
- *Power grid*
- *Transportation*
- *MANET (FCS Brigade Combat Teams)*
- *Social (friends, tribes, organizations, towns, cities, countries, global village)*
- *Insect (bees, ants, wasps and other swarms)*
- *Ecosystems*
- *Cellular (neuronal)*
- *Molecular (metabolic)*



Characteristics of Networks

Robustness

- *Redundancy -- duplicate pathways create a simple form of robustness*
- *Recurring circuits -- negative feedback for stability and tracking; positive feedback for enhanced sensitivity*
- *Modularity -- encapsulation of functions into simpler units yields better failsafe designs*
- *Hierarchies and protocols -- distributing functionality across different levels in the network to manage complexity*

Fragility

- *Systems that are robust face fragility and performance setback as an inherent trade-off*
- *Unexpected perturbations can lead to catastrophic failure*

Sophisticated, Complex Behavior

- *Often exhibit behavior that is greater than the sum of the parts*

Example of DoD Unique Network Challenges

Commercial

- Mobile Subscriber, Fixed Infrastructure
- Pre-configured Networks
- Tall, Fixed Antenna Towers
- Fiber optic Internodal Connections
- Greater Frequency Spectrum Availability
- Fixed Frequency Assignments
- Protection: None → Privacy (single level)
- Interference Rejection is Somewhat Important
- Low probability of Detection (LPD) is not an issue

COMMERCIAL | TACTICAL


High Bandwidth


Small Bandwidth


Primarily Robust Static Infrastructure


Radio-Based Highly Mobile Comms


Highly Skilled Large Teams


MOS w/Multi-duties

Military

- Mobile Subscriber - Mobile Infrastructure
- Ad Hoc, Self-Organizing Networks
- Small, Easily Erectable Masts; Low Profile OTM Antennas
- Mobile, Wireless, Internodal Connections
- Restricted Frequency Assignments; Geographically Impacted
- Protection: None → Top Secret/ SI (Multiple, Simultaneous Levels)
- Interference Rejection and Antijam are Critical
- Low Probability of Detection (LPD) is Critical

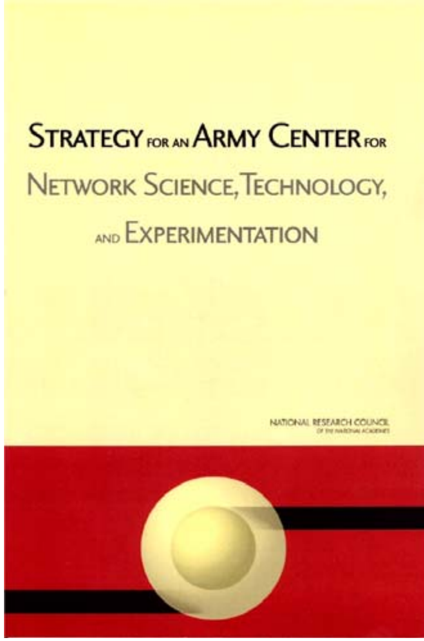
Strategy = Adopt Adapt Develop

NRC Study Findings

- Social and communications networks lie at the core of all military operations
- A fundamental understanding of complex and social networks is primitive
- Required for true, full NCO capability
- Current funding/programs focused on specific applications
- Research is fragmented

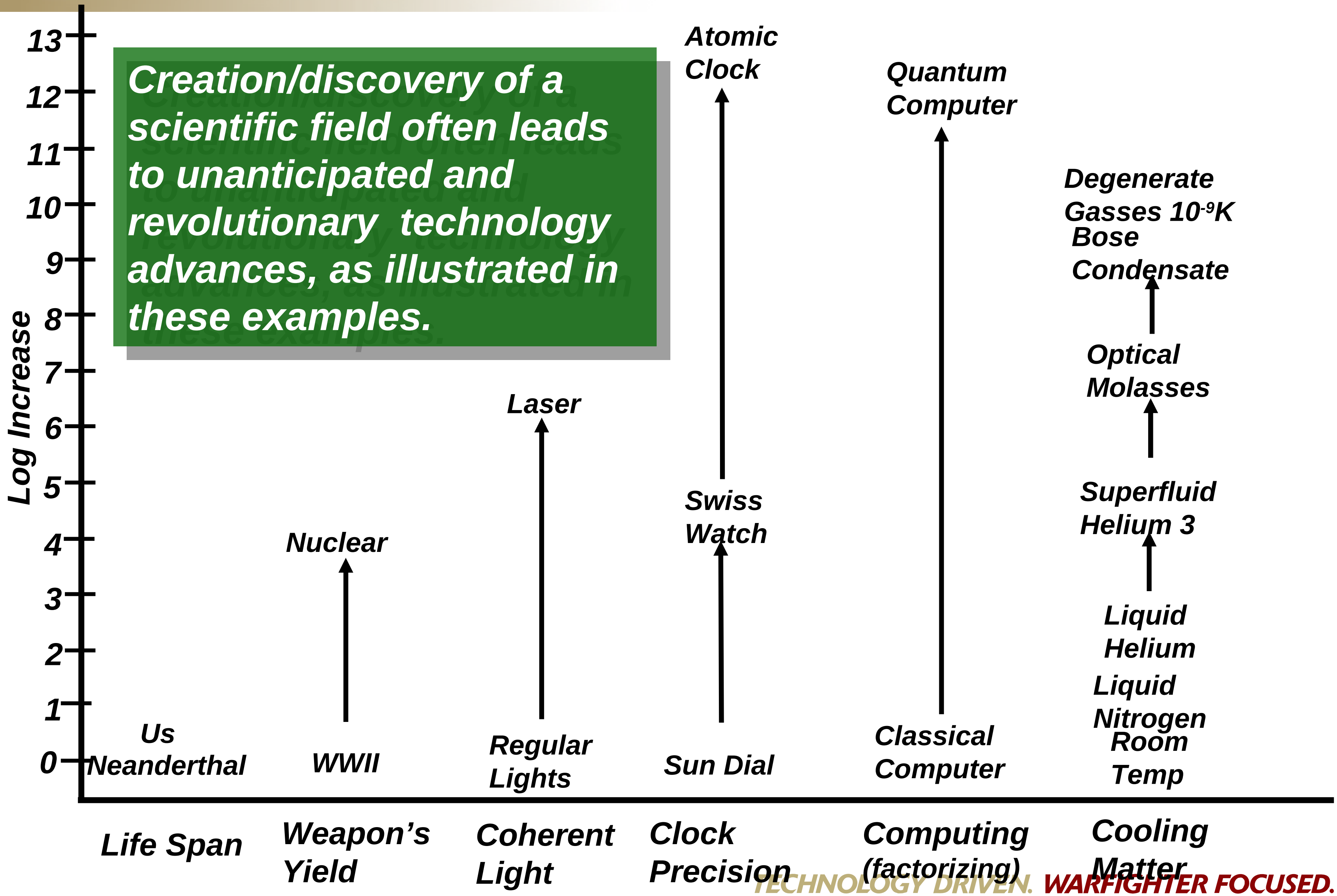
NRC Study
Center Recommendations

In order to implement its investment strategy in network science, technology, and experimentation (NSTE), the Army should organize a center for (NSTEC) with a mission to:



- Develop basic knowledge of networks, including social and cognitive, communication, and information domains
- Attract the best researchers in network science
- Manage activities in network science research, technology development, and experimentation for the Army
- Focus science and technology (S&T) investments to enable network-centric operations and warfare
- Focus applied S&T to enable social networks important to Army operations
- Enable development of network science applications and facilitate their transition to Army and joint operations

Ancillary Benefit of Creating NS



Network Science Strategic Guidance

NS receiving high-level strategic and programmatic guidance

DDRE Grand Challenges	ARL – Strategic Technical Initiatives	*TRADOC Top*-10 Warfighter Outcomes
▪ Information Assurance ▪ Network Sciences ▪ Counter WMD ▪ Science of Autonomy ▪ Information Fusion & Decision Science ▪ Biosensors and Bio-inspired Systems ▪ Quantum Information Sciences ▪ Energy & Power Management ▪ Counter Directed Energy Weapons ▪ Immersive Science for Training & Mission Rehearsal ▪ Human Sciences	▪ Information Assurance ▪ Network Science ▪ Robotics ▪ Information Fusion ▪ Bioscience ▪ Advanced Computing ▪ Power and Energy ▪ Neuroscience ▪ System of Systems Analysis ▪ Nanoscience	▪ Battle Command Network ▪ Counter IED and Mine ▪ Unmanned Systems Opns ▪ Battlespace Awareness ▪ Human Dimension ▪ Power and Energy ▪ Force Protection ▪ Training ▪ Force Application ▪ Logistics

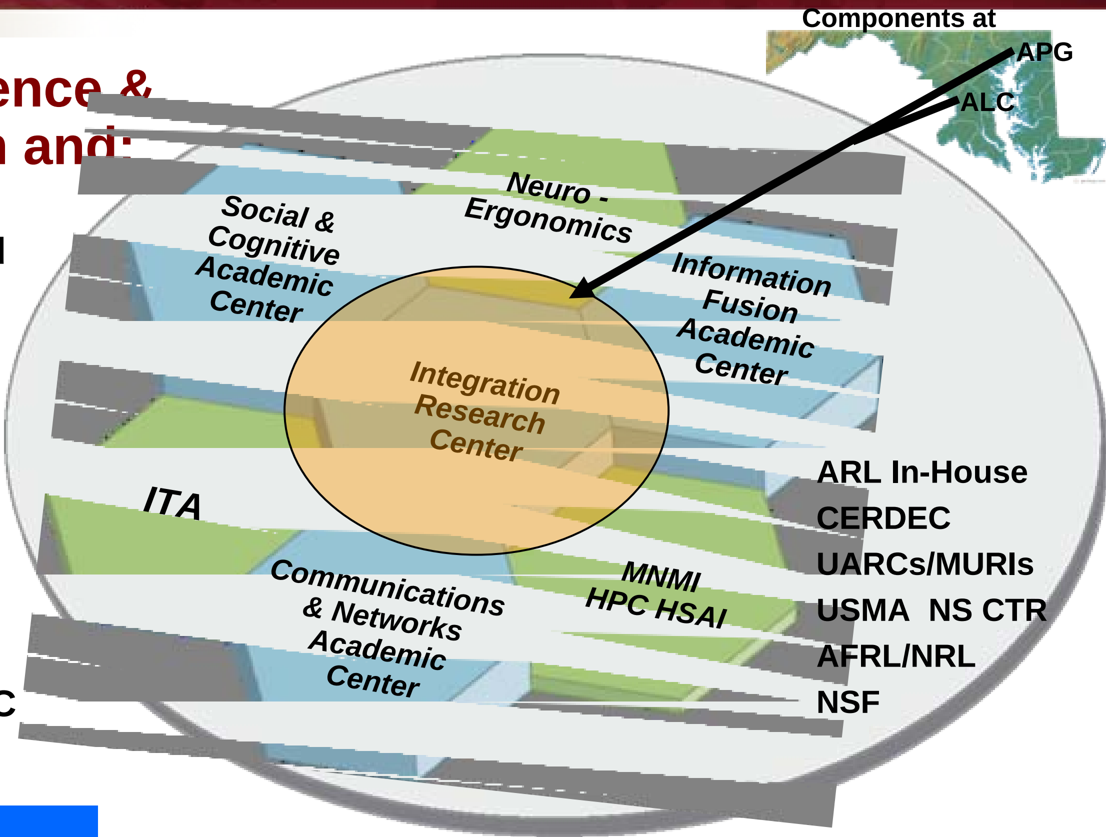
New Network Science Divisions created within ARL-CISD and ARL-ARO

Army Network Science Research Plans and Programs

RDECOM

Enhance Army's network science & technology research program and:

- Create a Sustainable World-Class Network Science Virtual Center awarded through the Net Sci CTA
- Strengthen & Exploit Government-Industry-Academia Partnerships
- Adopt a Multidisciplinary, Full-Spectrum Approach
- Accelerate the Transition & Improve the Relevance of Army-Sponsored Research
- Tightly Couple Efforts at ARL & CERDEC



Strategy

- Establish an Army distributed NSTRC of Government, Academia & Industry
- Maintain an internal Network Science program to transition Army-sponsored extramural research
- Establish strategic relationship with the HPC Mobile Network Modeling Institute (MNMI)
- Establish & maintain strategic relationships with the US/UK ITA, ATEC, NRL, AFRL, PEOs, & other DoD agencies

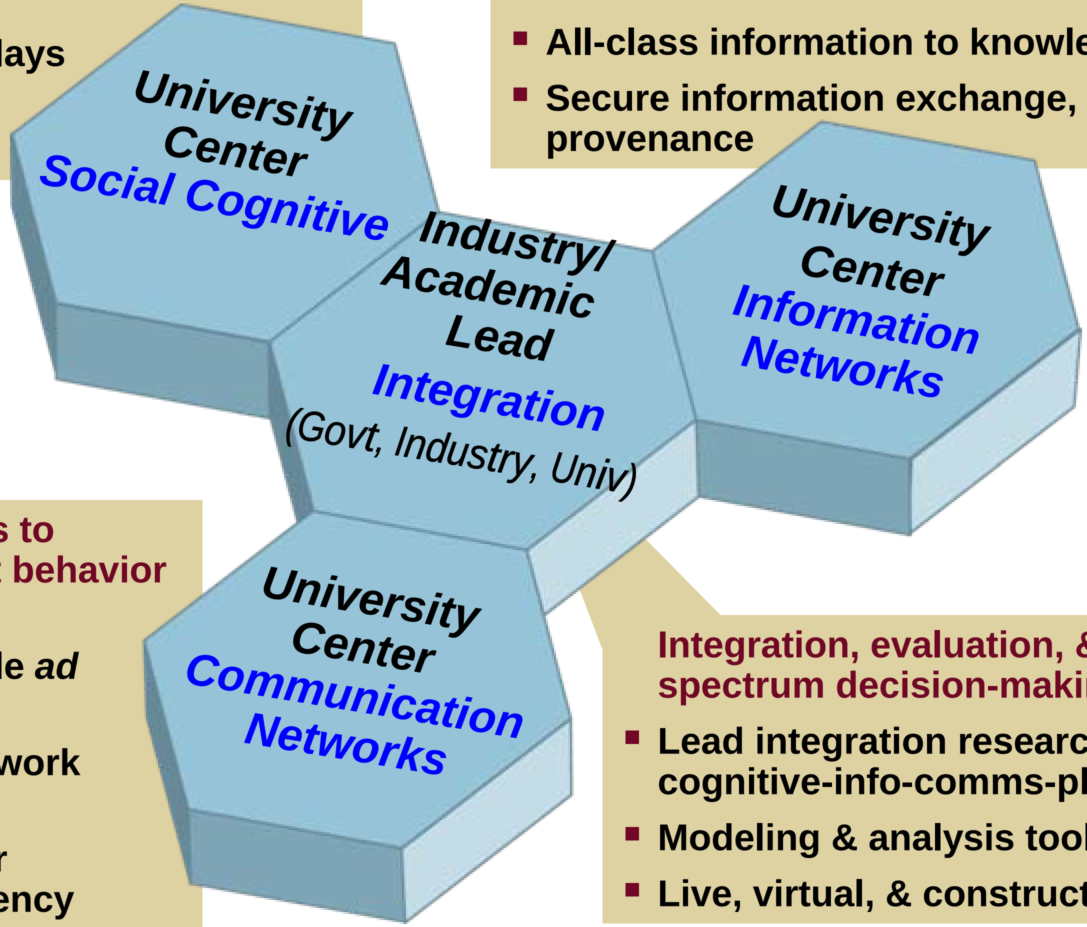
Network Science Collaborative Technology Alliance (NS CTA)

Understand social & cognitive networks to improve distributed decision-making

- Human-networked information interaction/exchange
- Data exploitation & displays
- Dynamic social-system networks

Underpinnings to enable humans & networks to acquire & assimilate information

- Knowledge management: distributed data mining, learned data management
- All-source data to information synthesis
- All-class information to knowledge synthesis
- Secure information exchange, trust & provenance



Foundational techniques to model, design, & predict behavior of tactical networks

- Adaptive & secure mobile *ad hoc* networks
- Self-aware, adaptive network control
- Cognitive networking for spectrum agility & efficiency

Integration, evaluation, & analysis of full spectrum decision-making networks

- Lead integration research across: social-cognitive-info-comms-physical
- Modeling & analysis tools & techniques
- Live, virtual, & constructive models

Network Science Programs

- Basic and applied research spanning Social/cognitive, Information, Communication domains
  - Network Science for Human Decision Making
  - THINK ATO (Tactical Human Integration with Networked Knowledge ATO
  - STEF (Soft Target Exploitation and Fusion) ATO
  - Node-level multi-modal sensor fusion
  - Network-level distributed/decentralized data & information fusion
  - Network Science for Tactical and wireless emulation for MANETs
- ARO Extramural Programs
  - eSenIF MURI (PSU, Duke, Harvard, OSU)
  - Urban Target Recognition MURI (Berkeley, MIT, Vanderbilt, Memphis)
  - Sensor Fusion Battlefield CoE (Tenn State)
- ARL Technology Alliances and Institutes
  - Advanced Decision Architectures CTA (ending this CY)
  - Communications & Networks CTA (ending this FY)
  - US-UK International Technology Alliance (ITA) on Network & Information Sciences
  - Mobile Network Modeling Institute (High Performance Computing Modernization Program)
- Partnerships with CERDEC: Network Design, TITAN, COBRA
- Multiple related DARPA programs

The ITA Program

THE PROGRAM

- **Initiated in May 2006**
  - Fundamental research in network and information sciences
  - IBM-Led Consortium
  - The Consortium and the US/UK Governments establish an Alliance
  - 5-year program with 5-year option
- **Awarded a fundamental research agreement and two transition contracts**
  - Total funding for first 5 years = $58M
  - Approximately 50-50% split industry-academia
  - Consortium cost share ~ 12%
- **Builds on UK Defence Technology Centres and US ARL Collaborative Technology Alliances**

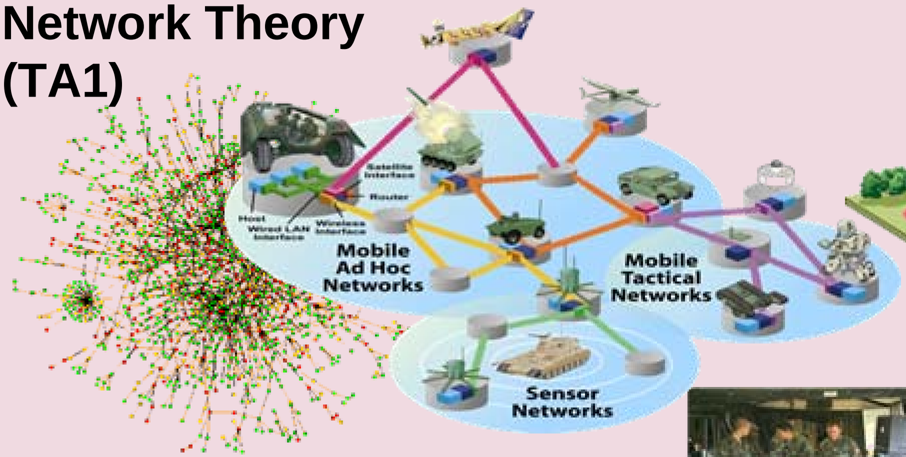
COLLABORATIVE LEADERSHIP

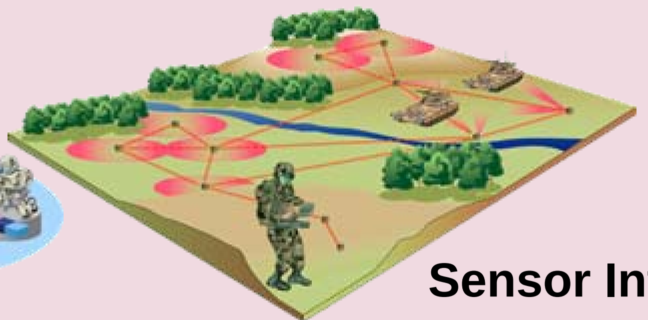
- **UK MOD/Dstl and US Army Research Laboratory working together closely to jointly lead program**
  - Single coherent fundamental research program
  - Involves US/UK industry, academia, and government
- **Promotes collaboration between leading industrial and academic organizations in both countries**
  - Collaboratively push the state-of-the-art
  - Critical mass of researchers focused on key challenges
  - Staff rotations to deepen collaborations
  - Develop a deep understanding of how technologies can contribute to future defence capabilities

ITA Areas of Investigation

TECHNICAL AREAS

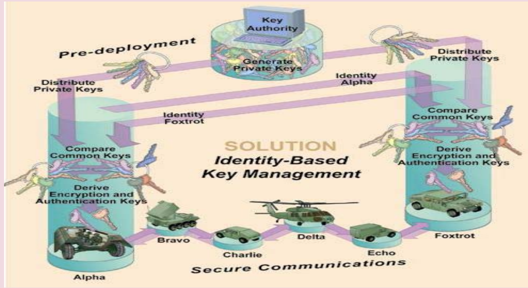
Network Theory (TA1)





Sensor Information Processing and Delivery (TA3)

Security Across a System-of-Systems (TA2)



Distributed Coalition Planning and Decision Making (TA4)

CROSS AREA THEMES and GOAL

- Dynamic Mission Focused Communities of Interest (CoIs)
- End-to-End Coalition Information Flows
- Enabling Context and Risk Based Decision Making
- Balancing Resource Efficiency/ Adaptability

NS Research Facilities

HPC-Enabled, Large-Scale, High Fidelity M&S

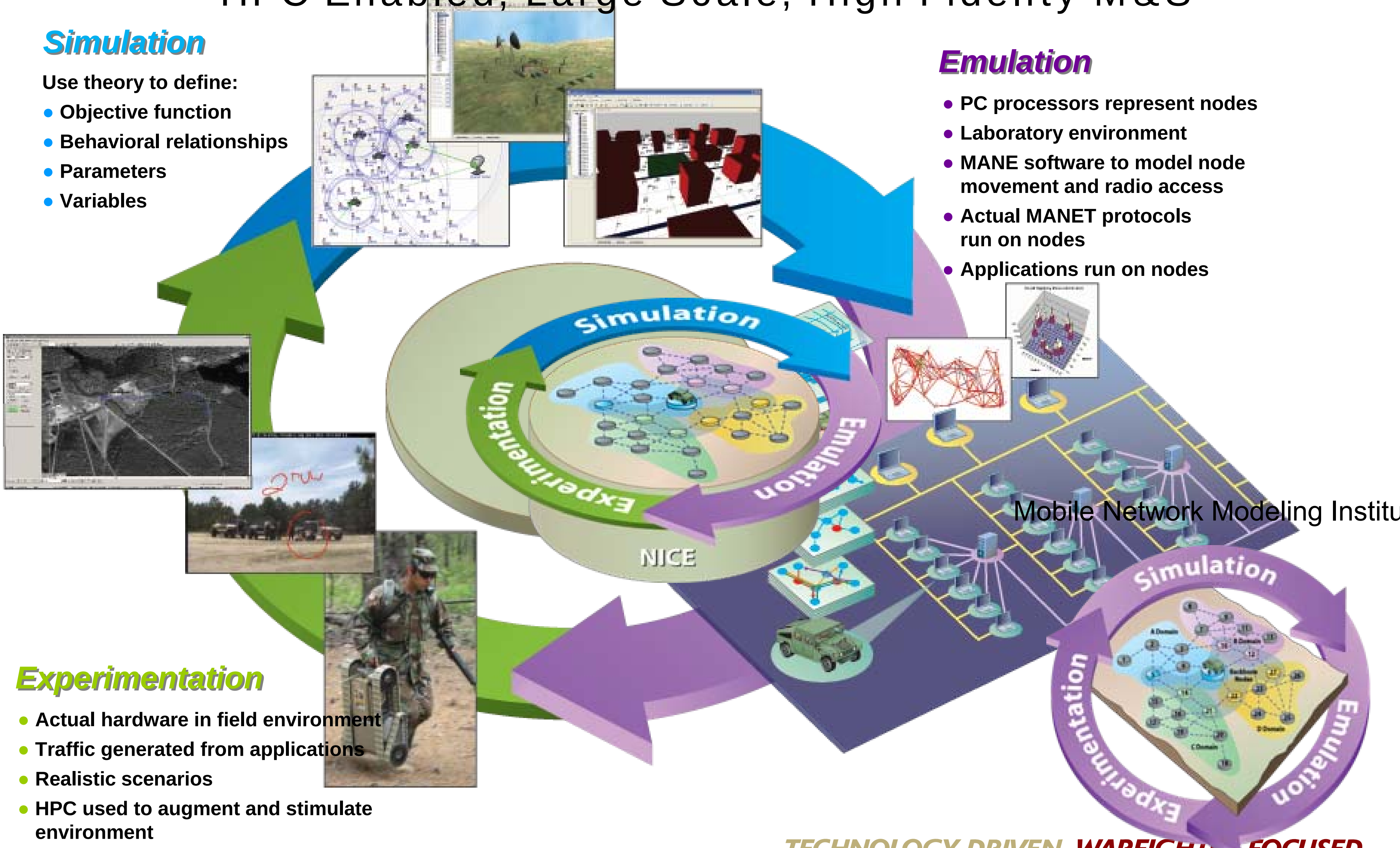
Simulation

Use theory to define:

- Objective function
- Behavioral relationships
- Parameters
- Variables

Emulation

- PC processors represent nodes
- Laboratory environment
- MANE software to model node movement and radio access
- Actual MANET protocols run on nodes
- Applications run on nodes



Experimentation

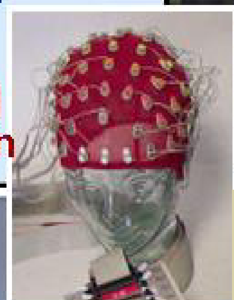
- Actual hardware in field environment
- Traffic generated from applications
- Realistic scenarios
- HPC used to augment and stimulate environment

NS Research Facilities

Cognitive Assessment, Simulation, & Engineering Laboratory (CASEL)

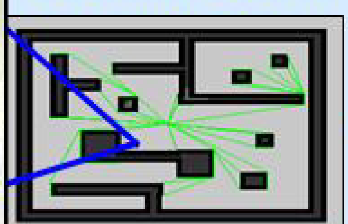
Simulated Tactical Operations Center (S-TOC)

Biosignal acquisition



360° Soldier Readiness Simulator

Robot Obstacle Course



Bldg 518

Immersive Environment Simulator (IES)

Social Network Analysis

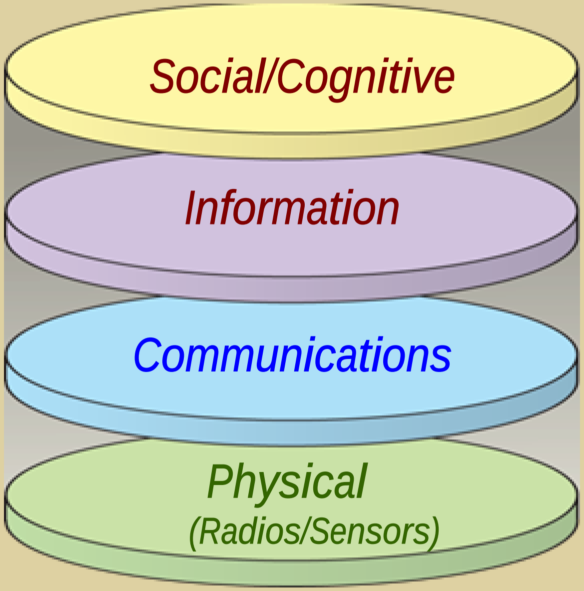
Improved Performance Research Integration Tool
IMPRINT

Modeling Tools

Aberdeen Test Center Mulberry Point MOUT Site

Network Science

Grand Challenge/Vision

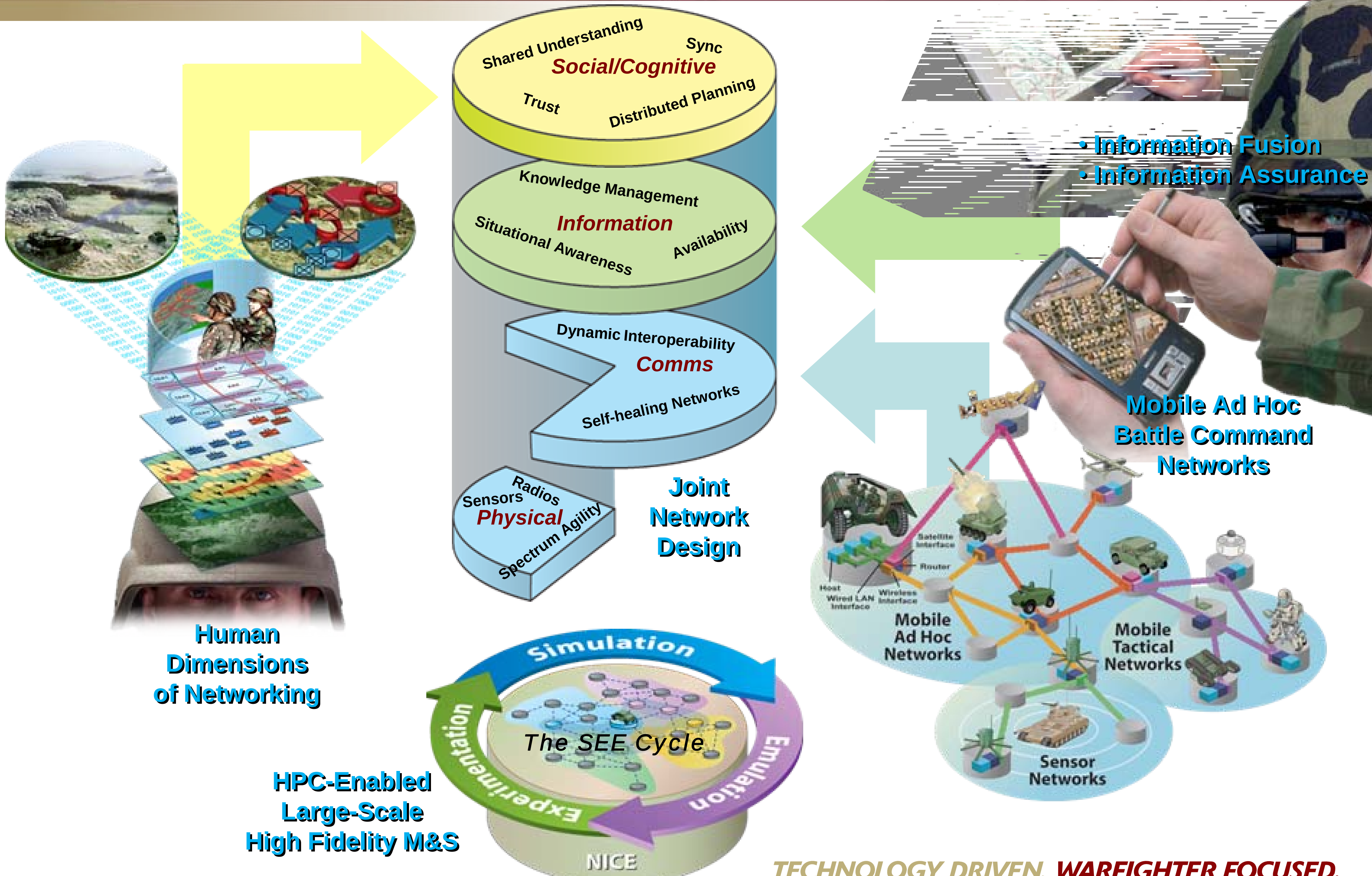


- Develop sciences which will enable us to model, design, analyze, predict, & control behaviors of secure tactical communications, sensing, & command & control networks

- Develop fundamental underpinnings to enable humans & networks of disparate information sources to discover, derive, infer, & optimize data, information & knowledge from the full range of structured & unstructured sources

- Understand the linkage between the physical & human domains as they relate to human decision making within the Army’s command & control structure

Questions/Comments?



Special Session
DoD Independent Research and Development

Introduction

23 April, 2009

Dr. André van Tilborg
Deputy Under Secretary of Defense
(Science & Technology)

Agenda

1:15pm	Introduction	Dr. André van Tilborg, DUSD(S&T)
1:30pm	Military Department Presentations	Dr. Jagadeesh Pamulapati, Deputy Director for Research and Laboratory Management, US Army
		Mr. Wendell Banks, Director, Plans & Programs, Air Force Research Lab, Wright–Patterson AFB
		RADM Nevin Carr, Chief of Naval Research
3:00pm	BREAK	
3:15pm	Discussion Topics	Dr. André van Tilborg, DUSD(S&T)
3:30pm	Industry Views	All

Objectives for Today's Session

- **Provide brief overviews of DoD IR&D objectives and activities**
- **Enable direct discussion with DoD IR&D leaders**
- **Identify DoD IR&D points-of-contact**
- **<u>Obtain feedback from industry</u> (inputs from DoD participants also welcome)**
  - **What improvements/adjustments should DoD consider to enhance the value, efficiency, and productivity of the IR&D program?**
  - **Are there any fundamental changes that merit consideration?**

Obtaining Feedback from Industry is the Top Priority.

Overview of DoD IR&D

- **Law**
  - 10 USC 2372, Independent research and development and bid and proposal costs: payments to contractors
- **Regulations**
  - DoD Directive 3204.1, May 10, 1999
  - Federal Acquisition Regulation (FAR) 31.205-18
  - Defense Federal Acquisition Supplement (DFARS) 231.205-18 and 242.771
  - Cost Accounting Standard (CAS) 420
- **Execution**
  - By military departments and agencies, as outlined in the presentations that follow
- **Coordination**
  - DDR&E-chaired Technical Coordination Group (TCG)

Regulations

- DOD IR&D Program Directive 3204.1, May 10, 1999
  - Policy and responsibilities for technical and business aspects of IR&D and B&P activities
  - Establishes Technical Coordination Group (TCG) to provide oversight of the IR&D Program and effective communications between industry and the DoD
- Federal Acquisition Regulation (FAR) 31.205-18.
  - Contract cost principles and procedures for IR&D and B&P costs
  - Definitions of IR&D and B&P costs, cost allowability, deferred IR&D costs, and cooperative arrangements
  - IR&D and B&P costs allowable as indirect expenses on contracts to the extent that those costs are allocable and reasonable
- Defense Federal Acquisition Regulation Supplement (DFARS) 231.205-18.
  - Contract cost principles and procedures for IR&D and B&P costs under defense contracts
  - For major defense contractors, allowable IR&D/B&P costs are limited to those for projects that are of potential interest to DoD
- Defense Federal Acquisition Regulation Supplement (DFARS) 242.771.
  - Contract administration functions relating to IR&D and B&P costs
- Cost Accounting Standard (CAS) 420.
  - Criteria for the accumulation and allocation of IR&D and B&P costs

10 USC 2372: IR&D is Intended to Encourage …

(1) Enabling superior performance of future United States weapon systems and components.

(2) Reducing acquisition costs and life-cycle costs of military systems.

(3) Strengthening the defense industrial base and the technology base of the United States.

(4) Enhancing the industrial competitiveness of the United States.

(5) Promoting the development of technologies identified as critical under § 2506 of 10 USC 2372.

(6) Increasing the development and promotion of efficient and effective applications of dual-use technologies.

(7) Providing efficient and effective technologies for achieving such environmental benefits as improved environmental data gathering, environmental cleanup and restoration, pollution reduction in manufacturing, environmental conservation, and environmentally safe management of facilities.

In Furtherance of 10 USC 2372, DODD 3204.1 Seeks to …

4.2.1. Create an environment that encourages DoD contractors to expand knowledge in mathematics and science, improve technology in areas of interest to the Department of Defense, and enrich and broaden the spectrum of technology available to the Department of Defense.

4.2.2. Create conditions that allow DoD contractors the freedom to determine the focus of their IR&D programs and especially the freedom to exploit fruitful avenues of research that, in their judgments, may provide the greatest benefits.

4.2.3. Broaden and strengthen the industrial base for the benefit of the U.S. economy and defense, to provide incentives for future defense-oriented R&D, and to improve the responsiveness of industrial capabilities essential to defense needs.

4.2.4. Encourage the commercialization of dual-use technologies to ensure the efficient and effective availability of those technologies for application to future military systems and for the economic benefit of the United States.

Role of the Technical Coordination Group

- **Established by DoD Directive 3204.1**
- **Provides oversight of the IR&D Program and effective communications between industry and the Department of Defense**
  - **Provide industry the information needed to effectively implement corporate IR&D programs while maintaining independence**
  - **Effectively use IR&D data obtained from industry by the Department of Defense (DTIC IR&D database)**
- **Current TCG membership is DoD only**
- **The TCG seeks to improve in its role as a coordination mechanism for the IR&D community – suggestions welcomed**

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DoD
Independent Research and Development

Discussion Topics

Dr. André M. van Tilborg
Deputy Under Secretary of Defense
(Science & Technology)

DoD Attendees Want to Hear Industry Perspectives

- How well is IR&D program meeting objectives of 10 USC 2372?
- What impediments constrain IR&D execution and impact?
- What improvements/adjustments should DoD consider to enhance the value, efficiency, and productivity of the IR&D program?
- Are there fundamental changes that merit consideration?

10 USC 2372: IR&D is Intended to Encourage …

(1) Enabling superior performance of future United States weapon systems and components.

(2) Reducing acquisition costs and life-cycle costs of military systems.

(3) Strengthening the defense industrial base and the technology base of the United States.

(4) Enhancing the industrial competitiveness of the United States.

(5) Promoting the development of technologies identified as critical under § 2506 of 10 USC 2372.

(6) Increasing the development and promotion of efficient and effective applications of dual-use technologies.

(7) Providing efficient and effective technologies for achieving such environmental benefits as improved environmental data gathering, environmental cleanup and restoration, pollution reduction in manufacturing, environmental conservation, and environmentally safe management of facilities.

In Furtherance of 10 USC 2372, DODD 3204.1 Seeks to …

4.2.1. Create an environment that encourages DoD contractors to expand knowledge in mathematics and science, improve technology in areas of interest to the Department of Defense, and enrich and broaden the spectrum of technology available to the Department of Defense.

4.2.2. Create conditions that allow DoD contractors the freedom to determine the focus of their IR&D programs and especially the freedom to exploit fruitful avenues of research that, in their judgments, may provide the greatest benefits.

4.2.3. Broaden and strengthen the industrial base for the benefit of the U.S. economy and defense, to provide incentives for future defense-oriented R&D, and to improve the responsiveness of industrial capabilities essential to defense needs.

4.2.4. Encourage the commercialization of dual-use technologies to ensure the efficient and effective availability of those technologies for application to future military systems and for the economic benefit of the United States.

Potential Topics for Discussion

1. DoD-Industry Communications
2. IR&D Reporting
3. Balance of Near- vs. Far-term Research
4. Return on Investment
5. Technical Coordination Group
6. Improvements, Adjustments, and Fundamental Changes

DoD-Industry Communications

• DoD and Industry use workshops to facilitate communication between IR&D researchers, government researchers, and acquisition programs. Technical Interchange Meetings (TIMs) afford Industry and DoD the opportunity to meet in structured, yet flexible forums to discuss R&D needs, interests and activities.

• Two most common types of TIMs are “Industry Day” events that have a distinct Industry “technical marketing” thrust and the Air Force/Industry IR&D Workshops with their alternating “technical exchange and review” sessions.

• Questions for Discussion:

– Are these kinds of activities effective?
– At what level (DoD, Service, Systems Command, Technical Center, Other?) are these types of activities most effective?
– How much of this type of activity can Industry support?
– What could be done to maximize the effectiveness of these workshops and interactions?
– Are there any additional activities you recommend DoD undertake to increase Industry awareness of DoD near-, medium-, and long-term capability objectives; and the current and planned DoD research and acquisition programs directed at these objectives?

IR&D Reporting

- Approximately $2-2.5B of annual DoD IR&D investments.

- Technical communication from industry to DoD describing this investment is only partially (40%) captured in the Defense Technical Information Center (DTIC) IR&D database.

- DoD staff are required to examine DTIC IR&D database before starting new projects.

- With encouragement, can voluntary measures substantially increase reporting?

Balance of Near- vs. Far-term Research

- From DODD 3204.1 "4.2.1. Create an environment that encourages DoD contractors to expand knowledge in mathematics and science, improve technology in areas of interest to the Department of Defense, and enrich and broaden the spectrum of technology available to the Department of Defense."

- What can DoD do better to foster such an environment?

Return on Investment

• **Approximately $2-2.5B of annual DoD IR&D investments.**

• **How to assess and demonstrate the value of IR&D reimbursement and the impacts of increasing, decreasing, or maintaining the current levels of investment?**

Technical Coordination Group

- **DODD 3204.1 directs DDR&E TCG to do the following:**
  - **1.3.1. Provide industry the information they need to effectively implement their IR&D programs while maintaining their independence to conduct research and development (R&D) activities.**
  - **1.3.2. Effectively use IR&D data obtained from industry by the Department of Defense.**

- **Should Industry be an integral part of the TCG?**
  - **If so, in what way, to what extent, and to what purpose?**
  - **How would industry get the most value from direct TCG participation?**
  - **What expectations from the TCG do you have?**

Improvements, Adjustments, and Fundamental Changes

What improvements, adjustments, and changes could the Department of Defense implement to enhance the value, efficiency, and productivity of the IR&D program?

Additional Feedback is Welcomed

- **IR&D is important to DoD**
- **Post-meeting comments are encouraged**
- **Please provide your comments to –** dhyman@dtic.mil
- **Additional IR&D outreach to industry sessions could be conducted**
  - **If there is sufficient interest, a one-day meeting could be scheduled in early fall in the Washington, DC area – please communicate interest to** dhyman@dtic.mil

UNITED STATES SOUTHERN COMMAND

Science, Technology and Experimentation Perspective on USSOUTHCOM Capability Needs

10th Annual Science & Engineering Technology Conf / DoD Tech Exposition

April 23, 2009

THIS BRIEFING IS UNCLASSIFIED

Our Focus: A Diverse Region

- 1/6th of earth's surface
- 41 countries and territories/protectorates
- 460 million people

- Varied ethnic heritage
- Multiple languages
- 190 million Portuguese speakers

Challenges




Transnational & Adaptive Threats

Security

- Crime/urban gangs
- Illicit trafficking
- Transnational terrorism
- Forgery/money laundering
- Mass migration
- Narco-terrorism
- Natural disasters

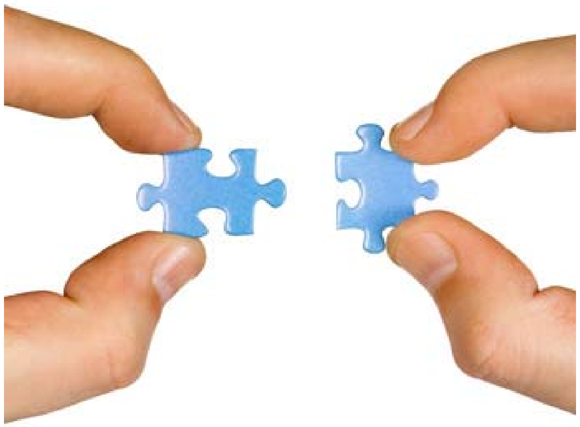
Warfighter

- Maritime Domain Awareness
- Counter Narcotics
- Information Collaboration and Integration
- Obscured Target Detection
- Cooperative Security Engagement

Regional challenges require cooperative solutions

Addressing WFCs through ST&E

Technology



Experimentation

International R&D

Security, Stability, Prosperity
.... for the Americas

MDA / Counter Narcotics

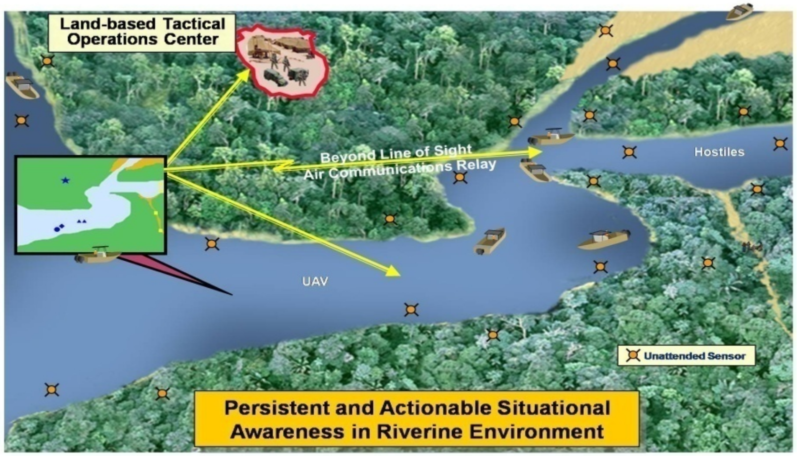
Warfighter Challenge

- **River-based criminal/terrorist activities represent a significant Operational and MDA challenge to Combatant Commanders**

- **Rivers are a primary lines of communication - drug trafficking & kidnapping generate tremendous revenues for terrorists**

Current ST&E Initiatives

RIO JCTD



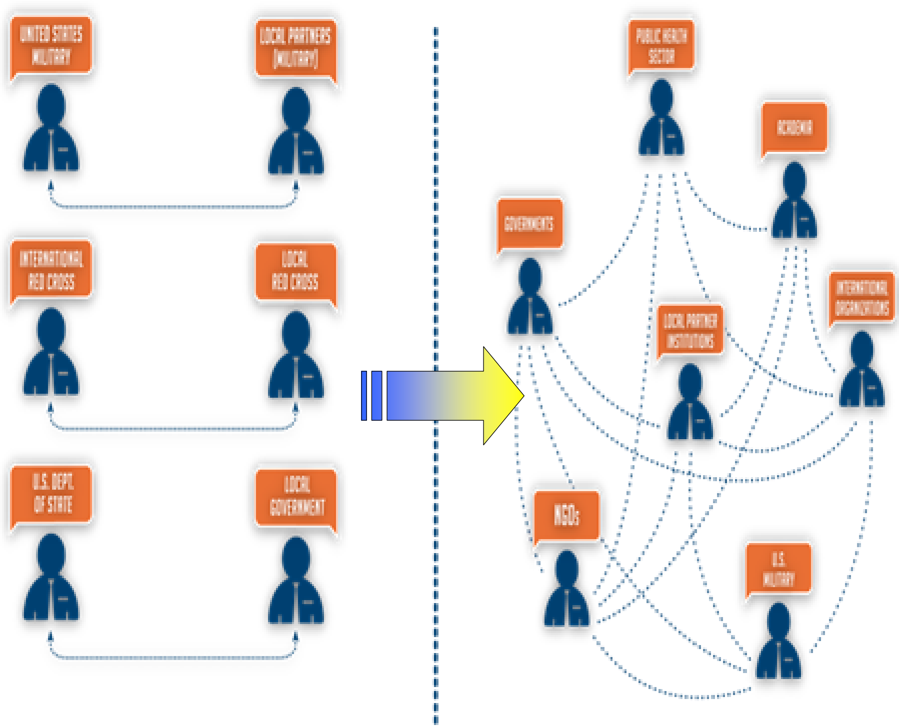
Information Collaboration / Integration

Warfighter Challenge

- **Today's environment requires effective communication, coordination, and collaboration among militaries, interagency communities, non-governmental organizations, private organizations, and international organizations involved in stability operations, complex humanitarian emergencies, and reconstruction activities**

Current ST&E Initiatives

TISC JCTD

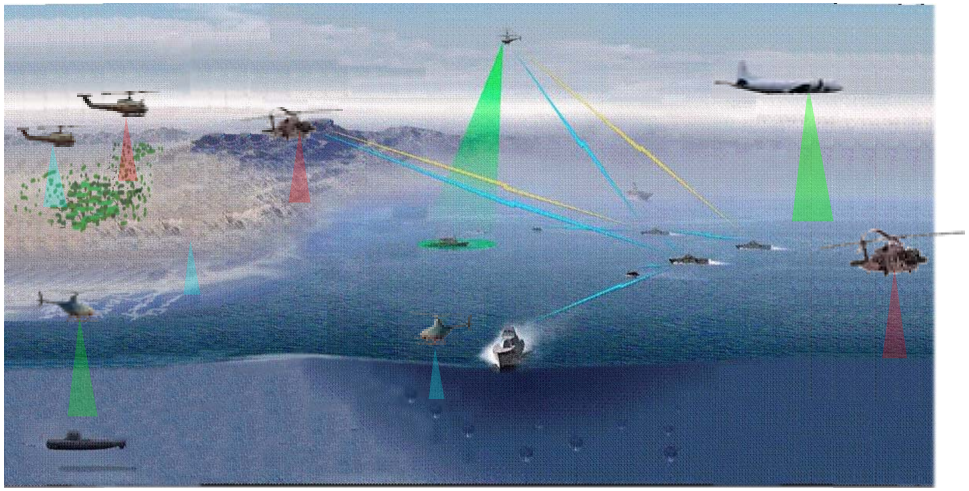


Obscured Target Detection

Warfighter Challenge

- **Full spectrum capability to detect adversary use of jungle, weather and camouflage for concealment and evasion**

Current ST&E Initiatives



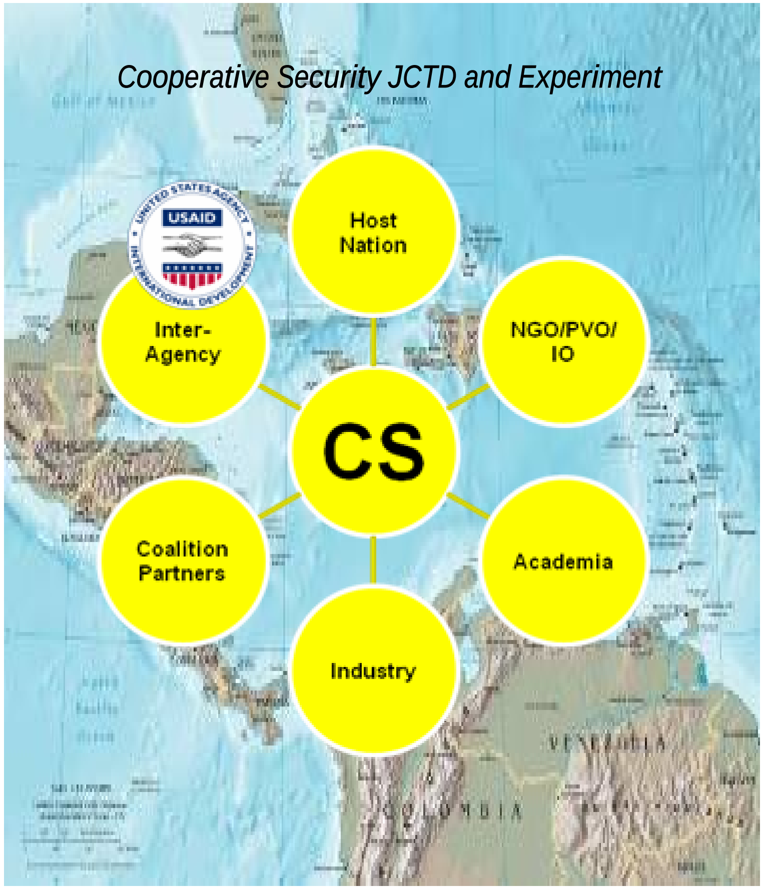
- Forester / A-160: UAV / GMTI
- Shadow Harvest JCTD: C-130-based / Multi-INT
- JMMES JCTD: Common Multi-Mission Sensor
- MASTIF JCTD: Data Fusion Engine

Cooperative Security Engagement

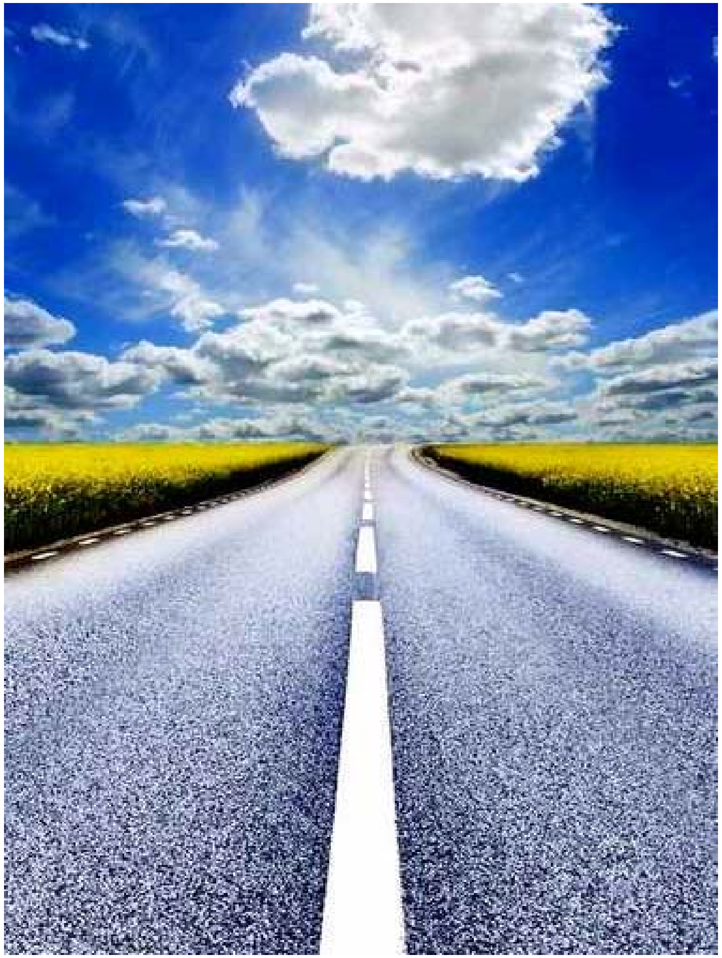
Warfighter Challenge

- Planning for conflict prevention and security cooperation is fragmented
- Assessment/Evaluation often an afterthought and largely unresourced
- Host nation assets often overlooked; survey/info focused mainly on "deficiencies"
- Visibility of employable USG and Partner assets, capabilities, projects and programs obscured
- Inputs/Outputs not always linked to Goals/Impacts
- Policy and technical barriers discourage routine information sharing

Current ST&E Initiatives



Potential Way Ahead



- Investigate where applicable
- Integrate
- Prioritize
- Assess, Plan, Execute, Evaluate
- Persistence

Fulfilling the Promise Together

Discussion