
# Defense Research and Engineering: The Path Ahead

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**Director, Defense Research and Engineering**

**12th Annual NDIA Systems Engineering Conference**

**October 27, 2009**

# Our Guidance

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

# Weapon Systems Acquisition Reform Act of 2009

- **Establishes Director, Systems Engineering (SE) and Director, Developmental Test & Evaluation (DT&E) as principal advisors to the SECDEF and the USD(AT&L)**
- **Mandates documented assessment and competitive prototyping**
- **Strengthens technical analysis of cost and schedule breaches during development**

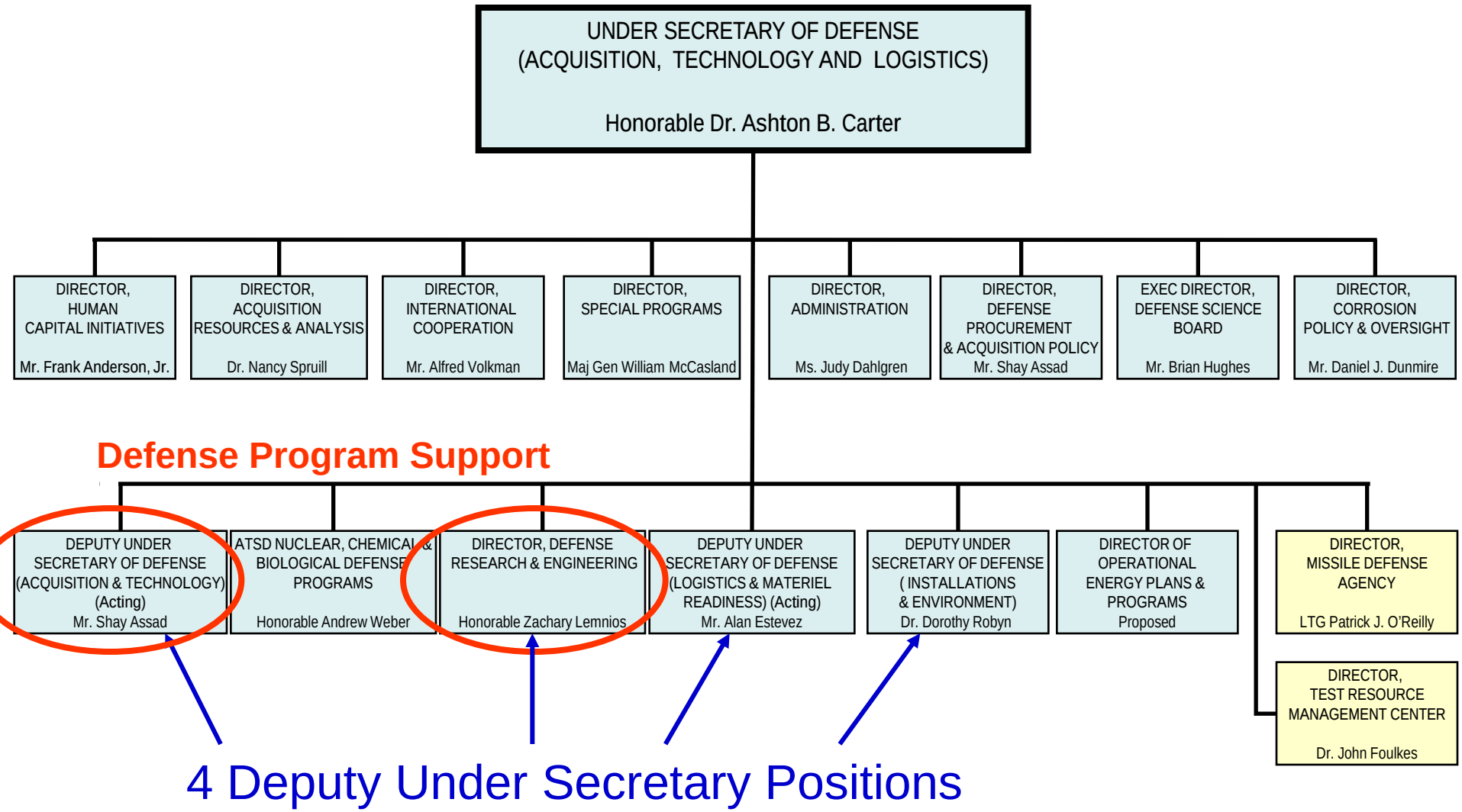
*President Barack Obama signing the Weapons Systems Acquisition Reform Act in the Rose Garden at the White House Friday, May 22, 2009.*

Official White House Photo by Samantha Appleton

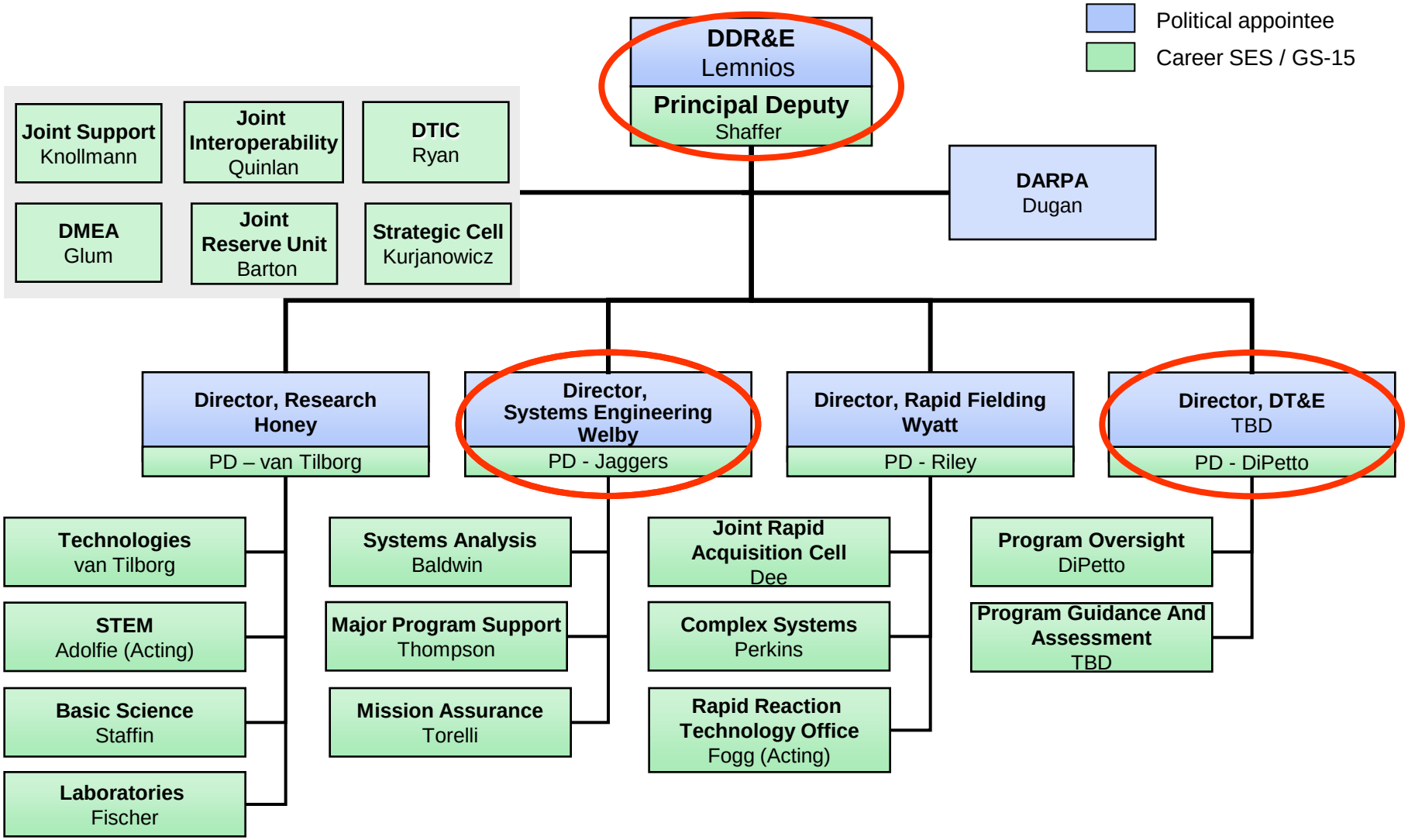
# DDR&E Imperatives

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

# Defense Program Support within the AT&L Organization



# DDR&E Organization



# New Coordinates

**Innovation**

**Speed**

**Agility**

# Comments from COCOMs


**"We need to detect IEDs at range… I am willing to test technologies in the field… We need persistent communications on the move…"**

**"I need the 70% solution today, rather than the 100% solution in 5-8 years…"**

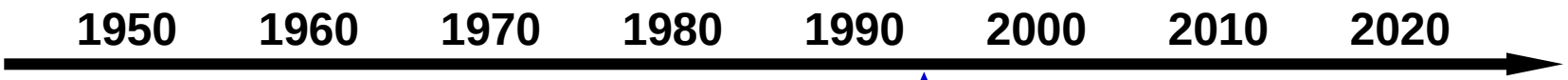
**"…we are concerned about our technological edge against a near peer competitor…"**

**"It took us 10 years to get to the Moon, we are 8 years into our research efforts for defeating IEDs…we need to find a solution to reliably detect and defeat IEDs at range…**

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

**"Often times we fail due to shortage of imagination…"**

# Perspective for the Next Decade




**National Security Challenges**

Cold War

Vietnam War

Desert Storm

Collapse of Soviet Union

Bosnia

Kosovo

OIF

OEF

Irregular/Hybrid Warfare

**Defense Capabilities**

ICBM

Satellite comms

C4ISR

Precision Strike

UAV

LGB's

GPS

Stealth

Robotics

Nuclear propulsion

Night Vision

Human Terrain
Ubiquitous Observation
Contextual Exploitation
Scaleable Action

**Enabling Technologies**

Transistor

Composite Materials

MEMS

Solid state laser

Superconductors

Space tracking

Web protocols

VHSIC

MIMIC

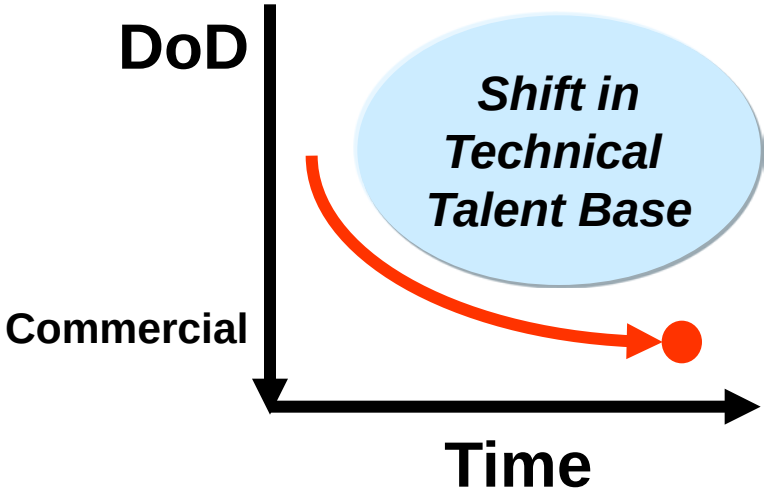
Digital computing

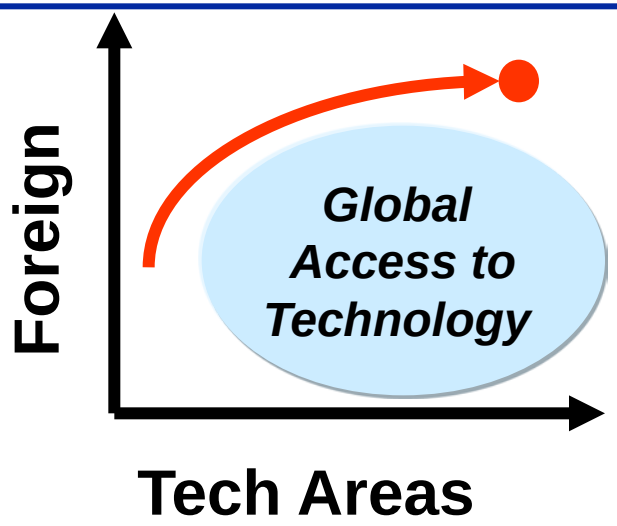
IR Sensors

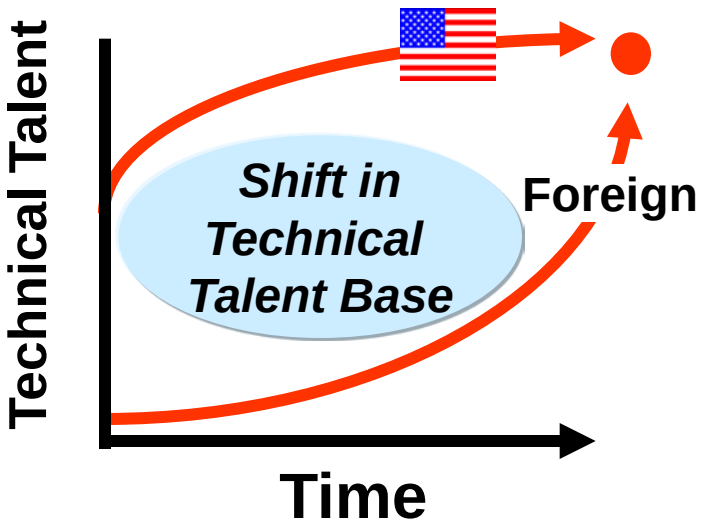
High Performance Computing

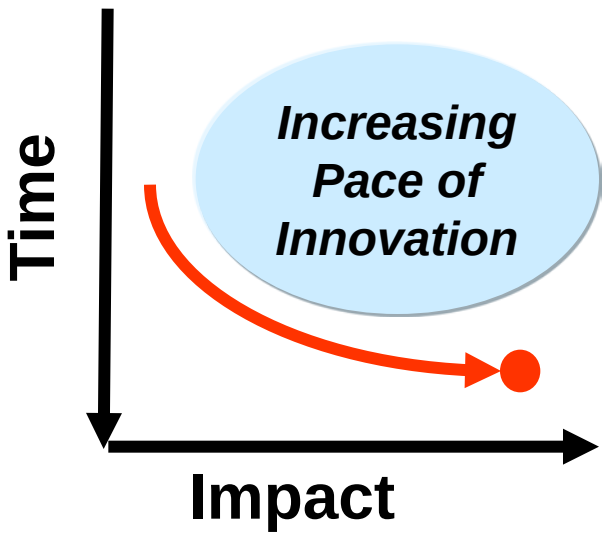
- Advanced Electronics, Photonics Algorithms, MEMS
- Nano; Meta; & New Materials
- Cognitive Computing
- Bio-Revolution

# Four Key Challenges to our Technical Base

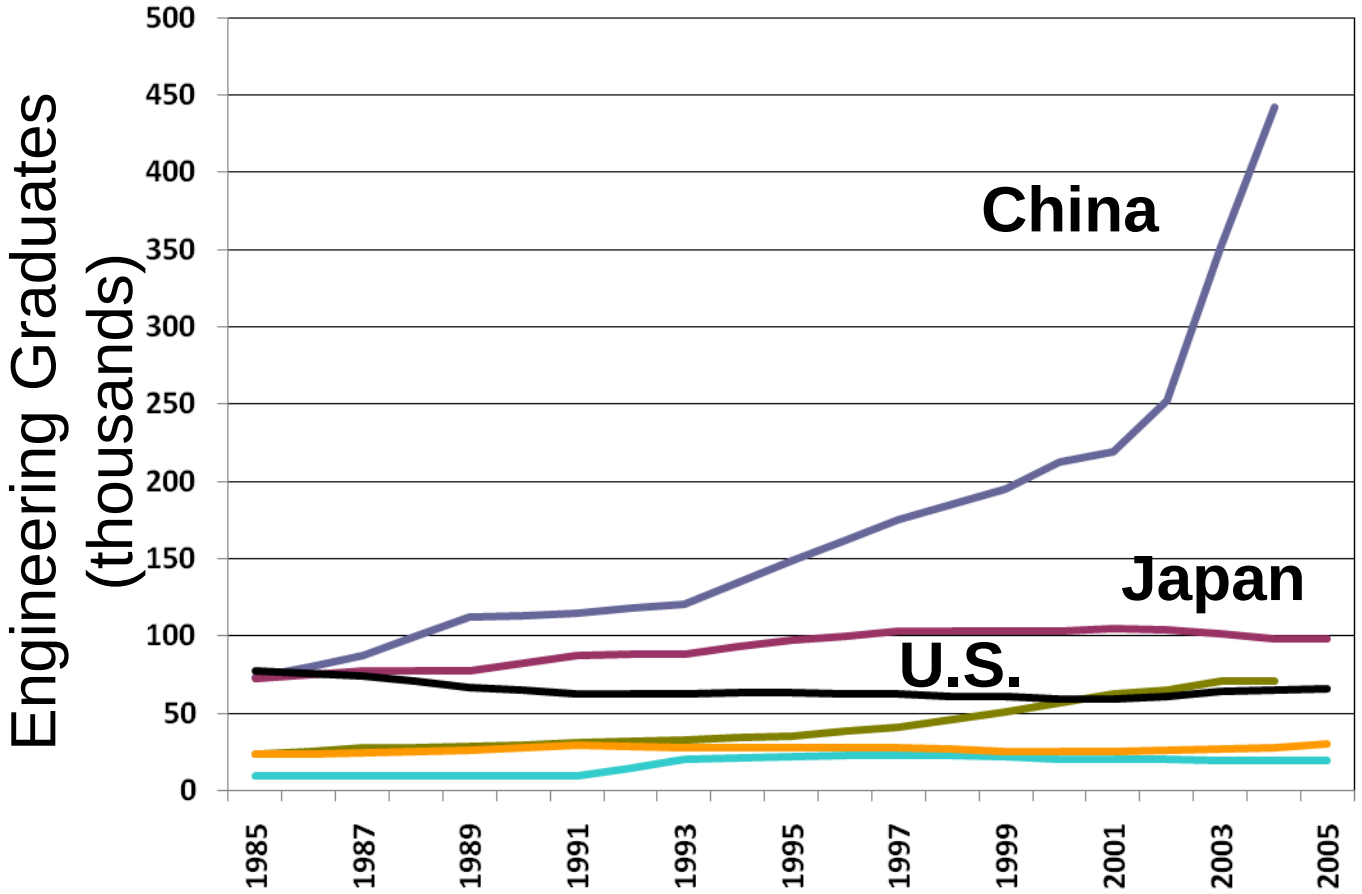


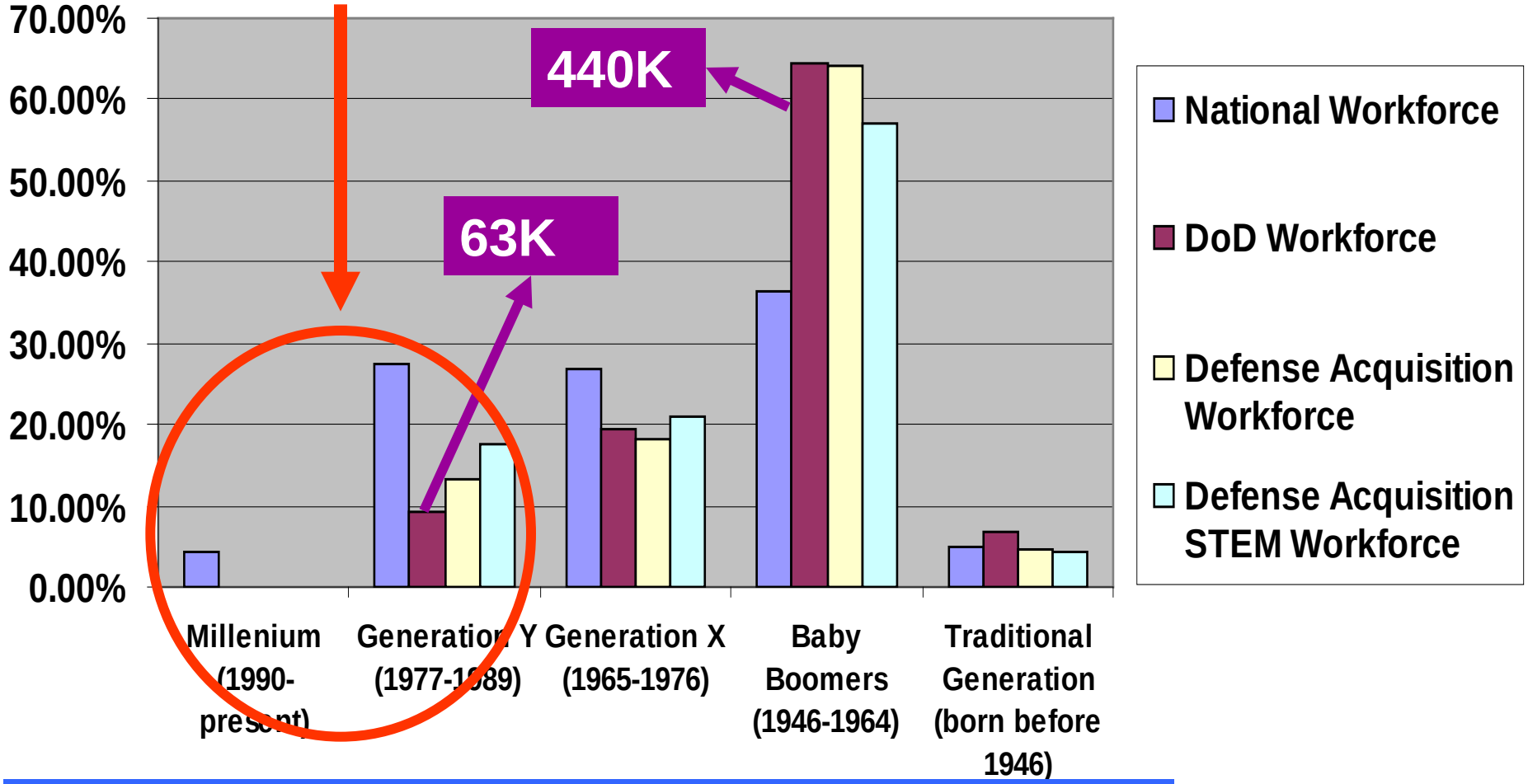
# We are in Competition for the Best and Brightest




S&E Indicators, 2008

# The STEM Workforce Challenge

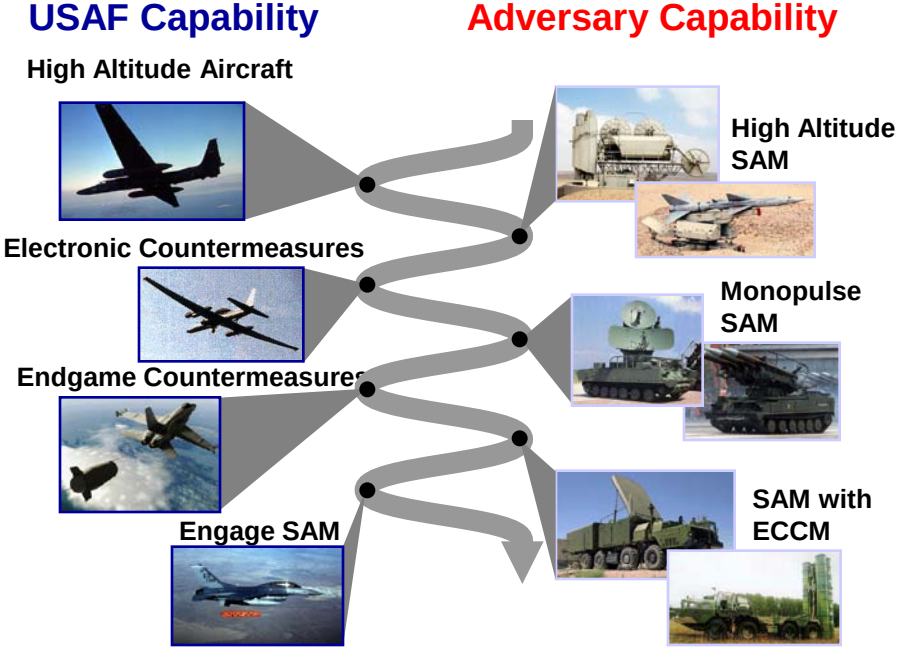
## Future Workforce




| Totals: | 6.6M | 42.8M | 41.8M | 56.7M | 7.4M |
|---|---|---|---|---|---|

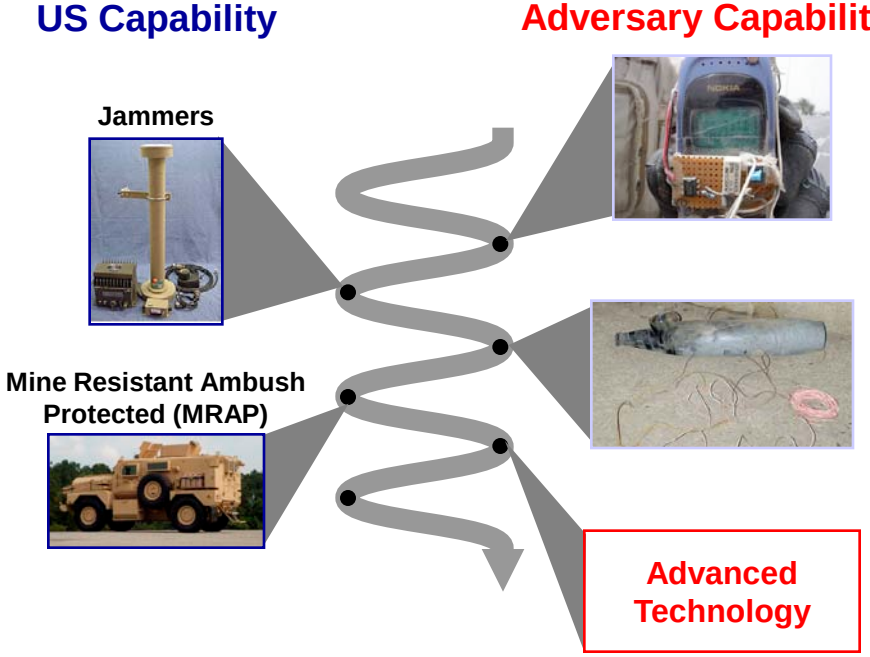
# The Timeline has Collapsed!

## Conventional Warfare



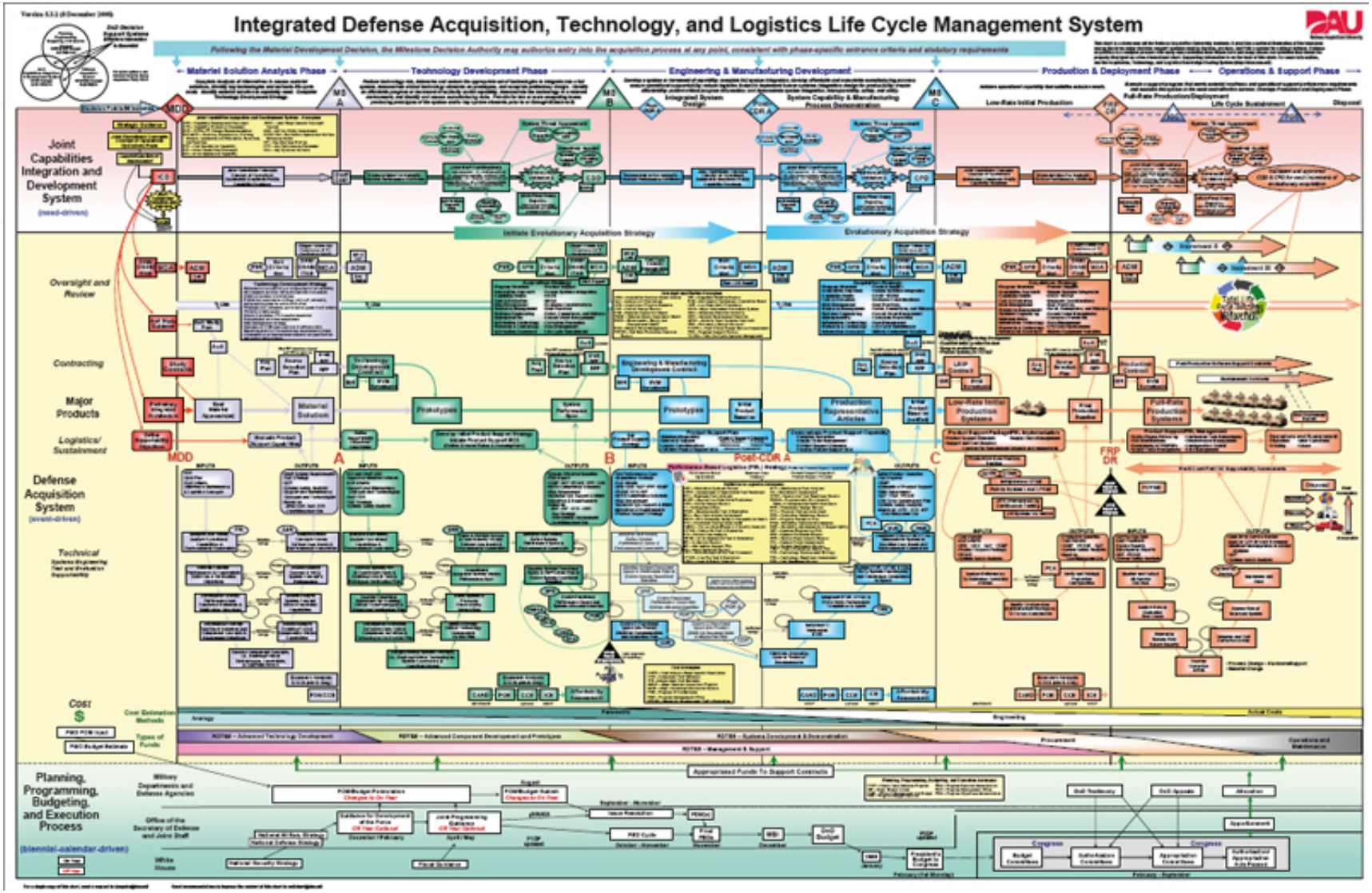

**Response loop measured in years**

## Counter-Insurgency Warfare




**Response loop measured in months or weeks**

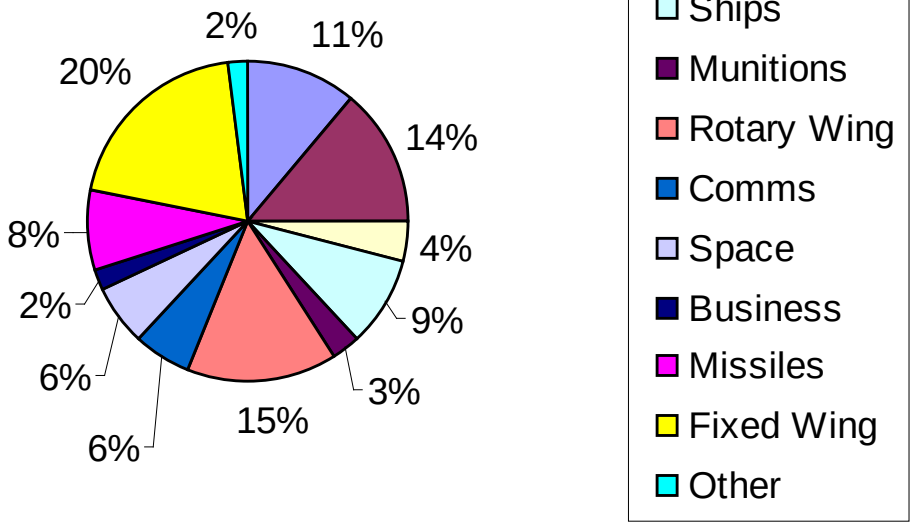
# An Effective Process for Major Defense Systems – but not very agile



# Scope of DDR&E Acquisition Program Oversight Efforts*

| Program Category | Increasing cost/risk | # of Progs |
|---|---|---|
| ACAT ID** | $$$ MDA = AT&L | 93 |
| ACAT IC** | $$$ MDA = CAE | 52 |
| Special Interest** | Any $s Risk | 19 |
| MAIS, ACAT IA | $-$$$, AIS | 30 |
| Pre-MDAP | $$$ pre-MS B | 53 |
| Pre-MAIS | $-$$$, AIS pre-MS B | 10 |
| ACAT II | $$ < ACAT I | 8 |
| ACAT III | $ < ACAT II | 9 |
| Total | | 274 |

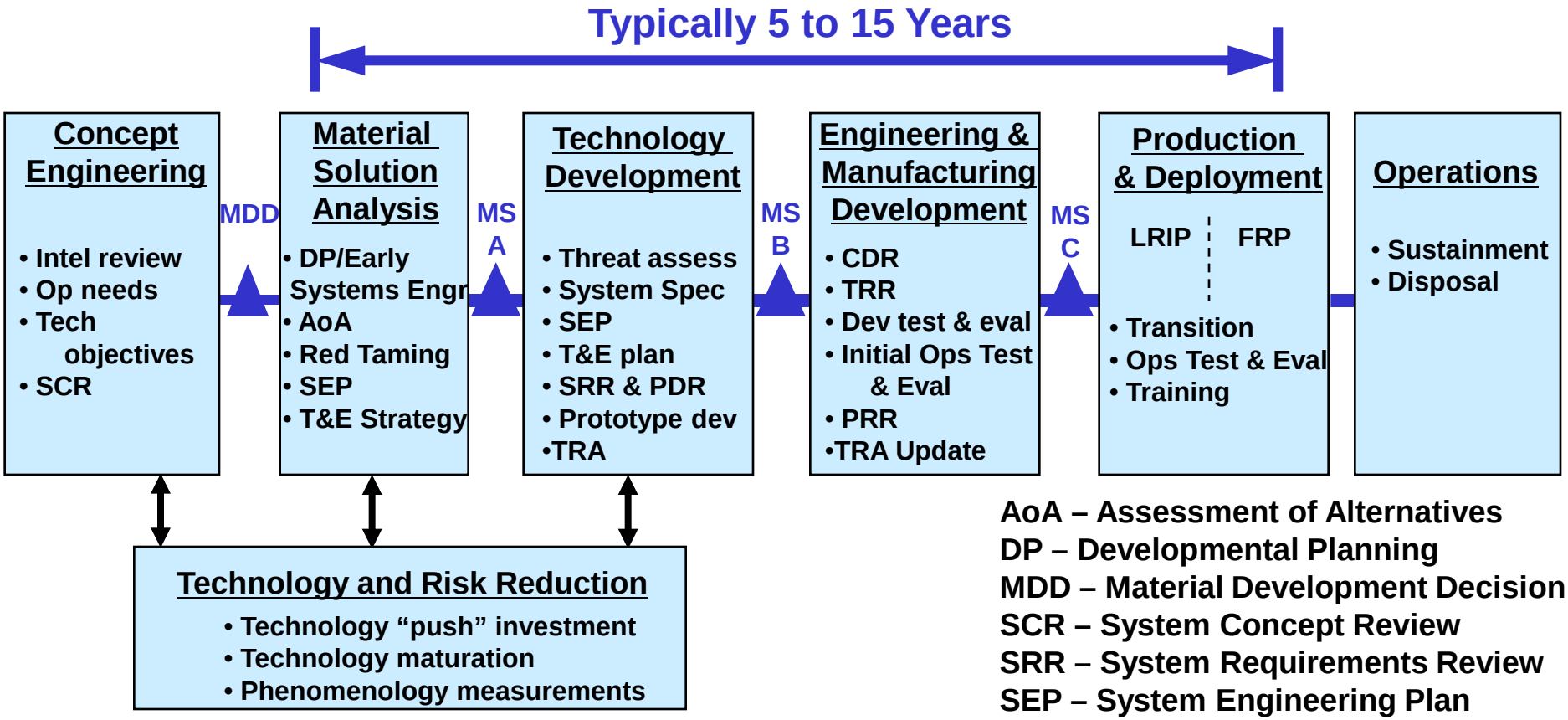
## % Distribution of MDAPs by Domain




*Based on 2009 T&E Oversight List (Jan 5, 2009)
**Major Defense Acquisition Program (MDAP)
+Major Automated Information System (MAIS)

MDA – Milestone Decision Authority
TMA – Technology Maturity Assessment
CAE – Component Acquisition Executive

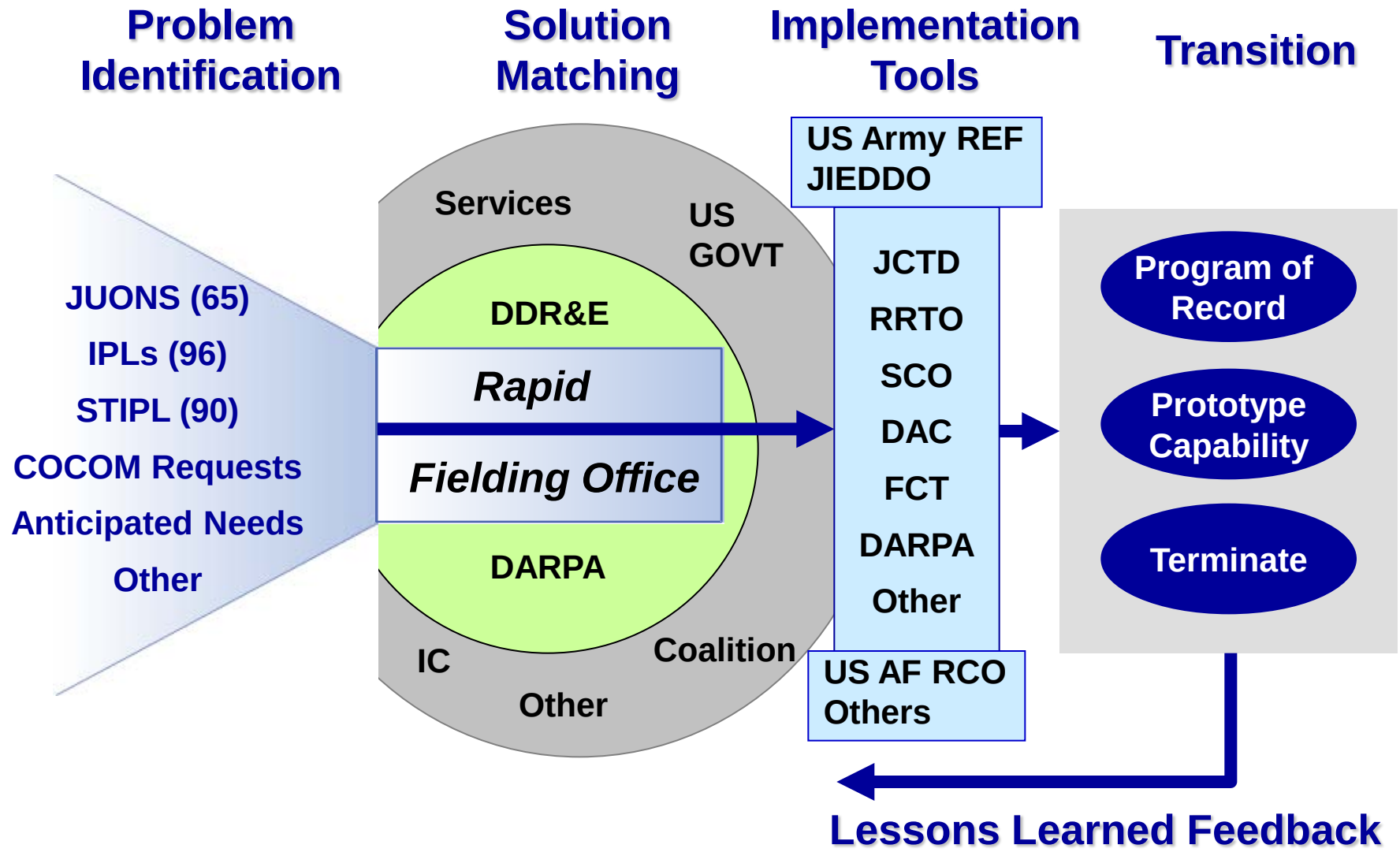
# Defense Acquisition Approach
## Systems Engineering is a key discipline



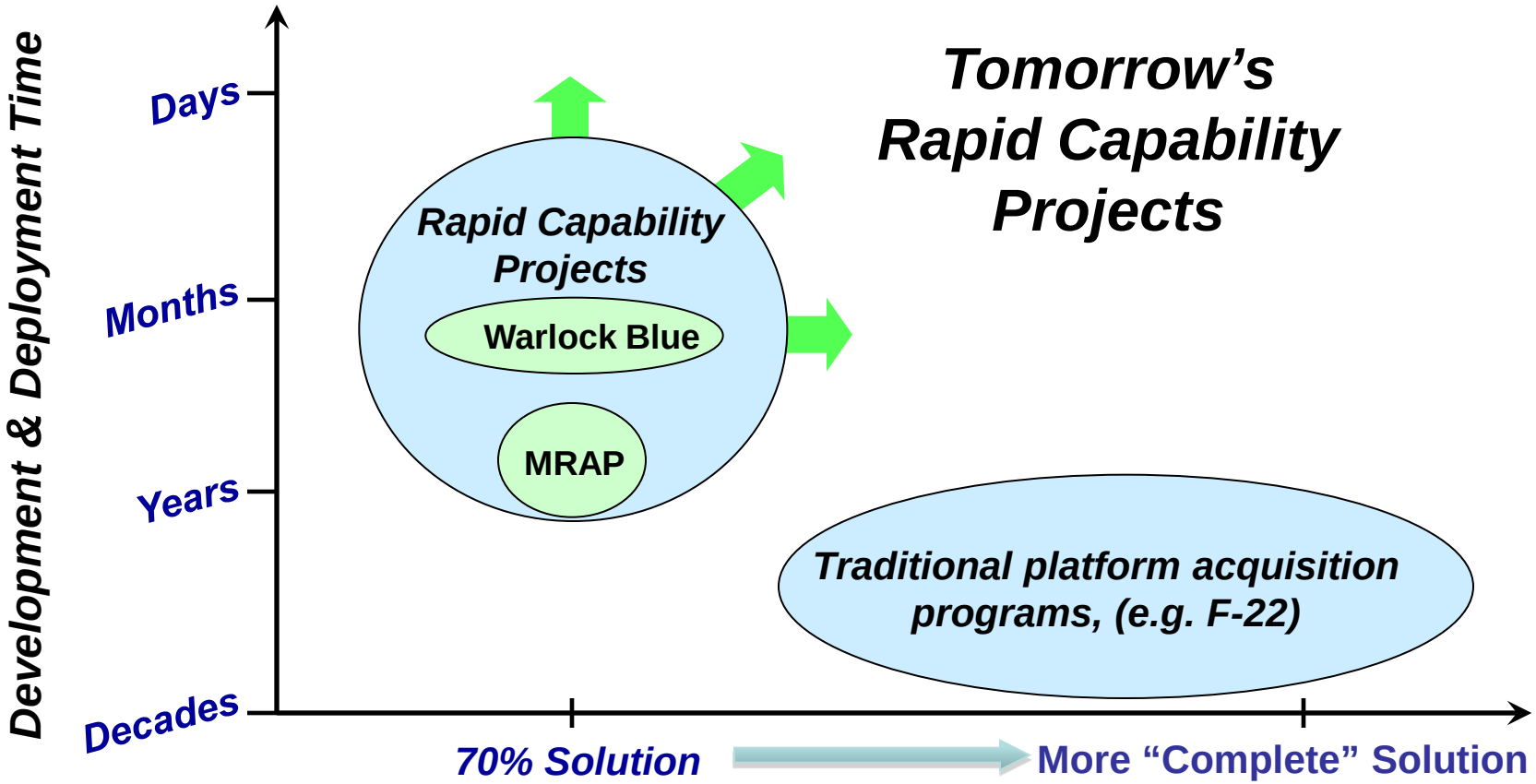

**70-75% of Cost Decisions Made Prior to Milestone A**
**Impact 72% of Total Life Cycle Costs**

AoA – Assessment of Alternatives
DP – Developmental Planning
MDD – Material Development Decision
SCR – System Concept Review
SRR – System Requirements Review
SEP – System Engineering Plan
PDR – Preliminary Design Review
CDR – Critical Design Review
TRR – Test Readiness Review
PRR – Production Readiness Review
LRIP – Low-Rate Initial Production
FRP – Full Rate Production

# DDR&E Rapid Fielding Office: Accelerating Delivery of Capabilities



# Pushing the Bounds of Innovation and Development




**Performance – Sustainability – Adaptability - Robustness of Solution**

# A New Generation of Concept Engineering Tools

Warfighter Needs

Anticipatory Opportunities

**Accelerated Concept Engineering Environment**

*Iterative Virtual and Real Prototyping*

- Conceptual Designs
- CONOPs
- TTPs
- Detailed Design Models

- **Immersive Virtual Environments**
- **Rapid Virtual Environment generation**
- **Virtual Environment to CAD tool translation**
- **Rapid Prototyping fabrication tools**
- **“Human-Centered Design” principles and tools**
- **Integrated engineering and virtual M&S**

# Summary: Challenges Ahead

- Develop tools to shorten the Acquisition cycle without diminishing the quality of solutions
- Evolve Systems Engineering to design systems for adaptability and to embrace complexity
- Expand the aperture of Defense Engineering to address 21st century technical challenges
- Expand the Defense Engineering human capital resource base