Transitioning S&T Programs

Defense Systems Acquisition Management Course

June 17, 2004

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Office of Director, Defense Research and Engineering

A Focus on Revolutionary Advances

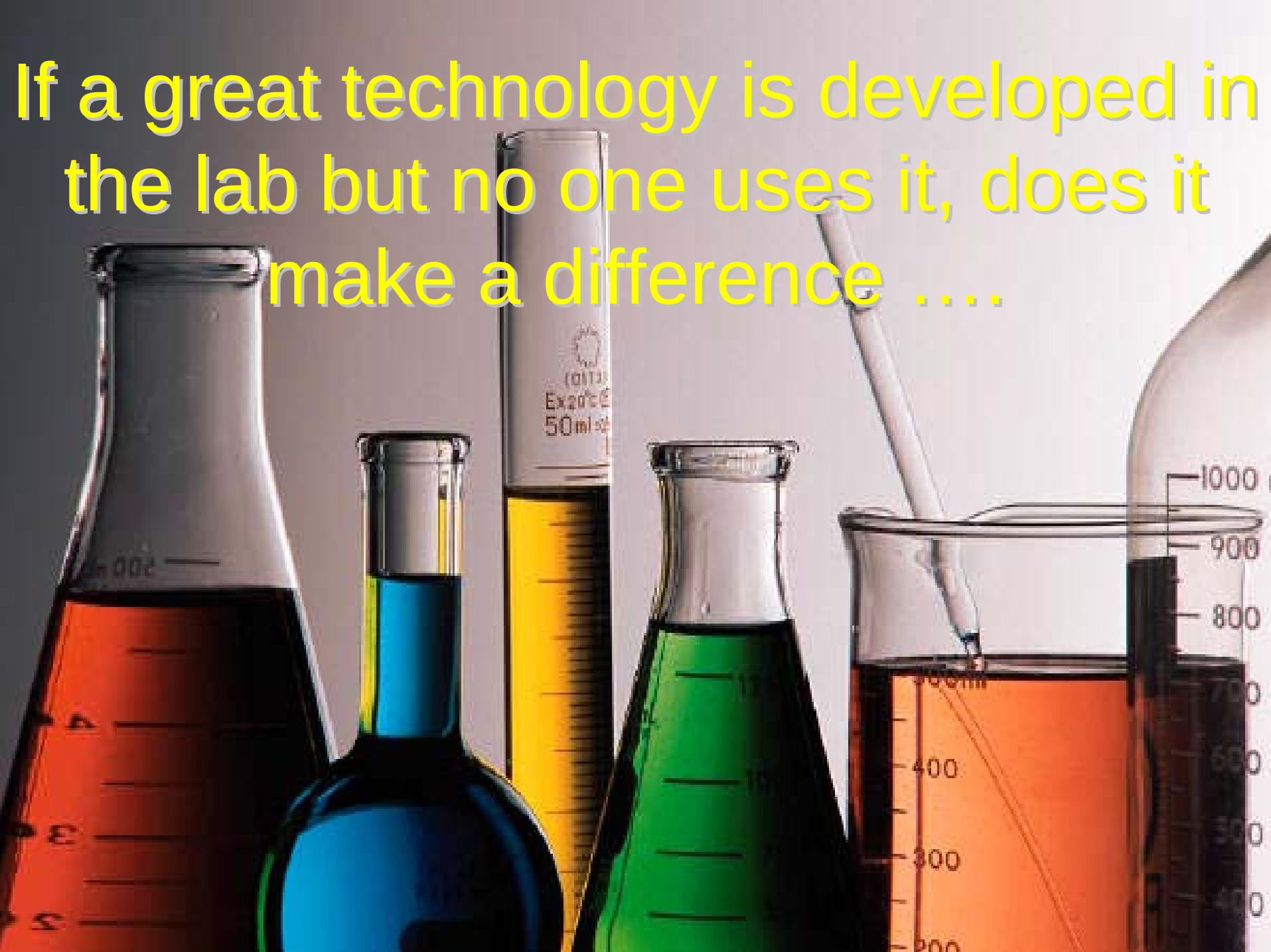
Stealth

Adaptive Optics and Lasers

GPS

Night Vision

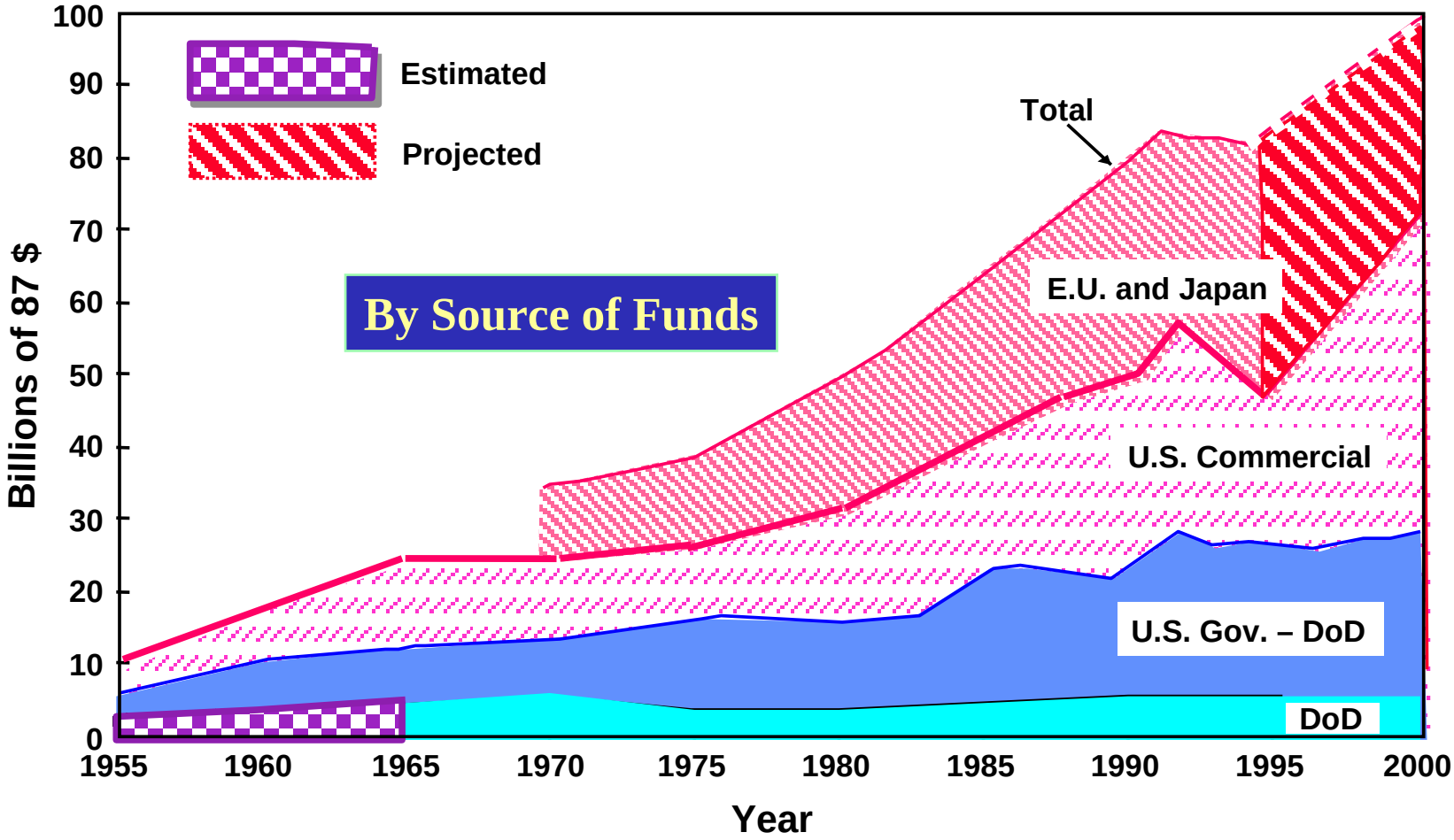
Phased Array Radar


If a great technology is developed in the lab but no one uses it, does it make a difference ….

Overview

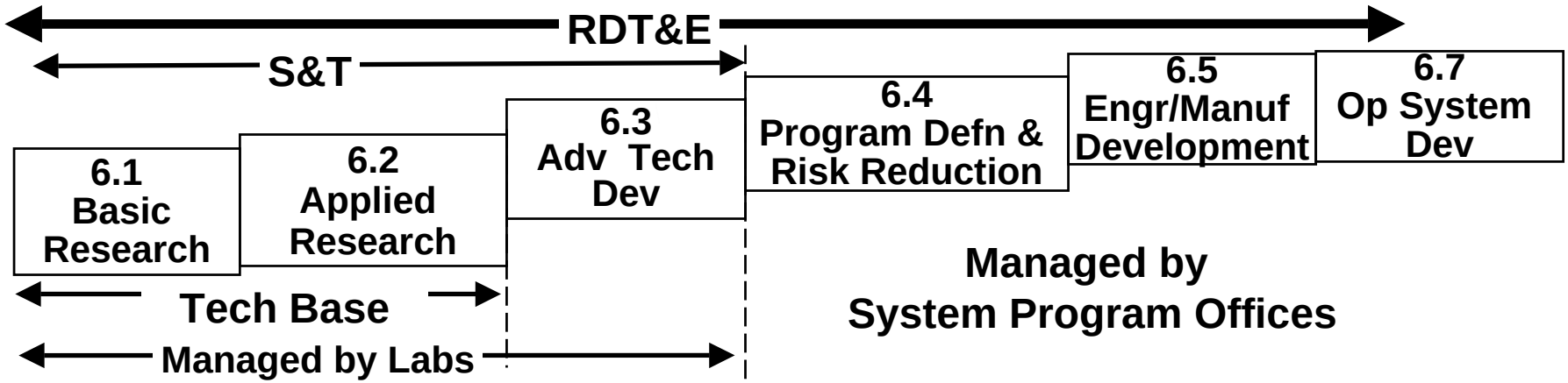
- Why Focus on Transition Issues?
- Capabilities Based Acquisition
- DoD Best Practices
  - Army
  - Navy
  - AF
- Technology Transition Thrusts and Opportunities
- Industry Role
- Summary

U.S. and Worldwide Research Base Since WWII

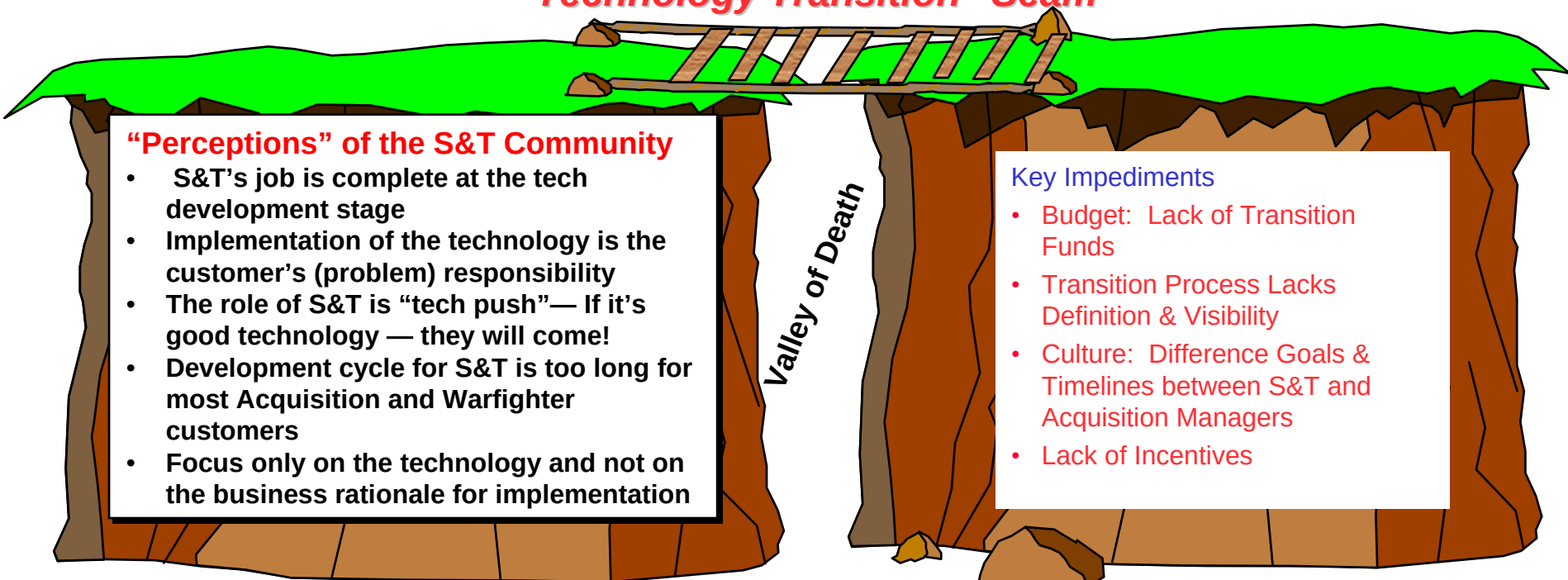


Source: Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers; June 2000; Data provided by the Organization for Economic Cooperation and Development & National Science Foundation

Speeding Technology Transition "The Challenge"



Technology Transition "Seam"



"Perceptions" of the S&T Community

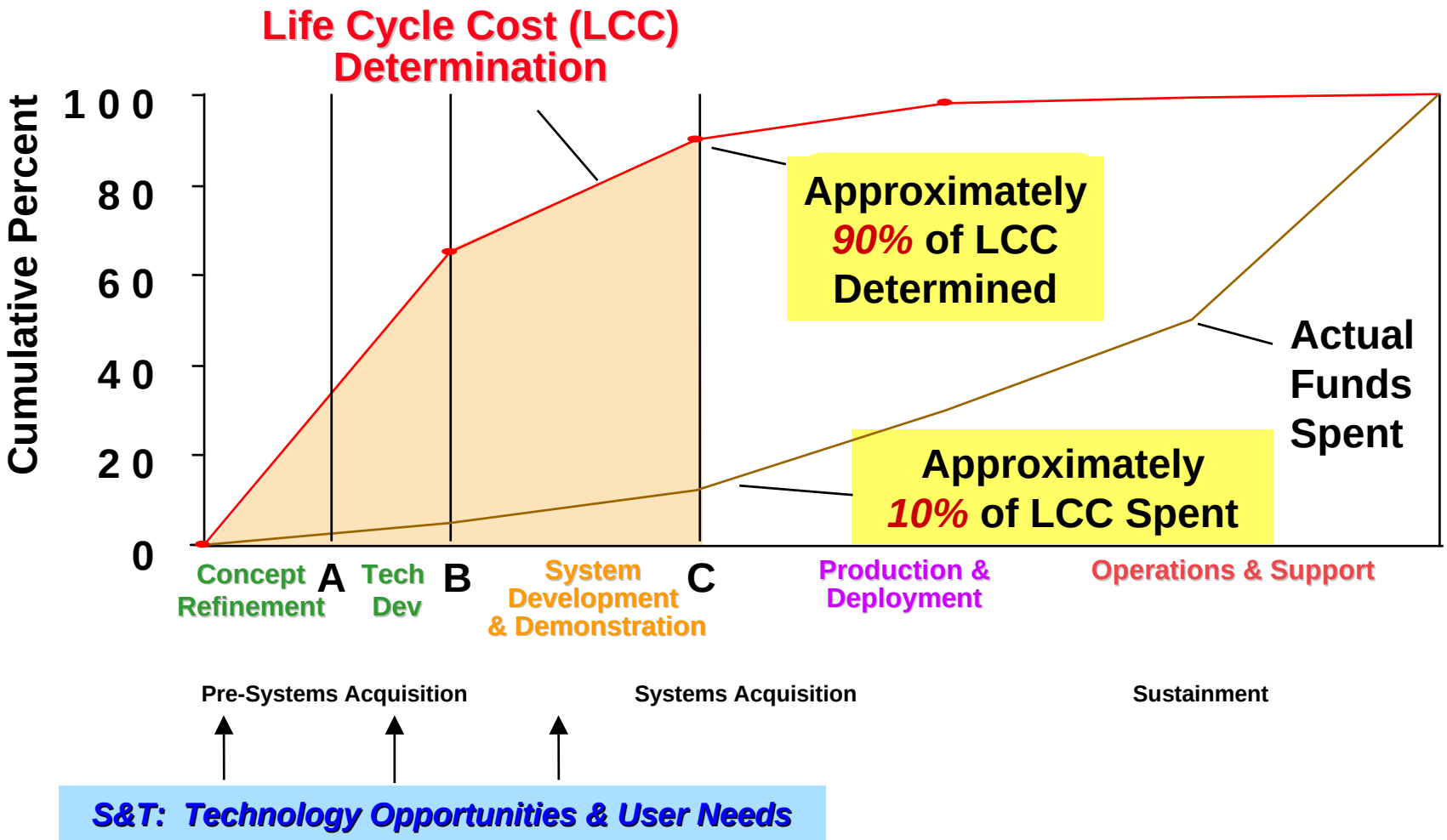
- S&T's job is complete at the tech development stage
- Implementation of the technology is the customer's (problem) responsibility
- The role of S&T is "tech push"— If it's good technology — they will come!
- Development cycle for S&T is too long for most Acquisition and Warfighter customers
- Focus only on the technology and not on the business rationale for implementation

Key Impediments

- Budget: Lack of Transition Funds
- Transition Process Lacks Definition & Visibility
- Culture: Difference Goals & Timelines between S&T and Acquisition Managers
- Lack of Incentives

Why Transition in S&T?

Acquisition Community is Focused on Cost Reduction Throughout Life Cycle



Dimensions to Technology Transition

- Rate of Technology Change is Increasing
- Capabilities-based Planning Acquisition
- Excellence and Spiral Insertion Provides New Transition Model
- Availability of Commercial Technology Increasing; Need to use to Maximum Extent
- Industry's Role Changing
- Try Before Buy
- Fail Small, Fast, Early

Multiple Dimensions Mean Multiple Solutions Needed

The Challenge: Technology Pace

"Moore's Law" → **Computing doubles every 18 months**

"Fiber Law" → **Communication capacity doubles every 9 months**

"Disk Law" → **Storage doubles every 12 months**

Defense Acquisition Pace

F-22	**Milestone I:**	**Oct 86**	**IOC:**	**Dec 05***
Comanche	**Milestone I:**	**Jun 98**	**IOC:**	**Sep 09**

*** Computers at IOC are 512 X faster, hold 65,000 X bits of information than they did at MS I**

Technology growth is Non-Linear…
Acquisition path has been

Say Hello to the Graduating Seniors

Class of 2004, most ***born in 1982***

- The Kennedy tragedy was a plane crash, not an assassination.
- We have always been able to reproduce DNA in the laboratory.
- There have always been automated teller machines.
- "Spam" and "cookies" are not necessarily foods.
- Joysticks are operated with the left thumb.

Source: Military-Related R&D an Academic's View by Peter Lee, Carnegie Mellon University, NDIA S&E Technology Conference, February 2002

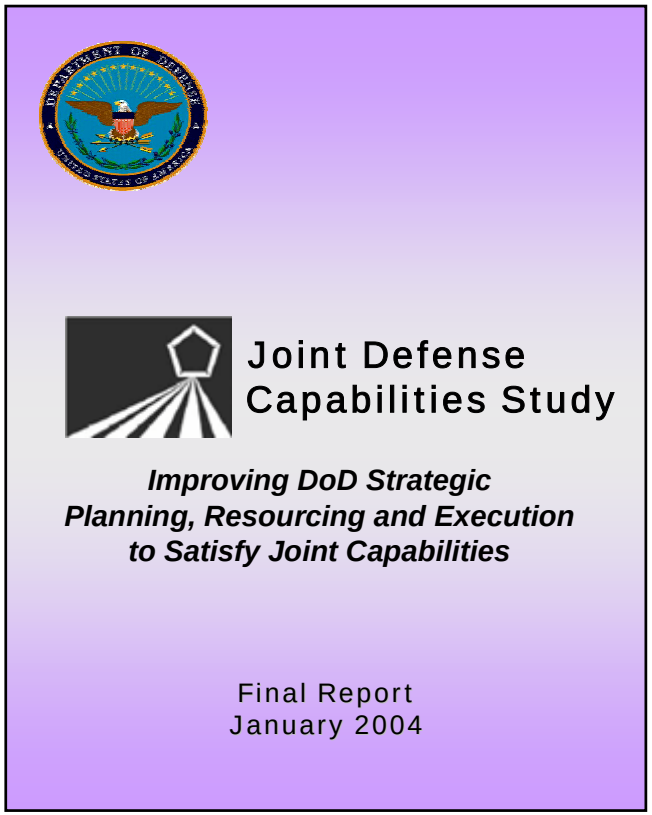
The average 18-year old has 1500 hrs in simulated environment

Over 2% of the Korean population subscribes to the MMP game *Lineage*.

Continuous competitive pressure spurs innovation

Source: Military-Related R&D an Academic's View by Peter Lee, Carnegie Mellon University, NDIA S&E Technology Conference, February 2002

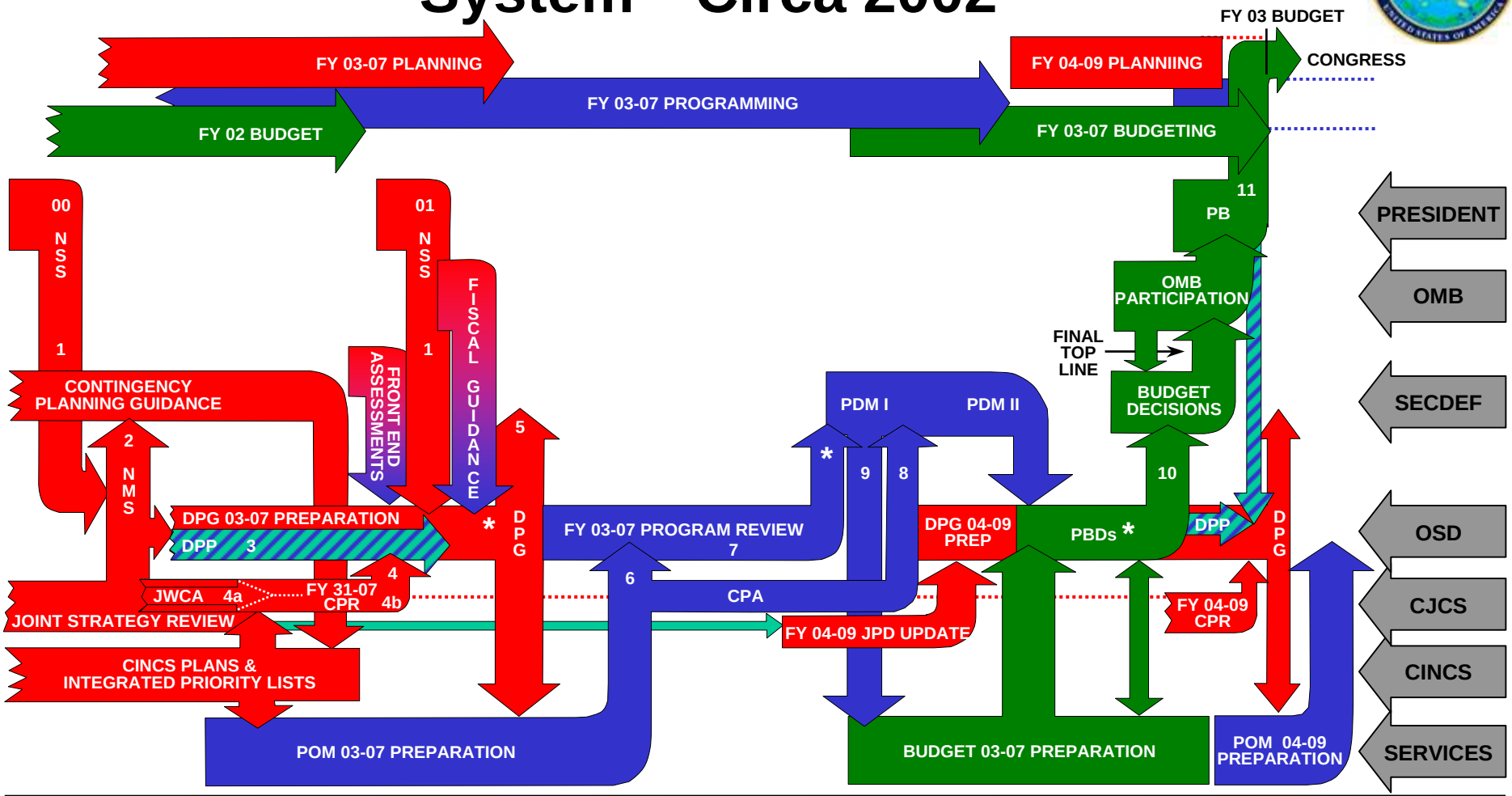
The Need For Change



"The resourcing function focuses senior leadership effort on fixing problems at the end of the process, rather than being involved early in the planning process"

The Joint Defense Capability Study….

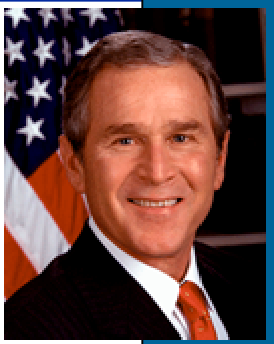
Defense Planning, Programming & Budgeting System—Circa 2002



1. National Security Strategy
2. National Military Strategy
3. Defense Program Projection
4a. Joint Warfighting Capabilities Assessment
4b. Chairman's Program Recommendations
5. Defense Planning Guidance
6. Program Objectives Memoranda
7. Program Review
8. Chairman's Program Assessment
9. Program Decision Memoranda
10. Program Budget Decisions
11. President's Budget

* Potential Defense Resources Board (DRB)/Expanded DRB

The Need for Transformation



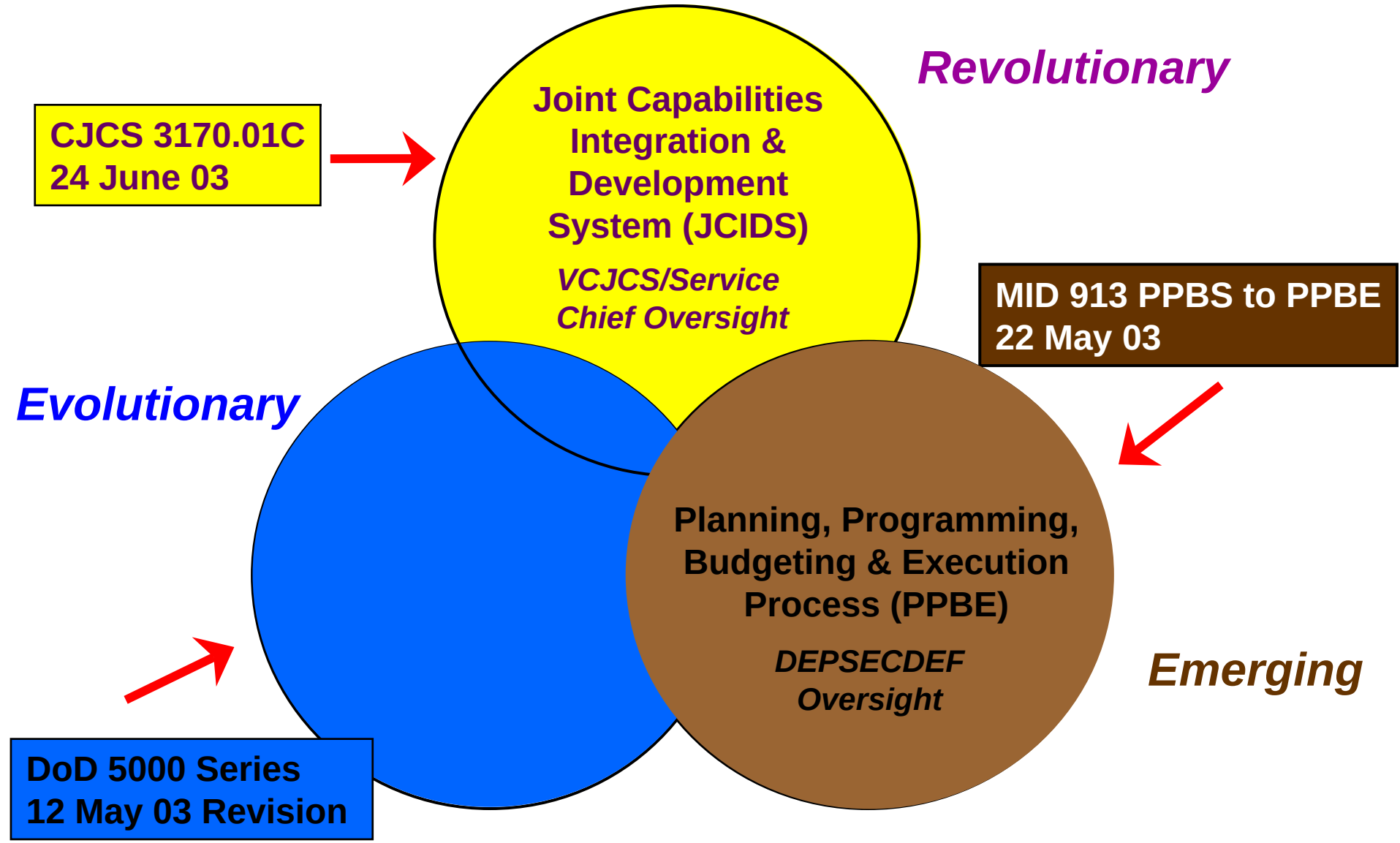
"The United States will … transform America's national security institutions to meet the challenges and opportunities of the twenty-first century."

President George W. Bush,
September 2002

"The Department currently is pursuing transformational business and planning practices such as adaptive planning, a more *entrepreneurial, future-oriented capabilities-based resource allocation process, accelerated acquisition cycles built on spiral development, out-put based management,* and a reformed analytic support agenda."

Secretary of Defense Donald Rumsfeld,
Transformation Planning Guidance
April 2003

Acquisition Decision Support Systems In Transformation



Previous Requirements, Acquisition, and Planning, Programming & Budgeting Process

Requirements

- Service, not Joint focused
- Joint warfighting needs not prioritized
- Systems not necessarily integrated
- Duplication existed, particularly in smaller programs
- Evolutionary Acquisition not well institutionalized

Acquisition

- Policies overly prescriptive
- Acquisition environment did not foster efficiency, creativity and innovation
- Evolutionary Acquisition not well institutionalized

PPBS

- Strategic planning process did not drive identification of needs for military capabilities
- Imposed fiscal discipline but did not integrate strategy into a coherent defense program

Technology and Defense Acquisition

DoD 5000-Series:
S&T Role in Evolutionary Acquisition
As of April 2002

- **DoDD 5000.1, The Defense Acquisition System**
  - Rapid & Effective Transition From S&T to Products
  - Emphasis on Cost & Affordability in Program Development
- **DoDD 5000.2, Operation of the Defense Acq. System**
  - Identify S&T Solutions in Pre-Systems Acquisition
  - Reduce Technology Risks Before the Acquisition Process
  - Use Mechanisms with User & Acq. Customer to Ensure Transition
    - ATDs, ACTDs, Service & Joint Experiments
- **DoD 5000.2-R, Procedures for Acquisition Programs**
  - Establish Technology Readiness Levels (TRLs) for Critical Technologies

Documents Available at http://www.acq.osd.mil/ara/

Changes to Defense Acquisition Regulation

- **DoDD 5000.1, The Defense Acquisition System**
  - Rapid & Effective Transition From S&T to Products
  - Emphasis on Cost & Affordability in Program Development
- **DoDD 5000.2**
  - Identify S&T
  - Reduce Tec ss
  - Use Mecha Transition
    - ATDs, ACTDs, Service & Joint Experiments
- **DoD 5000.2-R, Procedures for Acquisition Programs**
  - Establish Technology Readiness Levels (TRLs) for Critical Technologies

Cancelled By DepSecDef Oct 2002

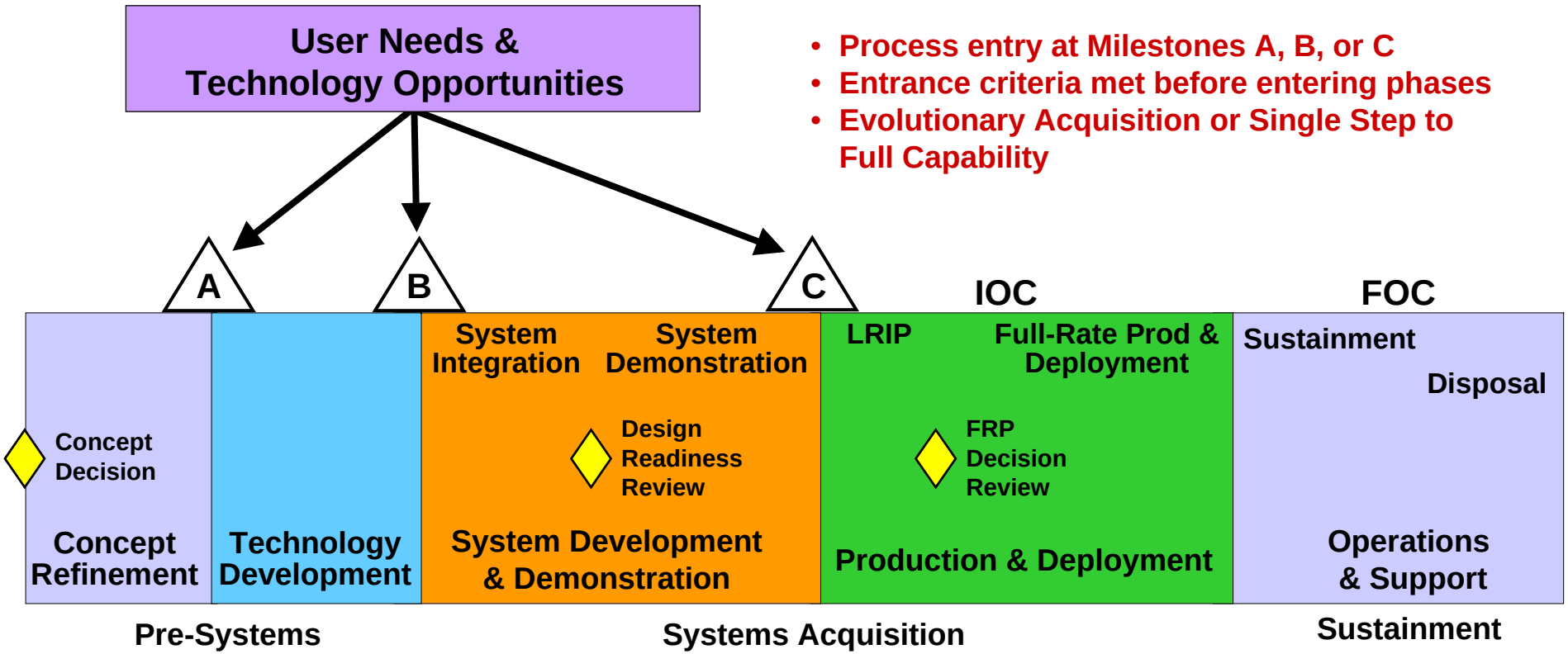
Why? "To create an acquisition policy environment that fosters efficiency, flexibility, creativity, and innovation"

Additional DepSecDef Guidance 30 Oct 2002

- DepSecDef Issued Interim Guidance (~40 Pages):
  - Reaffirmed the Importance of Technology Transition
  - Reaffirmed Evolutionary Acquisition
  - Reaffirmed Technology Development as a Continual Process
  - Directed Continuation of Technology Readiness Assessments and Independent Technology Assessments (Milestones B/C)

DepSecDef Intent: Streamline Acquisition, with increased flexibility for technology insertion

The Acquisition Model



- Process entry at Milestones A, B, or C
- Entrance criteria met before entering phases
- Evolutionary Acquisition or Single Step to Full Capability

IOC: Initial Operational Capability
FOC: Full Operational Capability

Initial Capabilities Document (ICD)	Capability Development Document (CDD)	Capability Production Document (CPD)

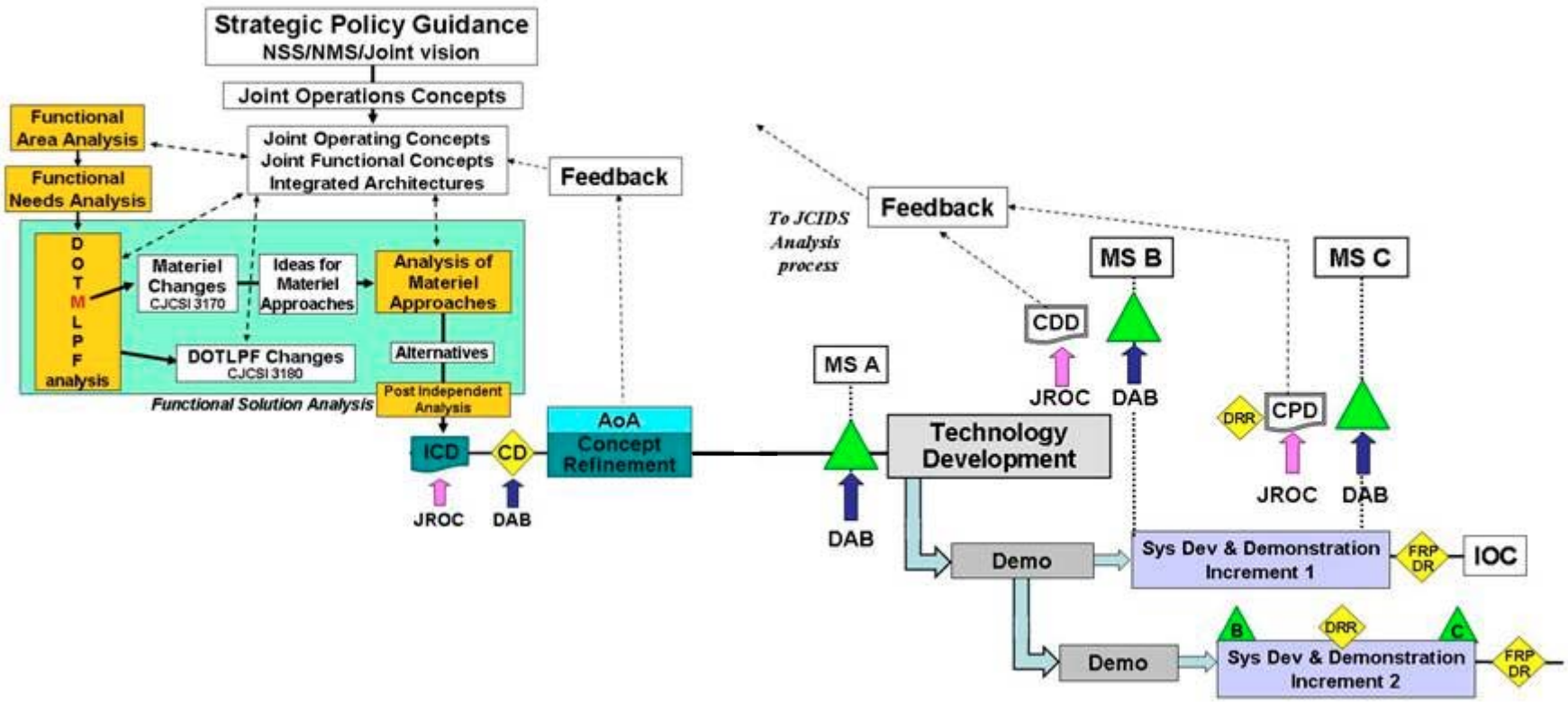
Validated & approved by capabilities validation authority

Relationship to Joint Capabilities Process

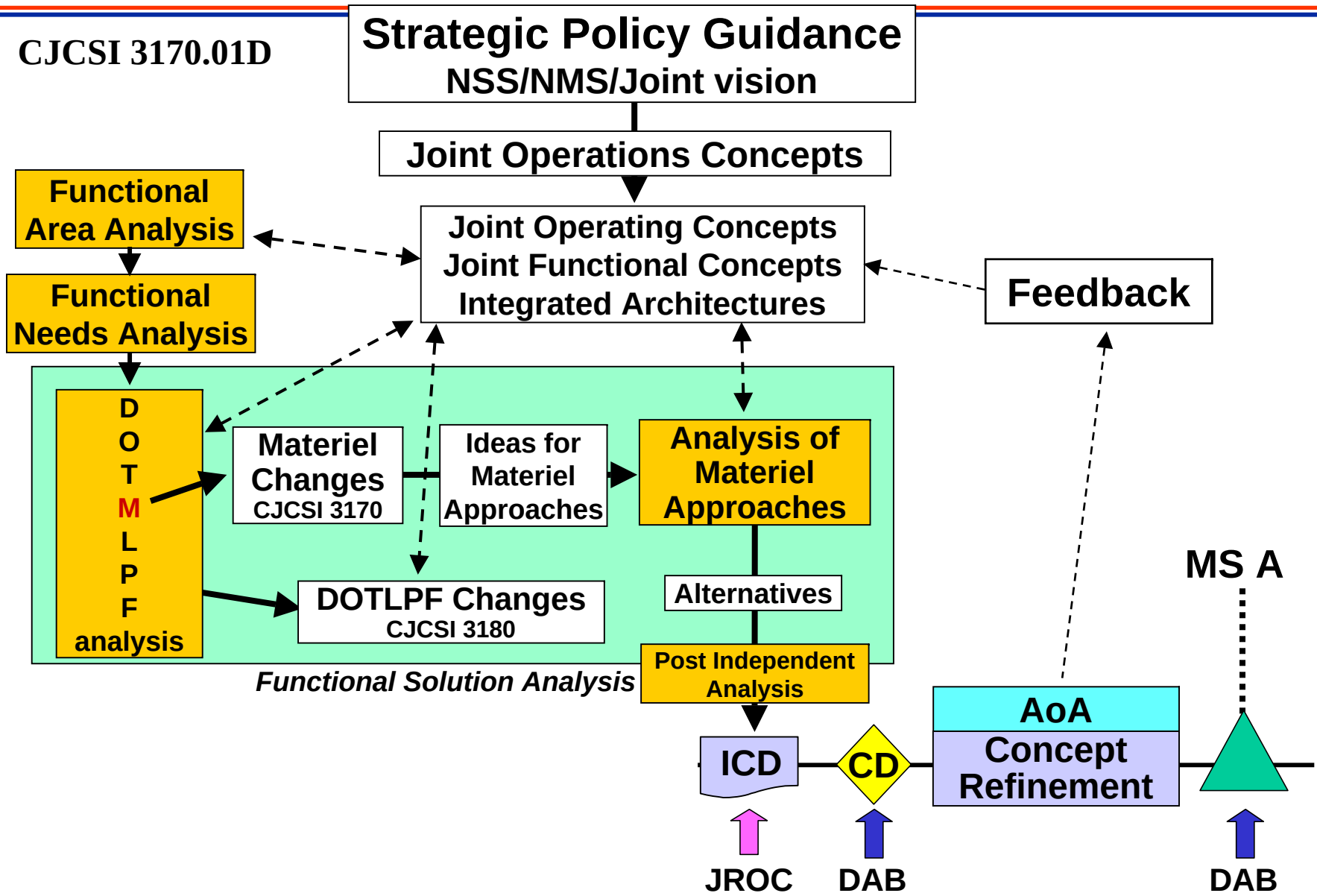
Changes to Requirements Process

- **Warfighter "owns" the Requirements Process**
- **Moving to Top-Down "Joint Capabilities Integration"**
- **Key Documents:**
  - **Joint Integrating Architecture (JIA) (Pre MS-A)**
  - **Initial Capabilities Document (ICD) (Pre MS-A)**
  - **Capability Development Document (CDD) (MS-B)**
  - **Capability Production Document (CPD) (MS-C)**
  - **Capstone Requirement Document (CRD)**

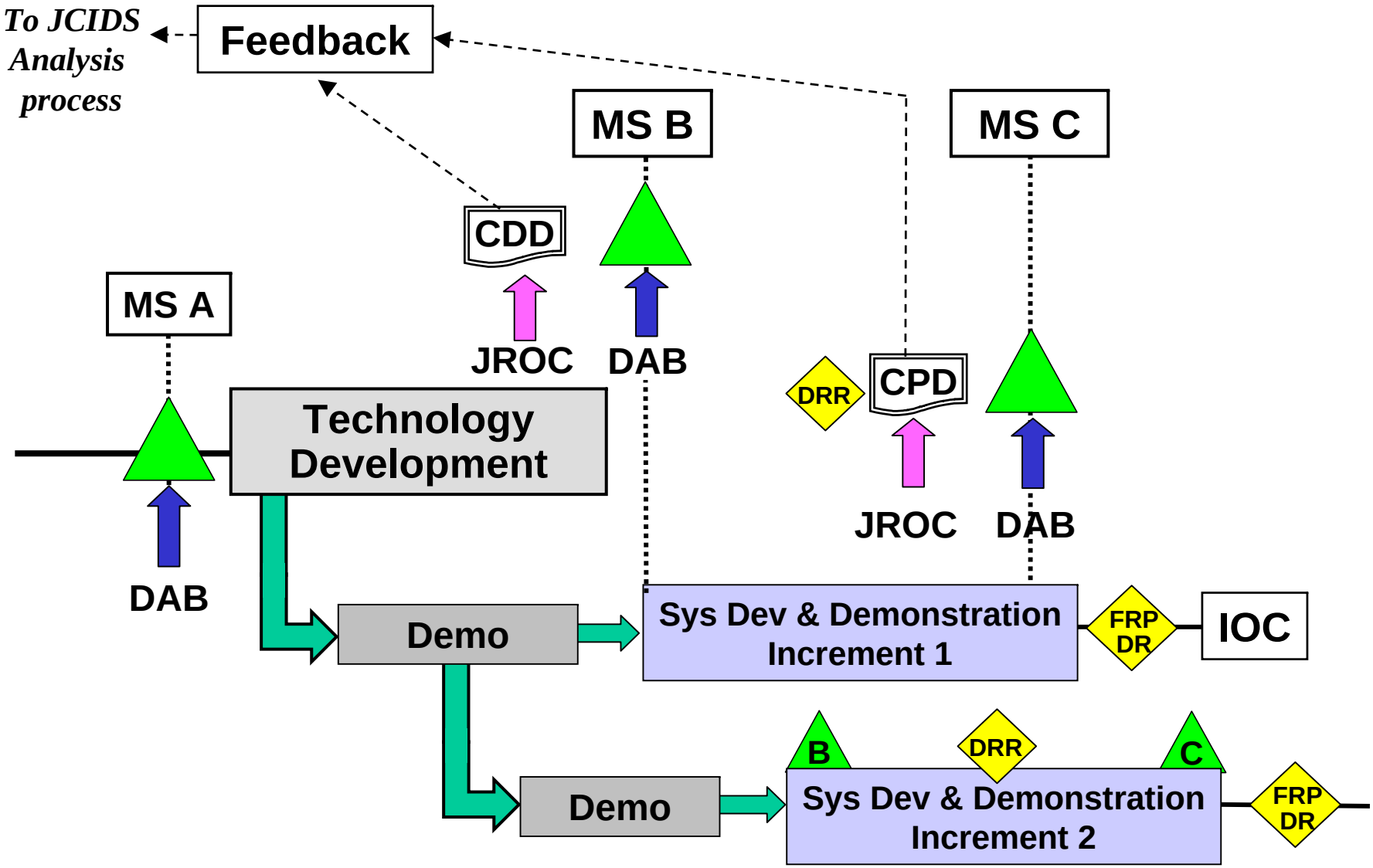
JCIDS/Acquisition Process



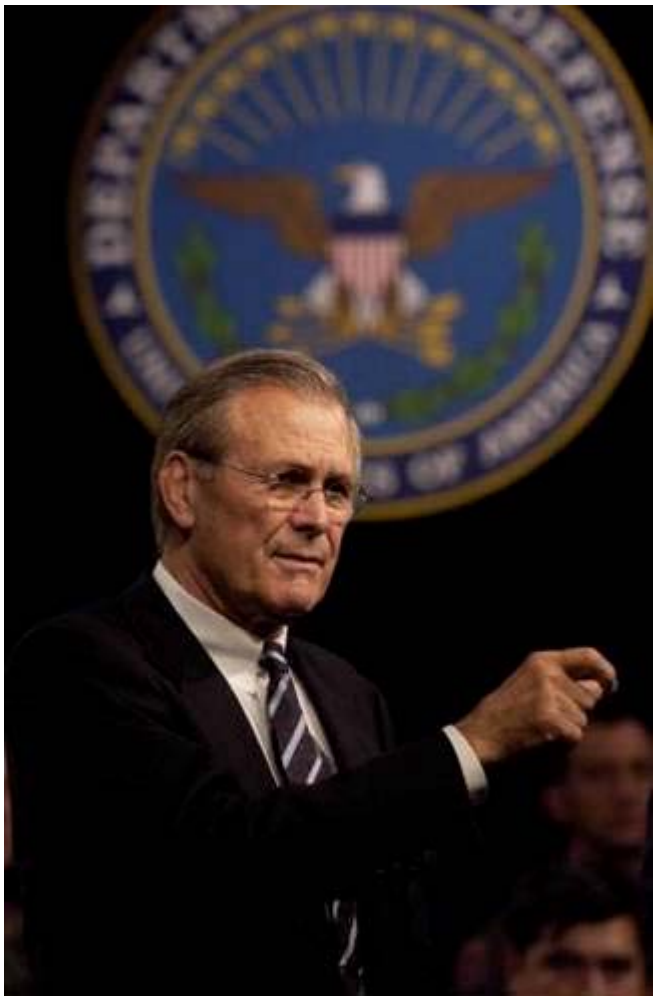
JCIDS Process



Evolutionary Acquisition and Spiral Development



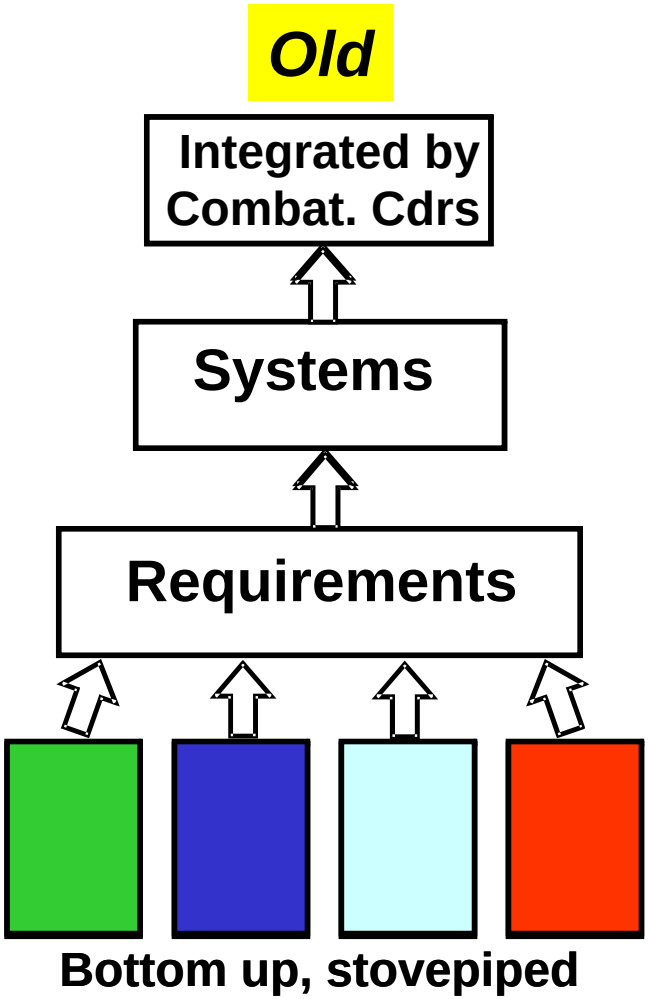
US Capabilities-Based Planning

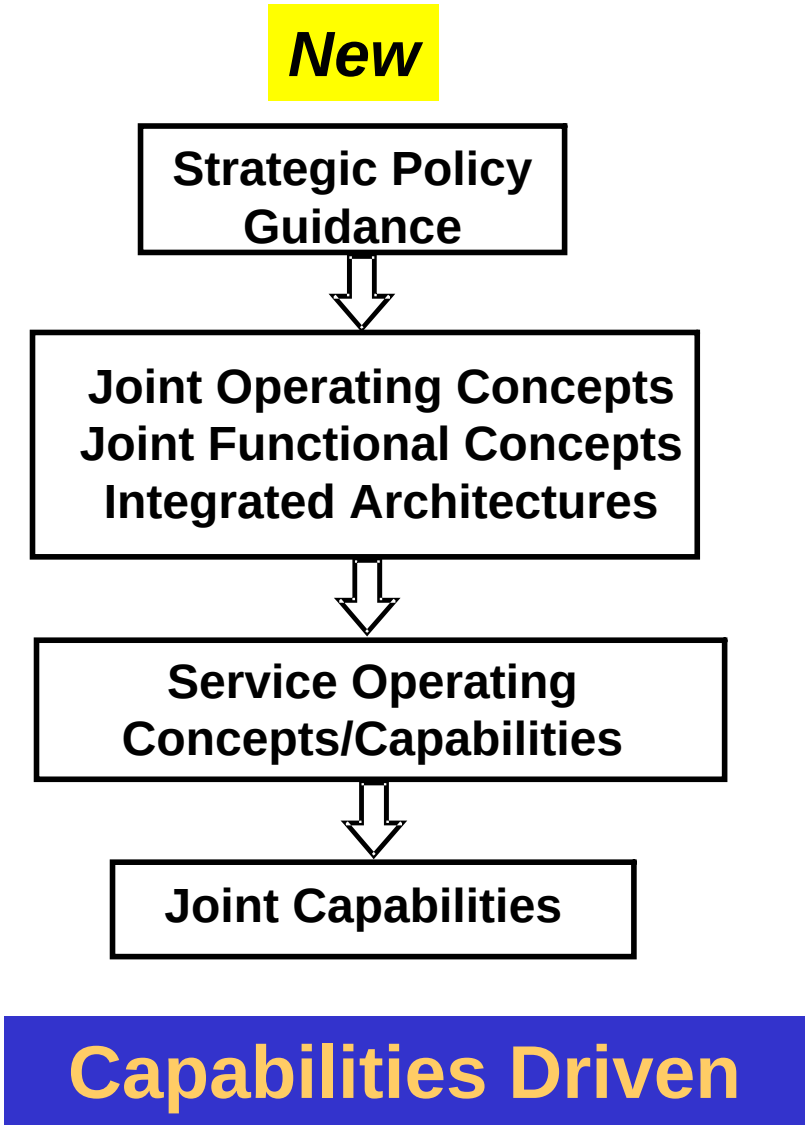


"A central objective of the Quadrennial Defense Review was to shift the basis of defense planning from a "threat-based" model that has dominated thinking in the past, to a "capabilities-based" model for the future. This capabilities-based model focuses more on how adversaries might fight, rather than specifically whom the adversary might be or where a war might occur. It recognizes that it is not enough to plan for large conventional wars in distant theaters. Instead the United States must identify the capabilities required to deter and defeat adversaries who will rely on surprise, deception, and asymmetric warfare to achieve their objectives."

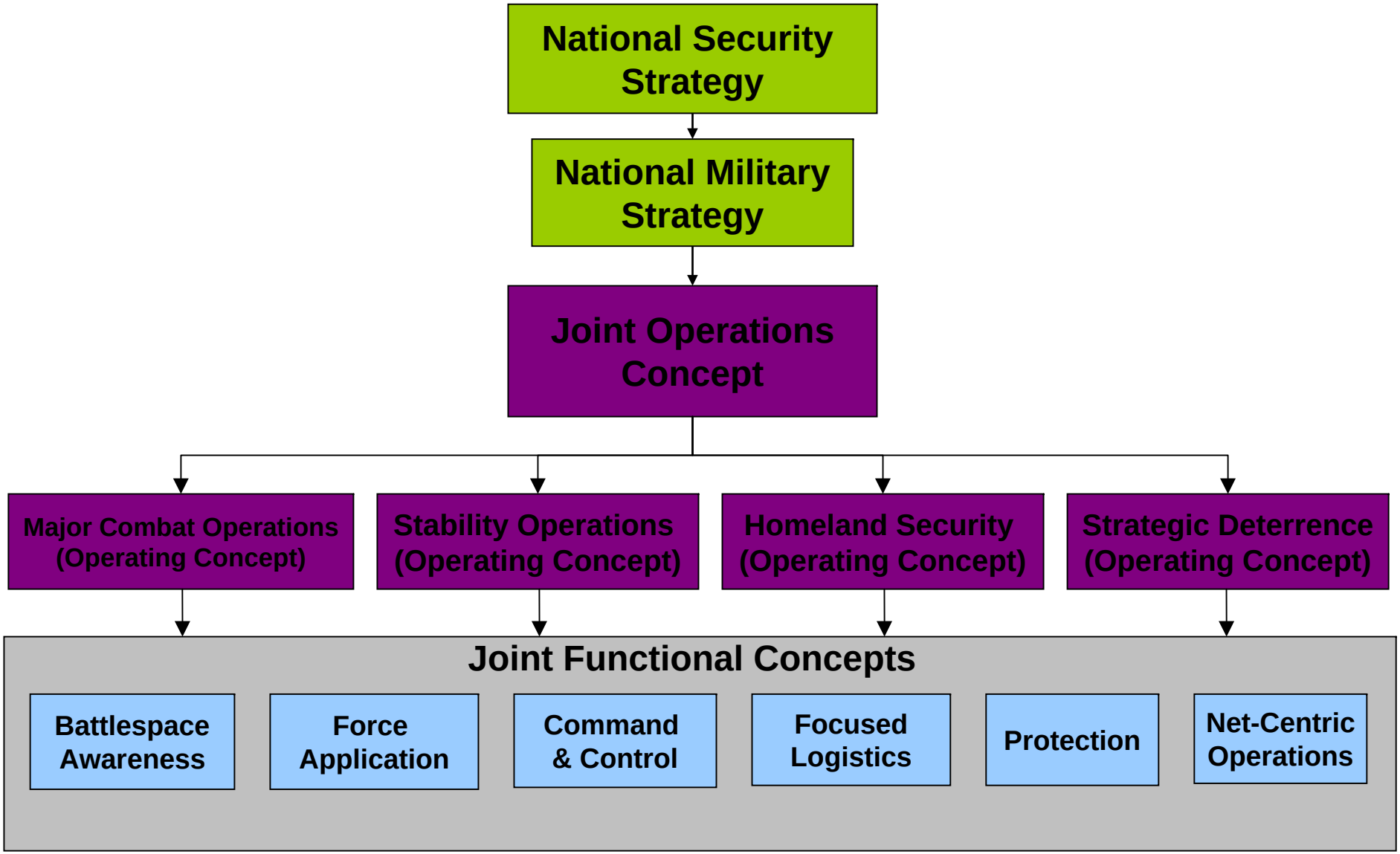
-- ***Donald Rumsfeld, Secretary of Defense, Sept. 30th, 2001, Foreward to the Quadrennial Defense Review Report***

New Process


Old
Integrated by Combat. Cdrs
Systems
Requirements
Bottom up, stovepiped
Systems Driven


New
Strategic Policy Guidance
Joint Operating Concepts
Joint Functional Concepts
Integrated Architectures
Service Operating Concepts/Capabilities
Joint Capabilities
Capabilities Driven

Hierarchy of Joint Concepts



Functional Concepts

BATTLESPACE AWARENESS

Collect and analyze battlespace information

COMMAND AND CONTROL

Develop alternatives and disseminate orders

NET-CENTRIC OPERATIONS

FORCE APPLICATION

Cause effects on the enemy

PROTECTION

Prevent an enemy's effect on us

FOCUSED LOGISTICS

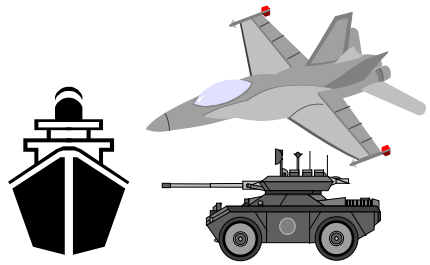
Sustain and support the force

Best Practices

All Services are moving their acquisition processes

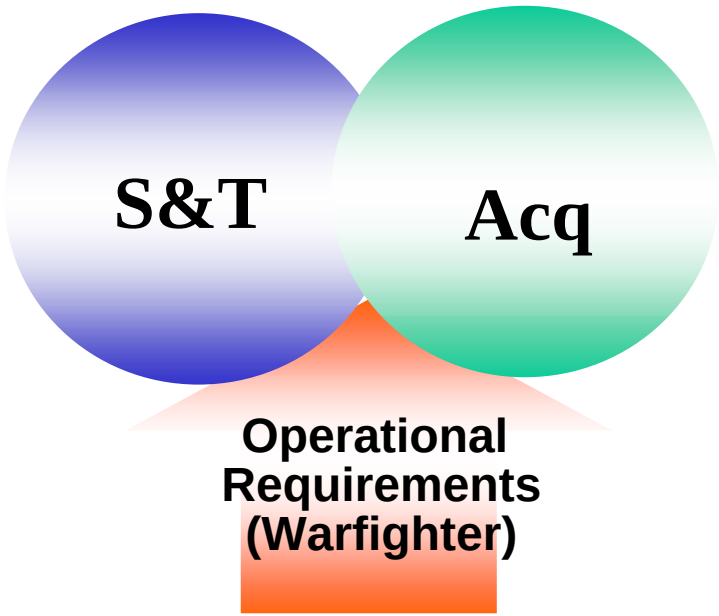
FROM

S&T



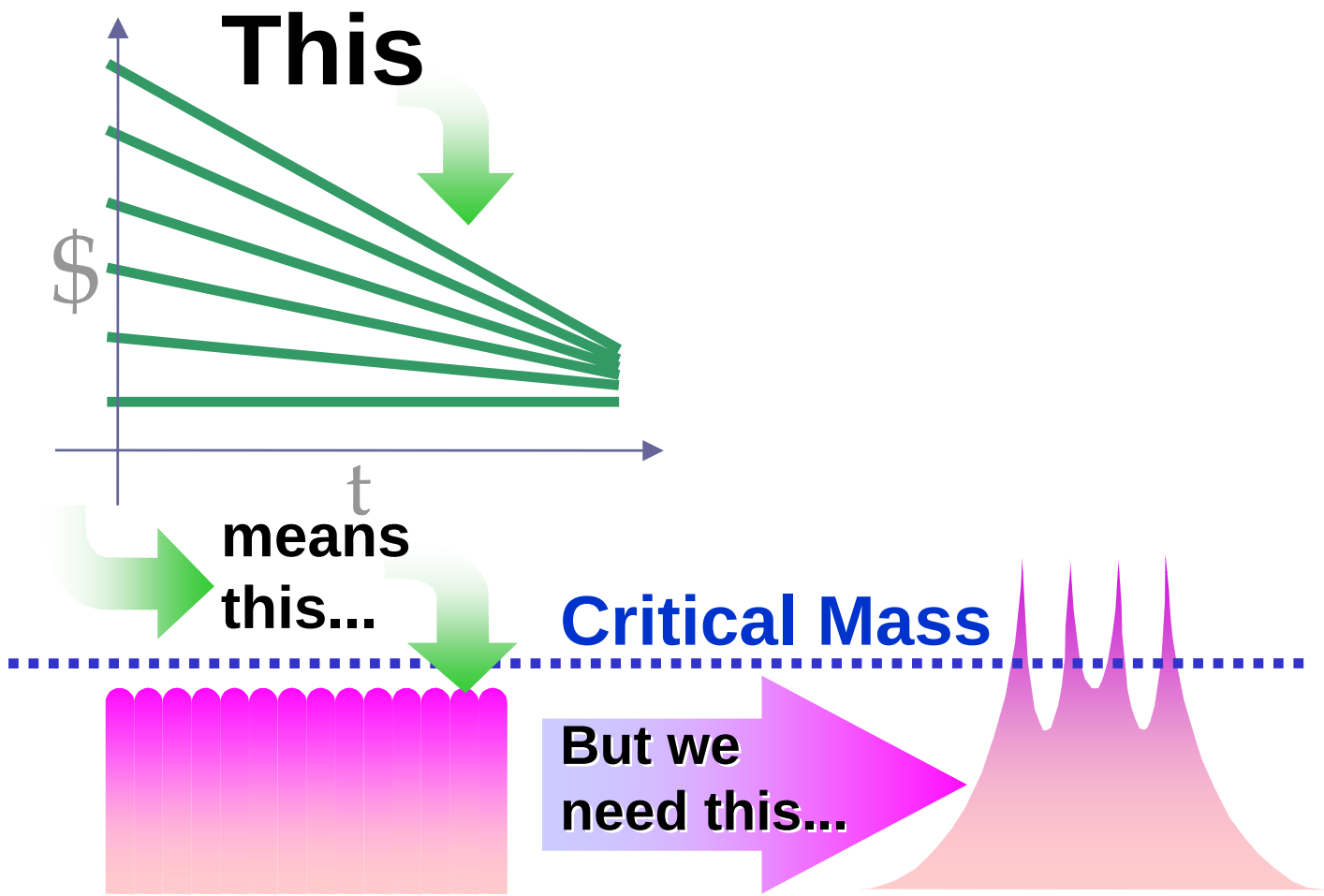
Acq

TO



Good start: Need Logistics & Industry

Navy Science & Technology (S&T) Problem / Solution



Programs below critical mass were never ready for transition

12 Future Naval Capabilities (FNCs)

- Time Critical Strike
- Organic Mine Countermeasures (MCM)
- Autonomous Operations
- Littoral Anti-Submarine Warfare (ASW)
- Electric Warship and Combat Vehicle
- Littoral Combat/Power Projection
- Total Ownership Cost
- Missile Defense
- Capable Manpower
- Warfighter Protection
- Fleet Force Protection
- Knowledge Superiority and Assurance

Navy FNC IPT Approach

- **Industry Board of Directors Model**
- **Principal Members:**
  - **Chair -- Requirements community -- Office of Chief of Naval Operations (OPNAV)/Marine Corp Combat Development Center (MCCDC)/Fleet/Force rep.**
  - **Transition Lead -- Acquisition community -- Systems Command (SYSCOM)/Program Executive Officer (PEO) rep.**
  - **Execution Manager/Technical Working Group Leader -- S&T community rep.**
  - **Executive Secretary -- S&T Resource Sponsor Rep.**

Air Force Applied Technology Council (ATC)

- Tech transition process should be a 3-legged stool
  - AFRL, Product Centers, and Users
- Recurring participation at senior levels is mandatory
  - MAJCOM/CVs, Product Center/CCs, and AFRL/CC
- Funding commitments for both S&T and transition program development are the key to technology transition
- Process Focuses on Advanced Technology Demonstration (ATD) Programs
- Developing an Air Force Instruction to standardize procedure

Air Force ATC

Basic Research	Applied Research	Adv. Technology Development	Demonstration & Validation	Engr. & Mfg Development
6.1	6.2	6.3	6.4	6.5

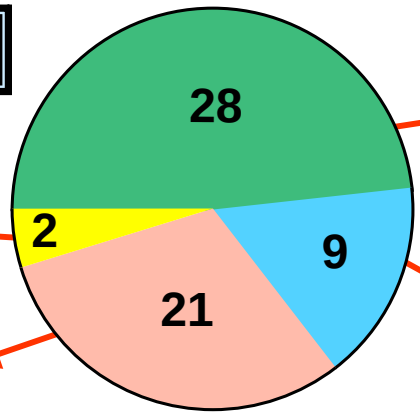
ATC

Lab (★★)
- Identifies ATD Candidates
- Budgets for Technology
- Develops Transition Strategies

Product Center (★★★)
- Interprets Requirements
- Builds the Transition Program
- Integrates Technology into Systems

MAJCOM (★★★)
- Defines Requirements
- Budgets for Development & Production Funds

ATD Categories



Category 1 : Warfighter Supports & POMs for Transition

Category 2A: Warfighter Committed To Work in POM Cycle

Category 2B: Warfighter Supports But Is Unable to POM for Transition At This Time

Category 3: Warfighter Does Not Support

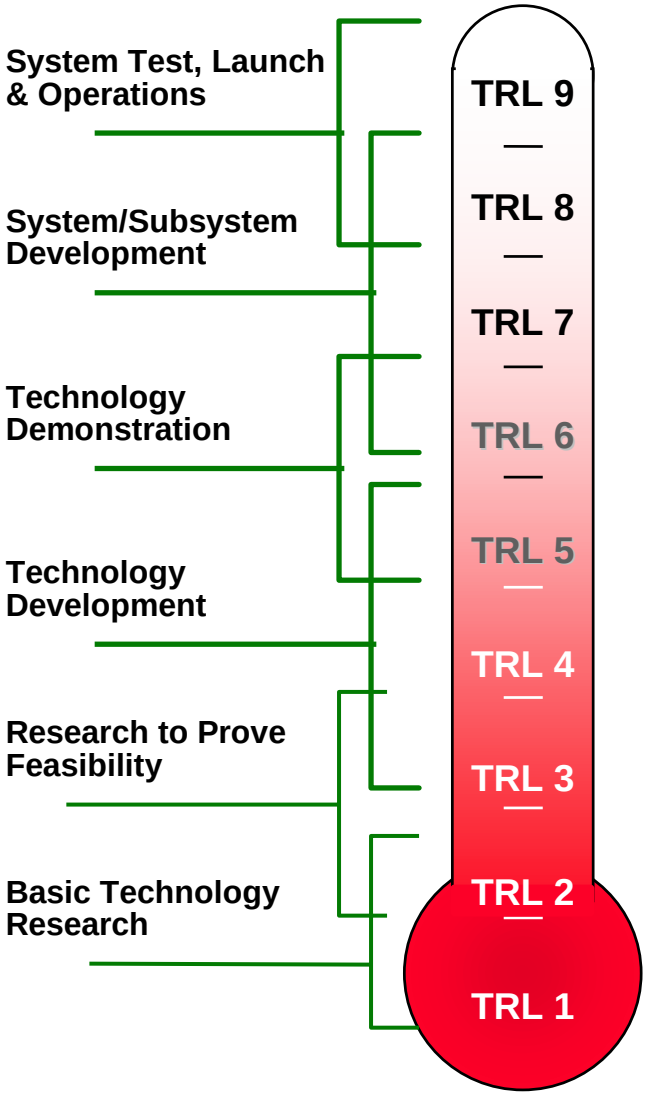
Technology Readiness Levels (TRLs)
Background

- **GAO report, " Best Practices- Better Management of Technology Development Can Improve Weapons System Outcomes"**
- **Inclusion in DoD 5000-Series Acquisition Documents**
- **Defense S&T Advisory Group Recommended Establishment of a TRL IPT**
  - **Develop a framework and guidelines for consistent implementation**

Consensus: Proper Use of TRLs Provides Effective Acquisition Assessment Tool

Measuring Technology Maturity

Technology Readiness Levels



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 a 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

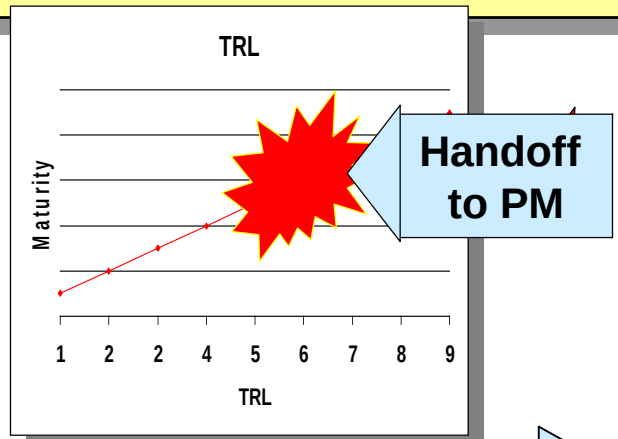
TRL 1 — Basic principles observed and reported

As Defined in 5000.2-R

Army Transition Plans

Develop directive from senior stakeholders requiring:

- Transition plans synchronized/supported in S&T & PM budgets
- Achievement of key Technology Readiness Levels as an exit criteria
- Use of affordability as an exit criteria



Handoff to PM

Mgmt Plan

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Science & Technology

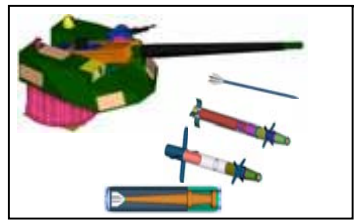
Acquisition Program

Army ATD Management Plans

Accelerating Transition

- **Coordinated and Documented partnership between Warfighting Customer, Technology Developer and Acquisition Buyer**
- **Proposed by Technologists and Tacticians**
- **Approved by GO/SES**
  - **HQ TRADOC Combat Developer**
  - **HQDA Chief Scientist**
  - **HQDA, G8 Force Development**
  - **PEO/PM**

ATD Management Plan



Commitments to Transition needed Technology as Fast as Possible

FCS Multi-Role Armament & Ammunition ATD

(III.WP.1999.01)

FY01	FY02	FY03	FY04	FY05	FY06	FY07

TRL=4
Recoil Mitigation Demo
METRICS:
• 40% reduced recoil force w/Fire-out-of-battery modified M35 cannon w/ETC ignition

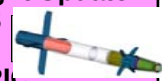
TRL=4+
Recoil Mitigation Variable FIB Modeling
METRICS:
• Manage 6659 Lb-Sec Impulse
•Trunnion Force < 100k Lbs

TRL=5
ETC Propulsion Demo
METRICS:
Fire Full Scale Case Telescoped Ammo

TRL=6
BLOS Programed Maneuver (G&C)
METRIC
• Maneuver capability

TRL=6
BLOS Seeker/G&C
METRIC:
• $P_{acq/Enc}$ via Integ Projectile Guide to Hit gun launch to 10km

TRL=6
In Flight Update NLOS
METRIC:
• $P_{acq/Enc}$ via Integ Projectile Guide to Hit gun launch to Max Range



TRL=4
ETC Propellant Demo
METRICS:
Sub-scale firings of Adv Propellant (Gen II) Model to validate launch velocity.
Full Scale Firing With JA2.

TRL=5
Multi-Mode WHD
METRIC:
• Shaped Charge L/D=1 (vs 1.7)
• EFP 25% increase in armor penetration

TRL=5
Recoil Mitigation Demo
METRICS:
• < 90K lbs force hardstand firing of KE slugs
•3500lb cannon

TRL=6
Turret on Hardstand Demo
METRICS:
Slew [illegible]el/ 400m
Gun Elevation –10, + 55 degrees
Autoloader Feed Rate of 15 rpm

TRL=6+
Integrated Armament Demo on Vehicle
METRICS:
• < 85K lbs force on surrogate vehicle
• < 3000lb cannon

TRL=4
Seeker Acquisition Demo
METRICS:
• $P_{acq/Enc}$ to 8km via TERM CFT Demo

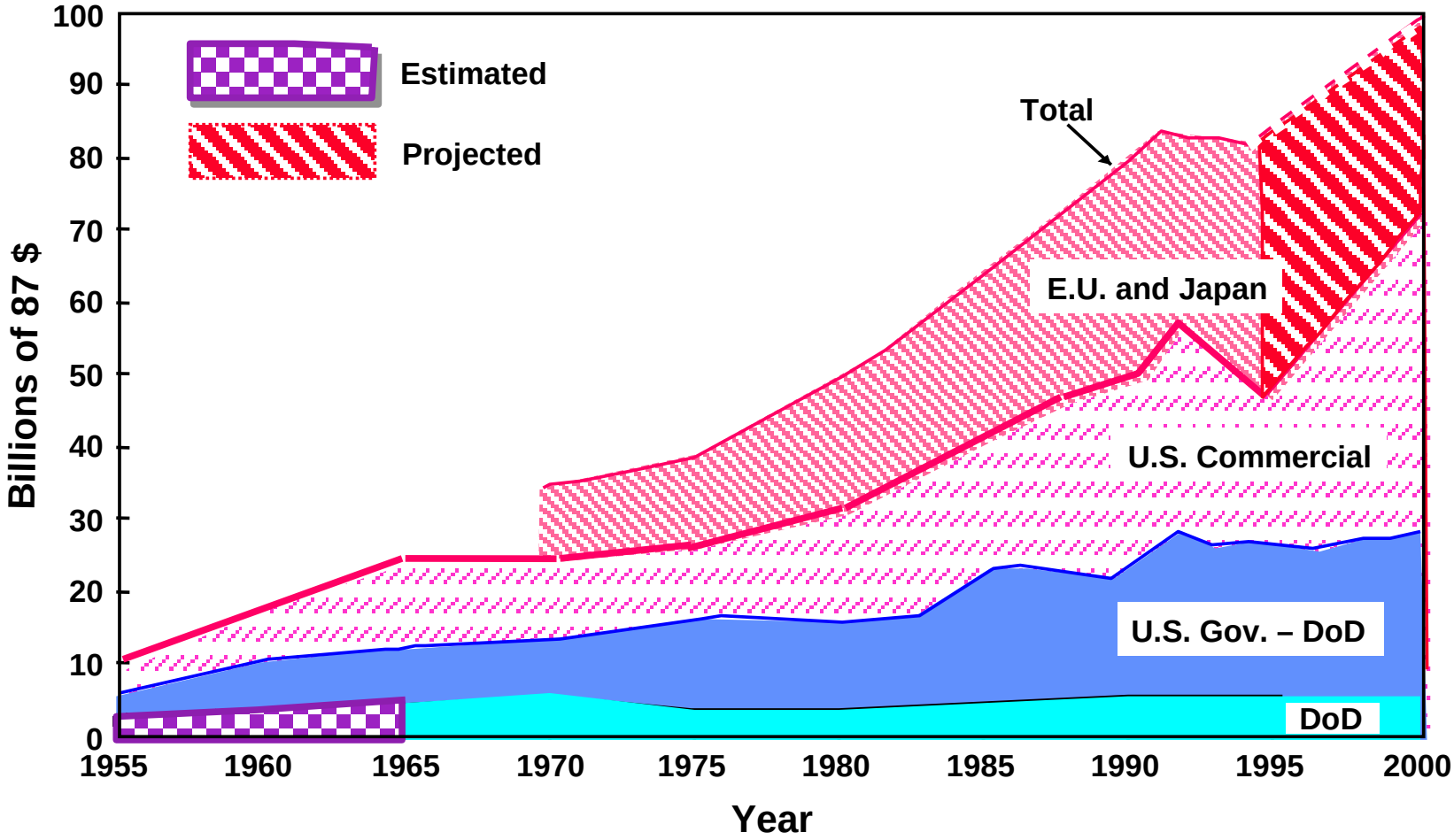
TRL=5
Seeker/G&C High-g Demo
METRIC
• MP-ERM: 18k g's air gun test
• Cargo: 20k g's air gun test

TRL=6
Multi-Mode WHD
METRIC:
•Warhead demo of 3 lethality modes

TRL=6
ETC Integrated Demo Over Temp Range
METRICS:
Fire Full Scale Case Telescoped Ammo

TRL=6
Programmed Maneuv[illegible] NLOS
METRIC:
• Smart Cargo-10 to 20m CEP to Max Range
- Ambient Temp functionality

Worldwide Research Base is Growing



Source: Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers; June 2000; Data provided by the Organization for Economic Cooperation and Development & National Science Foundation

FY05 RDT&E Budget Request

FY05 RDT&E = $68.9B requested (Budget Activity 1-7)

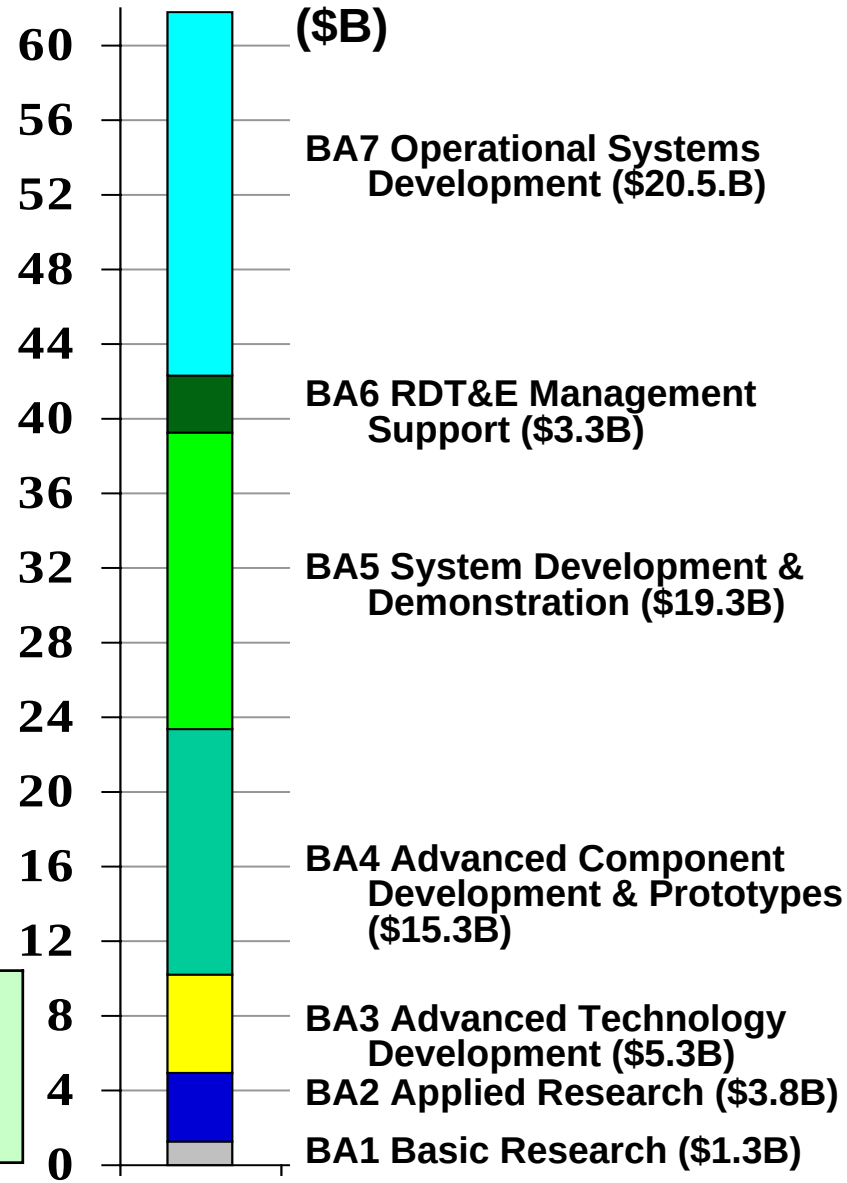
(BA6 + BA7 = $23.7B)

Development (BA4 + BA5 = $34.5B)

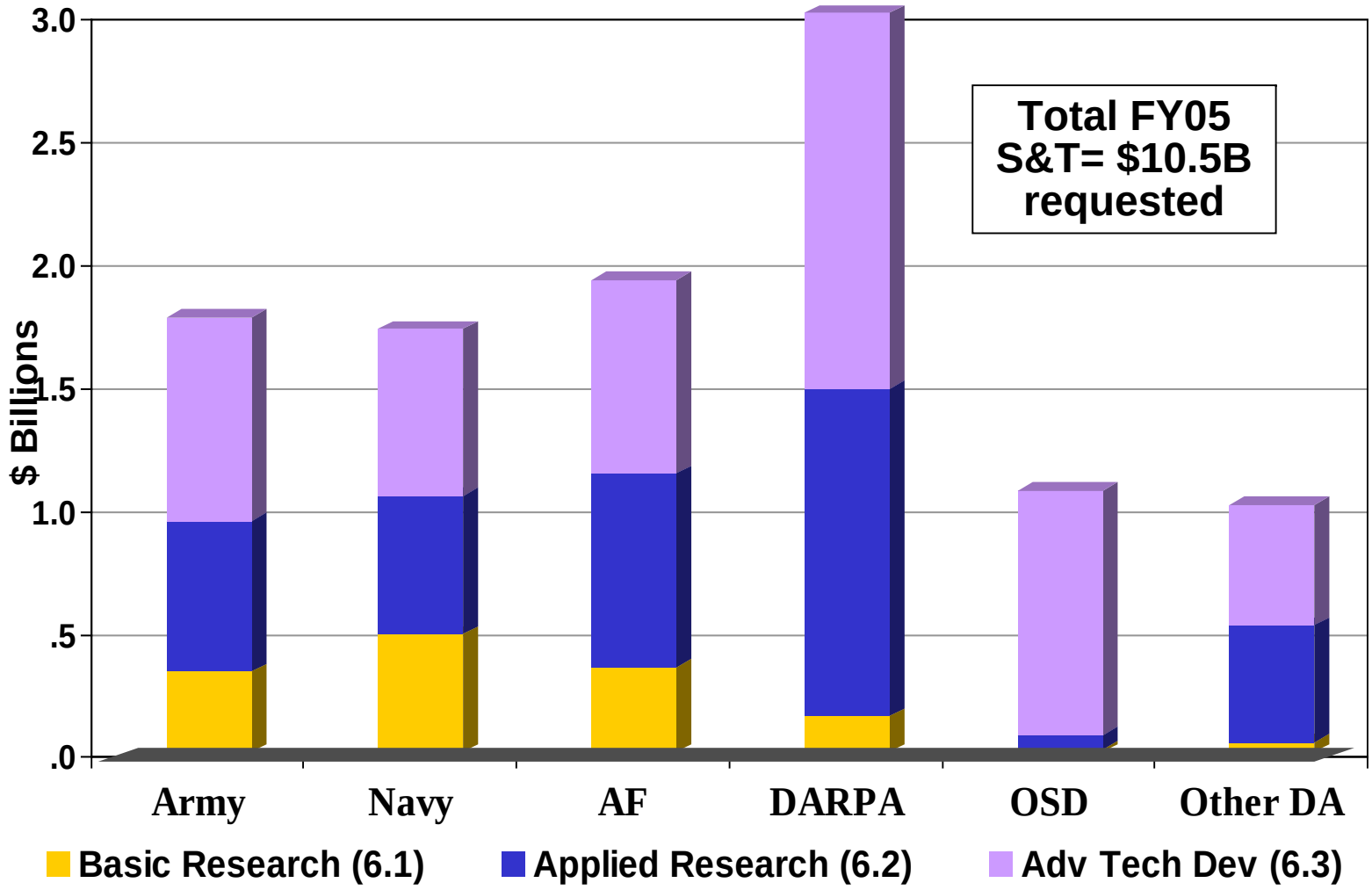
Technology Base (BA1 + 2) = $5.1B)

Science and Technology (6.1 + 6.2 + BA3 = $10.5B)

15% of RDT&E

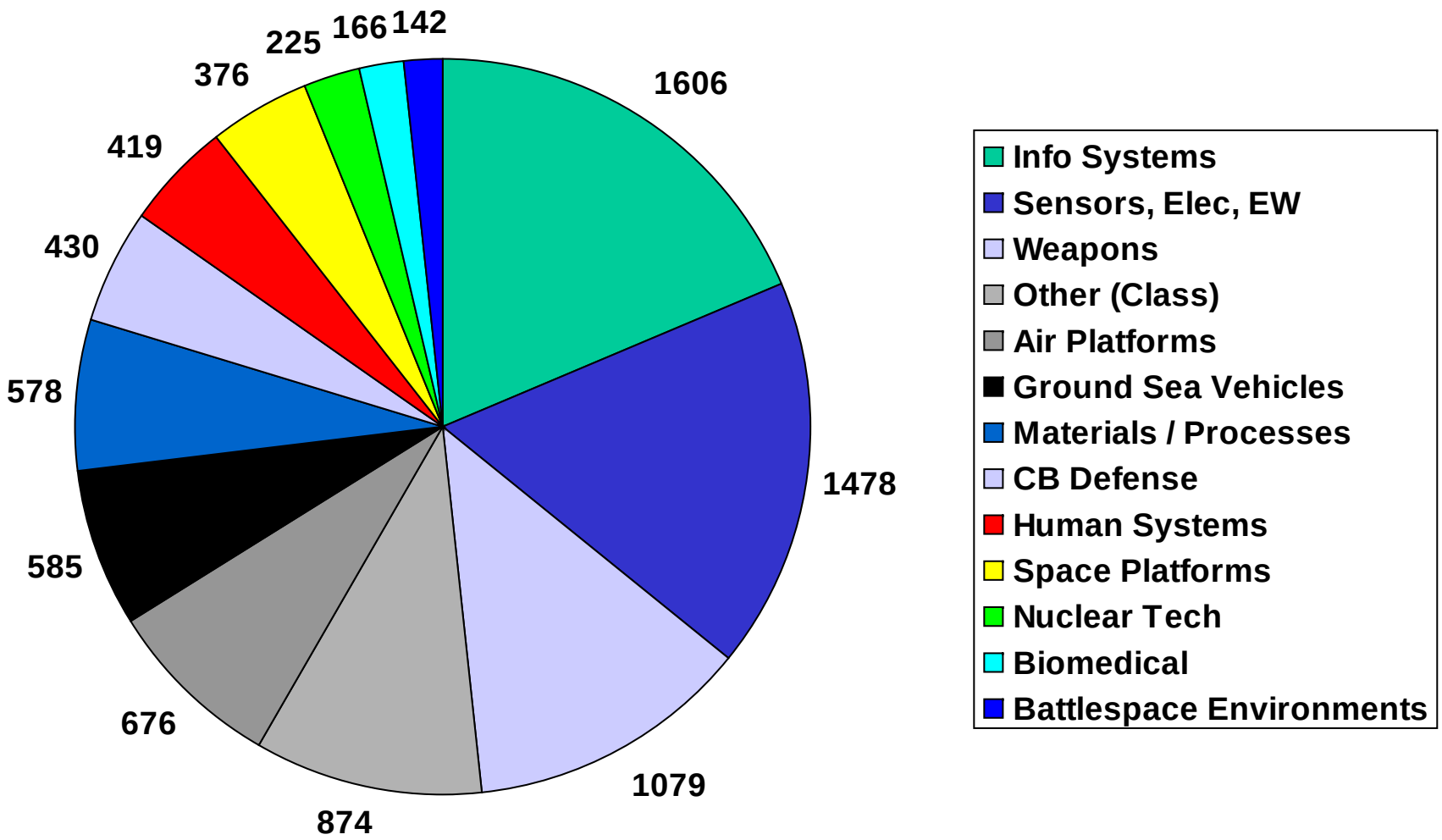


FY05 Budget Request DoD S&T



FY05 PBR

"Reliance Funding" by Technical Capability Area

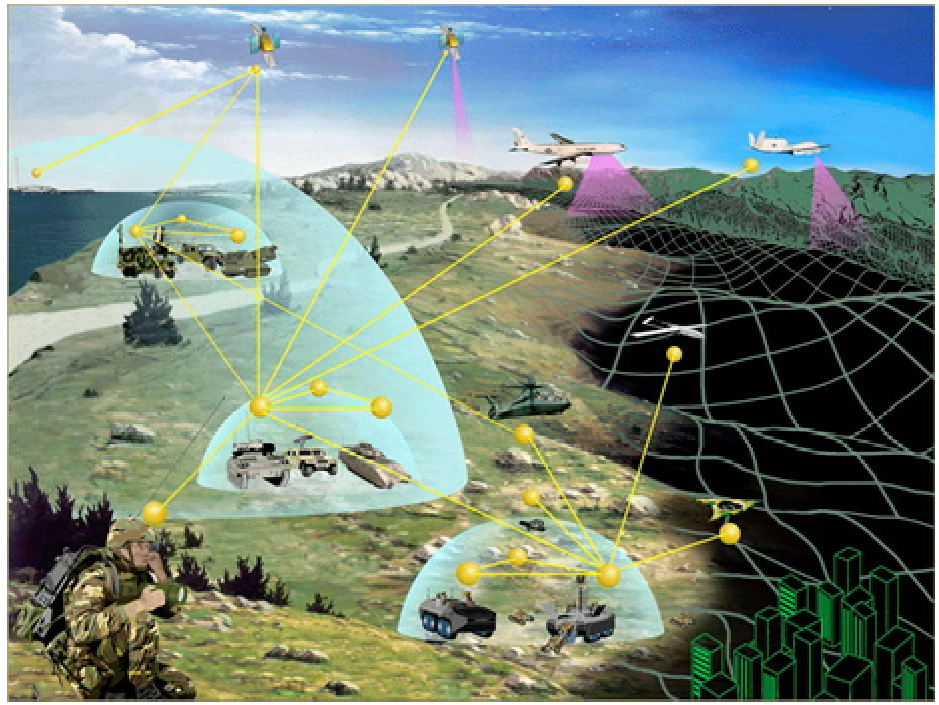


Future Combat Systems

S&T Investments to Enable the Future Force

Description

- *A system of multi-functional systems enabling soldiers to operate as a integrated, distributed, networked force*
- *The major fighting system in the Unit of Action—strategically responsive, lightweight, lethal, survivable, with its sustaining combat support force*



Major Goals

- *Implement the "power of the net" to achieve commander-centric operations providing decision superiority in all battlefield functions from Finding the Enemy to Decisive Defeat—through overwhelming speed of maneuver and precision fires with minimum logistics demands.*
- *Provides line of sight & non-line of sight fires, troop transport in a networked system of systems*

The Lighter Army

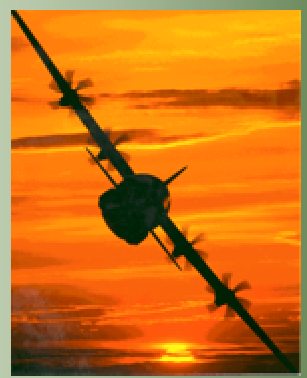
Today

~100 lb. load

70+ tons

0 mph

From Platforms to System of Systems



C-130-Like Transportability

Future Force

< 40 lb. effective load

Fully networked

< 20 tons

> 40 mph

Accelerating Transformational Capabilities

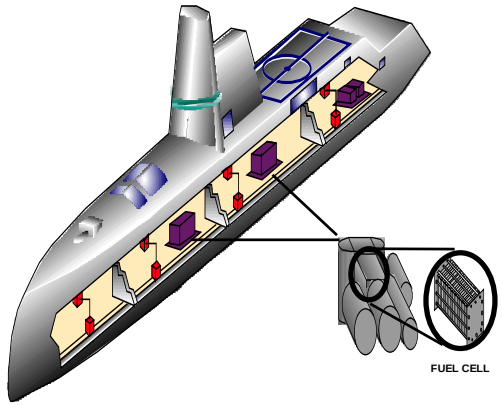
The Smaller Aerospace Force

The XSS-11 Small Sat

- First demonstration of a fully autonomous satellite designed for orbital navigation around another resident space object (RSO)
- Demonstrates:
  - Software logic and algorithms to safely rendezvous, navigate around, and inspect an RSO
  - Revolutionary mission planning and operation tools
  - Collision avoidance — space situational awareness

The Electric Navy

- **Enables Transformational Weapons Systems**
  - Electromagnetic Guns
  - Shipboard Laser Systems
  - Adv. High Powered Sensors
- **Improves Survivability**
  - Rapid and anticipatory reconfiguration of power and systems
- **Reduces Noise**
  - Eliminates propulsion gear noise
  - Enables lower speed propellers
  - Enables silent watch capabilities
- **Reduces Life Cycle Costs**
  - Reduction in Number of Prime Movers
  - Significantly Greater Fuel Efficiencies
  - Eliminate high maintenance hydraulic systems



Objective

Speed Rapid Technology Development

Technology Maturity

Quick Reaction Fund	Technology Transition Initiative	Defense Acquisition Challenge
Idea/ Technology Opportunity	***Transition To Planned/Fielded System***	***Improve Subsystem → Program of Record***

Three Complementary Projects to Develop Technology at Different Maturity Levels

Examples of Quick Reaction Efforts

Thermobaric Hellfire Enhanced Capability

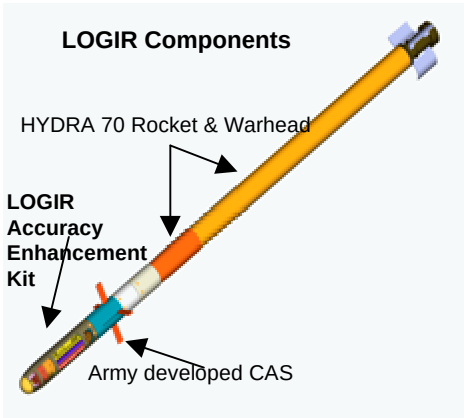
Chemistry to the Field in one year - Increased Blast Lethality in Multi-Room Structures

- Rapid Reaction to War Fighter Need; start Jan 02
- Form/Fit/Function Drop-In Warhead Section
- Unique Enhanced Explosive Formulation (metal augmented charge)
- Retains Effectiveness in Remaining Hellfire Blast-Frag Target Set
- Available for possible global war on terrorism

Low-Cost Imaging Rocket (LOGIR)

Making 2.75” Rocket Smart – Fire and Forget

- Rapid reaction to integrate precision guidance with developing weapon; start May 02
- Improve ability to kill moving and fixed targets
- Reduce warfighter exposure while increasing success
- Increase lethality while reducing collateral damage
- First flight Jan 03; Complete System ~4QFY03



Examples of Quick Reaction Efforts - Thermobaric Weapons

Rapid Technology Transition

- A “Quick Reaction” type development, enabled by base S&T program and ACTD Framework
- Chronology: Program Approved 21 Sept
  - Small Quantity Lab Testing – Oct 01
  - Full Up Static Test – Nov 17
  - Flight Tested - Dec 14
- Funding: Approximately $6M

Theory ⟶ ***Weapon***

3 months

Bottom Line: Warfighter Confidence

Right Materiel, Right Place,
Right Time, at the Right Cost -

All The Time