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# ***Ensuring Knowledge-based Technology Insertions in Defense Acquisition Programs***

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NDIA  
Test and Evaluation Forum  
March 9, 2005  
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# Overview

- Best Practices for Technology Insertion – Knowledge Point 1
- DOD Programs Meeting Best Practices Criteria
- DOD Programs Not Meeting Best Practices Criteria
- Recommendations

# Commercial Business Case Fosters Testing and Validation



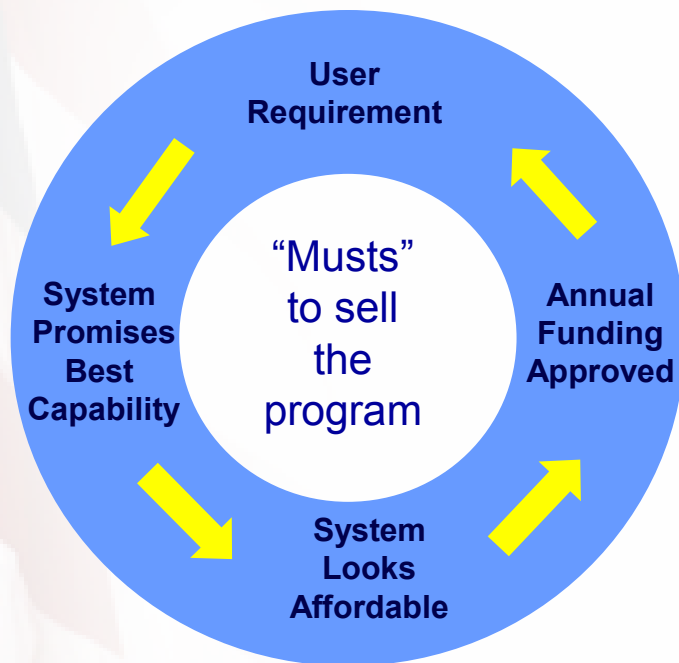
## Behaviors Encouraged

- Candid information and estimates
- Identify risks and resolve problems early

## Role of Testing

- Constructive
- ***Demonstrates knowledge***
- Improves ROI by delivering on time and within budgets
- Reduces customer problems

# DOD Business Case Discourages Early Testing and Validation



## Behaviors Encouraged

- Accept high risk
- Optimistic estimates
- No news is good news

## Role of Testing

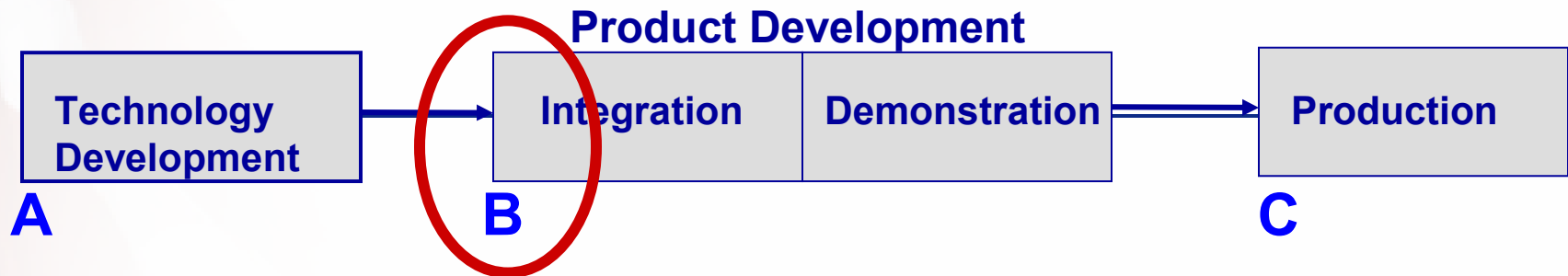
- Polarized relationships
- Failures punished through funding mechanisms
- Resources limited

# Knowledge-based Acquisition

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- Knowledge Point 1 – Indicated by a demonstration that technologies needed to meet essential product requirements work in their intended environment and the producer has completed a preliminary design of the product that shows that the design is feasible. Technology Readiness Levels (TRL) should be matured to level 7.
  - Knowledge Point 2 – Indicated by a prototype demonstration of the design and release of 90 percent of the engineering drawings to manufacturing organizations.
  - Knowledge Point 3 – Indicated by a full demonstration of an integrated product in its intended environment and by bringing critical manufacturing processes under statistical control.
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## Knowledge Point 1: Match Developer Resources With User Needs



**Knowledge:**

Resources match requirements

**Decision:**

Product development is ready to be launched

**Indicators:**

- User needs understood
- Systems engineering used to understand technology and design challenges
- Trades made to match user's needs & developer's resources (available time, funding, and mature technologies)

## Knowledge Point 1: TRLs need independent verification

- DOD 5000 instruction Para 3.6.7. states the following as criteria for exiting Technology Development: “...when an affordable increment of militarily-useful capability has been identified, the technology for that increment has been demonstrated in a relevant environment, and a system can be developed for production with a short timeframe, ...”
- Who should validate that technologies have been demonstrated in a relevant environment? (Program office? Contractor? Other?)
  - The need for an independent tester/evaluator to validate key TRLs is important to verify technologies are at the maturity levels the program office and contractor report they are.

# Summary of GAO review of major weapon programs

	Programs with Mature Technologies	Programs with Immature Technologies
Average RDT&E Cost Increase Over First Full Estimate	9%	41%
Average Schedule Increase	7 Months	13 Months
Average Program Acquisition Unit Cost Increase	1%	21%



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## DOD Programs Meeting Best Practices Criteria

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5 of 33 major acquisition programs that went into System Development and Demonstration demonstrated all of their technologies were mature.

- C-5 Reliability Enhancement and Reengining Program
- Joint Air-to-Surface Standoff Missile
- Navstar Global Positioning System (GPS II)
- Small Diameter Bomb
- Tactical Tomahawk Missile

## DOD Programs Not Meeting Best Practices Criteria

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These programs are some examples of many defense acquisition programs that have or will move to system development and demonstration without attaining Knowledge Point 1

- ***Space-Based Radar***
  - ***Joint Strike Fighter***
  - Aerial Common Sensor
  - Future Combat Systems
  - Joint Tactical Radio System
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## Space-Based Radar (SBR)

- Initial cost estimate is \$28.6 billion from FY2003 to FY2024
- DOD expects to mature the five critical SBR technologies to TRL 5 by program start in mid-2006.
  - First increment starts in 2006 and consists of assembly, integration, and test of previously built components, and ground station hardware and software
- Accurately estimating costs will be more difficult if DOD begins the acquisition program with less than mature technologies.

# SBR Critical Technology TRLs

Critical Technology	Current TRL Level	Expected TRL Level	Program Start Date
Electronically Scanned Array (ESA)	4	5	2006
On-Board Processor (OBP)	3	5	2006
Signal Processing (MTI) Algorithms	4-5	5	2006
Information Management System	3	5	2006
MTI Exploitation HW and SW	3-4	5	2006

# Joint Strike Fighter Acquisition

- DOD's most expensive weapons acquisition program -- \$244.8 billion.
- Three variants (CTOL,STOVL, CV)
- Milestone B decision in October 2001
- Low rate production to begin in 2007

# JSF Critical Technology TRLs

Critical Technology	TRL at Program Start in 2001	Current TRL at Level 7
Integrated Core Processor	5	NO
Integrated Support Systems	4	NO
Manufacturing	6	NO
Mission System Integration	4	NO
Prognostic & Health Management	4	NO
Radar	5	NO
STOVL/Integrated Flight Propulsion Control	6	NO
Subsystems	5	YES

## Joint-Strike Fighter (JSF)

- Previous GAO recommendations for JSF Program have not been implemented
  - In 2002 GAO recommended that the JSF program delay the start of engineering and manufacturing development (EMD) until critical technologies are matured to acceptable levels.
  - If DOD decided not to delay EMD the program should make sure technologies are matured by the critical design review.
  - The program did not implement these recommendations and will not demonstrate all critical technologies in relevant environments until well after the critical design reviews and low rate production decision. The program has experienced significant cost and schedule growth since 2002 due to immature technologies and design instability.

# Recommendations

**Focus on Product Maturity  
and Knowledge Validation**

**Sequence Lower Level  
Tests to Achieve Maturity**

**Demonstrate Maturity Levels  
Before Next Program Phase**



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# Questions?

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