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An Assessment of Acquisition Outcomes and the Impact of Recent Reforms

15th Annual NDIA Systems Engineering Conference
Technology Maturity Track

Observations from GAO's Annual Assessment of Selected Weapon Programs

GAO-12-400SP

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Cost Performance of DOD's Portfolio of Major Defense Acquisition Programs (MDAP)

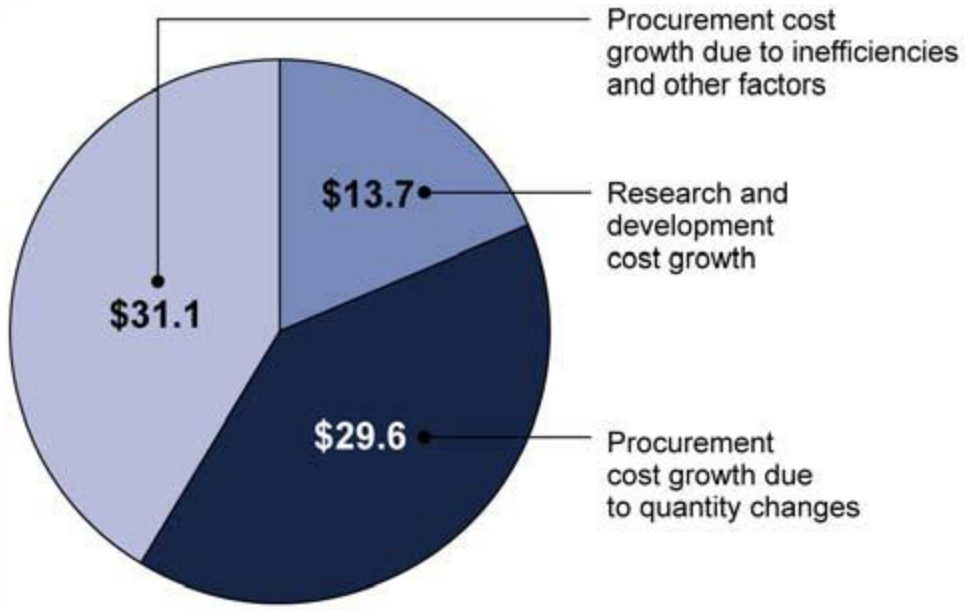
FY 2011 MDAP Portfolio Cost Growth Over Time: 1yr/5yr/Baseline Trend

Fiscal year 2012 dollars in billion	1-year comparison (2010 to 2011)	5-year comparison (2006 to 2011)	Since first full estimate (baseline to 2011)
Increase in total research and development cost	$14 billion 4 percent	$39 billion 14 percent	$113 billion 54 percent
Increase in total procurement cost	$61 billion 5 percent	$192 billion 19 percent	$321 billion 36 percent
Increase in total acquisition cost	$74 billion 5 percent	$233 billion 17 percent	$447 billion 40 percent
Average delay in delivering initial capabilities	1 month 2 percent	9 months 11 percent	23 months 32 percent

Source: GAO analysis of December 2010 Selected Acquisition Reports, prior Selected Acquisition Reports, and other DOD data.

Sources of Cost Growth in DOD's 2011 Portfolio of MDAPs for the Past Year

Cost Growth in Billions of Dollars



Source: GAO analysis of DOD data.

See GAO-12-400SP. Ballistic Missile Defense System excluded.

Most RDT&E Cost Growth in the Past Year is Due to Concurrency and Upgrade Efforts on Programs in Production

Program	Growth in last year (millions)	Reason for additional funding	Start of production
Joint Strike Fighter	$3,922	To reduce risk	2007
SBIRS High	$785	To meet requirements	2001
F-22 Raptor	$780	For modernization	2001
P-8A Poseidon	$742	For new increment of capability, to correct deficiencies, update estimates	2010
Virginia-class	$727	For enhancements, cost reduction initiatives, testing	1997
Global Hawk	$722	For inclusion of new capabilities, testing	2001
DDG 51	$656	For inclusion of new capabilities	1985
Trident II	$624	For modernization and replacement	1987
Apache Block IIIA	$506	For software development	2010

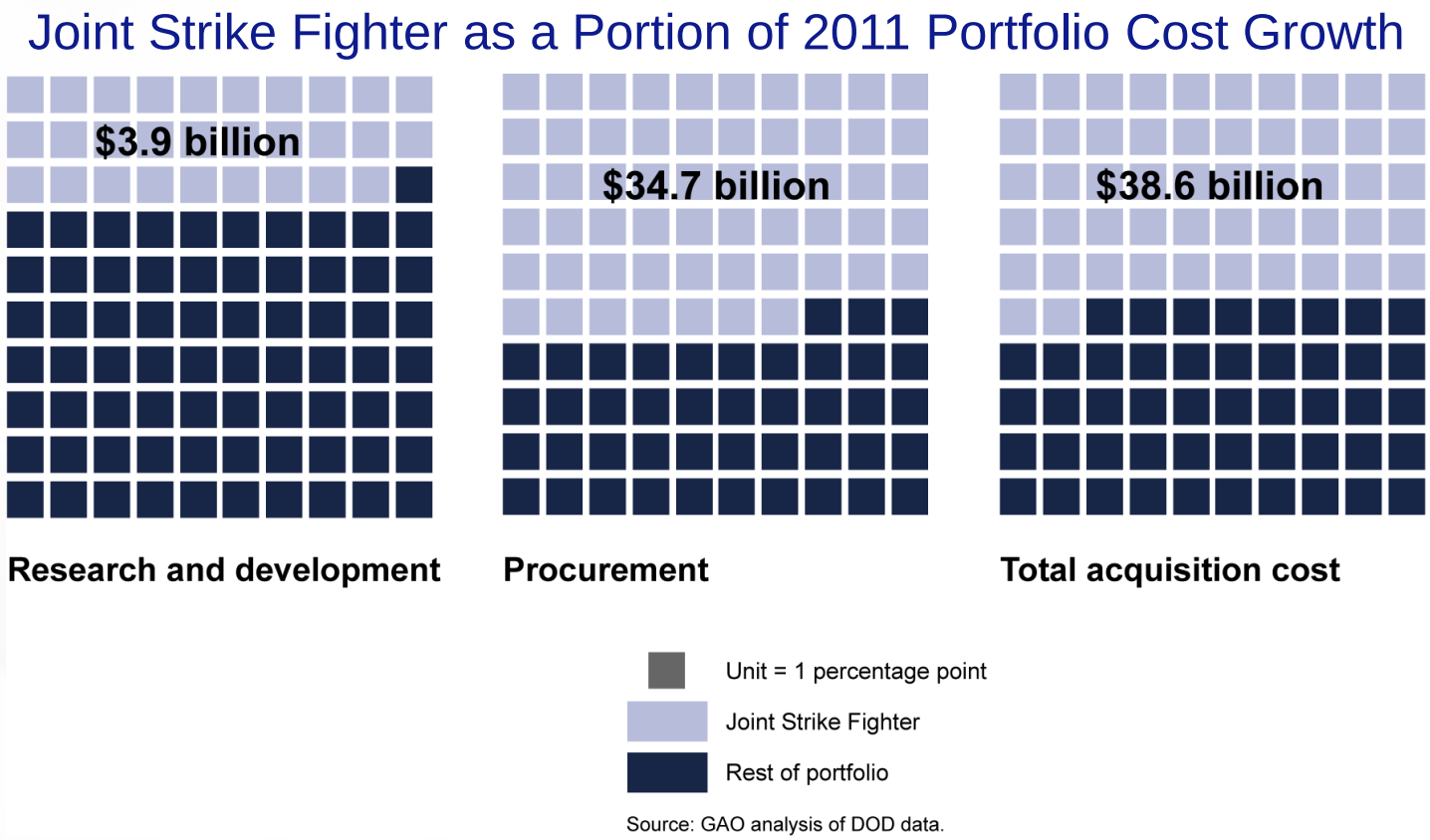
Source: GAO analysis of December 2010 Selected Acquisition Reports and other DOD data.

Quantity Changes Account for Half of Procurement Cost Growth in Past Year

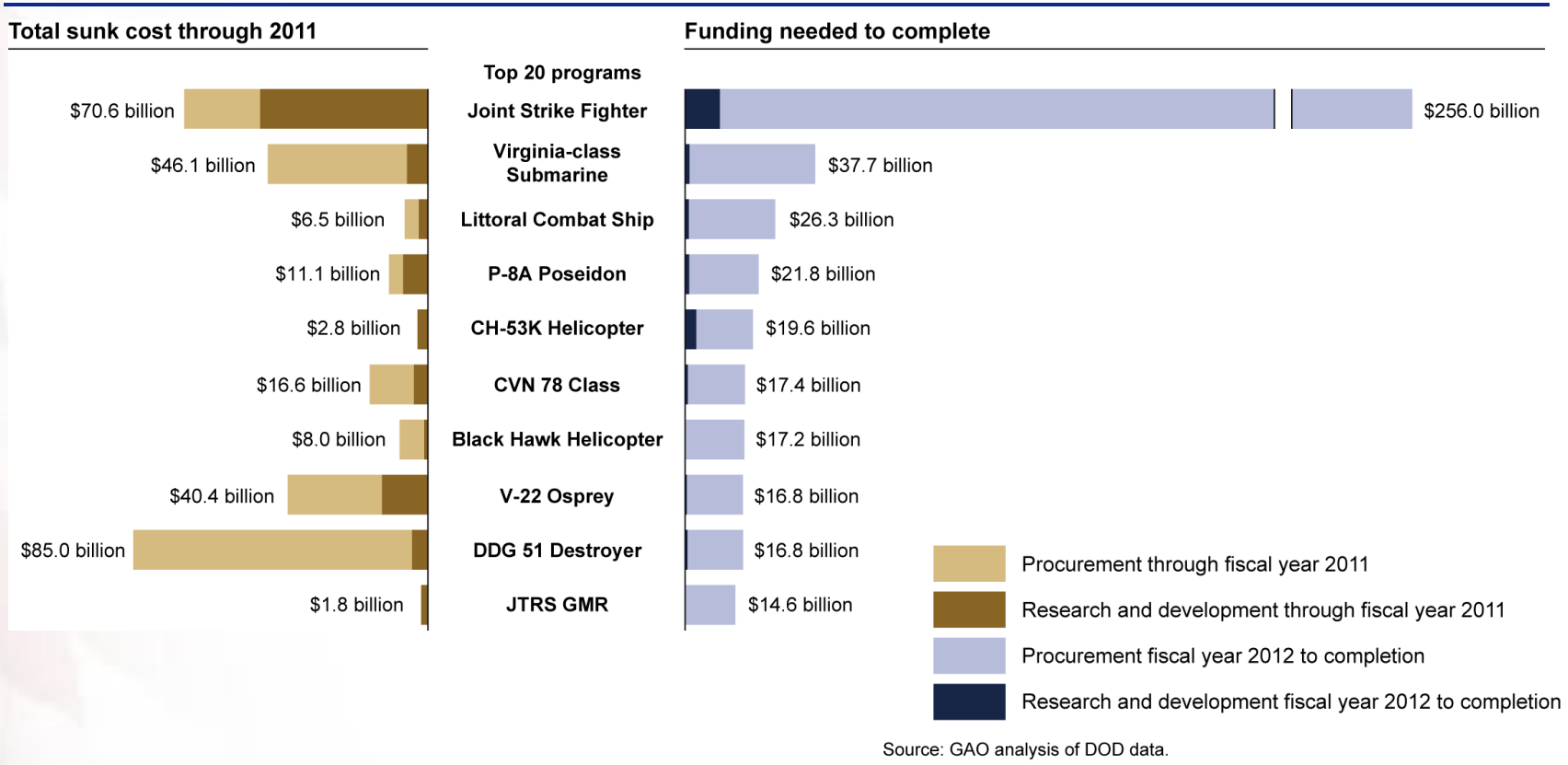
Fiscal year 2012 dollars in billions	Number of programs	Actual cost change	Estimated cost change directly attributable to quantity changes	Estimated cost change not directly attributable to quantity changes
Programs with quantity increases	22	$53.6	$63.0	-$9.3
Programs with quantity decreases	14	-$28.1	-$33.4	$5.2
Programs with no change in quantity	59	$35.2	$0	$35.2
Total	**95**	**$60.6**	**$29.6**	**$31.1**

Source: GAO analysis of DOD data.

JSF Accounts for Significant Portion of the Portfolio's Growth in the Past Year

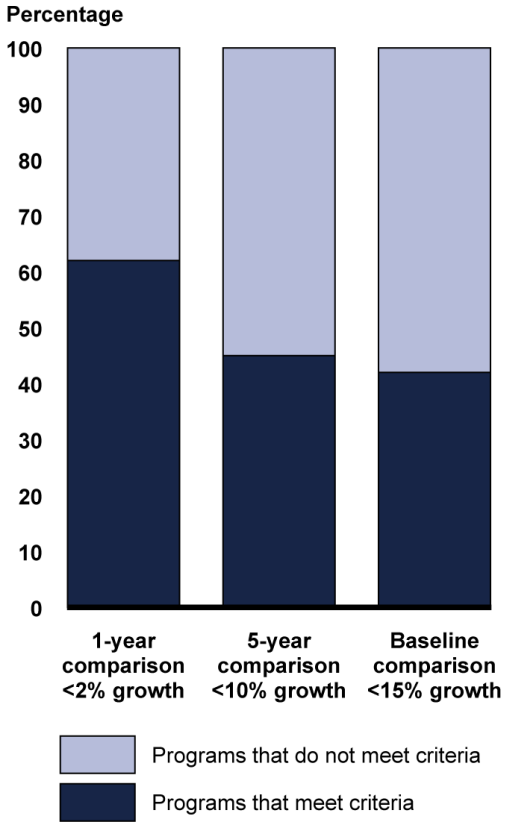


JSF Drives Much of Portfolio's Remaining Funding Needs



Source: GAO analysis of DOD data.

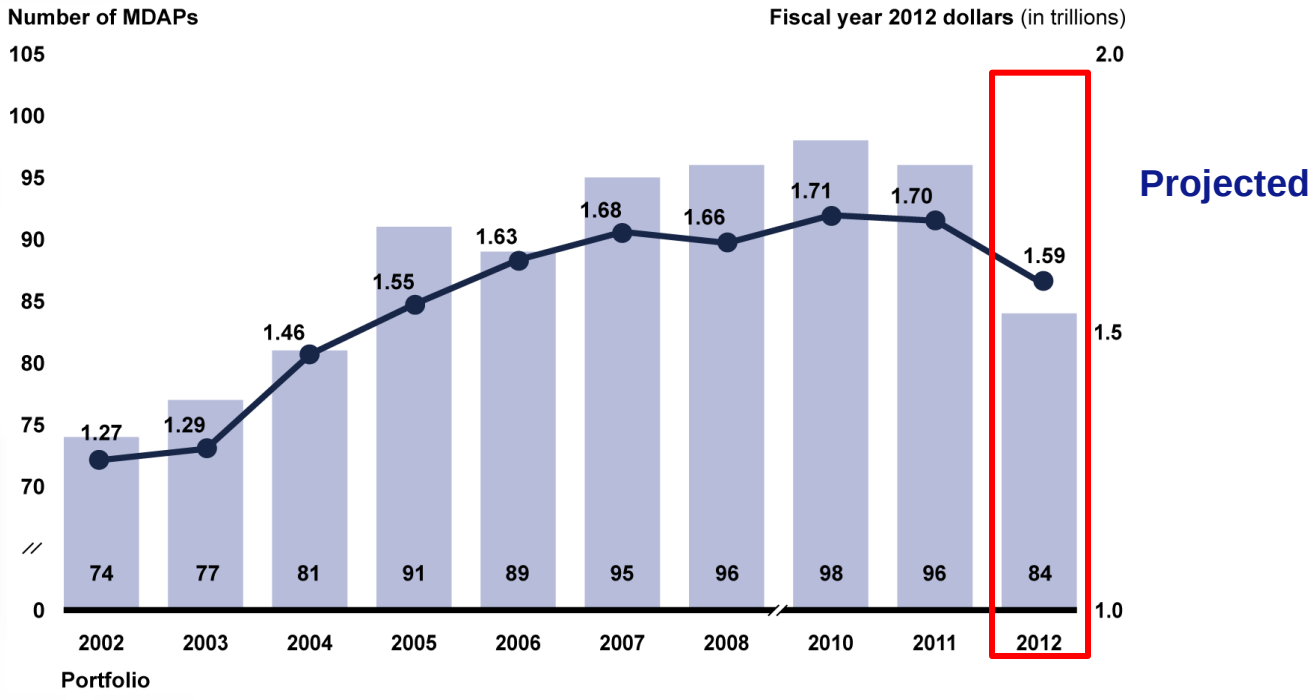
Less Than Half of MDAPs Meet GAO High-Risk Cost-Growth Targets: 1yr/5yr/Baseline



Source: GAO analysis of DOD data.

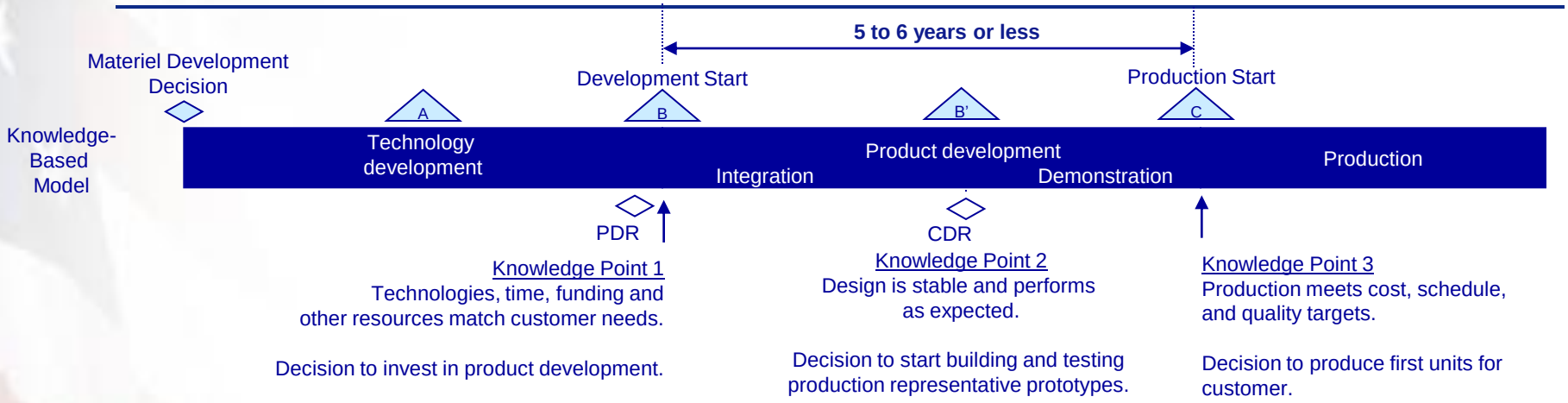
The number of programs includes those with December 2010 SARs—which break down several programs into smaller elements for reporting purposes. One program, Airborne Signals Intelligence Payload (ASIP) –Baseline, was not included in 5-year comparison because data were not available to make that comparison. The Ballistic Missile Defense System is also not included.

Size of DOD's Major Defense Acquisition Program Portfolio is Decreasing



Timing and Amount of Technology, Design, and Manufacturing Knowledge Achieved

A Knowledge-Based Approach is Key to Successful Program Outcomes



- Model provides framework for incremental, time certain (development constrained to 5 to 6 years or less), and knowledge-based approach to weapon system acquisitions.
- Success requires structured, disciplined application and adherence to model.
- Knowledge points align with key investment inflection points.
- Controls are in place for decisions makers to measure progress against specific criteria and ensure managers capture key knowledge before moving to next phase.

Knowledge-Based Criteria is Applied in Annual Assessments of Weapon Program Performance

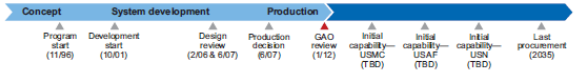
- GAO has developed a “Quick Look” product, which assesses about 70 weapon programs each year.
- Each program is summarized in 2 pages and includes an assessment of cost and schedule performance and an assessment of technology, design, and production knowledge attained by key points in the acquisition process.
- In 2008, GAO added a macro-level analysis of the cost and schedule performance of DOD’s entire major defense acquisition program portfolio.
- The report provides Congress with a quick, risk-based assessment of individual programs and an overall report card for DOD weapon system acquisition management.

Example of Quick Look Assessment

F-35 Lightning II (Joint Strike Fighter)

DOD's JSF program is developing a family of stealthy, strike fighter aircraft for the Navy, Air Force, Marine Corps, and U.S. allies, with the goal of maximizing commonality to minimize life-cycle costs. The carrier-suitable variant will complement the Navy F/A-18 E/F. The Air Force variant will primarily replace the air-to-ground attack capabilities of the F-16 and A-10, and will complement the F-22. The short take-off and vertical landing variant will replace the Marine Corps F/A-18 and AV-8B aircraft.

Source: 2010 Lockheed Martin.



Program Essentials

Prime contractor: Lockheed Martin, Pratt and Whitney
Program office: Arlington, VA
Funding needed to complete:
R&D: $10,117.8 million
Procurement: $245,676.5 million
Total funding: $255,970.4 million
Procurement quantity: 2,353

Program Performance (fiscal year 2012 dollars in millions)

	As of 10/2001	Latest 12/2010	Percent change
Research and development cost	$38,976.7	$58,387.6	49.8
Procurement cost	$172,921.4	$267,595.6	54.7
Total program cost	$213,708.2	$326,535.2	52.8
Program unit cost	$74.567	$132.900	78.2
Total quantities	2,866	2,457	-14.3
Acquisition cycle time (months)	116	TBD	NA

Latest column does not fully reflect the restructured JSF program. Costs are expected to grow and the schedule will be extended.

The JSF program has awarded contracts for production aircraft, but it still lacks key knowledge about its technologies and manufacturing processes. Four critical technologies are not mature and present significant development risks as the program integrates and tests them. The program is making progress in flight testing, but much of its developmental and operational testing remains and the risk of future design changes is significant. Manufacturing inefficiencies, parts shortages, and quality issues persist, but there has been some improvement. The program has been restructured to address development challenges, which triggered a Nunn-McCurdy unit-cost breach of the critical threshold. Aircraft quantities have been reduced in the near term to reduce risk and offset increased development funding needs. DOD has not yet approved a new baseline for the program.

Attainment of Product Knowledge

As of January 2012

Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	○
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●

● Knowledge attained ○ Knowledge not attained ▪▪▪▪ Information not available Not applicable

JSF Program

Technology Maturity

The JSF program began system development with none of its eight critical technologies mature; and, according to program officials, four of these technologies—mission systems integration, which includes the helmet-mounted display; the prognostics and health management system; integrated core processor; and integrated support systems—are still not fully mature. Deficiencies in the helmet-mounted display prompted the program to develop a second helmet. The program is also trying to fix the first helmet, which does not currently meet system requirements. Significant development risks remain as the program integrates and tests these technologies.

Design Maturity

The JSF program did not have a stable design at its critical design reviews. The program has now released 96 percent of its total expected design drawings; however, it continues to experience design changes. With most of developmental and operational flight testing still ahead, the risk of future design changes and their potential effects on the program could be significant.

Production Maturity

The JSF program's manufacturing processes have not been fully demonstrated as only 24 percent of the critical processes are in statistical control. The prime contractor has made manufacturing process improvements and some key production metrics are improving. However, manufacturing inefficiencies persist, primarily driven by parts shortages, parts quality issues, and technical changes arising from discoveries during test events, indicating that the aircraft's design and production processes may still lack the maturity needed to efficiently produce aircraft at planned rates. The prime contractor planned to deliver 16 production aircraft in 2011, but only 9 were delivered. Reintroduction of the carrier variant into the production line has resulted in parts shortages and out-of-station work, which can be highly inefficient. The prime contractor is also managing hundreds of suppliers within a global network, which adds to the complexity of producing aircraft efficiently and on-time. In addition, extensive testing remains to be completed and the program could be required to alter production processes, change its supplier base, and retrofit produced and fielded aircraft if problems are discovered.

Other Program Issues

DOD has restructured the JSF program by adding more time and money to address development challenges and reducing near-term quantities to reduce risk and offset the additional development costs. The projected cost of the restructured program triggered a Nunn-McCurdy unit-cost breach of the critical threshold in 2010. At the time of our assessment, the program had not yet completed a DOD review at which time the program's updated cost and schedule estimates may be approved. According to program officials, the services are also assessing the effect of the program changes and have not yet determined new initial operational capability dates for any of the variants.

All but one of the initial test assets have been delivered to their respective test locations, and the program made significantly more progress in flight testing compared to the previous year. The short take-off and vertical landing variant successfully completed initial ship trials. However, the program continues to experience challenges in developing and integrating the large and complex software requirements needed to achieve JSF capabilities, which could slow testing.

Program Office Comments

In commenting on a draft of this assessment, DOD noted that the JSF program has 10 years of development and aircraft in production. In reference to the helmet, officials explained that due to the need to demonstrate at the milestone B recertification that all technologies had been demonstrated in at least a relevant environment, the program is adding a second helmet as a risk-reduction effort while continuing to improve the first helmet. The program has a plan to mitigate development risks for the original helmet through developmental testing. DOD also provided technical comments, which were incorporated as appropriate.

Changes to Our Product Knowledge Scorecard

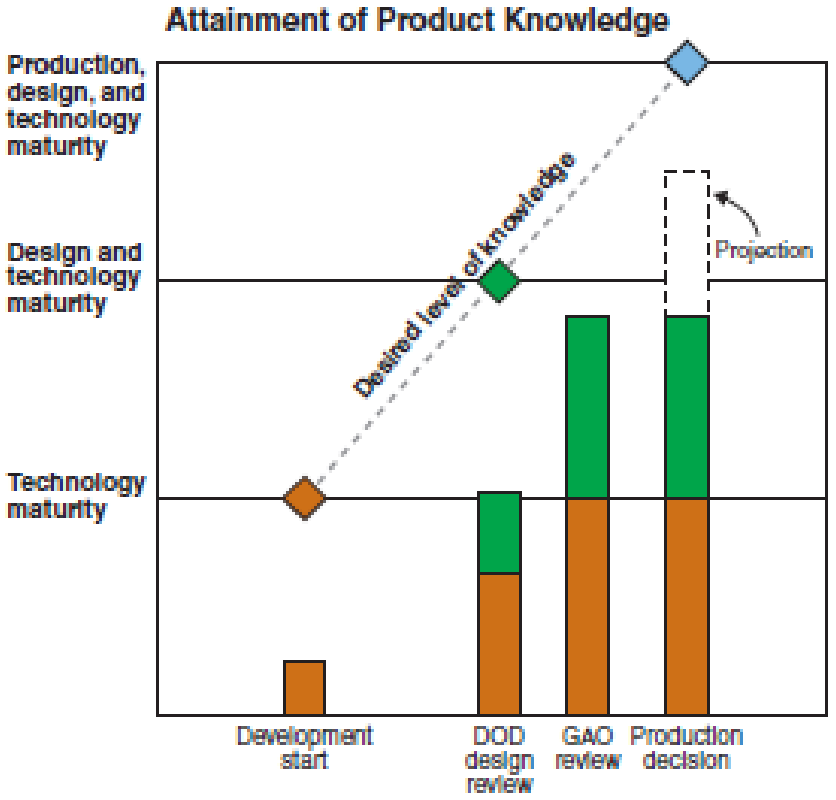
Program in production

Attainment of Product Knowledge

As of January 2012

Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●

● Knowledge attained
○ Knowledge not attained
•••• Information not available
Not applicable



Latest Assessments of Weapon Programs Shows Some Improvements in Execution

- GAO continues to find that newer programs are demonstrating higher levels of knowledge at key decision points, but most are still not fully adhering to a knowledge-based acquisition approach, putting them at a higher risk for cost growth and schedule delays.

- For the programs GAO assessed in depth, GAO found that a lack of technology maturity, changes to requirements, increases in the scope of software development, and a lack of focus on reliability were all characteristics of programs that exhibited poorer performance outcomes.

Knowledge at Three Critical Junctures Still Not Consistent with Best Practices

- 20 of 37 programs in the current portfolio entered development with their critical technologies nearing maturity; only 4 programs had technologies fully mature
- 8 of 37 programs had stable designs at critical design review or the start of ship fabrication; only 5 programs tested system-level integrated prototypes to prove demonstrate these designs
- 26 of 32 programs plan to demonstrate critical processes on a pilot line prior to production; only 4 programs plan to have these processes in control; 15 programs plan to test a productive representative prototype

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Progress In Implementing Acquisition Reforms

DOD Policies Could Improve Outcomes if Consistently Implemented

- **More discipline and up-front knowledge in early acquisition phases could put programs on more stable footing.**
  - Early Materiel Development Decision required for all programs.
  - Preference for incremental development.
  - PDR required before system development start.
  - Competitive prototyping required as part of technology development.
  - Configuration Steering Boards established to control requirements.
  - Acquisition strategies required to describe measures taken to ensure competition throughout the program lifecycle.
  - Trade-offs among cost, schedule, and performance objectives required to ensure affordability.

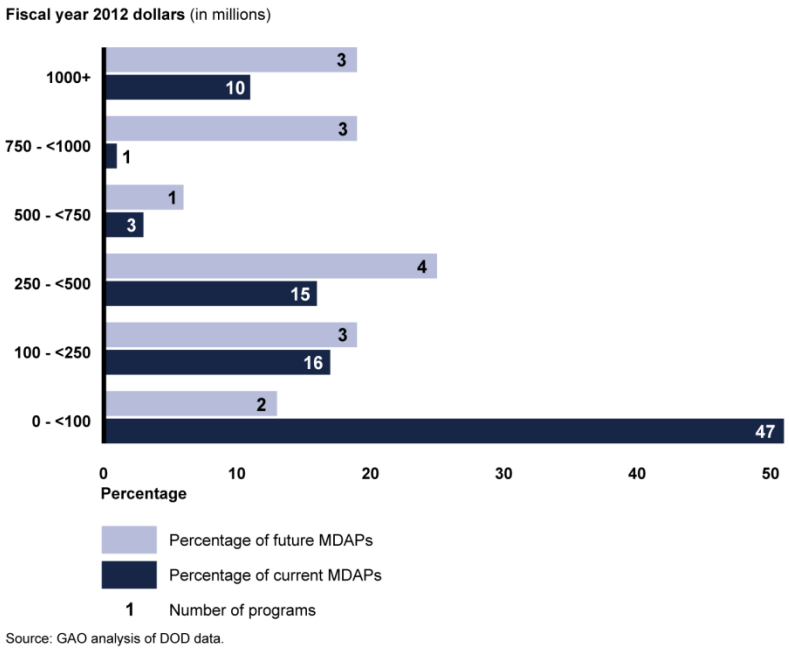
DOD Efficiency Initiatives Are Consistent with Many Best Practices

- **Sets shorter programs timelines –** Requirements and proposed schedules must be consistent; justification for proposed program schedule is required before a program can proceed.
- **Treats affordability as a requirement –** Affordability is to be treated like a key performance parameter.
- **Stresses the use of systems engineering analysis –** Systems engineering tradeoff analysis required to show how cost varies with schedule and design parameters.
- **Emphasizes competition throughout the program lifecycle –** Requires the presentation of a competitive strategy as each milestone.
- **Recommends portfolio analyses to eliminate redundancies –** Conduct portfolio reviews at the joint and Department-wide level to identify redundancies, as well as among smaller programs.

Policy Changes and Reforms Appear to Be Increasing Investments in Technology Development Phase

- The focus on pre-Milestone B activities in recent acquisition reforms seems to have resulted in increased spending in the technology development phase for pre-MDAPs, when compared to prior programs.
- This spending should increase knowledge and reduce program risks if the funds are spent on activities such as prototype demonstrations and systems engineering analysis.

Funding for MDAPs and pre-MDAPs during Technology Development



Source: GAO analysis of DOD data.

Programs Have Begun to Implement Reforms and Initiatives

- **Programs in our 2011 assessment have begun to implement acquisition reforms that could improve cost and schedule outcomes.**
  - Early systems engineering – 11 of 16 pre-MDAPs in our assessment have scheduled a preliminary design review before Milestone B
  - Competitive prototyping – 13 of 16 pre-MDAPs plan to develop competitive prototypes prior to Milestone B
  - Competition – 11 of 16 programs plan to incorporate competition into their acquisition strategy after Milestone B
- **Programs are still in the process of implementing new DOD initiatives.**
  - 6 of 16 pre-MDAPs in our assessment reported holding a MDD
  - 4 of 16 pre-MDAPs and 19 of 37 current MDAPs reported having affordability targets
  - 6 of 16 pre-MDAPs and 23 of 37 current MDAPs reported completing "should cost analysis"

Key Takeaways

Good trends

- Out with the old, in with the new – **it's improving the portfolio's health**
- More SE time & energy from MDD through A to B – **it's reducing risk**
- CAPE's new role may be best thing – **it's forcing change**

Things to think about

- Reconsider the role of the S&T community – **it will impact EVERYTHING!!**
- Continue to force incremental solutions – **it's easier to execute**
- Demand knowledge – **it will make things more predictable, less risky**
- Demand a 5-year cycle time from B to IOC – **it will force knowledge**
- Find a better way to disseminate lessons learned – **it creates role models**

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