United States Government Accountability Office

Report to Congressional Committees

April 2016

F-35 JOINT STRIKE FIGHTER

Continued Oversight Needed as Program Plans to Begin Development of New Capabilities

Accessible Version

GAO-16-390

April 2016

F-35 JOINT STRIKE FIGHTER

Continued Oversight Needed as Program Plans to Begin Development of New Capabilities

GAO Highlights

Highlights of GAO-16-390, a report to congressional committees

Why GAO Did This Study

With estimated acquisition costs of nearly $400 billion, the F-35 Joint Strike Fighter—also known as the Lightning II —aircraft is DOD's most costly and ambitious acquisition program. Since 2001, GAO has reported extensively on the F-35 program's cost, schedule, and performance problems. The program plans to begin increasing production rates over the next few years.

The National Defense Authorization Act for Fiscal Year 2015 contains a provision for GAO to review the F-35 acquisition program. This report assesses program (1) affordability, remaining development, and ongoing manufacturing, and (2) future modernization and procurement plans.

GAO analyzed total program funding requirements. GAO analyzed program documentation including management reports, test data and results, and internal DOD program analyses. GAO also collected and analyzed production and supply chain performance data, and interviewed DOD, program, and contractor officials.

What GAO Recommends

Congress should consider directing DOD to manage F-35 follow-on modernization, Block 4, as a separate and distinct acquisition program with its own baseline and regular cost, schedule and performance reporting. GAO included this matter for consideration because DOD did not concur with GAO's recommendation to manage Block 4 as a separate acquisition program. GAO continues to believe this recommendation is valid as discussed in this report.

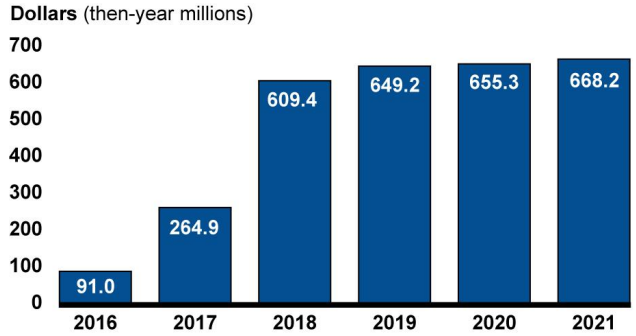
View GAO-16-390. For more information, contact Michael J. Sullivan at (202) 512-4841 or sullivanm@gao.gov.

What GAO Found

Although the estimated F-35 Joint Strike Fighter (F-35) program acquisition costs have decreased since 2014, the program continues to face significant affordability challenges. The Department of Defense (DOD) plans to begin increasing production and expects to spend more than $14 billion annually for nearly a decade on procurement of F-35 aircraft. Currently, the program has around 20 percent of development testing remaining, including complex mission systems software testing, which will be challenging. At the same time, the contractors that build the F-35 airframes and engines continue to report improved manufacturing efficiency and supply chain performance.

DOD plans to manage F-35 modernization as part of the existing program baseline and is exploring the use of a single contract to procure multiple lots of future aircraft. Both courses of action have oversight implications. DOD has begun planning and funding significant new development work to add to the F-35's capabilities. Known as Block 4, the funding needed for this effort is projected to be nearly $3 billion over the next 6 years (see figure below), which would qualify it as a major defense acquisition program in its own right.

F-35 Joint Strike Fighter Block 4 Development Costs Increase Near-Term Funding Needs



Source: GAO analysis of Department of Defense data. | GAO-16-390

DOD does not currently plan to manage Block 4 as a separate program with its own acquisition program baseline but rather as part of the existing baseline. As a result, Block 4 will not be subject to key statutory and regulatory oversight requirements, such as providing Congress with regular, formal reports on program cost and schedule performance. A similar approach was initially followed on the F-22 Raptor modernization program, making it difficult to separate the performance and cost of the modernization from the baseline program. Best practices recommend an incremental approach in which new development efforts are structured and managed as separate acquisition programs with their own requirements and acquisition program baselines. The F-22 eventually adopted this approach. If the Block 4 effort is not established as a separate acquisition program, transparency will be limited. Therefore, it will be difficult for Congress to hold it accountable for achieving its cost, schedule, and performance requirements.

Contents

Tables

Figures

Abbreviations

ALIS	Autonomic Logistics Information System
DOT&E	Director of Operational Test and Evaluation
DOD	Department of Defense
IOC	Initial Operational Capability
LCS	Littoral Combat Ship
MDAP	Major Defense Acquisition Program

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

April 14, 2016

Congressional Committees

With estimated acquisition costs of nearly $400 billion, the F-35 Joint Strike Fighter (F-35)—also known as the Lightning II—is the Department of Defense's (DOD) most costly and ambitious acquisition program. Through this program, DOD is developing and fielding a family of next generation strike fighter aircraft, integrating low observable (stealth) technologies with advanced sensors and computer networking capabilities for the United States Air Force, Marine Corps, and Navy as well as eight international partners.[1] The F-35 family is comprised of the F-35A conventional takeoff and landing variant, the F-35B short takeoff and vertical landing variant, and the F-35C carrier-suitable variant. The program is approaching the end of development and will begin increasing production rates significantly over the next few years. According to current projections, the U.S. portion of the program will require acquisition funding of $54 billion over the next five years as it approaches full rate production and is expected to require about $12 billion a year, on average, through 2038 to complete development and procure a total of 2,457 aircraft. In addition, DOD and program office estimates indicate that the F-35 fleet could cost over $1 trillion to operate and support over its lifetime, which will pose significant affordability challenges.

We have reported on F-35 issues for many years. For example, the National Defense Authorization Act for Fiscal Year 2010 included a provision for GAO to review the F-35 acquisition program annually for 6 years. The last report under that provision was issued in April 2015.[2] Similarly, over time, we have reported significant cost, schedule, and performance problems and have made numerous recommendations for improvement. DOD has taken action to address many of our

[1]The international partners are the United Kingdom, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway. These nations contributed funds for system development and all but Canada and Denmark have signed agreements to procure aircraft. In addition, Israel, Japan, and South Korea have signed on as foreign military sales customers.

[2]GAO, *F-35 Joint Strike Fighter: Assessment Needed to Address Affordability Challenges,* GAO-15-364 (Washington, D.C.: April 14, 2015).

recommendations to varying degrees. See appendix I for a matrix of prior recommendations and related DOD actions. In addition, a list of related GAO reports is included at the end of the report.

The National Defense Authorization Act for Fiscal Year 2015 included a provision for GAO to continue reviewing the F-35 acquisition program annually until the program reaches full-rate production. This is the first report under that provision, and in this report we assess (1) program cost and affordability; (2) remaining development and testing; (3) ongoing manufacturing including supply chain performance; and (4) future modernization and procurement plans.

To assess program cost and affordability, we reviewed and analyzed total program funding requirements to project annual funding requirements through 2038. To assess the program's remaining development and testing, we reviewed and analyzed program briefings, test data and results, and internal DOD program analyses. We collected data on and discussed key aspects of F-35 development and test progress with program management and contractor officials as well as DOD test officials and program test pilots. To assess ongoing manufacturing and supply chain performance, we collected and analyzed manufacturing and supply chain performance data from DOD, Lockheed Martin, and Pratt & Whitney. To assess future modernization and procurement plans, we reviewed budget documents to identify costs associated with the modernization effort and collected and analyzed information regarding capability and oversight plans. We also reviewed and analyzed best practices identified by GAO and reviewed relevant DOD policies and statutes. We also discussed cost and manufacturing efficiency initiatives, such as the block buy approach, with contractor and program office officials to understand potential cost savings and plans. We discussed the program's plans with program office officials. We assessed the reliability of the cost, schedule, and performance data by reviewing supporting documentation and interviewing knowledgeable officials. Based on these steps, we determined that all of the data we used were sufficiently reliable for the purposes of this report. Appendix II contains a more detailed description of our scope and methodology.

We conducted this performance audit from June 2015 to April 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that

the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

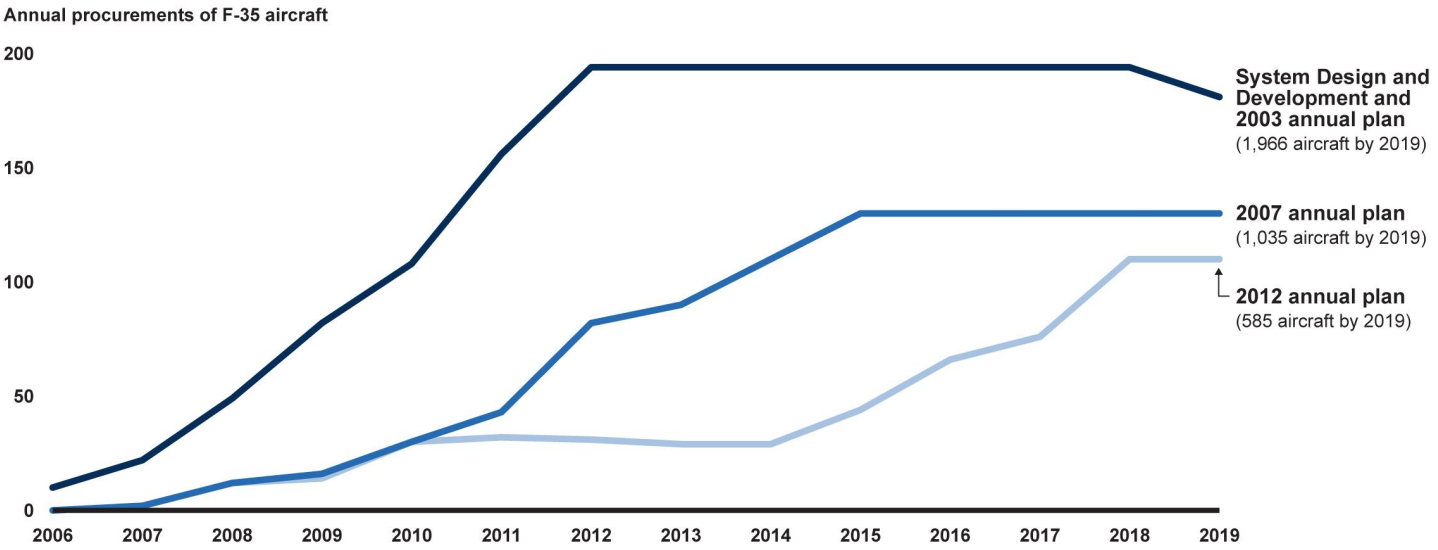
As we have previously reported, DOD began the F-35 acquisition program in October 2001 without adequate knowledge about the aircraft's critical technologies or design. In addition, DOD's acquisition strategy called for high levels of concurrency between development, testing, and production.[3] In our prior work, we identified the lack of knowledge and high levels of concurrency as major drivers in the significant cost and schedule growth as well as performance shortfalls that the program has experienced since 2001.[4] The program has been restructured three times since it began: first in December 2003, again in March 2007, and most recently in March 2012. The most recent restructuring was initiated in early 2010 when the program's unit cost estimates exceeded critical thresholds established by statute—a condition known as a Nunn-McCurdy breach.[5] DOD subsequently certified to Congress in June 2010 that the program was essential to national security and needed to continue. DOD then began restructuring the program. The restructuring continued through 2011 and into 2012, during which time the department established a new acquisition program baseline reflecting increased program cost estimates, extended test and delivery schedules, and reduced near-term aircraft procurement quantities—total procurement quantities did not change. Figure 1 shows how planned aircraft procurement quantities in the near-term have declined over time.

[3]Concurrency is broadly defined as the overlap between technology development and product development or between product development and production.

[4]GAO-15-364 and GAO, *F-35 Joint Strike Fighter: Problems Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities,* GAO-14-322 (Washington, D.C.: March 24, 2014).

[5]Section 2433 of title 10 of the United States Code, commonly referred to as Nunn-McCurdy, requires DOD to notify Congress whenever a major defense acquisition program's unit cost experiences cost growth that exceeds certain thresholds. This is commonly referred to as a Nunn-McCurdy breach. Significant breaches occur when the program acquisition unit cost or procurement unit cost increases by at least 15 percent over the current baseline estimate or at least 30 percent over the original estimate. For critical breaches, when these unit costs increase at least 25 percent over the current baseline estimate or at least 50 percent over the original, DOD is required to take additional steps, including conducting an in-depth reassessment of the program. Programs with critical breaches must be terminated unless the Secretary of Defense certifies to certain facts related to the program and takes other actions, including restructuring the program. 10 U.S.C. § 2433a.

Figure 1: Changes in F-35 Joint Strike Fighter Procurement Quantities Expected between 2006 and 2019



Source: GAO analysis of Department of Defense data. | GAO-16-390

While F-35 program cost, quantity, and schedule estimates increased significantly between the initial program baseline in 2001 and latest baseline in 2012, they have remained relatively stable over the past 3 years. Table 1 shows the cost, quantity, and schedule changes from the initial program baseline and the relative stability since the new baseline was established.

Table 1: Changes in Reported F-35 Joint Strike Fighter Program Expected Cost, Quantity, and Deliveries, 2001-2015

	Category	October 2001 initial baseline	March 2012 latest baseline	December 2015 estimates	Change from 2001 to 2012	Change from 2012 to 2015
Expected quantities (number of aircraft)	Developmental quantities	14	14	14	0%	0%
	Procurement quantities	2,852	2,443	2,443	-14	0
	Total quantities	**2,866**	**2,457**	**2,457**	**-14**	**0**
Cost estimates (then-year dollars in billions)[a]	Development	$34.4	$55.2	$55.1	60%	-.18%
	Procurement	196.6	335.7	319.1	71	-4.94
	Military construction	2.0	4.8	4.8	140	0
	Total program acquisition	**233.0**	**395.7**	**379**	**70**	**-4.22**
Unit cost estimates (then-year dollars in millions)[a]	Program acquisition	$81	$161	$154.3	99	-4.35
	Average procurement	69	137	130.6	99	-4.67
Estimated delivery and production dates	Initial operational capability	2010-2012	Undetermined	2015-2018	Undetermined	5-6 years
	Full-rate production	2012	2019	2019	7 years	0 years

Source: GAO analysis of DOD data | GAO-16-390

[a]Annual projected cost estimates expressed in then-year dollars reflect inflation assumptions made by a program.

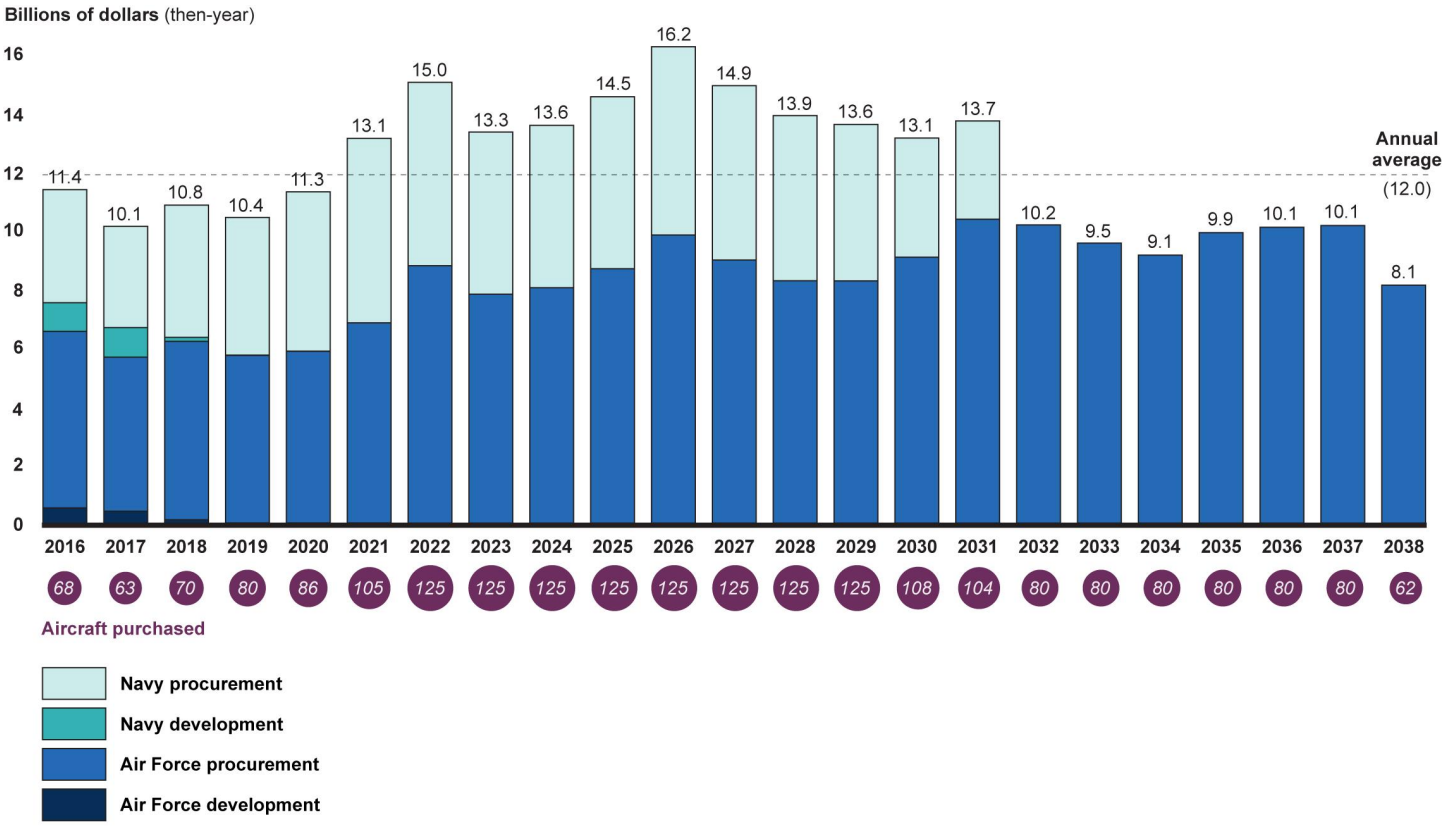
In March 2012, when the new acquisition program baseline was finalized, DOD had not yet identified new initial operating capability dates for the military services. The following year, DOD issued a memorandum stating that the Marine Corps and Air Force were planning to field initial operating capabilities in 2015 and 2016 respectively, and that the Navy planned to field its initial operating capability in 2018. These new dates represented a delay of 5 to 6 years from the program's initial baseline dates. The Marine Corps declared initial operational capability in July 2015.

Program Continues to Face Affordability Challenges

The F-35 program continues to face affordability challenges. The F-35 is still DOD's most costly acquisition program. As of December 2015, the estimated total acquisition cost for the F-35 program is $379 billion, or $12.1 billion less than DOD reported in 2014. The program will require an average of $12 billion per year to complete the procurement of aircraft through 2038. The program expects to reach peak production rates for U.S. aircraft in 2022, at which point DOD expects to spend more than $14 billion a year on average for a decade (see figure 2). These affordability challenges will compound as the program competes with other large acquisition programs including the long range strike bomber and KC-46A Tanker. At the same time, the number of operational F-35 aircraft that DOD will have to support will be increasing. The total cost to operate and

support the F-35 fleet is still estimated to be more than $1 trillion. In recent years, affordability challenges, in part, have forced the Air Force to defer F-35 aircraft procurements to later years. Since 2014, the Air Force deferred 45 aircraft between 2017 and 2021 to later years. This will likely require the military service to make unplanned investments in extending the service life of their current fighter aircraft. The cost of extending the lives of current fighter aircraft and acquiring other major weapon systems, while continuing to produce and field new F-35 aircraft, poses significant affordability risks in a period of austere defense budgets.

Figure 2: F-35 Joint Strike Fighter Budgeted Development and Procurement Costs by Service



Source: GAO analysis of Department of Defense data. | GAO-16-390

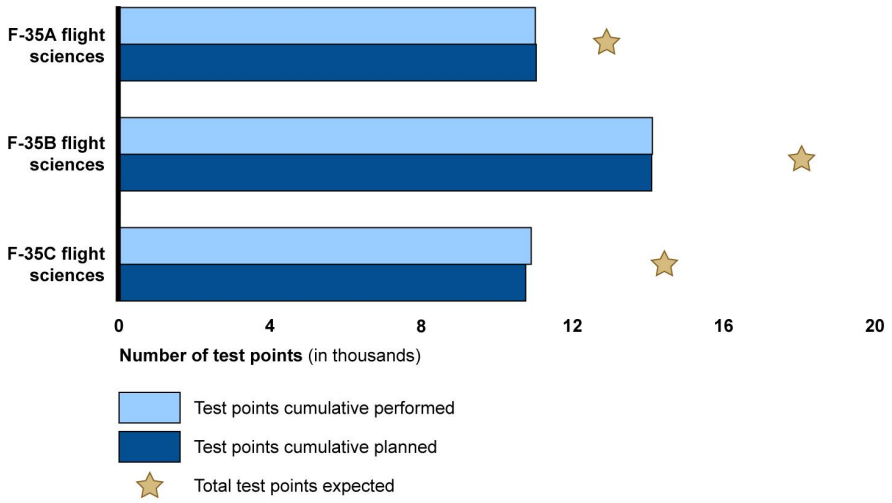
Initial Development is Nearing Completion and F-35 Program is Addressing Technical Risks

The F-35 program is nearing the completion of the developmental test program with about 20 percent of its flight sciences and mission systems testing remaining; however the remaining testing is likely to be challenging as it will require complex missions and stressing environments. Developmental flight testing is separated into two key areas referred to as flight sciences and mission systems. Developmental flight science testing is done to verify the aircraft's basic flying capabilities, while mission systems testing is done to verify that the software and systems that provide warfighting capabilities function properly and meet requirements. The remaining mission systems testing will consist of a large number of weapons accuracy events which have proven to be difficult in the past. Any delay could pose risk to the timely start of initial operational test and evaluation and could also increase concurrency costs. As developmental testing progresses, program officials continue to address and identify technical risks.

Developmental Flight Testing Is Nearing Completion with Challenging Mission Systems Software Testing Remaining

The F-35 program is nearing the completion of developmental flight testing with only 20 percent of its total planned test points remaining. As of December 2015, the program completed 6,201 of the 6,264 planned flight science test points for the year and overall flight science testing was 80 percent complete. Before completing the remaining high speed and high altitude flight science testing, Lockheed Martin officials noted that they will incorporate a pressure relief valve into the aircraft's fuel system to allow the aircraft to fly at altitudes and speeds that are currently restricted due to fuel pressure concerns. Lockheed Martin plans to implement this change by mid-2016. Figure 3 below shows the program's progress toward completing flight science testing.

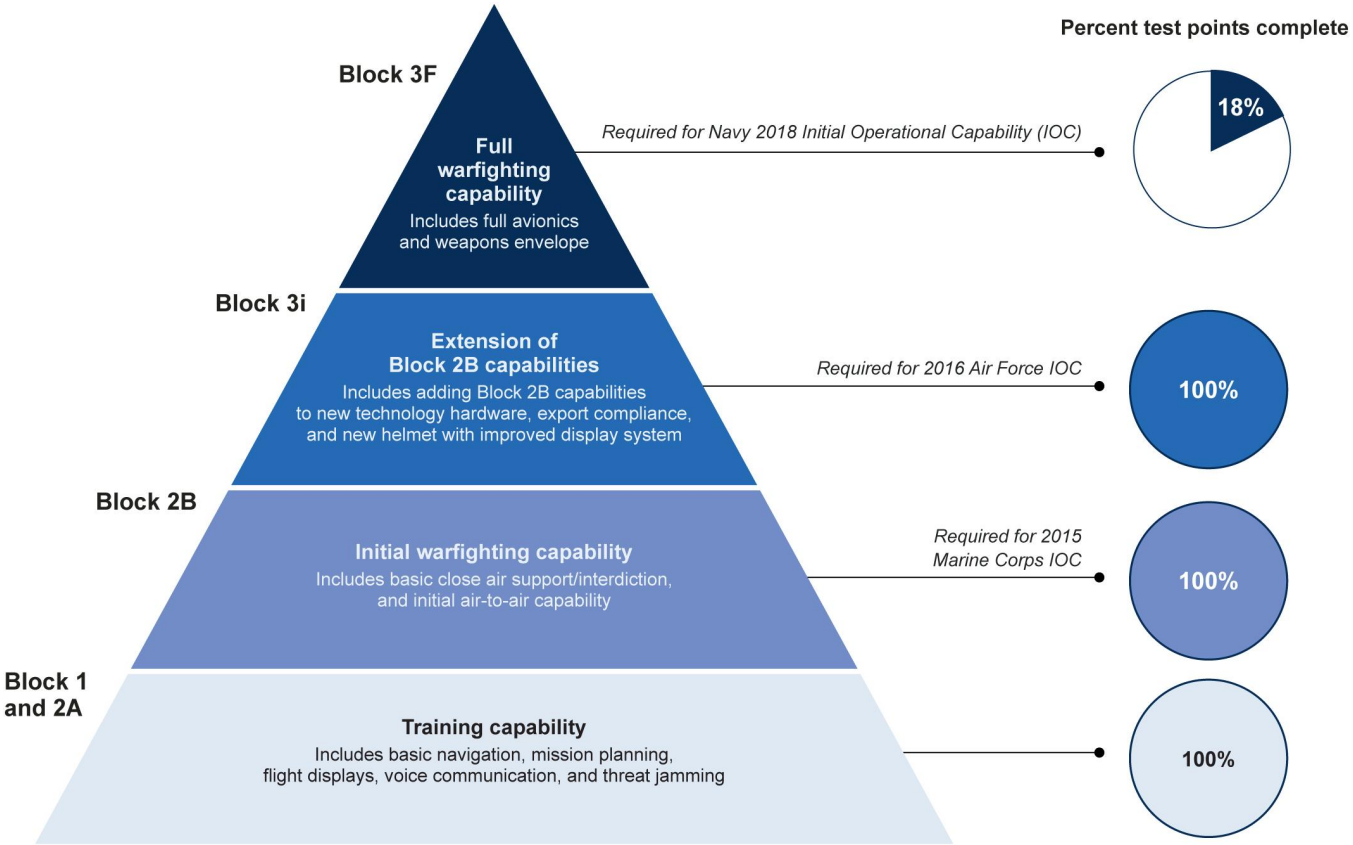
Figure 3: F-35 Joint Strike Fighter Flight Science Test Point Progress as of December 2015



Source: GAO analysis of Department of Defense data. | GAO-16-390

DOD is developing, testing, and fielding mission systems capabilities in software blocks. Figure 4 illustrates the mission systems software blocks being developed for the program, the percent of test points completed by block, and the build-up to full warfighting capability with Block 3F the final software block in the current development program.

Figure 4: Subsequent Development and Flight Test Status of F-35 Joint Strike Fighter Mission Systems Software Blocks as of December 2015



Source: GAO analysis of Department of Defense data. | GAO-16-390

While the program completed all of the mission systems software testing planned in 2015, much of its Block 3F testing remains and it could be challenging given the complexity of the missions and the stressing environments that are required. The program completed 3,381 mission systems test points, 218 more than the 3,163 test points planned in 2015. As of December 2015, the program had about 20 percent of mission systems testing remaining. Block 3F flight testing started later than planned and program officials believe that the completion of 3F developmental testing could be delayed by about 2 to 3 months. As of December 2015, our analysis of program data indicated that Block 3F testing could be delayed by as much as 6 months if the program performs at the same rate it has in the past and is executed according to the current plan with no additional test point growth. A recent report by the

Director of Operational Test and Evaluation Office noted completion of mission systems testing would likely be delayed until January 2018, or 8 months later than planned.

Although early software blocks (Blocks 1 through 3i) have completed testing, the program continues to experience problems with some mission system software functions shutting down and restarting during flight testing. Officials believed they had identified a fix at the end of 2015, but recent tests indicate problems still exist. Program officials plan to continue addressing the issue during 2016 in order to meet the Air Force initial operational capability in August 2016. Program officials are also concerned about the tight timeframes to conduct the 55 weapons accuracy events that remain—30 of which are related to a gun. As of December 2015, the program had completed 17 weapons events many of which were delayed by months due to software deficiencies and fleet groundings. Program officials are analyzing the remaining test schedule to identify potential efficiencies in their weapons test plan. Any delays in developmental testing could pose risk to the timely start of initial operational test and evaluation, currently planned for December 2017.

Delays in mission systems software testing could also increase costs. As the program conducts developmental testing it also continues to procure more and more aircraft per year, increasing program concurrency and cost risk. Through 2016 the program will have spent $56.1 billion to procure 285 aircraft. Fixes to problems identified during testing have required retrofits and rework to aircraft that had already been delivered. To date, program officials have identified a total of $1.4 billion to fix known issues and have forecasted an additional $369 million for retrofits and rework related to issues that have yet to be discovered in testing through 2016. Beyond 2016, the program will no longer track concurrency costs in the same way because developmental testing is expected to be complete and the program does not believe that much, if any, concurrency risk will remain. However, developmental and initial operational testing will continue beyond this period. By the time initial operational testing is complete, currently planned for 2019, the program will have procured 498 aircraft at a cost of $85.7 billion. DOD has taken steps over the past few years to decrease the costs of concurrency. For example, officials have tried to incorporate fixes into production earlier in order to limit the number of fielded aircraft that require retrofits. However, any delays in testing will likely result in delays in the incorporation of known fixes, which would increase the number of aircraft that will require retrofits and rework and increase concurrency costs.

Program Identifying and Addressing Technical Risks

As developmental testing nears completion, the F-35 program continues to address technical risks. The program has incorporated design changes that appear to have mitigated several of the technical risks that we have highlighted in prior reports, including problems with the arresting hook system and bulkhead cracks on the F-35B.[6] However, over the past year, the program continued to address risks with the Helmet Mounted Display, Autonomic Logistics Information System (ALIS), and engine seal that we have identified in the past. The program also identified new risks with the ejection seat and cracking in the F-35C wing structure. The status of DOD's effort to address these issues as of December 2015 is as follows:

- Helmet Mounted Display—A new helmet intended to address shortfalls in night vision capability, among other things, was developed and delivered to the program in 2015. Developmental testing of the new helmet is mostly complete, with final verification testing planned in 2016.

- ALIS—ALIS continues to face risks. For example, the system may not be deployable and does not have a back-up, should the hardware system fail. These and other ALIS risks, identified in a report issued in April 2016 may result in further schedule delays and cost increases.[7] In addition, ALIS continues to lack required capabilities; for instance, equipment management data is inaccurate or incomplete, and engine health information is not included in the current version of ALIS. The program office is taking steps to address these issues including procuring alternate hardware in case of a failure and working with the contractor to improve data quality processes.

- Engine Seal— Program officials have identified a design change to address the technical problem that resulted in an engine fire in June 2014. This design change has been validated and incorporated into production. Program and engine contractor officials have identified 180 total engines that will need to be retrofitted, and as of September 2015, 69 of those retrofits had been completed, including all of the test aircraft. The engine contractor, Pratt & Whitney, is paying for the retrofits.

[6]GAO-15-364 and GAO-14-322

[7]GAO, *F-35 Sustainment: DOD Needs a Plan to Address Risks Related to Its Central Logistics System*. GAO-16-439 (Washington, D.C.: April 14, 2016).

- Ejection Seat—In 2015, program officials discovered that pilots under 136 pounds could possibly suffer neck injuries during ejection. Officials stated the risk of injury is due to the rotation of the ejection seat in combination with the thrust from the parachute deployment during ejection. Officials noted that although the problem was discovered during testing of the new helmet mounted display, the helmet's weight was not the root cause. The program is exploring a number of solutions to ensure pilot safety including installing a switch for pilots that would slow the release of the parachute, installing a head rest that would reduce head movement, and reduce the weight of the helmet. The cost of these changes has not yet been determined.

- Wing Structure Cracks—In 2015, at around 13,700 hours of durability testing—about 85 percent of the total hours required—program officials recognized cracking in the wing structure of the F-35C structural test aircraft. Testing was halted for about 3 months while the test aircraft was repaired with internal and external straps to strengthen the structure. Lockheed Martin officials we spoke with stated that a long-term fix had not been identified. However, the impact on current fielded aircraft will likely be minimal because few F-35C aircraft have been delivered and the discovery occurred beyond the aircraft's expected lifecycle.

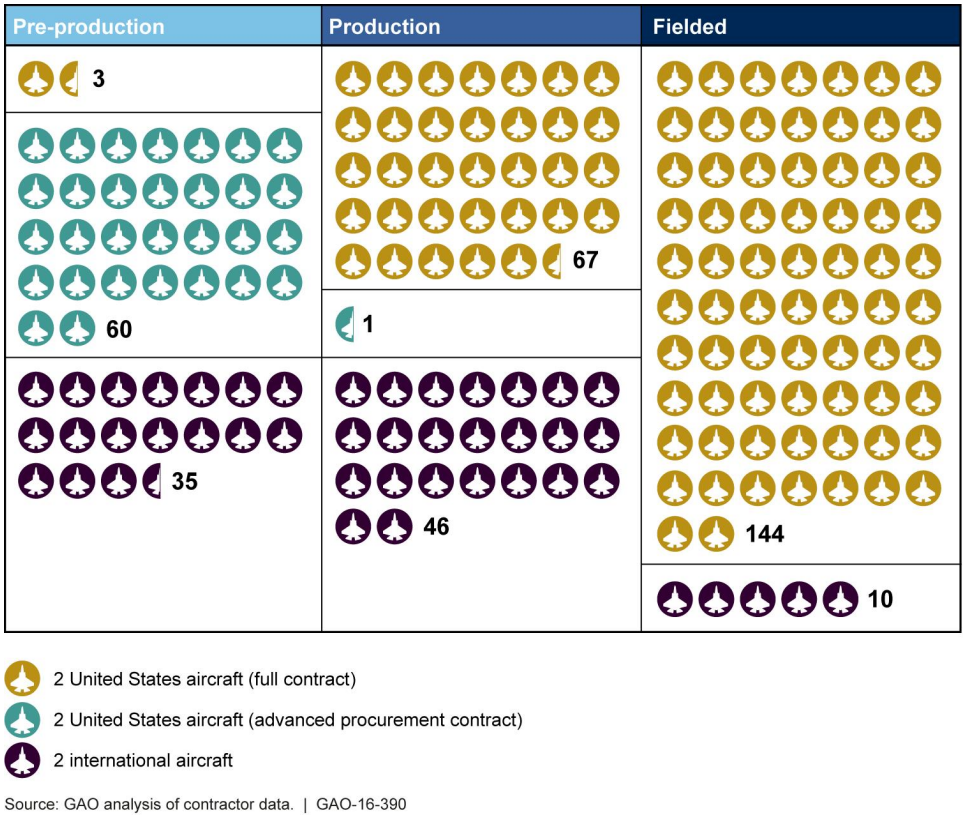
Manufacturing and Reliability Progress Continue

The F-35 airframe and engine contractors continue to report improved efficiency and supply chain performance, and program data indicates that reliability and maintainability are also improving. The number of U.S. aircraft produced and delivered by the F-35 prime contractor, Lockheed Martin has remained relatively stable in each of the last four years. As more aircraft are produced, Lockheed Martin's manufacturing efficiency and quality metrics have also improved. In contrast, manufacturing efficiency and quality metrics have remained relatively stable for Pratt & Whitney, the engine contractor. At the same time, aircraft reliability and maintainability have continued to improve, although at slower rates than program officials expected.

Airframe Manufacturing Efficiency and Quality Continue to Improve

Over the last four years, the number of U.S. aircraft produced and delivered by the F-35 prime contractor, Lockheed Martin, has remained relatively stable. Since 2011, a total of 154 aircraft have been delivered to DOD and international partners, 45 of which were delivered in 2015.[8] Figure 5 shows the number of U.S. and international partner aircraft delivered, as well as the number of F-35 aircraft in production at Lockheed Martin and its suppliers as of December 2015.

Figure 5: Number of F-35 Joint Strike Fighter Aircraft Delivered and in Production as of December 2015

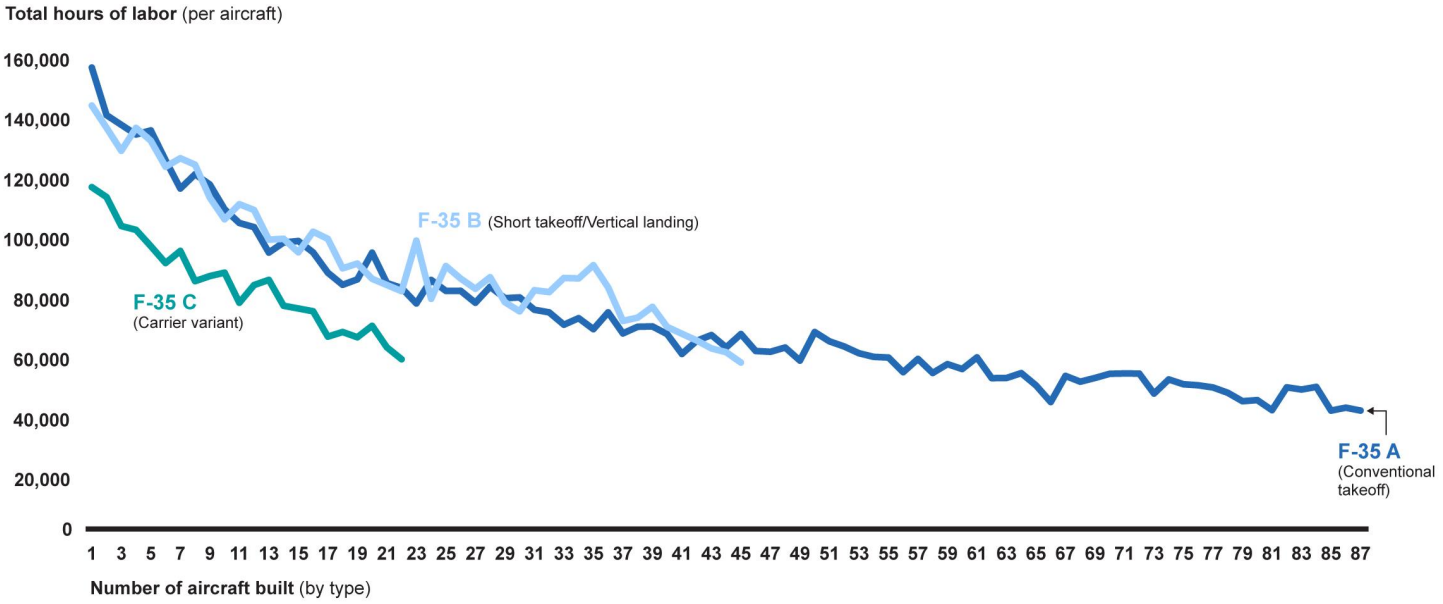


Source: GAO analysis of contractor data. | GAO-16-390

[8]Lockheed Martin has delivered 10 F-35s to international partners: 2 to Australia, 1 to Italy, 3 to Great Britain, 2 to the Netherlands, and 2 to Norway.

Although prior to 2015 Lockheed Martin had only delivered one aircraft on or ahead of their contracted delivery date, the contractor has been making progress, and in 2015, was able to deliver 15 of the 45 aircraft on time or early. As Lockheed Martin delivers more aircraft, the number of average labor hours needed to manufacture each aircraft continues to decline. Since 2011 average labor hours per aircraft have declined 60 percent on average since the first F-35 aircraft was delivered. Lockheed Martin officials stated that their goal is to reduce the average labor hours to around 30,000 hours by 2019. Based on the labor hour trends depicted in figure 6, Lockheed Martin appears to be on track to achieve its goal.

Figure 6: Trend in Labor Hours to Build F-35 Joint Strike Fighter Aircraft by Variant



Source: GAO analysis of Department of Defense data. | GAO-16-390

Other manufacturing data also indicate that manufacturing efficiency and product quality continue to improve.

- The amount of time spent on out-of-station work averaged 5 hours per aircraft in 2015. This is a reduction of 88 percent since 2014.

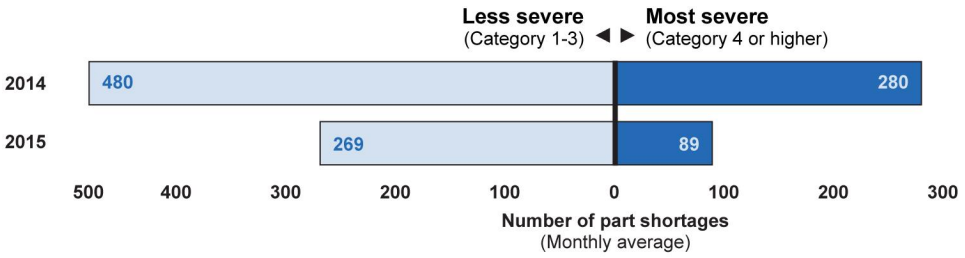
- The time spent on scrap, rework, and repair in the sixth production lot[9] averaged around 8,800 hours per aircraft. This is a reduction of 19 percent from the prior lot.

- Non-conformances averaged around 3,900 per aircraft in the sixth production lot. This is consistent with the prior lot.

- Engineering design changes remained the same. In 2015, changes averaged 23 per month, the same as in 2014.

Although it has improved, Lockheed Martin's supply chain continues to deliver parts late to production, resulting in inefficiencies and requiring workarounds. Since 2014, there has been a 53 percent reduction in part shortage occurrences. In 2015, there were a total of 269 less severe shortages, and 89 most severe shortages on average per month (see figure 7). The severity of part shortages is measured in four categories, category 1 being the least severe, and category 4 and above being the most severe with those shortages requiring a major workaround or work stoppage.

Figure 7: Reduction in Average Monthly F-35 Joint Strike Fighter Part Shortage Occurrences at Prime Contractor Facility from 2014 to 2015



Source: GAO analysis of Department of Defense data. | GAO-16-390

According to Lockheed Martin and F-35 program officials, parts continue to be delivered late largely because of late contract awards and because the supply base is not yet capable of handling large quantities. We found in April 2015 that inefficiencies related to limited supply base capabilities could be exacerbated if this trend continues as production increases.[10]

[9]Aircraft are procured in groups also known as production lots.

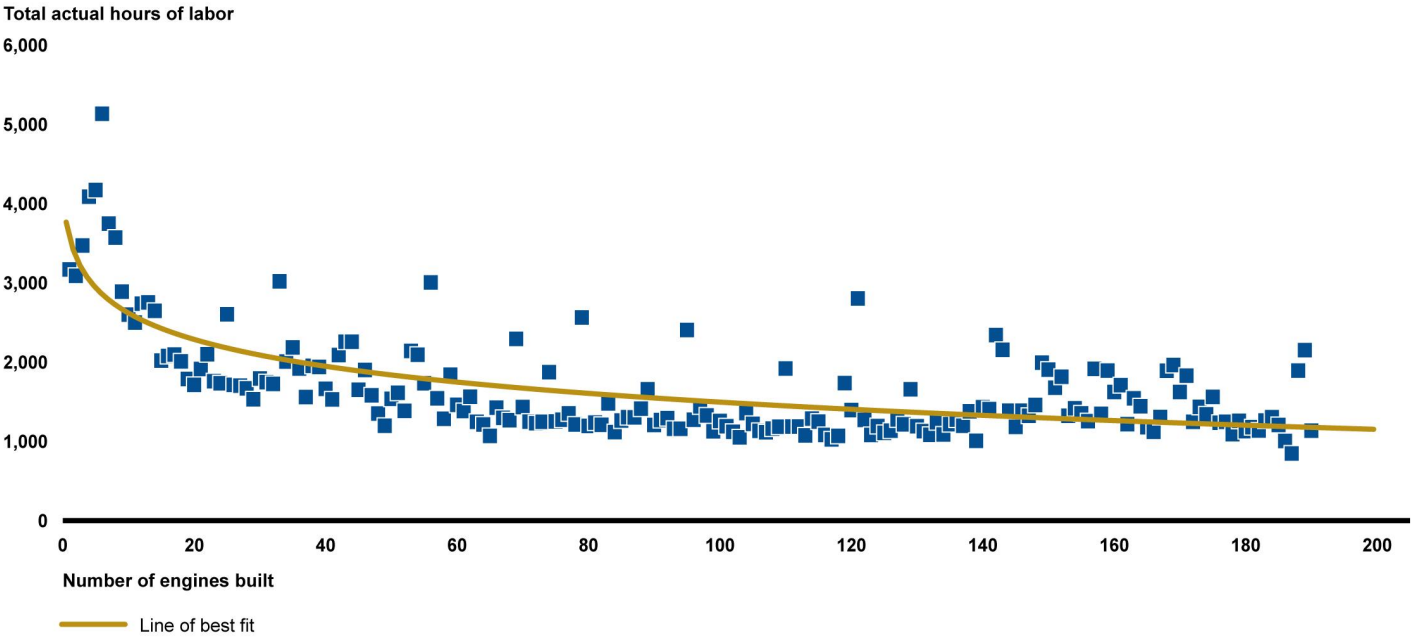
[10]GAO-15-364

This continues to be a risk to the program. Lockheed Martin officials stated they have a number of initiatives aimed at improving supplier performance, including conducting additional oversight of some suppliers and assisting some suppliers with developing corrective action plans. As a result, Lockheed Martin officials believe the performance of some key suppliers has improved over the last year.

Engine Deliveries Ahead of Contract but Efficiency Challenges Remain

Overall, the delivery rate of the engine manufacturer, Pratt & Whitney, increased from 27 in 2011 to 42 in 2015. A total of 218 engines have been delivered to date. In 2015, Pratt & Whitney delivered nearly half of the engines to DOD ahead of contract requirements. The labor hours required to assemble an F-35 engine decreased quickly and has remained relatively steady since engine number 70 was delivered. Pratt & Whitney officials largely attribute this improvement to lessons learned by the contractor on previous fighter aircraft engine programs, such as the F-22. Figure 8 illustrates the trend in labor hours required to build the F-35 engine, also known as the F-135. According to Pratt & Whitney data, few additional labor hour reductions are expected; therefore, the contractor is looking for other ways to gain more manufacturing efficiency.

Figure 8: Trend in Labor Hours to build the F-35 Joint Strike Fighter Engine



Source: GAO analysis of Department of Defense data. | GAO-16-390

Other Pratt & Whitney manufacturing metrics indicate that production efficiency and quality have remained relatively steady.

- Scrap, rework, and repair costs have remained steady at around 1.8 percent per engine. Difficulty manufacturing one of the engine rotor blades—a hollow blade design—has driven much of the scrap and rework costs in the engine program over the last year. However, Pratt & Whitney officials have changed the blade design to a solid design that is easier to produce. The solid blade is expected to decrease scrap and rework costs.

- Engineering design changes are relatively low and continue to decrease. Only 31 of 175 major design changes remain to complete the engine development program. A majority of these are scheduled to be implemented in 2016.

According to Pratt & Whitney officials, their supply base does not currently have the capacity to support maximum production rates. This poses risk as the F-35 program plans to significantly increase production rates over the next five years. To mitigate this risk, Pratt & Whitney is pursuing the potential to have multiple suppliers for some engine parts, known as dual-sourcing, which they believe will help increase manufacturing capacity within the supply chain. According to Pratt & Whitney officials, this approach may also lead to competitive pricing, provide production stability, and mitigate the risks posed by underperforming suppliers. In addition, Pratt & Whitney is conducting production reviews of its supply chain and is managing supplier quality initiatives to address shortfalls, according to officials.

Reliability and Maintainability Progress Continue but Not at Expected Rates

Although the program has made progress in improving system-level reliability and maintainability, some metrics continue to fall short of program expectations in several key areas. For example, as shown in figure 9, while the metrics in most areas were trending in the right direction, the F-35 program office's own assessment indicated that as of August 2015 the F-35 fleet was falling short of reliability and maintainability expectations in nine of 19 areas. As of August 2015, the F-35 fleet had only flown a cumulative total of 35,940 hours. The program has time for improvement as the ultimate goals for these reliability and maintainability metrics are to be achieved by full system maturity, or 200,000 cumulative flight hours across the fleet. The program currently has a number of projects planned to further increase reliability.

Figure 9: F-35 Joint Strike Fighter System-level Reliability and Maintainability Status as of August 2015

Metric	F-35A		F-35B		F-35C	
	Program office assessment	Trend of values	Program office assessment	Trend of values	Program office assessment	Trend of values
Mean flight hours between failure (design controlled) – measures time between failures that are directly attributable to the design of the aircraft and are considered fixable with design changes	●	+	●	+	●	+
Mean flight hours between critical failure – measures time between failures that result in the loss of a capability to perform a mission-essential function	⊙	+	⊙	−	N/A	N/A
Mean time to repair – measures the amount of time it takes a maintainer to repaire a failed component or device	⊙	+	⊙	+	●	+
Mean corrective maintenance time for critical failures – measures the amount of time it takes to correct critical failure events	⊙	−	⊙	+	N/A	N/A
Maintenance man hours per flight hour – measures the average amount of time spent on maintenance per flight hour	●	+	●	+	●	−
Mean flight hours between maintenance event – measures all failures that lead to maintenance, unscheduled inspections, and servicing actions	⊙	+	●	+	⊙	+
Mean flight hours between removal – measures time between part removals from the aircraft for replacement from the supply chain	●	+	●	+	⊙	+

● At or above the plan line

● At or above the threshold line

⊙ Below the threshold line

\+ Positive trend

− Negative trend

Source: GAO analysis of Department of Defense data. | GAO-16-390

Similarly, although engine reliability improved significantly in 2015, the engine was still not performing at expected levels. In 2014, Pratt & Whitney data indicated that engine reliability—measured as mean flight

hours between failure (design controllable)—was very poor and we reported in April 2015 that the engine would likely require additional design changes and retrofits.[11] While Pratt & Whitney has implemented a number of design changes that have resulted in significant reliability improvements, the F-35A and F-35B engines are still at about 55 percent and 63 percent, respectively, of where the program expected them to be at this point.[12] Program and contractor officials continue to identify ways to further improve engine reliability.

In addition, average aircraft availability—the percentage of F-35 aircraft capable of performing missions at a given time—was around 50 percent when DOD had expected it to be 60 percent as of December 2015. According to the office of the Director of Operational Test and Evaluation (DOT&E) aircraft availability must improve significantly before initial operational testing can begin.[13] In a December 2015 memorandum, DOT&E also noted that extensive modifications to operational test aircraft are required and will not be completed in time to start initial operational testing in 2017 as currently planned. Program officials stated they are working to accelerate aircraft upgrades to support initial operational test and evaluation.

DOD's Approach to Managing Follow-on Modernization and Plans for Purchasing Future Lots of Aircraft Have Oversight Implications

The program is facing key decisions that have transparency and oversight implications. DOD plans to manage F-35 follow-on modernization, formerly known as follow-on development, as part of the existing program baseline and not as a separate program which we have seen before. This approach does not align with best practices and will likely hinder transparency and oversight. In addition, the F-35 program is exploring the potential for using a single contract to purchase multiple lots of future aircraft—known as a block buy approach—which has potential benefits and risks.

[11] GAO-15-364

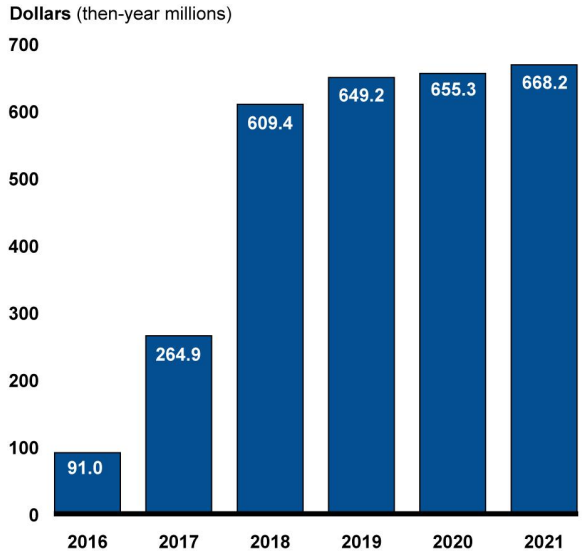
[12] The F-35C variant will use the same engine as the F-35A variant.

[13] The aircraft chosen for operational testing need to demonstrate an 80 percent availability rate.

F-35 Follow-on Modernization Approach Will Likely Hinder Transparency and Oversight

Due to evolving threats and changing warfighting environments, DOD has begun planning and funding the development of new F-35 capabilities, known as follow-on modernization, but DOD's current plan for managing the development of these new capabilities may limit transparency and oversight. The current F-35 development program is projected to end in 2017, when Block 3F developmental flight testing is complete, at a total development cost of $55.1 billion. The first increment of follow-on modernization, known as Block 4, is expected to add new capabilities and correct deficiencies of nine capabilities carried over from the current development program such as the prognostics health management system down-link and communication capabilities. Although the requirements are not yet final and no official cost estimate has been developed for Block 4, DOD's fiscal year 2017 budget request indicates that the department expects to spend nearly $3 billion on these development efforts over the next 6 years (see figure 10).

Figure 10: F-35 Joint Strike Fighter Block 4 Development Costs Increase Near-term Funding Needs



Source: GAO analysis of Department of Defense data. | GAO-16-390

With development costs of this magnitude, the Block 4 program would exceed the statutory and regulatory thresholds for what constitutes a major defense acquisition program (MDAP), and it would be larger than many of the MDAPs in DOD's current portfolio. However, in August 2015, the Under Secretary of Defense for Acquisition, Technology, and

Logistics issued an Acquisition Decision Memorandum directing the F-35 program office to manage Block 4 development under the existing F-35 acquisition program baseline and not as a separate incremental acquisition program. As a result, DOD will not hold a Milestone B review and will not establish a new baseline or business case.[14] Therefore, DOD will not be required to separately account for cost, schedule and performance progress to Congress with regular, formal reports.

In preparation for F-35 Block 4 modernization, DOD is currently conducting activities typical of a program preparing to begin system development—including requirements definition and preliminary design—and is planning to award a new development contract for Block 4 in the third quarter of fiscal year 2018. DOD policy indicates that the timing of this contract award would usually initiate a Milestone B review for typical programs of such magnitude. A Milestone B review would set in motion oversight mechanisms including an acquisition program baseline; Nunn-McCurdy unit cost growth thresholds; and periodic reporting of the program's cost, schedule, and performance progress. These mechanisms form the basic business case and oversight framework to ensure that a program is executable and that Congress and DOD decision makers are informed about the program's progress. Best practices recommend an incremental approach in which new development efforts are structured and managed as separate acquisition programs and that a business case should match requirements with resources—proven technologies, sufficient engineering capabilities, time, and funding—before undertaking a new product development. Because DOD does not yet have approved requirements and is not planning to hold a Milestone B review, its approach for Block 4 modernization will not require the program to have such important reporting and oversight mechanisms in place.

We are concerned with DOD's approach largely because of a similar case we reported on in March 2005. In that report we found that the Air Force was managing its multi-billion dollar F-22 modernization efforts as part of the program's existing acquisition baseline and had not established a knowledge-based business case.[15] We recommended that the Air Force

[14]Milestone B is a key decision point in DOD acquisitions that formally initiates a system development program and triggers key oversight mechanisms.

[15]GAO, *Tactical Aircraft: Air Force Still Needs Business Case to Support F/A-22 Quantities and Increased Capabilities*, GAO-05-304 (Washington, D.C.: March 15, 2005).

structure and manage F-22 modernization as a separate acquisition program with its own business case—matching requirements with resources—and acquisition program baseline. However, the F-22 baseline and schedule were not immediately adjusted to reflect the new timeframes and additional costs and funding of the baseline development and modernization effort were comingled. As a result, the content, scope, and phasing of capabilities changed over time and it appeared that the F-22 program was fraught with schedule delays and cost overruns. The comingling of cost and schedule information reduced transparency and Congress could not distinguish between increased costs associated with the original baseline funding and increased costs associated with modernization funding. As shown in table 2, the F-22 modernization program was less complex than the proposed F-35 Block 4 development but the F-22 program's approach still resulted in poor acquisition outcomes. Eventually, the department separated the F-22 modernization program from the baseline program with a Milestone B review, in line with our recommendation, which increased transparency and better facilitated oversight. The department has the opportunity to apply similar lessons learned to the F-35 Block 4 program.

Table 2: Comparison of the New Capabilities and Weapons of the F-22 Modernization and F-35 Joint Strike Fighter Block 4 Modernization

System	Capabilities	Weapons
F-22	8	3
F-35	80	17

Source: GAO analysis of DOD data.| GAO-16-390

Proposed Future Procurement Plan Has Benefits and Risks

In an effort to reduce procurement costs, the F-35 program office has begun exploring the potential benefits and risks of using what the program has called a block buy contracting approach. Currently, the program purchases aircraft under separate annual contracts that are negotiated on an annual basis. Program officials stated they are considering seeking specific legal authority from Congress that would enable them to enter into a 3 year contract to purchase three lots of

aircraft, although funding would still be authorized and appropriated by Congress annually.[16]

The F-35 block buy contracting approach under consideration does have a number of potential benefits. For example, block buy contracting would allow the program to purchase parts for all three lots of aircraft at the same time, which could result in cost savings. By purchasing supplies in economic quantities, Lockheed Martin and Pratt & Whitney estimate that 8 percent and 2.3 percent cost savings, respectively, could be achievable. Program officials believe that block buy contracting can also enhance program and supply chain stability by providing assurance that quantities and the program's ramp-up is nearing and steady work will continue. This stability could help address the supply base's delivery issues.

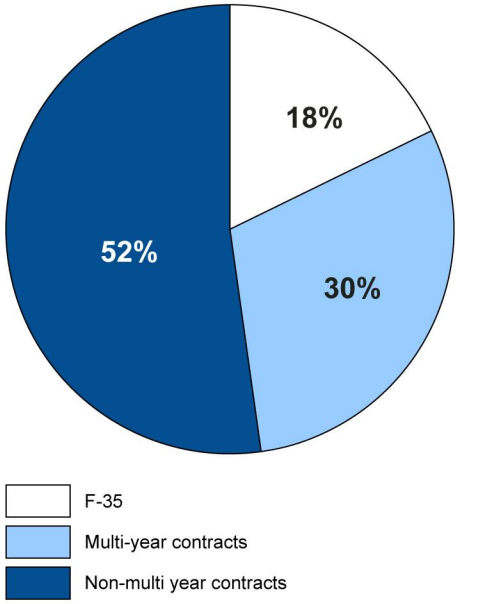
While the F-35 block buy contracting approach could result in cost savings and other benefits, it can present oversight challenges. Our analysis of the Navy's block buy contract for the Littoral Combat Ship (LCS) indicates that the contract could affect Congress's funding flexibility. For example, the LCS contract states that a failure to fully fund the purchase in a given year would mean that the contract is subject to renegotiation. This could result in the government paying more for the remaining ships. The F-35 block buy plan is still under consideration and the specific terms and conditions of the contract are not yet defined, nor has the specific statutory authority the program might seek been enacted. However, if the F-35 block buy contract contains similar provisions to those in the LCS contract, Congress's ability to make funding changes could be similarly affected. Program officials noted that they are examining prior block buys, like the LCS, to identify lessons learned and looking for ways to reduce risk to the government.

Reducing costs for a program of the F-35's size is clearly desirable. However, adding an F-35 block buy to DOD's portfolio of contracts with explicit or potential long-term commitments could further affect Congress's funding flexibility. As can be seen in figure 11, long-term contracts, such as block buys and multiyear contracts, will consume 30

[16]This approach would differ from multi-year contracting under 2306b and 2306c of Title 10, U.S. Code. Sections 2306b and 2306c authorize the military departments to obligate current appropriations to enter a multiyear contract for the acquisition of property and services for the bona fide needs of up to five fiscal years, provided certain criteria set out in the statute are met.

percent of DOD's fiscal year 2016 budget and if the F-35 block buy contract was included as a long-term agreement, such agreements would comprise nearly half of DOD's budget.

Figure 11: Percentage of Multiyear and Non Multiyear Contracts in Department of Defense's Fiscal Year 2016 Major Defense Acquisition Program Procurement Budget



Source: GAO analysis of Department of Defense data. | GAO-16-390

Conclusions

The F-35 development program is nearing completion and aircraft manufacturing continues to improve. While much of the remaining developmental flight testing will be challenging, and some additional discoveries are likely, the program has mitigated many of the technical risks that we have reported on over the past several years. However, the program is not without risks. Performance issues with ALIS and new issues with the ejection seat and F-35C wing structures pose ongoing risks. Going forward, the program will continue to experience affordability and oversight challenges. DOD still expects that beginning in 2022 it will need more than $14 billion a year on average for a decade to procure aircraft. It is unlikely that the program will be able to receive and sustain such a high level of funding over this extended period, especially given DOD's competing resources such as the long range strike bomber and KC-46A tanker. While a block buy can offer savings and stability, how the

contract terms are developed will be an important consideration so as not to affect congressional funding flexibility, especially when considering that nearly a third of DOD's acquisition budget is already covered by multiyear commitments. Further congressional oversight challenges are presented because of DOD's plan to manage Block 4 under the current acquisition program baseline and because key reporting requirements and oversight mechanisms will not be initiated. Best practices recommend an incremental approach in which new development efforts are structured and managed as separate acquisition programs with their own requirements and acquisition program baselines. Without an acquisition program baseline and regular reporting on progress, it will be difficult for Congress to hold DOD accountable for achieving F-35 Block 4 cost, schedule, and performance goals.

Matter for Congressional Consideration

To enhance program oversight and accountability given that DOD does not plan to modify its acquisition strategy and hold a Milestone B decision review for the F-35 follow-on modernization program, Congress should consider directing the Secretary of Defense to hold a Milestone B review and manage F-35 Block 4 as its own separate and distinct major defense acquisition program with its own acquisition baseline and regular cost, schedule, and performance report to Congress.

Recommendations for Executive Action

In order to ensure that proper statutory and regulatory oversight mechanisms are in place and to increase transparency into a major new investment in the F-35 program, we recommend that the Secretary of Defense hold a Milestone B review and manage F-35 Block 4 as a separate and distinct Major Defense Acquisition Program with its own acquisition program baseline and regular cost, schedule, and performance reports to the Congress.

Agency Comments and Our Evaluation

DOD provided us with written comments on a draft of this report. DOD's comments are reprinted in appendix II. DOD also provided technical comments, which were incorporated as appropriate.

DOD did not concur with our recommendation to hold a Milestone B review and manage F-35 Block 4 follow-on modernization as a separate and distinct major defense acquisition program. DOD stated that it views Block 4 as a continuation of the existing F-35 acquisition program, which it believes is the department's most closely managed system. DOD went on to explain that it plans to use existing F-35 oversight mechanisms like regularly scheduled high-level acquisition reviews to manage its Block 4

efforts. In addition, the department noted that it is exploring ways to provide further transparency into the cost, schedule, and performance progress of Block 4, like establishing separate Block 4 budget lines, instituting contract cost performance reporting, and developing an independent cost estimate.

While we recognize that DOD policy provides flexibility to manage programs in different ways, and we would encourage DOD to manage Block 4 efficiently, the management approach should not sacrifice transparency or oversight. As noted in this report, DOD is currently conducting activities typical of a program preparing to begin system development including requirements definition and preliminary design, and expects to award a new development contract for Block 4 in fiscal year 2018. DOD expects Block 4 modernization to develop and deliver 80 new capabilities and 17 weapons that were not part of the program's original acquisition baseline. In its fiscal year 2017 budget request, DOD has identified the need for nearly $3 billion over the next 6 years for development of these new capabilities. We continue to believe that a development effort of this magnitude should be established as a major defense acquisition program—as defined in statute and DOD policy—with a Milestone B review and a separate and distinct business case and acquisition program baseline. This would make the new program subject to key statutory oversight mechanisms—including Nunn-McCurdy unit cost growth thresholds—and DOD would be required to provide regular cost, schedule, and performance reports to Congress. If Block 4 is managed as a distinct program with a separate baseline, it would be easier for Congress and DOD decision makers to track program-specific cost and schedule progress. A hypothetical $1 billion cost increase in Block 4 illustrates the difference in cost reporting and oversight. While a $1 billion cost increase is significant, it would represent growth of less than 1 percent if tracked against the current F-35 program baseline, which is currently about $400 billion. That same cost increase, if tracked against the $3 billion funding estimate reflected in DOD's budget request for Block 4, would be more visible, representing a 33 percent cost increase. This is not the first time DOD has been faced with a decision like this. As noted in this report, the Air Force's F-22 modernization program began in a similar situation. However, the Air Force eventually chose to hold a Milestone B review for F-22 modernization and manage it as a separate and distinct acquisition program, which increased transparency and better facilitated oversight. Therefore, we continue to believe that our recommendation is valid and as such are making a matter for congressional consideration.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Defense, and Under Secretary of Defense for Acquisition, Technology, and Logistics. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or sullivanm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix IV.

Michael J. Sullivan
Director, Acquisition and Sourcing Management

List of Committees

The Honorable John McCain
Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Thad Cochran
Chairman
The Honorable Richard J. Durbin
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Mac Thornberry
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Rodney P. Frelinghuysen
Chairman
The Honorable Pete Visclosky
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Appendix I: Prior GAO Reports on F-35 Joint Strike Fighter and Department of Defense (DOD) Responses and Subsequent Actions

GAO report	Estimated Development Costs Development Length Aircraft unit cost	Key program event	Primary GAO Conclusions/Recommendation	DOD response and actions
2001 GAO-02-39	$34.4 Billion 10 years $69 Million	Start of system development and demonstration approved.	Critical technologies needed for key aircraft performance elements are not mature. Program should delay start of system development until critical technologies are mature to acceptable levels.	DOD did not delay start of system development and demonstration stating technologies were at acceptable maturity levels and stated it will manage risks in development.
2005 GAO-05-271	$44.8 Billion 12 years $82 Million	The program undergoes re-plan to address higher than expected design weight, which added $7 billion and 18 months to development schedule.	We recommended that the program reduce risks and establish executable business case that is knowledge-based with an evolutionary acquisition strategy.	DOD partially concurred but did not adjust strategy, believing that its approach was balanced between cost, schedule and technical risk.
2006 GAO-06-356	$45.7 Billion 12 years $86 Million	Program sets in motion plan to enter production in 2007 shortly after first flight of the non-production representative aircraft.	The program was entering production with less than 1 percent of testing complete. We recommended the program delay investing in production until flight testing shows that the Joint Strike Fighter performs as expected.	DOD partially concurred but did not delay start of production because it believed the risk level was appropriate.
2007 GAO-07-360	$44.5 Billion 12 years $104 Million	Congress reduced funding for first two low-rate production buys thereby slowing the ramp-up of production.	Progress was being made but concerns remained about undue overlap in testing and production. We recommended limits to annual production quantities to 24 a year until flying quantities were demonstrated.	DOD did not concur and stated that the program had an acceptable level of concurrency and an appropriate acquisition strategy.
2008 GAO-08-388	$44.2 Billion 12 years $104 Million	DOD implemented a Mid-course Risk Reduction Plan to replenish management reserves from about $400 million to about $1 billion by reducing test resources.	We found the new plan increased risks and DOD should revise it to address concerns about testing, management reserves, and manufacturing. We determined that the cost estimate was not reliable and recommended the need for a new cost estimate and schedule risk assessment.	DOD did not revise the risk plan or restore testing resources, stating that they will monitor the new plan and adjust it if necessary. Consistent with a report recommendation, a new cost estimate was prepared, but DOD did not conduct a risk and uncertainty analysis.
GAO report	Estimated development costs Development length aircraft unit cost	Key program event	Primary GAO Conclusion/Recommendation	DOD response and actions

2009 GAO-09-303	$44.4 Billion 13 years $104 Million	The program increased the cost estimate and added a year to development but accelerated the production ramp-up. An independent DOD cost estimate (JET I) projected even higher costs and further delays.	We concluded that moving forward with an accelerated procurement plan and use of cost reimbursement contracts was very risky. We recommended the program report on the risks and mitigation strategy for this approach.	DOD agreed to report its contracting strategy and plans to Congress and conduct a schedule risk analysis. The program reported completing the first schedule risk assessment with plans to update semi-annually. The Department announced a major program reducing procurement and moving to fixed-price contracts.
2010 GAO-10-382	$49.3 Billion 15 years $112 Million	The program was restructured to reflect findings from a recent independent cost team (JET II) and independent manufacturing review team. As a result, development funds increased, test aircraft were added, the schedule was extended, and the early production rate decreased.	Costs and schedule delays inhibited the program's ability to meet needs on time. We recommended the program complete a full comprehensive cost estimate and assess warfighter and IOC requirements. We suggested that Congress require DOD to tie annual procurement requests to demonstrated progress.	DOD continued restructuring, increasing test resources and lowering the production rate. Independent review teams evaluated aircraft and engine manufacturing processes. Cost increases later resulted in a Nunn-McCurdy breach. Military services are currently reviewing capability requirements as we recommended.
2011 GAO-11-325	$51.8 Billion 16 years $133 Million	Restructuring continued with additional development cost increases, schedule growth, further reduction in near-term procurement quantities, and decreased the rate for future production. The Secretary of Defense placed the Short-takeoff Vertical Landing variant on a two-year probation; decoupled STOVL from the other variants; and reduced STOVL production plans for fiscal years 2011 to 2013.	We concluded that the restructuring actions were positive and if implemented properly, should lead to more achievable and predictable outcomes. Concurrency of development, test, and production was substantial and provided risk to the program. We recommended DOD maintain funding levels as budgeted; establish criteria for STOVL probation; and conduct an independent review of software development, integration, and test processes.	DOD concurred with all three of the recommendations. DOD lifted STOVL probation citing improved performance. Subsequently, DOD further reduced procurement quantities, decreasing funding requirements through 2016. The initial independent software assessment began and ongoing reviews were planned to continue through 2012.

2012 GAO-12-437	$55.2 Billion 18 years $137 Million	The program established a new acquisition program baseline and approved the continuation of system development, increasing costs for development and procurements and extending the period of planned procurements by 2 years.	Extensive restructuring placed the program on a more achievable course. Most of the program's instability continued to be concurrency of development, test, and production. We recommended that the Cost Assessment Program Evaluation office conduct an analysis on the impact of lower annual funding levels; and the program office conduct an assessment of the supply chain and transportation network.	DOD partially concurred with conducting an analysis on the impact of lower annual funding levels and concurred with assessing the supply chain and transportation network.
2013 GAO-13-309	$55.2 Billion 18 years $137 Million	The program continued to move forward following a new acquisition program baseline in 2012. In doing so, the program incorporated positive and more realistic restructuring actions taken since 2010 including more time and funding for development and deferred procurement of more than 400 aircraft to future years.	The program was moving in the right direction but must fully validate design and operational performance and at the same time make the system affordable. We did not make recommendations to DOD in this report.	DOD agreed with GAO's observations.
2014 GAO-14-322	$55.2 Billion 18 years $135 Million	The services established initial operational capabilities dates in 2013. The Marine Corps and Air Force are planning to field initial operational capabilities in 2015 and 2016, respectively, and the Navy plans to field its initial capability in 2018.	Delays in developmental flight testing of the F-35's critical software may hinder delivery of the warfighting capabilities to the military services. We recommended DOD conduct an assessment of the specific capabilities that can be delivered and those that will not likely be delivered to each of the services by their established initial operational capability dates.	DOD concurred with our recommendation and officials stated they are in the process of conducting the assessment.

2014 GAO-14-778	Not reported	DOD was developing several plans and analyses that will make up its overall F-35 sustainment strategy, which was expected to be complete in fiscal year 2019.	The annual F-35 operating and support costs were estimated to be considerably higher than the combined annual costs of several legacy aircraft. DOD had not fully addressed several issues that have an effect on affordability and operational readiness. Operating and support cost estimates may not be fully reliable. GAO recommended that DOD develop better informed affordability constraints; address three risks that could affect sustainment, affordability, and operational readiness; and take steps to improve the reliability of its cost estimates.	DOD concurred with all but one recommendation and partially concurred with the recommendation to conduct uncertainty analysis on one of its cost estimates, stating it already conducts a form of uncertainty analysis.
2015 GAO-15-364	$54.9 billion 18 years $136 million	Since the 2012 re-baselining, DOD has made changes to its F-35 procurement plans on an annual basis. The program also competed with other high priority DOD programs for funding. In 2013 and 2014 DOD deferred a number of aircraft, extending the length of the program, and increasing funding liability in the future.	The consistent changes in F-35 procurement plans indicate that the analysis done to support the program's 2012 baseline did not accurately account for future technical risks or funding realities. We recommended DOD conduct an affordability analysis of the current procurement plan that reflects various assumptions about technical progress and funding availability.	DOD concurred with the recommendation and stated that it accomplishes an analysis of the program's current procurement plans with various assumptions about technical progress and funding availability every year as it conducts reviews for the budget process.

Appendix II: Scope and Methodology

To assess the program's cost and affordability, we reviewed total program funding requirements using the December 2015 Selected Acquisition Report. We used these data to project annual funding requirements through the expected end of the F-35 acquisition in 2038. We also compared the December 2015 Selected Acquisition Report to prior Selected Acquisition Reports to identify changes in cost and quantity. We obtained life-cycle operating and support cost through the program's 2015 Selected Acquisition Report and projections made by the Cost Analysis and Program Evaluation office.

To assess the program's remaining development and testing we interviewed officials from the program office, contractors, Lockheed Martin and Pratt & Whitney. We obtained and analyzed data on flights and test points, both planned and accomplished during 2015. We compared test progress against the total program plans to complete. In addition, we interviewed officials from the F-35 program office, Lockheed Martin, Pratt & Whitney, and the Director, Operational Test and Evaluation office to discuss development test plans, achievements, and test discoveries. We also collected relevant information from the program office, Lockheed Martin, Pratt & Whitney, and Department of Defense test pilots regarding the program's technical risks including the helmet mounted display, autonomic logistics information system, carrier arresting hook, structural durability, ejection seat, and engine.

To assess ongoing manufacturing and supply chain performance we obtained and analyzed data related to aircraft delivery rates and work performance data through the end of calendar year 2015. These data were compared to program objectives identified in these areas and used to identify trends. We reviewed data and briefings provided by the program office, Lockheed Martin, Pratt & Whitney, and the Defense Contract Management Agency in order to identify issues in manufacturing processes. We discussed reasons for delivery delays and plans for improvement with Lockheed Martin and Pratt & Whitney. We also toured Lockheed Martin's manufacturing facility in Ft. Worth, Texas and Pratt & Whitney's manufacturing facility in Middletown, Connecticut. We collected and analyzed data related to aircraft quality through December 2015. We collected and analyzed supply chain performance data and discussed steps taken to improve quality and deliveries with Lockheed Martin and Pratt & Whitney. We also analyzed reliability and maintainability data and discussed these issues with program and contractor officials.

To assess future modernization and procurement plans, we discussed cost and manufacturing efficiency initiatives, such as the block buy

approach, with contractor and program office officials to understand potential cost savings and plans. To assess the program's follow-on modernization plans we discussed the program's plans and with program office officials. We reviewed the fiscal year 2016 and fiscal year 2017 budget requests to identify costs associated with the effort. We collected and analyzed information regarding capability and oversight plans for the development effort. We also reviewed and analyzed best practices identified by GAO and reviewed relevant DOD policies and statutes.

We assessed the reliability of DOD and contractor data by reviewing existing information about the data, and interviewing agency officials knowledgeable about the data. We determined that the data were sufficiently reliable for the purposes of this report. We conducted this performance audit from June 2015 to April 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix III: Comments from the Department of Defense

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3015 DEFENSE PENTAGON
WASHINGTON, DC 20301-3015

ACQUISITION

APR 4 2016

Mr. Michael J. Sullivan
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, NW
Washington DC 20548

Dear Mr. Sullivan:

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-16-390, "F-35 JOINT STRIKE FIGHTER: Continued Oversight Needed as Program Plans to Begin Development of New Capabilities," dated March 1, 2016 (GAO Code 100138).

The Department acknowledges receipt of the draft report. As more fully explained in the enclosure, the Department non-concurs with the recommendation.

We appreciate the opportunity to comment on the draft report. Should you have any questions, please contact Ms. Leigh Anne Bierstine who can be reached at 703-692-4149 or leigh.a.bierstine.civ@mail.mil.

Sincerely,

James A. MacStravic
Deputy Assistant Secretary of Defense
Tactical Warfare Systems
Performing the Duties of the ASD(A)

Enclosure:
As stated

GAO DRAFT REPORT DATED MARCH 1, 2016
GAO-16-390 (GAO CODE 100138)

"F-35 JOINT STRIKE FIGHTER: CONTINUED OVERSIGHT NEEDED AS PROGRAM PLANS TO BEGIN DEVELOPMENT OF NEW CAPABILITIES"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATION

RECOMMENDATION: In order to ensure that proper statutory and regulatory oversight mechanisms are in place and to increase transparency into a major new Investment in the F-35 program, GAO recommends that the Secretary of Defense hold a Milestone B review and manage F-35 Block 4 as a separate and distinct Major Defense Acquisition Program with its own acquisition program baseline and regular cost, schedule, and performance reports to the Congress.

DoD RESPONSE: Non-concur. The Department views Block 4 efforts as a continuation of the existing program rather than the start of a new Major Defense Acquisition Program. F-35 continues to be the Department's most closely managed system. The existing oversight mechanisms, management structure, and decision processes, including Defense Acquisition Board reviews prior to any major commitments of resources, will be used to manage F-35 Follow on Modernization. From a cost and programming perspective, additional transparency measures include: separate budget lines for the modernization effort; creating a plan for cost reporting that clearly tracks modernization content, apart from other F-35 program content; and initiating plans to conduct an independent cost estimate that assesses the effort required to execute the modernization effort. This streamlined yet measured acquisition approach enables a seamless continuation of the current F-35 program with a focus on delivering accelerated incremental improvements.

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

Michael J. Sullivan (202) 512 – 4841 or sullivanm@gao.gov

Staff Acknowledgments

In addition to the contact name above, the following staff members made key contributions to this report: Travis Masters, Assistant Director; Peter Anderson, Kurt Gurka, Kristine Hassinger, Jillena Roberts, Megan Setser, and Roxanna Sun.

Appendix V: Accessible Data

Agency Comment Letter

Text of Appendix III: Comments from the Department of Defense

Page 1

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

3015 DEFENSE PENTAGON

WASHINGTON, DC 20301-301 5

ACQUISITION

APR 4 2016

Mr. Michael J. Sullivan

Director, Acquisition and Sourcing Management

U.S. Government Accountability Office

441 G Street, NW

Washington DC 20548

Dear Mr. Sullivan:

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GA0-16-390, "F-35 JOINT STRIKE FIGHTER: Continued Oversight Needed as Program Plans to Begin Development of New Capabilities," dated March 1, 2016 (GAO Code 100138).

The Department acknowledges receipt of the draft report. As more fully explained in the enclosure, the Department non-concurs with the recommendation.

We appreciate the opportunity to comment on the draft report. Should you have any questions, please contact Ms. Leigh Anne Bierstine who can be reached at 703-692-4149 or leigh.a.bierstine.civ@mail.mil.

Sincerely,

James A. MacStravic

Deputy Assistant Secretary of Defense

Tactical Warfare Systems

Performing the Duties of the ASD(A)

Enclosure: As stated

Page 2

GAO DRAFT REPORT DATED MARCH 1, 2016 GA0-16-390 (GAO CODE 100138)

"F-35 JOINT STRIKE FIGHTER: CONTINUED OVERSIGHT NEEDED AS PROGRAM PLANS TO BEGIN DEVELOPMENT OF NEW CAPABILITIES"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATION

RECOMMENDATION: In order to ensure that proper statutory and regulatory oversight mechanisms are in place and to increase transparency into a major new Investment in the F-35 program, GAO recommends that the Secretary of Defense hold a Milestone B review and manage F-35 Block 4 as a separate and distinct Major Defense Acquisition Program with its own acquisition program baseline and regular cost, schedule, and performance reports to the Congress.

DoD RESPONSE: Non-concur. The Department views Block 4 efforts as a continuation of the existing program rather than the start of a new Major Defense Acquisition Program. F-35 continues to be the Department's most closely managed system. The existing oversight mechanisms, management structure, and decision processes, including Defense Acquisition Board reviews prior to any major commitments of resources, will be used to manage F-35 Follow on Modernization. From a cost and programming perspective , additional transparency measures include: separate budget lines for the modernization effort; creating a plan for cost reporting that clearly tracks modernization content, apart from other F-35 program content; and initiating plans to conduct an independent cost estimate that assesses the effort required to execute the modernization effort. This streamlined yet measured acquisition approach enables a seamless continuation of the current F-35 program with a focus on delivering accelerated incremental improvements.

Data Tables

Data Table for Highlights Figure: F-35 Joint Strike Fighter Block 4 Development Costs Increase Near-Term Funding Needs

Year	Dollars (then-year millions)
“2016	91.0
"2017	264.9
"2018	609.4

Year	Dollars (then-year millions)
"2019	649.2
"2020	655.3
"2021	668.2

Data Table for Figure 1: Changes in F-35 Joint Strike Fighter Procurement Quantities Expected between 2006 and 2019

	System Design and Development and 2003 annual plan (1,966 aircraft by 2019)	2007 annual plan (1,035 aircraft by 2019)	2012 annual plan (585 aircraft by 2019)
"2006"	10	0	0
"2007"	22	2	2
"2008"	49	12	12
"2009"	82	16	14
"2010"	108	30	30
"2011"	156	43	32
"2012"	194	82	31
"2013"	194	90	29
"2014"	194	110	29
"2015"	194	130	44
"2016"	194	130	66
"2017"	194	130	76
"2018"	194	130	110
“2019”	181	130	110

Data Table for Figure 2: F-35 Joint Strike Fighter Budgeted Development and Procurement Costs by Service

	Air Force development	Air Force procurement	Navy development	Navy procurement	Average	Aircraft purchased
"2016"	0.5155	6.0198	0.9737	3.857	11.4	68
"2017"	0.4035	5.25	1.0114	3.4532	10.1	63
"2018"	0.1136	6.0814	0.1322	4.5119	10.8	70
"2019"	0.0053	5.7102	0.0096	4.6919	10.4	80
"2020"	0.0054	5.8495	0.0058	5.4289	11.3	86
"2021"	0.0055	6.8191	0.0039	6.2878	13.1	105
"2022"	0	9.0387	0	5.8661	14.9	120
"2023"	0	8.1643	0	5.1451	13.3	120

	Air Force development	Air Force procurement	Navy development	Navy procurement	Average	Aircraft purchased
"2024"	0	8.3072	0	5.2718	13.6	120
"2025"	0	9.1248	0	5.5928	14.	120
"2026"	0	10.1977	0	6.1419	16.3	120
"2027"	0	9.6861	0	5.6928	15.4	120
"2028"	0	8.818	0	5.2636	14.1	120
"2029"	0	9.1267	0	5.2209	14.3	120
"2030"	0	9.8767	0	4.3725	14.2	112
"2031"	0	11.1599	0	2.9177	14.1	100
"2032"	0	10.6152	0	3.064	13.7	100
"2033"	0	9.9707	0	2.8957	12.9	100
"2034"	0	10.1021	0	0	10.1	80
"2035"	0	11.0095	0	0	11.0	80
"2036"	0	11.1847	0	0	11.2	80
"2037"	0	11.3339	0	0	11.3	80
"2038"	0	9.5869	0	0	9.6	62

Data Table for Figure 3: F-35 Joint Strike Fighter Flight Science Test Point Progress as of December 2015

F-35A flight sciences	Test points cumulative performed	11.02
	Test points cumulative planned	11.043
	Total test points expected	12.893
F-35B flight sciences	Test points cumulative performed	14.118
	Test points cumulative planned	14.099
	Total test points expected	18.069
F-35C flight sciences	Test points cumulative performed	10.909
	Test points cumulative planned	10.766
	Total test points expected	14.430

Accessible Text for Figure 4: Subsequent Development and Flight Test Status of F-35 Joint Strike Fighter Mission Systems Software Blocks as of December 2015

Block 3F:

Full warfighting capability

Includes full avionics and weapons envelope

Block 3i:

Extension of Block 2B capabilities

Includes adding Block 2B capabilities to new technology hardware, export compliance, and new helmet with improved display system

Block 2B:

Initial warfighting capability

Includes basic close air support/interdiction, and initial air-to-air capability

Block 1 and 2A:

Training capability

Includes basic navigation, mission planning, flight displays, voice communication, and threat jamming

Data Table for Figure 6: Trend in Labor Hours to Build F-35 Joint Strike Fighter Aircraft by Variant

	F-35A	F-35B	F-35C
"1"	153875	141219	113997
2	138007	133781	110681
"3"	134776	126119	101032
4	131550	133758	99749.8
"5"	132922	129453	94321.6
6	122957	120784	88690.4
"7"	113535	123641	92731.6
8	118299	121476	82652
"9"	114877	110488	84343.5
10	106620	103280	85491.5
"11"	102047	108321	75449.5
12	100662	106370	81356
"13"	92181.1	96484.5	83077.1
14	95550.7	96783.3	74439.5
"15"	96042.9	92265.2	73541.7
16	92249.8	99151.2	72614.4
"17"	85465.2	96760.9	64149.5
18	81430.2	86928.6	65688.9
"19"	83242.3	88520.9	63947.5
20	92144.5	83442.3	67757.4
"21"	82027.4	81366.1	60583.1

	F-35A	F-35B	F-35C
22	80368.8	79315.5	56609.5
"23"	75220.7	96174.8	No data
24	83064.8	76761.8	No data
"25"	79400.2	87686.7	No data
26	79433.4	83520	No data
"27"	75453.7	80105.4	No data
28	80788.1	83967.3	No data
"29"	76982.4	75650.7	No data
30	77229.4	72576.1	No data
"31"	73115.3	79641.8	No data
32	72249.9	78999.4	No data
"33"	68126.1	83709.2	No data
34	70310.6	83564.4	No data
"35"	66640.4	87986.2	No data
36	72250	80559.5	No data
"37"	65220.6	69384.5	No data
38	67445.3	70471.8	No data
"39"	67566.2	74095.6	No data
40	64988.6	67393.5	No data
"41"	58372.7	65109.6	No data
42	62752.3	62879.9	No data
"43"	64680.8	60227	No data
44	60565.4	58959.1	No data
"45"	65012.3	55515.6	No data
46	59365.9	No data	No data
"47"	59100.4	No data	No data
48	60522.2	No data	No data
"49"	56160.8	No data	No data
50	65686.5	No data	No data
"51"	62583.6	No data	No data
52	60871	No data	No data
"53"	58615.1	No data	No data
54	57407.7	No data	No data
"55"	57185.4	No data	No data
56	52303.5	No data	No data
"57"	56725.2	No data	No data
58	52030.6	No data	No data

	F-35A	F-35B	F-35C
"59"	54988.4	No data	No data
60	53348.3	No data	No data
"61"	57234.8	No data	No data
62	50308.5	No data	No data
"63"	50353.9	No data	No data
64	51991.8	No data	No data
"65"	47904.4	No data	No data
66	42338.7	No data	No data
"67"	51061.9	No data	No data
68	49127.7	No data	No data
"69"	50369.8	No data	No data
70	51765.6	No data	No data
"71"	51872.1	No data	No data
72	51831.2	No data	No data
"73"	45169.1	No data	No data
74	49878.1	No data	No data
"75"	48267.2	No data	No data
76	47927.6	No data	No data
"77"	47203.3	No data	No data
78	45432.9	No data	No data
"79"	42618.3	No data	No data
80	42992.3	No data	No data
"81"	39637.6	No data	No data
82	47253.4	No data	No data
"83"	46518	No data	No data
84	47392.2	No data	No data
"85"	39483	No data	No data
86	40462.4	No data	No data
"87"	39502.6	No data	No data

Data Table for Figure 7: Reduction in Average Monthly F-35 Joint Strike Fighter Part Shortage Occurrences at Prime Contractor Facility from 2014 to 2015

	Less severe (category 1-3)	Most severe (category 4 or more)
2014	480	280
2015	269	89

Data Table for Figure 8: Trend in Labor Hours to build the F-35 Joint Strike Fighter Engine

Total actual hours of labor	Number of engines built	Line of best fit
3170	1	3765.9
3089	2	3420.8
3471	3	3218.9
4087	4	3075.7
4172	5	2964.6
5133	6	2873.8
3748	7	2797.0
3572	8	2730.5
2889	9	2671.9
2599	10	2619.4
2500	11	2572.0
2738	12	2528.7
2754	13	2488.8
2647	14	2451.9
2019	15	2417.6
2078	16	2385.4
2096	17	2355.2
2009	18	2326.8
1787	19	2299.9
1714	20	2274.3
1914	21	2250.0
2100	22	2226.9
1760	23	2204.7
1734	24	2183.5
2603	25	2163.2
1713	26	2143.7
1703	27	2124.9
1669	28	2106.8
1531	29	2089.3
1794	30	2072.4
1748	31	2056.1
1726	32	2040.3
3020	33	2025.0
2007	34	2010.1
2186	35	1995.7

Total actual hours of labor	Number of engines built	Line of best fit
1919	36	1981.7
1560	37	1968.0
1954	38	1954.7
1939	39	1941.8
1664	40	1929.2
1529	41	1916.9
2089	42	1904.9
2258	43	1893.2
2258	44	1881.8
1651	45	1870.6
1902	46	1859.6
1581	47	1848.9
1352	48	1838.4
1198	49	1828.2
1538	50	1818.1
1613	51	1808.2
1386	52	1798.6
2142	53	1789.1
2093	54	1779.8
1734	55	1770.6
3006	56	1761.7
1544	57	1752.9
1286	58	1744.2
1842	59	1735.7
1462	60	1727.3
1384	61	1719.1
1564	62	1711.0
1248	63	1703.0
1214	64	1695.2
1069	65	1687.5
1426	66	1679.9
1298	67	1672.4
1268	68	1665.0
2293	69	1657.7
1434	70	1650.6
1250	71	1643.5
1230	72	1636.5

Total actual hours of labor	Number of engines built	Line of best fit
1248	73	1629.7
1874	74	1622.9
1251	75	1616.2
1274	76	1609.6
1354	77	1603.1
1213	78	1596.7
2564	79	1590.4
1195	80	1584.1
1237	81	1577.9
1209	82	1571.8
1480	83	1565.8
1118	84	1559.8
1263	85	1553.9
1306	86	1548.1
1304	87	1542.3
1413	88	1536.6
1658	89	1531.0
1207	90	1525.4
1270	91	1519.9
1294	92	1514.5
1159	93	1509.1
1159	94	1503.8
2405	95	1498.5
1273	96	1493.3
1441	97	1488.2
1328	98	1483.0
1128	99	1478.0
1257	100	1473.0
1192	101	1468.0
1122	102	1463.1
1052	103	1458.3
1357	104	1453.5
1222	105	1448.7
1133	106	1444.0
1115	107	1439.3
1162	108	1434.7
1185	109	1430.1

Total actual hours of labor	Number of engines built	Line of best fit
1920	110	1425.5
1188	111	1421.0
1188	112	1416.6
1075	113	1412.1
1288	114	1407.7
1250	115	1403.4
1081	116	1399.1
1025	117	1394.8
1069	118	1390.6
1736	119	1386.4
1395	120	1382.2
2804	121	1378.1
1272	122	1374.0
1082	123	1369.9
1193	124	1365.9
1108	125	1361.9
1136	126	1357.9
1278	127	1354.0
1215	128	1350.1
1658	129	1346.2
1192	130	1342.4
1129	131	1338.5
1084	132	1334.8
1241	133	1331.0
1087	134	1327.3
1217	135	1323.6
1276	136	1319.9
1198	137	1316.2
1379	138	1312.6
1008	139	1309.0
1432	140	1305.5
1407	141	1301.9
2341	142	1298.4
2155	143	1294.9
1388	144	1291.4
1183	145	1288.0
1388	146	1284.6

Total actual hours of labor	Number of engines built	Line of best fit
1323	147	1281.2
1459	148	1277.8
1993	149	1274.4
1906	150	1271.1
1677	151	1267.8
1815	152	1264.5
1323	153	1261.2
1417	154	1258.0
1354	155	1254.8
1256	156	1251.6
1916	157	1248.4
1347	158	1245.2
1893	159	1242.1
1623	160	1239.0
1710	161	1235.9
1217	162	1232.8
1543	163	1229.7
1443	164	1226.7
1179	165	1223.6
1121	166	1220.6
1308	167	1217.7
1891	168	1214.7
1964	169	1211.7
1623	170	1208.8
1829	171	1205.9
1248	172	1203.0
1436	173	1200.1
1342	174	1197.2
1561	175	1194.4
1236	176	1191.5
1247	177	1188.7
1091	178	1185.9
1259	179	1183.1
1129	180	1180.3
1179	181	1177.6
1137	182	1174.8
1263	183	1172.1

Total actual hours of labor	Number of engines built	Line of best fit
1306	184	1169.4
1208	185	1166.7
1005	186	1164.0
847	187	1161.3
1893	188	1158.7
2151	189	1156.0
1136	190	1153.4

Data Table for Figure 10: F-35 Joint Strike Fighter Block 4 Development Costs Increase Near-term Funding Needs

Year	Dollars (then-year millions)
“2016	91.0
"2017	264.9
"2018	609.4
"2019	649.2
"2020	655.3
"2021	668.2

Data Table for Figure 11: Percentage of Multiyear and Non Multiyear Contracts in Department of Defense’s Fiscal Year 2016 Major Defense Acquisition Program Procurement Budget

Category	Percentage
F-35	18%
Multi-year contracts	30%
Non-multi year contracts	52%

Related GAO Products

F-35 Sustainment: DOD Needs a Plan to Address Risks Related to its Central Logistics System. GAO-16-439. Washington, D.C.: April 14, 2016.

F-35 Joint Strike Fighter: Preliminary Observations on Program Progress. GAO-16-489T. Washington, D.C.: March 23, 2016.

F-35 Joint Strike Fighter: Assessment Needed to Address Affordability Challenges. GAO-15-364. Washington, D.C.: April 14, 2015.

F-35 Sustainment: Need for Affordable Strategy, Greater Attention to Risks, and Improved Cost Estimates. GAO-14-778. Washington, D.C.: September 23, 2014.

F-35 Joint Strike Fighter: Slower Than Expected Progress in Software Testing May Limit Initial Warfighting Capabilities. GAO-14-468T. Washington, D.C.: March 26 2014.

F-35 Joint Strike Fighter: Problems Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities. GAO-14-322. Washington, D.C.: March 24, 2014.

F-35 Joint Strike Fighter: Restructuring Has Improved the Program, but Affordability Challenges and Other Risks Remain. GAO-13-690T. Washington, D.C.: June 19, 2013.

F-35 Joint Strike Fighter: Program Has Improved in Some Areas, but Affordability Challenges and Other Risks Remain. GAO-13-500T. Washington, D.C.: April 17, 2013.

F-35 Joint Strike Fighter: Current Outlook Is Improved, but Long-Term Affordability Is a Major Concern. GAO-13-309. Washington, D.C.: March 11, 2013.

Fighter Aircraft: Better Cost Estimates Needed for Extending the Service Life of Selected F-16s and F/A-18s. GAO-13-51. Washington, D.C.: November 15, 2012

Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks. GAO-12-437. Washington, D.C.: June 14, 2012.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-12-400SP. Washington, D.C.: March 29, 2012.

Joint Strike Fighter: Restructuring Added Resources and Reduced Risk, but Concurrency Is Still a Major Concern. GAO-12-525T. Washington, D.C.: March 20, 2012.

Joint Strike Fighter: Implications of Program Restructuring and Other Recent Developments on Key Aspects of DOD's Prior Alternate Engine Analyses. GAO-11-903R. Washington, D.C.: September 14, 2011.

Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Is Still Lagging. GAO-11-677T. Washington, D.C.: May 19, 2011.

Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags. GAO-11-325. Washington, D.C.: April 7, 2011.

Joint Strike Fighter: Restructuring Should Improve Outcomes, but Progress Is Still Lagging Overall. GAO-11-450T. Washington, D.C.: March 15, 2011.

Tactical Aircraft: Air Force Fighter Force Structure Reports Generally Addressed Congressional Mandates, but Reflected Dated Plans and Guidance, and Limited Analyses. GAO-11-323R. Washington, D.C.: February 24, 2011.

Defense Management: DOD Needs to Monitor and Assess Corrective Actions Resulting from Its Corrosion Study of the F-35 Joint Strike Fighter. GAO-11-171R. Washington D.C.: December 16, 2010.

Joint Strike Fighter: Assessment of DOD's Funding Projection for the F136 Alternate Engine. GAO-10-1020R. Washington, D.C.: September 15, 2010.

Tactical Aircraft: DOD's Ability to Meet Future Requirements is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions. GAO-10-789. Washington, D.C.: July 29, 2010.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-10-388SP. Washington, D.C.: March 30, 2010.

Joint Strike Fighter: Significant Challenges and Decisions Ahead. GAO-10-478T. Washington, D.C.: March 24, 2010.

Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time. GAO-10-382. Washington, D.C.: March 19, 2010.

Joint Strike Fighter: Significant Challenges Remain as DOD Restructures Program. GAO-10-520T. Washington, D.C.: March 11, 2010.

Joint Strike Fighter: Strong Risk Management Essential as Program Enters Most Challenging Phase. GAO-09-711T. Washington, D.C.: May 20, 2009.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-09-326SP. Washington, D.C.: March 30, 2009.

Joint Strike Fighter: Accelerating Procurement before Completing Development Increases the Government's Financial Risk. GAO-09-303. Washington D.C.: March 12, 2009.

Defense Acquisitions: Better Weapon Program Outcomes Require Discipline, Accountability, and Fundamental Changes in the Acquisition Environment. GAO-08-782T. Washington, D.C.: June 3, 2008.

Defense Acquisitions: Assessments of Selected Weapon Programs. GAO-08-467SP. Washington, D.C.: March 31, 2008.

Joint Strike Fighter: Impact of Recent Decisions on Program Risks. GAO-08-569T. Washington, D.C.: March 11, 2008.

Joint Strike Fighter: Recent Decisions by DOD Add to Program Risks. GAO-08-388. Washington, D.C.: March 11, 2008.

Tactical Aircraft: DOD Needs a Joint and Integrated Investment Strategy. GAO-07-415. Washington, D.C.: April 2, 2007.

Defense Acquisitions: Analysis of Costs for the Joint Strike Fighter Engine Program. GAO-07-656T. Washington, D.C.: March 22, 2007.

Joint Strike Fighter: Progress Made and Challenges Remain. GAO-07-360. Washington, D.C.: March 15, 2007.

Tactical Aircraft: DOD's Cancellation of the Joint Strike Fighter Alternate Engine Program Was Not Based on a Comprehensive Analysis. GAO-06-717R. Washington, D.C.: May 22, 2006.

Defense Acquisitions: Major Weapon Systems Continue to Experience Cost and Schedule Problems under DOD's Revised Policy. GAO-06-368. Washington, D.C.: April 13, 2006.

Defense Acquisitions: Actions Needed to Get Better Results on Weapons Systems Investments. GAO-06-585T. Washington, D.C.: April 5, 2006.

Tactical Aircraft: Recapitalization Goals Are Not Supported by Knowledge-Based F-22A and JSF Business Cases. GAO-06-487T. Washington, D.C.: March 16, 2006.

Joint Strike Fighter: DOD Plans to Enter Production before Testing Demonstrates Acceptable Performance. GAO-06-356. Washington, D.C.: March 15, 2006.

Joint Strike Fighter: Management of the Technology Transfer Process. GAO-06-364. Washington, D.C.: March 14, 2006.

Tactical Aircraft: F/A-22 and JSF Acquisition Plans and Implications for Tactical Aircraft Modernization. GAO-05-519T. Washington, D.C: April 6, 2005.

Tactical Aircraft: Opportunity to Reduce Risks in the Joint Strike Fighter Program with Different Acquisition Strategy. GAO-05-271. Washington, D.C.: March 15, 2005.