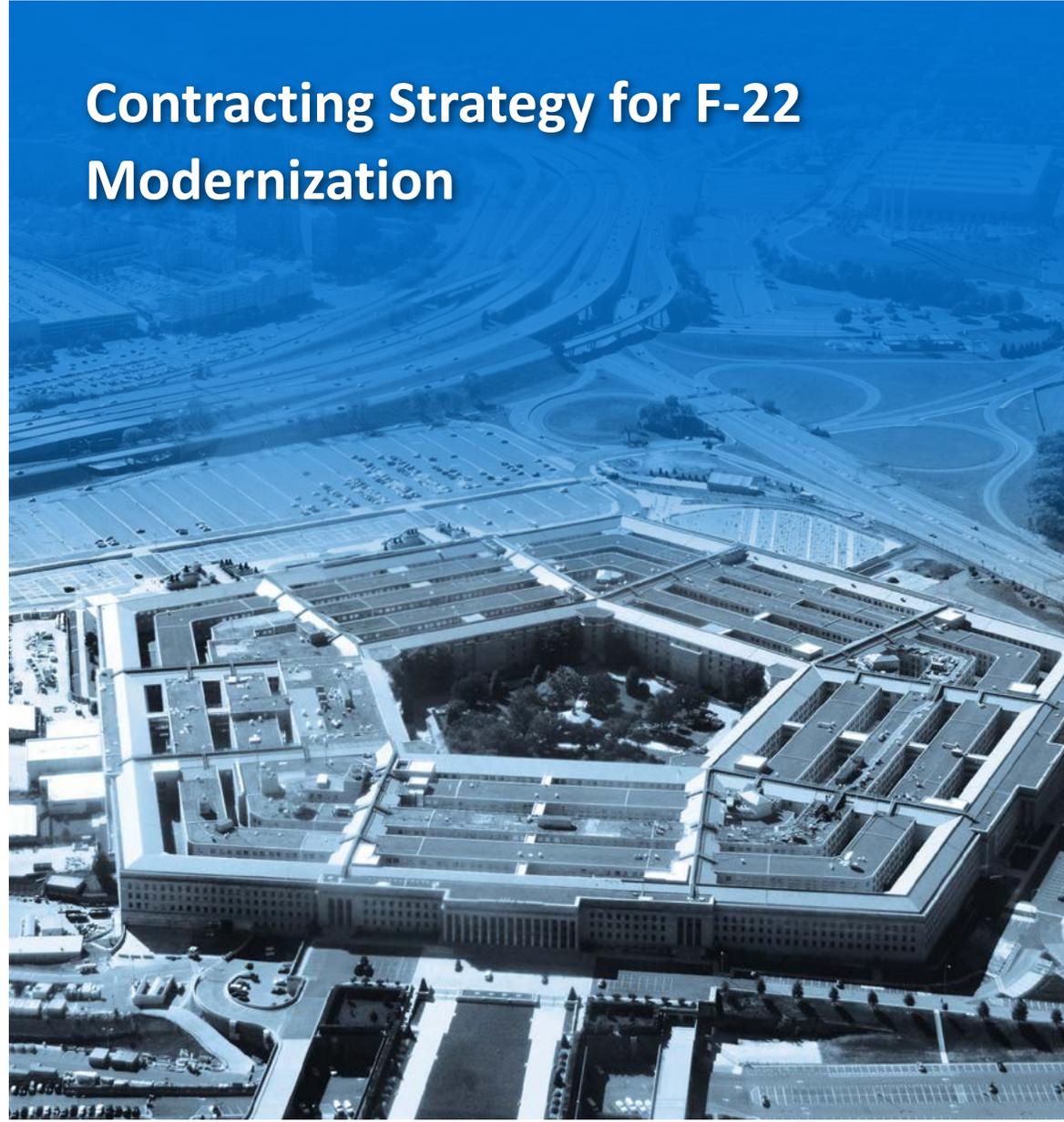




# INSPECTOR GENERAL

*U.S. Department of Defense*

MARCH 21, 2018



## Contracting Strategy for F-22 Modernization

INTEGRITY ★ EFFICIENCY ★ ACCOUNTABILITY ★ EXCELLENCE

INTEGRITY ★ EFFICIENCY ★ ACCOUNTABILITY ★ EXCELLENCE

## Mission

*Our mission is to provide independent, relevant, and timely oversight of the Department of Defense that supports the warfighter; promotes accountability, integrity, and efficiency; advises the Secretary of Defense and Congress; and informs the public.*

## Vision

*Our vision is to be a model oversight organization in the Federal Government by leading change, speaking truth, and promoting excellence—a diverse organization, working together as one professional team, recognized as leaders in our field.*



Fraud, Waste, & Abuse

**HOTLINE**

Department of Defense

[dodig.mil/hotline](https://dodig.mil/hotline) | 800.424.9098

For more information about whistleblower protection, please see the inside back cover.



# Results in Brief

## *Contracting Strategy for F-22 Modernization*

March 21, 2018

### Objective

We determined whether the U.S. Air Force effectively managed the modernization of the F-22 Raptor (F-22) fleet. Specifically, we reviewed the F-22 Program Office's implementation of Scaled Agile Framework (SAFe). SAFe is a software development method that uses short time periods to develop smaller portions of software that contribute to the final product.

### Background

The Air Force F-22 is a fighter aircraft that incorporates stealth capability in the performance of air-to-air and air-to-ground missions. In 2003, the Air Force established a modernization program to add enhanced capabilities. The Air Force divided the F-22 modernization program into 10 separate programs, with each providing multiple capabilities that included both hardware and software development.

The Program Office used several software development methods for F-22 modernization. These methods resulted in the identification of numerous deficiencies late in development and correction of the deficiencies required additional software updates. This also led to F-22 modernization schedule delays to allow time to complete the testing on the additional updates.

To identify deficiencies quicker and deliver capabilities faster, the Program Office implemented agile software development methods on future F-22 modernization

programs. Agile software development methods use close collaboration, and frequent delivery of software updates. The Program Office specifically chose to use an agile software development method known as SAFe.

### Findings

The U.S. Air Force did not effectively manage the modernization of the F-22 Raptor fleet. Specifically, the Program Office did not update its contracting strategy for SAFe implementation on F-22 modernization programs. This occurred because Program Office officials have not identified the appropriate contracting strategy to best incentivize the contractor when using SAFe. In addition, the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, and the Assistant Secretary of the Air Force, Acquisition have not issued policy for implementing agile software development methods on weapon system acquisitions. As a result, without an appropriate contracting strategy, the Program Office may not deliver F-22 modernized capabilities necessary to sustain air superiority against rapidly evolving U.S. adversaries.

### Recommendations

We recommend that the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics:

- Review and revise acquisition guidance to allow for the implementation of agile software development methods on programs that include both hardware and software development.
- Compile lessons learned from DoD programs implementing agile software development methods to share with other DoD programs.



# Results in Brief

## *Contracting Strategy for F-22 Modernization*

### **Recommendations (cont'd)**

We recommend that the F-22 Program Office:

- Determine the contracting strategy to best incentivize the contractor prior to awarding the order for the next modernization program.
- Document the lessons learned when developing the contracting strategy for use by other programs.

### **Management Comments and Our Response**

The Official Performing the Duties of the Assistant Secretary of Defense for Acquisition, responding for the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics; and the Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, responding for the F-22 Program Office, provided comments in response to a draft of this report.

The Official Performing the Duties of the Assistant Secretary of Defense for Acquisition, partially agreed with our recommendation to review and revise acquisition guidance and agreed with our recommendation to compile lessons learned from DoD programs implementing agile software development methods and share with other DoD programs. Therefore, the recommendations are resolved but remain open. We will close the recommendations once we verify that the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics has:

- reviewed and revised DoD guidance based on lessons learned and best practices to allow for the implementation of agile development methods on programs that include both hardware and software; and
- compiled lessons learned from acquisition programs implementing agile and has shared this information with other DoD programs.

The Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, agreed with our recommendations to determine the contracting strategy that best incentivizes the contractor and to document the lessons learned when developing the contracting strategy. Therefore, the recommendations are resolved but remain open. We will close the recommendations once we verify that the F-22 Program Office has:

- implemented the new contracting strategy; and
- documented lessons learned when developing the contracting strategy for agile implementation.

Please see the Recommendations Table on the next page for the status of recommendations.

## Recommendations Table

Management	Recommendations Unresolved	Recommendations Resolved	Recommendations Closed
Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics	None	1.a, 1.b	None
F-22 Program Office	None	2.a, 2.b	None

Note: The following categories are used to describe agency management’s comments to individual recommendations.

- **Unresolved** – Management has not agreed to implement the recommendation or has not proposed actions that will address the recommendation.
- **Resolved** – Management agreed to implement the recommendation or has proposed actions that will address the underlying finding that generated the recommendation.
- **Closed** – OIG verified that the agreed upon corrective actions were implemented.





**INSPECTOR GENERAL  
DEPARTMENT OF DEFENSE  
4800 MARK CENTER DRIVE  
ALEXANDRIA, VIRGINIA 22350-1500**

March 21, 2018

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION,  
TECHNOLOGY, AND LOGISTICS  
PROGRAM MANAGER, F-22 PROGRAM OFFICE

SUBJECT: Contracting Strategy for F-22 Modernization  
(Report No. DODIG-2018-089)

We are providing this report for your information and use. We conducted this audit in accordance with generally accepted auditing standards.

We considered management comments on a draft of this report when preparing the final report. Comments from an Official Performing the Duties of the Assistant Secretary of Defense for Acquisition, responding for the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics; and the Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, responding for the F-22 Program Office, conformed to the requirements of DoD Instruction 7650.03; therefore, we do not require additional comments.

We appreciate the cooperation and assistance received during the audit. Please direct questions to Mr. Kenneth VanHove at (216) 535-3777 (DSN 499-9946).

A handwritten signature in black ink, appearing to read "Theresa S. Hull", is positioned above the typed name.

Theresa S. Hull  
Assistant Inspector General  
Acquisition, Contracting, and Sustainment

# Contents

---

## Introduction

Objective .....	1
Background .....	1
F-22 Modernization Programs .....	2
Review of Internal Controls .....	6

## Finding

Contracting Strategy Needed for Scaled Agile Framework .....	7
Existing Contracting Strategy Not Updated .....	7
Contracting Strategy for Scaled Agile Framework Not Identified .....	8
No Policy for Implementing Agile Software Development Methods .....	8
Modernized Capabilities Must Be Delivered in a Timely Manner .....	10
Management Comments on the Finding and Our Response .....	10
Recommendations, Management Comments, and Our Response .....	12

## Appendix

Scope and Methodology .....	16
Use of Computer-Processed Data .....	17
Prior Coverage .....	17

## Management Comments

Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics .....	18
F-22 Program Office .....	21

<b>Acronyms and Abbreviations</b> .....	<b>23</b>
---	-----------

# Introduction

---

## Objective

We determined whether the U.S. Air Force effectively managed the modernization of the F-22 Raptor (F-22) fleet. Specifically, we reviewed the F-22 Program Office's implementation of the contract strategy for Scaled Agile Framework (SAFe). SAFe is a software development method that uses short time periods to develop smaller portions of software that contribute to the final product. See the Appendix for a discussion of the scope and methodology and prior audit coverage related to the objective.

## Background

The Air Force F-22 is a fighter aircraft that incorporates stealth capability in the performance of air-to-air and air-to-ground missions. The F-22 features a combination of integrated avionics and sophisticated sensors that allow the pilot to track, identify, shoot, and kill threats before an adversary can detect it. These features allow the F-22 to achieve and maintain air superiority against U.S. adversaries. The F-22 development began in 1986, with initial production beginning in 2001. In 2003, the Air Force established a modernization program to add enhanced capabilities. As of September 2017, the Air Force had 183 F-22s in service.



Figure 1. F-22 Aircraft  
Source: F-22 Program Office.

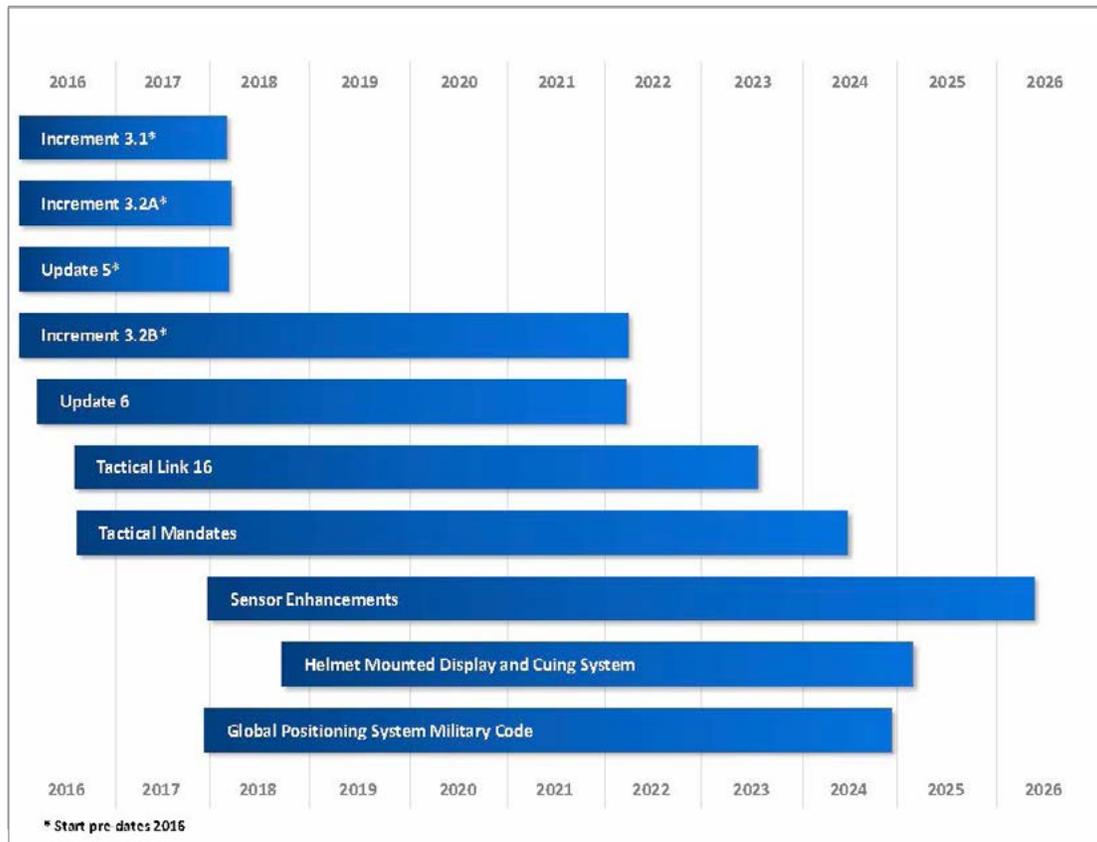
## F-22 Modernization Programs

The Air Force divided the F-22 modernization program into 10 separate programs, with each providing multiple capabilities. These modernization programs included both hardware and software development. The combined cost of these modernization programs up to the Tactical Mandates program is estimated at \$4.97 billion and includes:

- **Increment 3.1** provided enhanced air-to-ground attack capability, targeting, and electronic protection. Electronic protection prevents enemy identification of F-22 aircraft.
- **Increment 3.2A**, a software-only upgrade, provided improved electronic protection and friend-or-foe identification capabilities.
- **Update 5**, a software-only upgrade, provided radar, communications and safety of flight enhancements.
- **Increment 3.2B** will provide an enhanced weapons control processor, an improved targeting capability, new missile systems, electronic protection, and improved communications.
- **Update 6**, a software-only upgrade, will provide additional electronic protection and security for communications.
- **The Tactical Link 16** will provide DoD mandated communication transmission capabilities for fighter aircraft.
- **Tactical Mandates** will provide enhanced friend-or-foe identification capabilities.
- **The Sensor Enhancements** will provide advanced sensors.
- **The Helmet Mounted Display and Cuing System** will provide improved tracking, targeting, and enhanced weapons controls.
- **The Global Positioning System Military Code** will provide new hardware and software to prevent enemy jamming and interference.

Table 1 details the 10 ongoing and future F-22 modernization programs as of June 2017.

Table 1. Ongoing and Future F-22 Modernization Programs



Source: F-22 Program Office.

### ***Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics***

The Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (OUSD [AT&L]) is the principal staff assistant and advisor to the Secretary of Defense and Deputy Secretary of Defense. This office has oversight responsibility for major weapon systems. The OUSD (AT&L) writes acquisition, maintenance, and logistics policies for all Services and offices within the DoD.

### ***Assistant Secretary of the Air Force, Acquisition***

The Assistant Secretary of the Air Force, Acquisition, is responsible for all Air Force research, development, and acquisition activities, to include F-22 modernization. The Assistant Secretary of the Air Force, Acquisition, provides direction, guidance, and supervision on all matters pertaining to Air Force acquisition plans, policies, and programs. The Assistant Secretary of the Air Force, Acquisition, also performs milestone reviews in the acquisition process, participates in strategy development, and addresses any acquisition issues during the development of operational capabilities.

## ***F-22 Program Office***

The F-22 Program Office Modernization Branch, located at Wright-Patterson Air Force Base, Ohio, is responsible for the overall management of the modernization for the F-22 program. The Program Office's responsibilities include programming and budgeting funds, coordinating testing, and providing logistics support. One of the Program Office's key responsibilities is to develop and execute the acquisition strategy, which includes the contracting strategy.

## ***Defense Innovation Unit Experimental***

The Defense Innovation Unit Experimental is a DoD organization that solicits commercial innovations to solve national defense problems. The Defense Innovation Unit Experimental establishes pilot contracts between commercial companies and DoD organizations to determine if commercial technologies can be applied to DoD programs. The Defense Innovation Unit Experimental provided input to the Program Office pertaining to software development for the modernization programs.

## ***F-22 Modernization Contracts***

The Program Office awarded two modernization contracts. The maximum value of the first contract, awarded in 2003, was \$6 billion and included Increments 3.1, 3.2A, as well as planning for Increment 3.2B. The maximum value of the second contract, awarded in 2013, was \$6.9 billion and included Update 5; development and production work on Increment 3.2B and Update 6; and planning and development work for the Tactical Link 16 and Tactical Mandates programs. Both contracts are indefinite-delivery, indefinite-quantity contracts with primarily cost-plus-incentive-fee and cost-plus-fixed-fee delivery orders. An indefinite-delivery, indefinite-quantity contract is used when the exact quantity and times of future deliveries are not known at the time of contract award. A cost-plus-incentive-fee contract pays the contractor for costs plus a negotiated incentive fee that can be adjusted based on cost and performance. A cost-plus-fixed-fee contract pays the contractor for costs, plus a fixed fee negotiated at the beginning of the contract. The Program Office plans to award the next order on the F-22 modernization contract in the spring of 2018.

## ***F-22 Software Development***

The Program Office used several software development methods for the modernization programs. The Program Office used the waterfall method for Increments 3.1 and 3.2A. The waterfall method provided one large software update made up of several small portions of software tested individually. Under this method, developmental testers did not perform integrated testing until the

software update was installed on the aircraft for flight testing.<sup>1</sup> Developmental testers identified numerous deficiencies requiring significant software changes because they did not perform integrated testing until the updates were tested in flight.

In an attempt to reduce the number of deficiencies identified during flight testing, the Program Office began changing to an iterative method with Update 5. Update 5 used a combination of the iterative and waterfall methods and the Program Office completely implemented the iterative method for Increment 3.2B. The iterative method provided more frequent software updates than the waterfall method throughout development, and enabled quicker identification of deficiencies. However, developmental testers still did not perform integrated testing until the updates were installed on the aircraft and were tested during flight. Developmental testers still identified numerous deficiencies requiring additional software updates after the original updates were installed on the aircraft.

The deficiencies caused additional software updates under both methods, which added additional time to the original testing schedule and led to delays and increased testing costs. For example, radar deficiencies, identified in Increment 3.2A during integrated flight testing, contributed to a 12-month schedule delay and a \$5.2 million cost increase. Additionally, in Increment 3.2B, developmental testers identified a deficiency during integrated flight testing that caused the pilot's display to malfunction. The aircraft required 2 additional software updates, which incorporated 11 software changes over a 4-month period, to correct this deficiency. Table 2 provides a comparison of planned and actual software updates for each of the last three modernization programs, and the resulting delays.

*Table 2. Comparison of planned and actual software updates and associated delays for the last three F-22 modernization programs.*

Modernization Program	Number of Planned Software Updates	Number of Actual Software Updates	Number of Months Delayed*
Increment 3.2A	4	10	12
Update 5	5	12	3
Increment 3.2B	7	23	13

\*Additional unplanned software updates were the main factor in schedule delays, but testing resource availability also contributed.

Source: DoDIG.

<sup>1</sup> Integrated testing is a software development process that combines smaller portions of software to test together. Developmental testers are engineers, technicians, and pilots who conduct tests on the aircraft to determine if technical performance requirements have been achieved.

Because of these delays, the Program Office implemented an agile software development method on future modernization programs, starting with Update 6, to address issues encountered on previous programs and to deliver capabilities faster. Agile software development methods use close collaboration during development and frequent delivery of software updates. In addition, agile software development methods use smaller teams of software developers to write and deliver software products to the users. Agile software development methods also incorporate user feedback during the software development, which results in reduced errors and faster identification of deficiencies. The Program Office specifically chose to use SAFe, an agile software development method. Program Office officials described SAFe as a process that uses 12- to 14-week periods to develop smaller portions of software that contribute to the final product, rather than waiting until scheduled review points. Under SAFe, software developers perform integrated testing during the development process, which may reduce the number of identified deficiencies during flight testing and reduce the number of unplanned software updates.

## Review of Internal Controls

DoD Instruction 5010.40 requires DoD organizations to implement a comprehensive system of internal controls that provides reasonable assurance that programs are operating as intended and to evaluate the effectiveness of the controls.<sup>2</sup> We determined that the Program Office's internal controls for the F-22 modernization program were effective as they applied to the audit objective. However, Program Office officials did not update the contracting strategy for SAFe because they have not identified the appropriate contracting strategy to best incentivize the contractor on modernization programs using SAFe.

---

<sup>2</sup> DoD Instruction 5010.40, "Managers' Internal Control Program Procedures," May 30, 2013.

## Finding

### Contracting Strategy Needed for Scaled Agile Framework

The U.S. Air Force did not effectively manage the modernization of the F-22 Raptor fleet. Specifically, the Program Office did not update its contracting strategy for SAFe implementation on F-22 modernization programs. This occurred because Program Office officials have not identified the appropriate contracting strategy to best incentivize the contractor when using SAFe. In addition, the OUSD (AT&L), and the Assistant Secretary of the Air Force, Acquisition, have not issued policy for implementing agile software development methods on weapon system acquisitions. As a result, without an appropriate contracting strategy, the Program Office may not deliver F-22 modernized capabilities necessary to sustain air superiority against rapidly evolving U.S. adversaries.

### Existing Contracting Strategy Not Updated

The Program Office did not update its contracting strategy for SAFe implementation on F-22 modernization programs. The Program Office implemented SAFe for the Update 6 and Tactical Mandates modernization programs and awarded separate cost-plus-incentive-fee delivery orders under the current contracting strategy. According to Program Office contracting officials, the contracting strategy does not support SAFe and they need to determine an appropriate contracting strategy prior to awarding the next modernization program delivery order in 2018. The Program Office is considering using level of effort contracts, or other transaction authority efforts.<sup>3</sup> Other programs implementing agile software development methods are using other transaction authority efforts and time and material contracts.<sup>4</sup> In September 2017, Program Office officials began working with the Defense Innovation Unit Experimental to research potential contracting strategies for future modernization programs. However, the Program Office used the current contract to issue delivery orders in the interim to keep the overall F-22 modernization program on schedule.

<sup>3</sup> Level of effort contracts specify work in general terms for a stated period of time and do not produce definite deliverables. Payment is based on efforts expended rather than the results achieved. Other transactions are legally binding instruments that allow for research and prototyping efforts that are not subject to the Federal Acquisition Regulation and the Defense Federal Acquisition Regulation Supplement.

<sup>4</sup> Time and materials contracts provides for supplies and services based on direct labor hours and actual cost of materials.

## Contracting Strategy for Scaled Agile Framework Not Identified

Program Office officials have not identified the appropriate contracting strategy to best incentivize the contractor on modernization programs using SAFe. Previous contracting strategies used cost-plus-incentive-fee and cost-plus-fixed-fee delivery orders to incentivize the contractor based on a defined deliverable. A deliverable is an item developed by the contractor and delivered as part of the contract. The Program Office identified specific performance targets for the contractor in areas such as cost, delivery dates, and technical capabilities of the deliverable. The contractor earned an incentive fee based on the actual performance measured against the specific performance targets in the contract.



Program Office officials have not identified the appropriate contracting strategy to best incentivize the contractor on modernization programs using SAFe.

Alternatively, SAFe uses flexible principles that do not require the Program Office to define the specific deliverable and performance targets at contract award and allows the Program Office to refine the requirements during development. Additionally, the contractor can provide a different solution to meet the users need. Since the deliverable is only generally defined, and requirements can be refined under SAFe, the contractor's incentive fees cannot be established up front. According to the Program Office, there would be an allowance for flexibility that does not jeopardize the contractor's fee under an agile software development method. The existing contract does not allow for adjusting the incentive fees. According to Program Office officials, they would have difficulty assessing work already completed versus work not yet completed on each order, as well as reprioritizing the incentive structures across the orders. Therefore, the Program Office is not sure how to use a cost-plus-fixed-fee or cost-plus-incentive-fee contracting strategy to properly incentivize the contractor using SAFe. Program Office officials should determine the contracting strategy to best incentivize the contractor to develop and deliver capabilities prior to awarding the order for the next modernization program. In addition, the Program Office should document the lessons learned when developing the contracting strategy for use by other program offices implementing agile software development methods on weapon systems.

## No Policy for Implementing Agile Software Development Methods

The OUSD (AT&L) and the Assistant Secretary of the Air Force, Acquisition, have not issued policy for implementing agile software development methods on weapon system acquisitions. DoD Instruction 5000.02 provides mandatory policies,

procedures, and instructions for managing all DoD acquisition programs.<sup>5</sup> These policies require that an acquisition program have a deliverable with specific requirements defined early in development. The instruction indicates that structured reviews are performed at set points in the acquisition cycle, called milestones, to determine if progress is being made toward developing the defined deliverable. DoD Instruction 5000.02 does not address the implementation of agile software development methods in weapon system acquisitions when the deliverable is generally defined and requirements can be refined during development. Similarly, Air Force Instruction 63-101/20-1, which implements DoD Instruction 5000.02, does not address how to apply agile software development methods when acquiring weapon systems.<sup>6</sup>

Likewise, neither the Federal Acquisition Regulation (FAR) nor the Defense FAR Supplement (DFARS) provides guidance on options for measuring contractor performance when using agile software development methods. FAR Part 34 and DFARS Part 234 require the contractor for a major acquisition program to use an established measurement system for tracking the progress of a program.<sup>7</sup> The system measures elements of a program's progress including cost, schedule, and the scope of the work against the contracted deliverable. Since the deliverable is generally defined and requirements can be refined under SAFe, the established measurement system for weapon system acquisitions cannot be used.

DoD has started addressing the use of agile software development methods. According to OUSD (AT&L) officials, since 2014, DoD identified six software development programs that have or will be implementing agile software development methods. However, the F-22 modernization program will be the first DoD weapon system to implement agile software development methods that also includes hardware development. Agile has historically only been used for software development and has not previously been used for hardware development on DoD weapon systems.

The OUSD (AT&L) recognized that DoD needs guidance on implementing agile software development methods and reviewed the proposed language for the FY 2018 National Defense Authorization Act. The proposed language establishes training for the use of agile software development methods and establishes programs that will test implementation. According to OUSD (AT&L) officials, DoD policy allows acquisition requirements to be tailored; however, policy revisions may be needed to allow for implementation of agile software development

<sup>5</sup> DoD Instruction 5000.02, "Operation of the Defense Acquisition System," January 7, 2015.

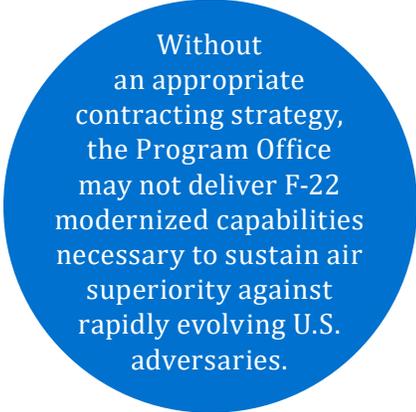
<sup>6</sup> Air Force Instruction 63-101/20-101, "Integrated Life Cycle Management," May 9, 2017.

<sup>7</sup> FAR Part 34, "Major System Acquisition," November 18, 2016.  
DFARS Part 234, "Major System Acquisition," January 29, 2014.

methods on weapon system acquisitions. Overall DoD guidance is needed to enable the successful implementation of agile software development methods, which should allow faster delivery of capabilities. The OUSD (AT&L) should review DoD Instruction 5000.02 and relevant acquisition guidance and revise, as necessary, to allow for the implementation of agile software development methods on programs that include both hardware and software. Additionally, the OUSD (AT&L) should compile lessons learned from DoD programs implementing agile software development methods to share with other DoD programs.

## Modernized Capabilities Must Be Delivered in a Timely Manner

Without an appropriate contracting strategy, the Program Office may not deliver F-22 modernized capabilities necessary to sustain air superiority against rapidly evolving U.S. adversaries. According to a Program Office official, the DoD is at risk of losing its technological edge against U.S. adversaries and it needs to find innovative ways to bring capabilities to the warfighters faster. The rapid development of new technology by U.S. adversaries will challenge the F-22's ability to sustain air superiority without the efficient delivery of modernized capabilities. Additionally, future F-22 modernization programs could be affected because each program builds upon the capabilities or enhancements achieved in prior modernization efforts. Therefore, a delay in one modernization program can have a cascading effect on follow-on modernization programs. For example, Increment 3.2A built upon the capabilities developed in Increment 3.1, and all future modernization programs will rely on upgraded processors and new hardware developed for Increment 3.2B. The use of agile across DoD is increasing, and it is imperative that DoD address the use of methodologies like agile by updating acquisition guidance. In addition, the Program Office needs to quickly identify an effective contracting strategy to increase the possibility that SAFe implementation is successful.



Without an appropriate contracting strategy, the Program Office may not deliver F-22 modernized capabilities necessary to sustain air superiority against rapidly evolving U.S. adversaries.

## Management Comments on the Finding and Our Response

### *Under Secretary of Defense for Acquisition, Technology, and Logistics Comments*

An Official Performing the Duties of the Assistant Secretary of Defense for Acquisition provided comments on the finding of this report. The Official stated that the description of capabilities added to the F-22 is partially inaccurate.

According to the Official, the F-22 does not have air-to-ground missiles, information warfare, and information gathering capabilities. Additionally, the background information on the F-22 modernization programs is incomplete and distracts from the contracting strategy finding in the report.

The Official further stated that he does not believe the evidence presented in the report provides a reasonable basis for the finding. According to the Official, the finding that the U.S. Air Force did not effectively manage the modernization of the F-22 Raptor fleet is inconsistent with the determination that the F-22 Program Office's internal controls for the F-22 modernization program were effective, as they applied to the audit objective. The Official stated that the only evidence to support that the F-22 modernization program is not effectively managed is that the F-22 Program Office had not updated its contracting strategy. Additionally, the Official stated that the report does not identify the best contracting strategy to use under the agile software development methods.

### *Our Response*

We agree with the Official's comments that the F-22 modernization program does not add air-to-ground missiles, information warfare, or information gathering capabilities and have removed references to these capabilities from the report. However, we do not agree with the Official's comment that the background information is incomplete. The background information presented is limited to include information that is relevant to the finding and the offices involved.

As stated in the report and in management's comments, the Program Office's internal controls were effective in relation to the audit objective. While the Program Office has effectively managed aspects of the F-22 modernization program, it did not effectively manage updating the contracting strategy for implementing SAFe. The contractor began using SAFe in December 2014 and the Program Office has yet to update its contracting strategy. According to Program Office officials, the current contracting strategy does not support SAFe implementation and the Program Office is currently in the process of identifying an appropriate contracting strategy. Therefore, the Program Office did not effectively manage the modernization of the F-22 Raptor fleet. We agree with the Official's comment that our report does not identify the specific contracting strategy for the Program Office to use under SAFe. The intent of the report was not to limit the Program Office's decision-making ability on which contracting strategy is best when implementing agile development methods, but rather to ensure that a new strategy is completed.

### *Assistant Secretary of the Air Force for Acquisition Comments*

The Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, disagreed that the Air Force did not effectively manage the modernization of the F-22 Raptor fleet. The Director stated that since 2015, the F-22 Program Office has successfully completed the engineering and manufacturing development phase and is in the final stages of initial operational test and evaluation. According to the Director, the F-22 Program Office demonstrated effective management by implementing an agile strategy to field capabilities faster. Additionally, the F-22 modernization program will be the first program to implement agile strategies for weapon system software and hardware. Finally, the Director stated that the agile strategy is consistent with the Air Force Digital Services 2017 report, the National Defense Authorization Act for Fiscal Year 2018, and Recommendation 1.

### *Our Response*

We agree with the Director's comments that the Program Office has effectively managed aspects of the F-22 modernization program, such as completing the engineering and manufacturing development phase for Increment 3.2B. However, the Program Office did not effectively manage updating its contracting strategy for SAFe, which the contractor started using in December 2014. According to Program Office officials, the current contracting strategy does not support SAFe implementation and the Program Office is in the process of identifying an appropriate contracting strategy. The Program Office plans to have the strategy in place prior to awarding the next delivery order in 2018, which is over three years after SAFe was first implemented.

## **Recommendations, Management Comments, and Our Response**

### ***Recommendation 1***

**We recommend that the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics should:**

- a. Review the DoD Instruction 5000.02 and relevant acquisition guidance and revise, as necessary, to allow for the implementation of agile software development methods on programs that include both hardware and software.**

*Under Secretary of Defense for Acquisition, Technology, and Logistics Comments*

An Official Performing the Duties of the Assistant Secretary of Defense for Acquisition, partially agreed with the recommendation, stating that acquisition guidance and the DoD Instruction 5000.02 allows for the implementation of agile development methods on both hardware and software. Additionally, in March of 2016, the Office of the Under Secretary of Defense for Acquisition and Sustainment issued agile guidance in the Program Manager's Desk Guide for Agile and Earned Value Management. Agile implementation on DoD programs is new, especially on programs that include hardware, and the DoD is early in the process of collecting lessons learned and best practices from other acquisition programs implementing agile. Additionally, the Official stated that DoD Acquisition guidance is under continual review and will be revised, as necessary, to include lessons learned and best practices.

*Our Response*

Comments from the Official Performing the Duties of the Assistant Secretary of Defense for Acquisition addressed all specifics of the recommendation; therefore, the recommendation is resolved but will remain open. We will close the recommendation once we verify that the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics has reviewed and revised DoD guidance based on lessons learned and best practices to allow for the implementation of agile development methods on programs that include both hardware and software.

- b. Compile lessons learned from DoD programs implementing agile software development methods to share with other DoD programs.**

*Under Secretary of Defense for Acquisition, Technology, and Logistics Comments*

An Official Performing the Duties of the Assistant Secretary of Defense for Acquisition, agreed with the recommendation, stating that, as directed in the FY18 National Defense Authorization Act, the Under Secretary of Defense for Acquisition and Sustainment is compiling and sharing lessons learned from acquisition programs implementing agile software development methods through the Defense Acquisition University. Specifically, the Defense Acquisition University is performing research on agile programs, observing agile software development methods, and developing training on agile software development methods.

### *Our Response*

Comments from the Official Performing the Duties of the Assistant Secretary of Defense for Acquisition, addressed all specifics of the recommendation; therefore, the recommendation is resolved but will remain open. We will close the recommendation once we verify that the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics has compiled lessons learned from acquisition programs implementing agile and has shared this information with other DoD programs.

## **Recommendation 2**

**We recommend that the F-22 Program Office:**

- a. Determine the contracting strategy to best incentivize the contractor to develop and deliver capabilities prior to awarding the order for the next modernization program.**

### *F-22 Program Office Comments*

The Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, responding for the F-22 Program Office, agreed with the recommendation, stating that the F-22 Program Office will use a cost-plus fixed fee level of effort approach to replace the existing contracting strategy. The level of effort approach will maximize flexibility for changing priorities and track the contractor's progress by delivered capabilities and continuous backlog reviews, which will appropriately incentivize the contractor to deliver quality capabilities faster. Senior program leadership and the Air Combat Command will establish work priorities.

### *Our Response*

Comments from the Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, addressed all specifics of the recommendation; therefore, the recommendation is resolved but will remain open. We will close the recommendation once we verify that the F-22 Program Office has implemented the new contracting strategy.

- b. Document the lessons learned when developing the contracting strategy for potential use by other program offices implementing agile software development methods on weapon systems.**

### *F-22 Program Office Comments*

The Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, responding for the F-22 Program Office, agreed with the recommendation, stating that the F-22 Program Office will continue to document lessons learned when developing the contracting strategy with the F-35 and other programs.

### *Our Response*

Comments from the Director, Global Powers Program, Office of the Assistant Secretary of the Air Force for Acquisition, addressed all specifics of the recommendation; therefore, the recommendation is resolved but will remain open. We will close the recommendation once we verify that the F-22 Program Office has documented lessons learned when developing the contracting strategy for agile implementation.

## Appendix

---

### Scope and Methodology

We conducted this performance audit from May 2017 through January 2018 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.

To determine whether the U.S. Air Force effectively managed the F-22 modernization, we interviewed program stakeholders and reviewed program documentation. Specifically, we interviewed DoD and Air Force officials to determine how SAFe was being implemented for the F-22 modernization program. Additionally, we reviewed DoD and Air Force acquisition policies to determine whether policies addressed the implementation of agile software development methods on weapon system acquisitions.

We interviewed stakeholders from the following organizations.

- OUSD (AT&L)
- Director, Operational Test & Evaluation
- Assistant Secretary of the Air Force, Acquisition
- F-22 Program Office
- Air Combat Command
- Test Director, Combined Test Forces
- Air Force Operational Test and Evaluation Center
- Defense Contract Management Agency
- Defense Digital Service

We reviewed the following regulations and guidance related to weapons systems acquisitions.

- DoD Instruction 5000.02, "Operation of the Defense Acquisition System," January 7, 2015
- FAR Part 16, "Types of Contracts," January 13, 2017
- FAR Part 34, "Major System Acquisition," November 18, 2016
- DFARS Part 234, "Major System Acquisition," January 29, 2014
- Air Force Instruction 63-101/20-1, "Integrated Life Cycle Management," May 9, 2017

## Use of Computer-Processed Data

We did not use computer-processed data to perform this audit.

## Prior Coverage

During the last 5 years, the Government Accountability Office (GAO) issued one report discussing F-22 Modernization Programs. Unrestricted GAO reports can be accessed at <http://www.gao.gov>.

### **GAO**

Report No. GAO-14-425, “F-22 Modernization: Cost and Schedule Transparency Is Improved, Further Visibility into Reliability Efforts Is Needed,” May 2014

This report assessed the Air Force’s approach to, and challenges facing, F-22 modernization programs. The report found that structuring modernization as distinct programs has been successful and the Air Force plans to continue doing so.

## Management Comments

### Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics



ACQUISITION

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

FEB 15 2018

MEMORANDUM FOR DEPARTMENT OF DEFENSE INSPECTOR GENERAL  
THROUGH: DIRECTOR, ACQUISITION RESOURCES AND ANALYSIS *NS 2/15/18*  
SUBJECT: Response to Department of Defense Inspector General Draft Report on Contracting Strategy for F-22 Modernization (Project No. D2017-D000AT-0151.000)

As requested, I am providing responses to the general content and recommendations contained in the subject report. This is important work and I sincerely appreciate your efforts to promote accountability, integrity, and efficiency as we strive to deliver warfighting capabilities faster and in a more effective manner. Regarding the general content of the report, I am concerned with the accuracy and completeness of the information presented. The description of capabilities that the modernization program added to the F-22, for example, is misleading and partially inaccurate. Specifically, the report states the modernization program was established to add enhanced capabilities in areas such as “air-to-ground missiles, information warfare, and information gathering.” There is not now, nor has there been, any attempt to add air-to-ground missile capability on the F-22. Likewise, information warfare and information gathering have never been mission areas for the F-22. Additionally, the background information on F-22 modernization programs is incomplete and presented in a way that distracts from the contracting issue at the heart of the report.

Most importantly, I do not believe the evidence presented in the report provides a reasonable basis for the finding in the context of the audit objective. The finding that the U.S. Air Force did not effectively manage the modernization of the F-22 Raptor fleet is inconsistent with the determination that the F-22 Program Office’s internal controls for the F-22 modernization program were effective as they applied to the audit objective. The only evidence presented in support of this finding is the assertion that the F-22 program office had not updated its contracting strategy to “best incentivize” the contractor prior to agile implementation. The report does not offer what this best contracting strategy might have been, while at the same time acknowledging the F-22 program is the first within the Department of Defense (DoD) to attempt agile implementation on a program that includes hardware development. The report acknowledges the existing contract was used as an interim solution in order to begin implementing agile while keeping the overall F-22 modernization program on schedule. Given the lack of a “right answer” on agile contracting and the report’s recognition of the need to deliver capabilities faster, it does not follow that delaying the implementation of agile development methods would have constituted more effective management of F-22 modernization.

Again, I appreciate your efforts and I thank you for the opportunity to review this draft report. My staff is standing by to work with you to fix any factual errors. Responses to the recommendations contained in the report follow:

## Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (cont'd)

### **Recommendation 1a:**

The Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics should review the DoD Instruction 5000.02 and relevant acquisition guidance and revise, as necessary, to allow for the implementation of agile software development methods on programs that include both hardware and software.

### **Response:**

Partially Concur. DoD acquisition guidance, including DoD Instruction (DoDI) 5000.02, already allows for the implementation of agile development methods on programs that include both hardware and software. Consistent with law and regulation, DoDI 5000.02 encourages the following characteristics in acquisitions:

1. Flexibility: tailoring program strategies and oversight
2. Responsiveness: rapid integration of advanced technologies
3. Innovation: adapt practices that reduce cost and cycle time
4. Discipline: use of program baseline parameters as control objectives
5. Effective Management: decentralization to the extent practicable

These characteristics have led to an increased focus on flexible development approaches which include agile. Many acquisition programs are moving forward with implementation of agile software development methods. To support this increased focus, the Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(A&S)) has issued guidance and is actively collecting lessons learned and best practices to share throughout the Department. An example of recent agile guidance is the Program Manager's Desk Guide for Agile and Earned Value Management (EVM), released by the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics in March of 2016. This guide provides insights on maintaining a robust overall management process when implementing agile methods. As noted in the report, agile implementation on DoD programs is new, especially on programs that include hardware, and the DoD is early in the process of gathering lessons learned and best practices. That said, DoD acquisition guidance is under continual review and will be revised, when appropriate, to codify refined lessons learned and best practices.

### **Recommendation 1b:**

The Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics should compile lessons learned from DoD programs implementing agile software development methods to share with other DoD programs.

### **Response:**

Concur. As directed in the Fiscal Year (FY) 2018 National Defense Authorization Act (NDAA), the OUSD(A&S) is already compiling and sharing lessons learned from acquisition programs implementing agile software development methods through the Defense Acquisition University (DAU). The OUSD(A&S) has taken the following actions in this area:

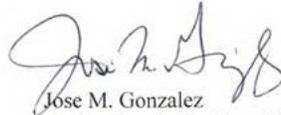
1. Throughout the Fall of 2017, the DAU embedded a faculty member in the Air Operations Center Program Office to observe agile software development methods, capture lessons learned, and document policy recommendations. A briefing summarizing the findings of this opportunity was developed in November 2017. Discussions to expand this project to

## Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (cont'd)

include faculty with expertise in test and evaluation, contracting, and cloud based implementation is ongoing.

2. As directed by FY 2018 NDAA section 891, the DAU is developing a training course on agile software development. This effort is ongoing with a projected fielding date of June 2018. In addition, the training will support programs and software development activities designated under sections 873 and 874 of the FY 2018 NDAA. The DAU will capture lessons learned as it supports the agile training of these programs and activities.
3. Section 891 also tasked the DAU to establish a research program focused on agile acquisition practices and tools best tailored to meet the mission needs of the DoD. This research program will capture lessons learned from DoD acquisition programs and feed the results into DAU's curriculum. Planning for this research activity is ongoing.

Please contact [REDACTED] if additional information is required.



Jose M. Gonzalez  
Performing the Duties of the Assistant Secretary of  
Defense for Acquisition

## F-22 Program Office



DEPARTMENT OF THE AIR FORCE  
WASHINGTON DC

FEB 12 2018

OFFICE OF THE ASSISTANT SECRETARY

MEMORANDUM FOR DOD INSPECTOR GENERAL  
ATTENTION: [REDACTED]  
CLEVELAND, OH

FROM: SAF/AQP  
1060 Air Force Pentagon  
Washington, DC, 20330-1060

SUBJECT: Department of Defense Office of Inspector General Draft Report "Contracting Strategy for F-22 Modernization" Project Number D2017-D000AT-0151.000

REFERENCE: DoDIG email requesting comments for the subject report, January 11, 2018

1. This memo responds to a request for comments regarding the subject report. While I agree with the recommendations, I disagree with the finding that we did not effectively manage the modernization of the F-22 Raptor fleet. The Under Secretary of Defense for Acquisition, Technology, and Logistics delegated the F-22 Increment 3.2B Major Defense Acquisition Program (MDAP) to the Air Force in 2015. Since then, the program office has successfully completed the Engineering & Manufacturing Development phase and is in the final stages of Initial Operational Test and Evaluation. Additionally, the Assistant Secretary of the Air Force for Acquisition endorsed the initiative for F-22 Modernization to be a Pathfinder and prototype Agile processes. The F-22 Program Office and its contractors are the first to implement Agile strategies for weapon system software and hardware. They proactively sought to define and implement an Agile strategy in order to field capability faster, which demonstrates foresight and effective management. The Agile strategy is consistent with the Air Force Digital Services 2017 report, the National Defense Authorization Act for Fiscal Year 2018 and Recommendation 1.

a. Recommendation 1: Determine the contracting strategy to best incentivize the contractor prior to awarding the order for the next modernization program.

Response: I agree with this this recommendation. As noted in the report, the F-22 is the first Department of Defense weapon system attempting to implement an Agile strategy for both hardware and software. The first step towards Agile was Scaled Agile Framework (SAFe) and was by the contractor while the Air Force investigated the best contracting strategy. I believe we have identified the best contract strategy will be a Level of Effort approach.

Using a Cost-Plus Fixed Fee Level of Effort (LoE) approach will maximize flexibility for changing priorities and replace the traditional contracting strategy that results in separate contracts for each program that complete for the same limited resources. The LoE will support the contractor's transition to an Agile culture and establish the F-22 software factory. The contractor's progress will be tracked by delivered capabilities and continuous backlog reviews.

## F-22 Program Office (cont'd)

Work priorities will be set by a formalized governance structure involving senior program leadership and Air Combat Command. I feel this approach provides the best flexibility for changing priorities, provides insight and oversight to the work being performed, and appropriately incentivizes the contractor to both deliver quality capabilities faster.

b. Recommendation 2: Document the lessons learned when developing the contracting strategy for use by other programs.

Response: F-22 Program Office will continue to document lessons learned with F-35 and the enterprise.

2. If you have any additional questions or concerns, please feel free to contact the [REDACTED]



MICHAEL A. FANTINI, Maj Gén, USAF  
Director, Global Power Programs  
Assistant Secretary (Acquisition)

cc:  
AFLCMC/WWO/WWU/LPS/PK  
SAF/AQ

## Acronyms and Abbreviations

---

<b>DFARS</b>	Defense Federal Acquisition Regulation Supplement
<b>FAR</b>	Federal Acquisition Regulation
<b>OUSD (AT&amp;L)</b>	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
<b>SAFe</b>	Scaled Agile Framework



# **Whistleblower Protection**

## **U.S. DEPARTMENT OF DEFENSE**

*The Whistleblower Protection Ombudsman's role is to educate agency employees about prohibitions on retaliation and employees' rights and remedies available for reprisal. The DoD Hotline Director is the designated ombudsman. For more information, please visit the Whistleblower webpage at [www.dodig.mil/Components/Administrative-Investigations/DoD-Hotline/](http://www.dodig.mil/Components/Administrative-Investigations/DoD-Hotline/).*

### **For more information about DoD OIG reports or activities, please contact us:**

**Congressional Liaison**

703.604.8324

**Media Contact**

[public.affairs@dodig.mil](mailto:public.affairs@dodig.mil); 703.604.8324

**DoD OIG Mailing Lists**

[www.dodig.mil/Mailing-Lists/](http://www.dodig.mil/Mailing-Lists/)

**Twitter**

[www.twitter.com/DoD\\_IG](http://www.twitter.com/DoD_IG)

**DoD Hotline**

[www.dodig.mil/hotline](http://www.dodig.mil/hotline)



DEPARTMENT OF DEFENSE | OFFICE OF INSPECTOR GENERAL

4800 Mark Center Drive  
Alexandria, Virginia 22350-1500  
[www.dodig.mil](http://www.dodig.mil)  
Defense Hotline 1.800.424.9098

