



PROJECT AIR FORCE

CHILDREN AND FAMILIES
EDUCATION AND THE ARTS
ENERGY AND ENVIRONMENT
HEALTH AND HEALTH CARE
INFRASTRUCTURE AND
TRANSPORTATION
INTERNATIONAL AFFAIRS
LAW AND BUSINESS
NATIONAL SECURITY
POPULATION AND AGING
PUBLIC SAFETY
SCIENCE AND TECHNOLOGY
TERRORISM AND
HOMELAND SECURITY

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

This electronic document was made available from www.rand.org as a public service of the RAND Corporation.

Skip all front matter: [Jump to Page 1](#) ▼

Support RAND

[Purchase this document](#)

[Browse Reports & Bookstore](#)

[Make a charitable contribution](#)

For More Information

Visit RAND at www.rand.org

Explore [RAND Project AIR FORCE](#)

View [document details](#)

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND electronic documents to a non-RAND website is prohibited. RAND electronic documents are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see [RAND Permissions](#).

This product is part of the RAND Corporation technical report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

R E P O R T

Retaining F-22A Tooling

Options and Costs

John C. Graser, Kevin Brancato, Guy Weichenberg,
Soumen Saha, Akilah Wallace

Prepared for the United States Air Force

Approved for public release; distribution unlimited



RAND PROJECT AIR FORCE

The research described in this report was sponsored by the United States Air Force under Contract FA7014-06-C-0001. Further information may be obtained from the Strategic Planning Division, Directorate of Plans, Hq USAF.

Library of Congress Cataloging-in-Publication Data is available for this publication.

ISBN 978-0-8330-5098-4

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

RAND® is a registered trademark.

© Copyright 2011 RAND Corporation

Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Copies may not be duplicated for commercial purposes. Unauthorized posting of RAND documents to a non-RAND website is prohibited. RAND documents are protected under copyright law. For information on reprint and linking permissions, please visit the RAND permissions page (<http://www.rand.org/publications/permissions.html>).

Published 2011 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
4570 Fifth Avenue, Suite 600, Pittsburgh, PA 15213-2665
RAND URL: <http://www.rand.org>
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

Summary

Background

Through FY 2010, Congress has authorized the procurement of 187 F-22A aircraft, the last of which is scheduled for delivery in early 2012. The Air Force plans to continue contracts that provide for modernization and sustainment work but not those that provide for new production. As the last component is fabricated, assembled, or integrated at each of the many facilities involved in producing the F-22A, decisions must be made as to what tooling will be retained for sustainment¹ or modernization support and what will be disposed of. (See p. 1.)

Complicating these decisions are the differing views about future F-22A production. The Obama administration has repeatedly rejected the idea of building more than 187 F-22A aircraft for the Air Force. In February 2010, Secretary of Defense Robert Gates, during a hearing before the Senate Armed Services Committee, reaffirmed that he was not going to revisit the decision to produce more than the 187 F-22A aircraft.² In addition, Congress continues to prohibit the sale of the F-22A to other countries, precluding the continuation of production for foreign sales. However, in the FY 2010 Department of Defense Appropriations Bill, Congress removed the previous restriction on spending appropriated funds on the development of a foreign military sales (FMS) version of the F-22A. In fact, the FY 2010 NDAA calls for the Secretary of Defense to conduct a study on the cost, technical feasibility, and strategic implications of permitting FMS of the F-22A and to identify any associated required modifications to current law (see p. 2).³ Just as the F-22A contractors have entered shutdown planning (and in some cases have actually ended production of F-22A parts), production at some future point has emerged as a possibility. Reflecting this possibility, the following language was included in the FY 2010 NDAA:

- (a) PLAN.—The Secretary of the Air Force shall develop a plan for the preservation and storage of unique tooling related to the production of hardware and end items for F-22 fighter aircraft. The plan shall—
 - (1) ensure that the Secretary preserves and stores required tooling in a manner that—
 - (A) allows the production of such hardware and end items to be restarted after a period of idleness; and

¹ In this report, *sustainment* is used to denote all the postproduction activities that would require tooling to support the F-22A during its operational life (i.e., spare-parts production, depot-level repair and maintenance, base-level maintenance, and modification work).

² U.S. Senate Committee on Armed Services, Military Posture Hearing, Washington, D.C., February 2, 2010, p. 50.

³ Public Law 111-84, National Defense Authorization Act for Fiscal Year 2010, October 28, 2009, Section 1250.

- (B) provides for the long-term sustainment and repair of such hardware and end items;
 - (2) with respect to the supplier base of such hardware and end items, identify the costs of restarting production; and
 - (3) identify any contract modifications, additional facilities, or funding that the Secretary determines necessary to carry out the plan.
- (b) RESTRICTION ON THE USE OF FUNDS.—None of the amounts authorized to be appropriated by this Act or otherwise made available for fiscal year 2010 for aircraft procurement, Air Force, for F-22 fighter aircraft may be obligated or expended for activities related to disposing of F-22 production tooling until a period of 45 days has elapsed after the date on which the Secretary submits to Congress a report describing the plan required by subsection (a).⁴

Purpose

This report is designed to answer the requirement for the tooling plan. Its contents reflect the outcome of discussions among congressional staffers, the Air Force, and RAND regarding congressional intent. The report focuses on two key questions:

1. How much more would it cost to retain all the F-22A unique government tooling required for a future F-22A production restart than to retain only the tooling required for the sustainment support of the aircraft during its forecasted operational life?
2. How much would it cost to restart production at some future date?⁵

The Earlier RAND Report on the F-22A

This report updates portions of an earlier RAND report on options for the F-22A program;⁶ reflects program decisions made since early 2008, when data gathering for the earlier report was completed; and focuses more specifically on tooling and other restart issues. This report addresses only two of the four scenarios addressed in the earlier report: *shutdown* and *shutdown and restart*.⁷ Two other scenarios from that report, *warm production* and *continuing production*, are now deemed infeasible given the current administration's declared intention to fund no more F-22A production, the unlikelihood that supplemental FY 2010 funds will be appropriated for further production of F-22A aircraft for the Air Force, and the fact that an FMS

⁴ Public Law 111-84, National Defense Authorization Act for Fiscal Year 2010, October 28, 2009, Section 133.

⁵ Despite interest in an FMS variant of the F-22A, this report is based on production restart of the current Air Force variant.

⁶ Obaid Younossi, Kevin Brancato, John C. Graser, Thomas Light, Rena Rudavsky, and Jerry M. Sollinger, *Ending F-22A Production: Costs and Industrial Base Implications of Alternative Options*, Santa Monica, Calif.: RAND Corporation, MG-797-AF, 2010.

⁷ The *shutdown* scenario in Younossi et al. (2010) is very similar to the *shutdown and sustain* scenario described in this report.

variant cannot be developed before production lines are shut down and the tooling is dispositioned.⁸ (See p. 2.)

Two Major Options

Without the likelihood of additional production in the near future, the Air Force has two options for the tooling at the end of production. The first option is *shutdown and sustain*. In this scenario, the production lines are closed once the last aircraft (or aircraft part) is delivered. As work is completed on the last aircraft, government-owned special tooling, special test equipment, and other equipment unique to the F-22A production is transferred to other F-22A activities (such as F-22A sustainment), transferred to other programs, or scrapped. In essence, no tooling is retained aside from that required to support the F-22A during its operational life.

The second option is *shutdown and retain*. In this scenario, the production line is shut down in such a way that restart could occur efficiently at an undetermined point in the future. This option requires the wrapping, packing, transporting, storing, and maintaining of nearly *all* F-22A government-unique tools and equipment and technical information, not just what is required for sustainment.⁹ (See pp. 4–5.)

Other Factors in a Restart

Tooling retention is a major factor in a plan to restart production. Other key ingredients for a restart include the following: the expertise of production personnel, the capabilities and capacities of key suppliers of parts and subsystems (particularly those with unique processes and products that may require requalification), and the availability of contractor-owned production facilities and capital equipment. (See pp. 7–12, 25–28.)

The Window for Efficient Shutdown Is Narrowing

The window to efficiently implement F-22A shutdown is narrowing. Shutdown activities have already begun at some suppliers and will continue through 2012. In addition, Lockheed Martin will begin to shut down F-22 production at Air Force Plant 4 in Fort Worth, Texas, in 2010 as the last aircraft center section is completed. As each facility completes production, tooling-disposition decisions must be made to ensure efficient shutdown execution of either of the major options. Absent direction from the Air Force, the contractors must hold all government tooling as a temporary measure. However, at some point in the future, each item of tooling must be either disposed of or retained for sustainment purposes. (See pp. 7–12.)

⁸ In this report, *disposition* refers to the decision process that determines whether tools are ultimately retained or disposed of.

⁹ If a restart of the F-22A production were to result in 20 new aircraft per year, virtually all current tooling would be required.

The tooling-disposition decision process requires an estimate of the differential cost of keeping the production-only tooling.¹⁰ Through analysis of the nonrecurring costs of wrapping, packaging, and transporting the production-only tooling and analysis of the recurring annual storage and maintenance costs, this research estimates the differential funding required in FY 2011 and beyond to maintain the production-only tooling. It also estimates both the nonrecurring costs of planning and administration, setting up tooling and facilities, and hiring personnel for the production line and the recurring costs of restarting F-22A production for 75 new Air Force aircraft either in FY 2012 or between FY 2013 and FY 2016.¹¹ It also highlights other key but largely unquantifiable issues that may emerge over time, such as the loss of certain critical suppliers and processes that may not be immediately available for a restart. (See pp. 13–15.)

Conclusions

Costs of Tooling Options

Table S.1 shows the differential cost of the *shutdown and sustain* and *shutdown and retain* options,¹² comparing their nonrecurring and annual recurring costs. The basis for these cost estimates is the Conex storage approach detailed in Chapters Two and Three. Those chapters document what a plan to preserve the tooling would entail at this point in the F-22A shutdown-decision process.

The costs are relatively modest. The \$17 million represents about 9 percent of the original acquisition cost (\$194 million in FY 2010 dollars) of the production-only tooling, and the recurring costs are a tiny fraction of a percent of the original acquisition cost. (See p. 15.)

Table S.1
The Differential Cost of the *Shutdown and Retain* Option Compared with the *Shutdown and Sustain* Option (FY 2010\$, millions)

	FY 2011–FY 2013	FY 2012	FY 2013	FY 2014 and Beyond
Nonrecurring	\$17.0	N/A	N/A	N/A
Annual recurring	N/A	\$0.07	\$0.15	\$0.15

The Cost of Restart

Table S.2 shows the recurring production costs under three restart scenarios. The hypothetical scenario is a baseline to show what the estimated cost of producing 75 aircraft might have been had funding been appropriated for a Lot 11 advance procurement for 20 units in FY 2010 and

¹⁰ In this report, the term *production-only tooling* is used to denote duplicate tooling (i.e., tooling required for rate production but not for sustainment activities, and tooling for which no anticipated need has been identified for sustainment whatsoever). As noted earlier, another congressionally mandated study of the feasibility and cost of an FMS version of the F-22A may have a role in informing this decision.

¹¹ A quantity of 75 aircraft is consistent with Younossi et al. (2010).

¹² Unless otherwise noted, in these analyses, the term *cost* includes profit and fee, so the dollar amounts represent the appropriated amounts required. Constant FY 2010 dollars are used due to the unknown length of the shutdown period.

Table S.2
The Recurring Production Cost of 75 Additional Aircraft (FY 2010\$)

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Total	APUC
Hypothetical	\$0.6B	\$3.6B	\$3.6B	\$3.3B	\$2.7B	N/A	N/A	N/A	\$13.7B	\$183M
Transition	N/A	\$0.8B	\$3.8B	\$4.0B	\$3.9B	\$3.4B	\$1.0B	N/A	\$16.7B	\$222M
Future	N/A	N/A	\$0.5B	\$2.4B	\$3.1B	\$4.1B	\$3.8B	\$3.5B	\$17.4B	\$233M

NOTES: APUC = average procurement unit cost. B = billion. M = million.

had there been a clear intent to continue production instead of shutting down the production line. (See pp. 21–22.)

In the transition scenario, advance-procurement funding for ten F-22A aircraft is appropriated and available at the start of FY 2011; full funding for ten aircraft is appropriated in FY 2012, and there is clear intent to conduct future production. Quantities in FY 2013, FY 2014, FY 2015, and FY 2016 are 20, 20, 20, and five, respectively. The transition scenario has a production gap of 9–18 months at many sites due to variations in the approved production quantities.

In the future scenario, restart occurs sometime between FY 2013 and FY 2016. To simplify presentation, we chose restart in FY 2013 for our estimate. Restart begins at some point after all production-only tooling has been stored after shutdown, and it involves the production of 75 aircraft, with a ramp-up in quantity of five, 10, 20, 20, and 20 aircraft in the first through fifth production years. The future scenario has a production gap of at least two and a half years, and there will be at least an additional two-year lead time before production starts.

Under all three scenarios, production is followed by another *shutdown and sustain* period for the life of the F-22A, at a cost of \$82 million. In addition to the recurring production costs shown in Table S.2, there would be a nonrecurring restart cost of \$307 million for the future scenario and of \$127 million for the transition scenario. (See pp. 22–23.)

The Costs and Benefits of *Shutdown and Retain*

For a one-time cost of an additional \$17 million (in FY 2010 dollars) and a very small additional annual recurring cost, the Air Force can retain all F-22A unique government tools. Retention of all tools reduces the risk that tools may not be available for unanticipated future restart, for a service-life extension program, or for major accident-repair requirements. Additionally, retention permits an expeditious near-term tooling disposition process, and the Conex approach for storing tooling obviates the need for new warehouse space. This work, moreover, can be accommodated within normal Air Force contracting activities. (See pp. 29–30.)