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F-22A Multiyear Procurement Program

An Assessment of Cost Savings

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Summary

Acquiring defense weapon systems under multiyear contracts rather than a series of single-year contracts offers the possibility of cost savings. Such contracts afford contractors the opportunity to buy materials in more economical quantities, schedule workers and facilities more efficiently, and reduce the burden of preparing multiple proposals. The U.S. government also benefits from a reduced workload. The U.S. Air Force is in the process of awarding a multiyear contract for 60 F-22A aircraft over three years. Congress wants to assure itself that the proposed contract will yield the promised savings and asked, in the FY 2007 National Defense Authorization Act, for an independent review of the estimated savings. RAND's National Defense Research Institute was asked to conduct the review by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics.

Purpose and Approach

The National Defense Authorization Act asked for two things. First, it requested a comparison of the multiyear procurement of 60 F-22A aircraft and associated engines with three single-year procurements of 20 aircraft and engines. Second, it asked for a comparison between historical cost savings achieved for aviation-related multiyear contracts dating back to fiscal year 1982 and the projected savings of the F-22A multiyear contract.

To comply with this congressional request, the research team identified three tasks:

1. Estimate the costs for baseline procurement of 60 aircraft and associated engines, including spare engines, in FYs 2007–2009 under annual (single-year) contracts at the rate of 20 aircraft per year.
2. Substantiate contractor-proposed savings, and compare them to the difference between multiyear negotiated prices and RAND’s single-year price estimates.
3. Report the cost savings resulting from historical and ongoing aviation-related (aircraft and aircraft engines) multiyear procurement contracts back to FY 1982.

To accomplish these tasks, the research team reviewed existing literature on multiyear contracts in other aircraft programs and analyzed historical data. Team members also reviewed both the multiyear proposals for Lots 7, 8, and 9 and the Lot 7 single-year proposals submitted by the F-22A air vehicle and engine prime contractors. They visited and collected considerable information and historical data from the F-22A System Program Office and prime contractors—Lockheed Martin (LM), Boeing, and Pratt & Whitney (P&W)—and some of the major subcontractors involved in the production of the F-22A. They also visited and gathered information from the C-17, C-130, and F/A-18E/F program offices, as well as the Institute for Defense Analyses (IDA).

Results

The results of our assessment of the single-year procurement, our substantiation of contractor savings, and our analysis of historical savings appear below. Although some historical comparisons in this report are shown in base year dollars, we primarily present our results in then-year (TY) dollars.³

³ We use this format for four reasons: (1) Wide discrepancies exist between various indices for deflating TY to BY. These discrepancies mask the actual contract prices and savings that were negotiated or estimated. (2) Congressional interest is in annual budgets, which are authorized and appropriated in then-year dollars. (3) The negotiated prices between the

Cost of Single-Year Procurement (SYP)

One of the more challenging tasks in assessing the realism of cost savings due to a multiyear procurement strategy is evaluating the costs of the alternative single-year contract strategy (the path not taken). We estimated the three single-year equivalent prices for FYs 2007–2009 using the same program content as that of the multiyear proposal, along with F-22A historical cost data, negotiated proposal values, and three alternative cost improvement curve (CIC)⁴ assumptions, as follows:

- A. The downward trend in costs experienced during Lots 1–6 will continue through Lots 7–9. Thus, costs for Lots 7–9 would reflect the same cost improvement curve.
- B. The trend for Lots 5 and 6 is more indicative of what will occur in Lots 7–9. In this assumption, a new CIC was developed using the same cumulative quantities and lot midpoints as above, except that the Lot 5 and 6 costs were used in the regression. The new CIC was used to predict Lot 7–9 costs. These resulting costs were adjusted for the change in annual production rate from Lot 6 to Lot 7 and beyond.
- C. Lot 6 cost data are the most indicative of likely costs for the next three lots. Lot 6 costs (adjusted for annual rate of inflation) were used for Lots 7–9.

Added to the above three assumptions was the cost of the engines, both those to be installed at the end of the air vehicle production (120 engines) and spare engines (13) to be procured under multiyear procurement (MYP). Propulsion costs were based on unit price data for

USAF and contractors for both the single-year and multiyear contracts and for the savings initiatives are all in TY dollars. By leaving the contractor proposals in TY dollars, we avoid distorting the numbers. (4) Formal justifications for historical multiyear aircraft procurements were part of the DoD budgeting and congressional justification processes and were shown only in TY dollars.

⁴ A *cost improvement curve* is similar to a learning curve (wherein average labor hours per lot decrease at a certain percentage as cumulative quantities double), except that recurring costs are substituted for labor hours in the CIC equation. (Younossi, Kennedy, and Graser, 2001).

whole engines and were not broken out by labor hours and material because of the limited data available.

The differences between our single-year estimate and the negotiated multiyear proposals are shown in Table S.1.

Based on our model, we estimate the savings range to be between \$274 million and \$643 million and our most realistic estimate to be \$411 million.⁵

Substantiation of Contractor-Proposed Savings

To better assess the realism of our savings estimate, we also undertook to substantiate the MYP savings proposed by the contractors. As part of the pre-award activities for the multiyear contract for Lots 7–9, the U.S. Air Force (USAF) asked Boeing, Lockheed Martin, Pratt & Whitney, and their subcontractors and suppliers to develop cost savings initiatives that could be implemented as part of the contract. We substantiated the reasonableness of the proposed savings associated with these initiatives as follows: We reviewed their methodology for computing the savings by comparing the single-year cost estimate with the multiyear cost for each initiative, evaluated the feasibility of the initiative, and ensured that the savings were incorporated into the negotiated values for the multiyear contract by tracing each initiative into the final con-

**Table S.1
Estimated Multiyear Savings CIC Assumption
(TY \$millions)**

CIC Assumption	Lot 7 Savings	Lot 8 Savings	Lot 9 Savings	Total Savings
Lots 1–6	43	108	123	274
Lots 5–6	48	153	210	411
Lot 6	65	229	349	643

⁵ These estimates do not include any potential savings due to reduced program office workload from not having to write yearly contracts. Estimating those further savings was outside the scope of this study, and historically they are not included in the estimates of MYP savings.

tract price.⁶ We organized savings into six categories. We also noted aspects of the F-22A multiyear contract that could not be quantified in dollar terms per se but that are positive aspects of a multiyear contract. In addition, we noted that certain activities remained basically the same under either case because the overall program is not being accelerated to a more efficient annual rate due to the constrained budget available. The total value of the savings proposed by the contractors was \$311 million in TY dollars; we substantiated \$296 million. Almost three-fourths of the savings were accounted for in two categories: the buy-out of materials and parts and support labor savings. The \$296 million in substantiated savings for the contractor initiatives falls within the range of our estimated savings of \$274 million to \$643 million using the alternative CIC analysis (see Table S.1). Therefore, we found that about 70 percent of our most realistic estimate of \$411 million can be traced to substantiated contractors' identified savings estimates.

Historical Savings

Our analysis of historical fixed-wing aircraft multiyear procurement showed that program savings estimates from 1982 through 2007 varied from 5.5 percent to 17.7 percent. Estimated savings for fighter aircraft multiyear programs during this period ranged from 5.7 percent to 11.9 percent. For multiyear programs after 1995, we could find no significant statistical correlation between the contract savings estimates and such factors as contract size, total number of aircraft procured, number of aircraft procured annually, length of the MYP program, or funding provided for economic order quantity (EOQ) or cost reduction

⁶ As part of the contract award process, the USAF asked the prime contractors to submit two proposals each. One addressed a single-year contract for 20 aircraft (Lot 7) in FY 2007 and the other addressed a multiyear contract for 60 aircraft (Lots 7–9) in FYs 2007–2009. Since the multiyear award was contingent upon a certification by the Secretary of Defense, both the single-year and multiyear options were fully negotiated and prepared for award, because neither the USAF nor the contractors knew whether the multiyear option would be approved. These negotiated proposals included negotiated prices between the prime contractors and their subcontractors and suppliers. As a result, the negotiated single-year Lot 7 values were a source of valuable data in establishing savings between the two options.

initiatives.⁷ However, we note that this does not necessarily mean that no correlations exist among these or other factors and the magnitude of estimated savings. The problem is that we do not have enough data points to support a statistically valid correlation analysis. Correlations may exist, but they cannot be statistically demonstrated with this limited database.

Qualitative examination of the post-1995 multiyear programs and many of the pre-1995 programs suggested that achieving subcontractor and vendor quantity discounts is a key factor in obtaining savings on multiyear procurement programs. Achieving significant savings in this area, however, did not always appear to hinge on EOQ funding. Moreover, our qualitative assessment of the historical programs' characteristics that contributed to the multiyear cost savings—such as total number and rate of aircraft procured under the multiyear program, EOQ funding and timing of the funding, timing of the multiyear contract implementation, and availability of funding for cost reduction initiatives—indicates that these characteristics were more favorable to the historical programs than to the F-22A multiyear program because the F-22A MYP differs in many key characteristics from historical multiyear programs.

F-22A MYP Savings

We calculated the savings percentage by dividing our estimate of the single-year contract for Lots 7, 8, and 9 by the difference between our SYP estimates and the MYP negotiated prices. Table S.2 shows our percentage of estimated savings.

The substantiated contractor savings that would result from the F-22A firm-fixed-price multiyear contracts for 60 aircraft, instead of three separate single-year contracts for lot sizes of 20 aircraft each, is about \$296 million (TY), or 3.3 percent, for the three single-year contracts. This percentage falls within the range of our estimated savings of 3.1 percent, in our most pessimistic case, and 6.9 percent, in our most optimistic case.

⁷ *Economic order quantity* refers to the optimal quantity to order that minimizes total variable costs required to order and hold inventory.

Table S.2
RAND's Estimated Savings Percentages

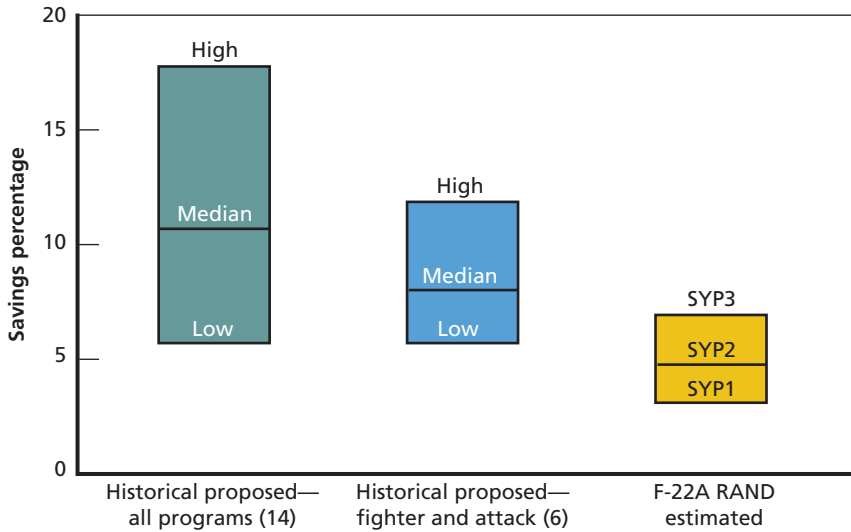
CIC Assumption	Single-Year Estimate (TY \$millions)	Savings, SYP Minus MYP (TY \$millions)	Savings Percentage
Lots 1 to 6	8,952	274	3.1%
Lots 5 and 6	9,089	411	4.5%
Lot 6	9,320	643	6.9%

Figures S.1 and S.2 provide two additional ways of thinking about the savings for the multiyear procurement by comparing the F-22A estimated savings with those of the savings estimated for historical programs.⁸ The first arrays the results of our research as a function of the percentage of contract savings relative to a single-year procurement contract. The leftmost bar shows historical data for all fixed-wing aircraft that underwent a multiyear procurement from 1982 to 2007 and indicates the low, median, and high values. The next bar presents the data for fighter and attack aircraft only, displayed in a similar fashion. Finally, the last bar shows savings based on assumptions about SYP learning curves (SYP1 reflects our first assumption, SYP2 reflects our second assumption, and SYP3 reflects our third assumption). Our estimated savings are low by estimated historical values both for the all-aircraft programs mix and for just fighter and attack aircraft.

Another way to evaluate savings is by the dollars saved per aircraft. Figure S.2 is similar to Figure S.1, except that the metric is dollar savings per aircraft in FY 2005 dollars. In this case, our estimated savings are high by historical standards of fighter and attack aircraft but well within the historical range of all aircraft MYP since 1982, which can be partially explained by the higher unit cost of the F-22A compared with other fighters.

⁸ In general, the savings shown for historical programs were *estimates of savings* made as part of the multiyear contract budget justifications (pre-contract award) and are not historical "actual" savings per se.

Figure S.1
Savings Percentage Relative to SYP Value



NOTE: The numbers in parentheses in the first two bar labels show the number of aircraft programs included in the analysis.

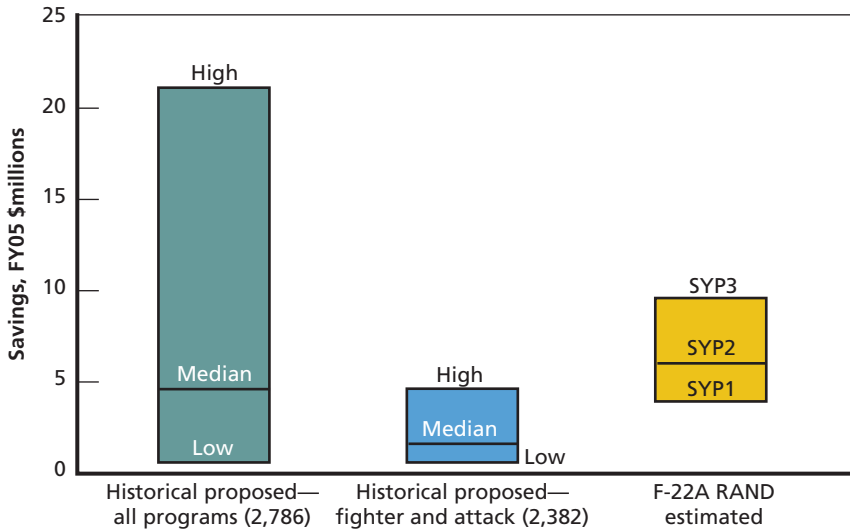
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Overall Findings

We find that examining the issue of multiyear savings using several approaches produces a consistent range of results.

- We estimate cost savings due to the F-22A MYP contract to be about \$411 million compared with three separate SYP contracts.* Estimating the three single-year contract prices and comparing them with the recently negotiated multiyear contracts for air vehicles and engines between the USAF and the F-22A contractors produces a range of estimates. When using the second cost improvement assumption for predicting these costs, we found that our prediction and the separate, negotiated single-year Lot 7 price were similar. This method resulted in overall savings of \$411 mil-

Figure S.2
Dollar Savings per Aircraft



NOTE: The numbers included in the parentheses in the first two bar labels show the number of aircraft included in the analysis.

RAND MG664-5.2

lion, which translates to about 4.5 percent of the overall contract value.

- *More than 70 percent of the savings can be supported by substantiated contractors' savings initiatives.* Our substantiation of the contractor-proposed savings initiatives produced savings estimates of \$296 million. We substantiated these savings by tracing them to the final negotiated MYP contract.
- *F-22A MYP contract savings percentages are lower than the historical range, but the program has fewer cost savings opportunities than the historical programs we analyzed.* Although the savings percentage for the multiyear prices compared with the single-year predicted prices is relatively low by historical estimated standards (4.5 percent), the dollar savings per aircraft in the F-22A multiyear contract are on the upper end of the savings of previous fighter/attack multiyear contracts (a result of the higher unit cost for the F-22A). In addition, our qualitative assessment of the pro-

gram attributes that contributed to the cost savings on historical multiyear programs indicates that the F-22A MYP differs in many key characteristics from historical MYPs, often in ways that put the F-22A MYP program at a disadvantage when compared with the historical MYPs.