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Do Joint Fighter Programs Save Money?

Technical Appendixes on Methodology

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Summary

The U.S. Department of Defense (DoD) has launched or attempted to launch numerous joint fighter and other joint aircraft programs in the past 50 years. These programs were intended to save life cycle cost (LCC) by eliminating duplicate research, development, test, and evaluation (RDT&E) efforts and achieving economies of scale in procurement and operations and support (O&S). Thus far, there have been no comprehensive assessments of empirical data to verify that joint aircraft programs have, indeed, saved LCC compared with an equivalent set of specialized single-service aircraft systems. Although it is acknowledged that the need to integrate multiple-service requirements in a single design or common design family can increase programmatic and technical complexity and lead to performance and cost penalties with greatest common denominator designs, analysts are unsure how large these factors are and the degree to which they reduce or even negate the efficiency savings from having only one program. Analysts are also unsure of the degree to which the effects of these factors are accurately estimated.

In the absence of direct cost comparisons in which multiple similar single-service programs were developed in parallel with an equivalent joint program, RAND Project AIR FORCE (PAF) sought to answer the question of which approach costs less by comparing the cost growth of joint versus single-service aircraft programs. If cost growth tends to differ and be higher for joint aircraft programs, this would suggest that the difficulties of joint, common programs are typically underestimated. The degree of underestimation, if any, can be used to estimate whether total costs become higher or lower compared to single service programs.

The ultimate question we seek to answer with our full methodology is whether, in the end, the actual realized cost benefits of joint aircraft programs offset and exceed any increased costs due to greater complexity, resulting in a force of aircraft with lower LCC than an equivalent force of specialized single-service aircraft.

PAF sought to answer this question by assessing historical joint aircraft program outcomes and cost data from the early 1960s through today's Joint Strike Fighter (JSF). Among the major findings, PAF found that historical joint aircraft programs have experienced rates of acquisition cost growth so much higher than single-service programs that they have not saved overall LCC despite any efficiencies from common efforts. Researchers also found that, nine years after Milestone B (MS B), the JSF program is not on the path to achieving the LCC savings expected at MS B compared with three

comparable notional single-service fighter programs. These findings are presented in a separate report.¹

This report provides a series of appendixes that describe the underlying methodology. The first four detail the methods used to estimate whether historical joint aircraft programs have saved LCC over the likely LCC had single-service programs been pursued instead, as reported in Chapter Two of the main report, particularly Sections 1 and 2:

- Appendix A describes how researchers calculated the theoretical maximum savings a joint aircraft program could achieve in the acquisition phase (i.e., in RDT&E and procurement), assuming 100 percent commonality between the joint aircraft design variants procured by each participating service, and two 100 percent common single-service aircraft developed and produced entirely separately by each service. Using algebraic formulae and reasonable assumptions, researchers found that an “ideal” joint aircraft program can save a maximum of 20 percent of acquisition costs compared with two single-service programs.
- Appendix B shows how researchers compared acquisition cost-growth rates for four historical joint aircraft programs and four historical single-service aircraft programs.² This analysis leads to the finding that, nine years past MS B,³ the joint programs experienced an additional 41 percent cost growth on average compared with the single-service programs. This amount of excess program cost growth experienced by joint programs would eliminate any joint savings realized during the acquisition phase, even in an ideal joint program.
- Appendix C shows how researchers calculated the maximum joint O&S savings that can be achieved in an ideal joint program. Reviewing empirical data, researchers found that an ideal two-service joint fighter program (with each program having an equal number and mix of the same type of aircraft and 100 percent common O&S activities) could save a maximum of 2.9 percent in O&S costs.
- Appendix D completes the analysis of historical joint aircraft programs by analyzing the O&S cost savings that joint aircraft programs would need to achieve to offset the greater average cost growth experienced by joint programs during the acquisition phase in order to achieve overall LCC savings compared to the LCC of equivalent single-service programs. Researchers found that a typical

¹ Mark A. Lorell, Michael Kennedy, Robert S. Leonard, Ken Munson, Shmuel Abramzon, David L. An, and Robert A. Guffey, *Do Joint Fighter Programs Save Money?* Santa Monica, Calif.: RAND Corporation, MG-1225-AF, 2013.

² Our analysis used the RAND Selected Acquisition Report (SAR) data base for consistent comparisons of cost estimates across programs. The eight aircraft programs examined represent the entire available body of Major Defense Acquisition (MDAP) aircraft programs from the mid 1980s through the present that have full cost data reported in the annual SARs out to at least nine years past MS B. However, classified and other special aircraft programs developed outside the normal DoD acquisition process, such as the B-2, are excluded because they have no SAR reported acquisition cost data available.

³ Nine years after MS B was the longest period after MS B for which we had complete and comparable SAR data for all eight aircraft at the time the analysis was conducted in late 2011.

representative joint aircraft program would need to save more than 10.3 percent in O&S costs to offset the average joint acquisition cost growth premium described in Appendix B (even when assuming the theoretical maximum acquisition cost savings for an ideal joint program described in Appendix A). This showed that joint O&S savings, even under ideal conditions, are not sufficient to offset the average joint acquisition cost growth premium.

Using the methodology and findings reported in Appendixes A through D, we concluded that recent historical joint aircraft programs have not saved overall LCC compared with comparable single-service aircraft programs.⁴

The last two appendixes describe two separate methods used to compare JSF savings and costs with three notional comparable single-service fighters (which represent the “path not taken”) and support the analysis reported in Chapter Three of the main report, particularly Sections 1 and 2:

- Appendix E describes the methodology for assessing the JSF presented in the report. Researchers made a set of plausible, conservative assumptions to calculate the LCC of three separate, notional single-service fighter aircraft programs before and after nine years of cost growth (assuming F-22 cost-growth rates for the single-service programs⁵). These costs were compared with the actual JSF cost estimates at MS B and nine years later (the most-recent SAR data available at the time of the study). This analysis resulted in the conclusion that nine years after MS B, JSF is not on course to providing the savings that were expected at MS B compared with three separate notional single-service programs.
- Appendix F presents an alternative method of comparing JSF procurement costs with those of three notional single-service fighter programs, using weight-cost relationship curves based on F-22 program data and historical aircraft program cost data for the procurement phase. Researchers arrived at a very similar cost relationship as the methodology described in Appendix E.

The findings based on the methodology reported in Appendixes E and F led us to conclude that the JSF F-35 program is not on the path to providing the joint savings anticipated at MS B.

The main report provides further analysis of the qualitative factors that drive these cost results. Together with the quantitative analysis detailed in this report, they support PAF’s overall recommendation that, unless the participating services have identical,

⁴ Our data show that the average joint cost-growth premium varies between 30 and 44 percent from five years out beyond MS B through nine years beyond MS B. We used this variation to develop an uncertainty band for the comparison of joint versus single-service acquisition costs and LCC. In both cases, the findings at year nine fall within the uncertainty band. For this reason, we conclude that, on average, historical joint programs have not saved overall costs for either the acquisition program or the overall LCC including RDT&E, procurement, and O&S costs.

⁵ Different time frames for calculating F-22 cost growth rates as well as considerable sensitivity analysis were conducted to increase confidence in our analysis.

stable requirements, DoD should avoid future joint fighter and other complex joint aircraft programs.