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PROJECT AIR FORCE

DO JOINT FIGHTER PROGRAMS SAVE MONEY?

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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.[1] The largest and most recent is the F-35 Joint Strike Fighter (JSF), which was designed for use by the U.S. Air Force, U.S. Navy, U.S. Marine Corps, and international partners and is currently in low-rate initial production. The main purpose of a joint program, versus a set of single-service programs, is to save overall 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). Yet, the need to integrate multiple service requirements in a single design increases the complexity of joint programs and potentially leads to higher-than-average cost growth that could reduce or even negate potential savings.

There have been no comprehensive assessments of costs and savings in historical joint aircraft programs based on actual joint aircraft program outcomes and historical cost data. To help inform future acquisition strategies for fighter aircraft, the commander of Air Force Materiel Command (AFMC) asked RAND Project AIR FORCE (PAF) to analyze the costs and benefits of historical joint aircraft programs, from the early 1960s through today's JSF. The project addressed five major questions:

[1] Our definition of a fully joint aircraft program is an aircraft program in which two or more services are significantly involved in all stages of the acquisition and operational phases—that is, in the design, development, procurement, and operations and support (O&S) of the aircraft.

- Have historical joint aircraft programs saved LCC compared with comparable single-service aircraft programs?
- Is JSF on track to save LCC compared with notional equivalent single-service fighter programs?
- What factors contributed to cost outcomes in historical joint aircraft programs, as well as JSF?
- What are the implications of a joint aircraft approach for the industrial base?
- What are the implications of a joint aircraft approach for operational and strategic risk?[2]

The project performed quantitative and qualitative reviews of joint fighter and other joint aircraft programs, drawing from a broad range of published sources, as well as the RAND Selected Acquisition Report (SAR) database (SARs document cost and schedule estimates at different stages; the RAND SAR database includes more than 300 major defense acquisition programs) and databases of historical O&S costs for Air Force aircraft. The data-cutoff point for this analysis was November 2011. Greater detail on the methodologies and approaches used in the analysis reported in this document has been published in a separate document.[3]

Because of the impossibility of making direct cost comparisons, in which multiple similar single-service programs were developed in parallel with an equivalent joint program, PAF sought to answer the question of which approach costs less by comparing the cost growth of joint and single-service programs. If cost growth tends to differ and be higher for joint programs, this would suggest that the difficulties

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[2] One of the operational benefits of a joint approach is greater interoperability among the participating services. We addressed this in our assessment of economies of scale in O&S costs, which include the benefits of a common spare parts pool, a key part of interoperability. We did not assess other potential benefits of interoperability, such as the ability of one service to do maintenance on another's aircraft if necessary.

[3] See 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? Technical Appendixes on Methodology*, Santa Monica, Calif.: RAND Corporation, MG-1225/1-AF, 2013.

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.

The ultimate question we seek to answer with our full methodology is whether or not, 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 those of 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 JSF. Among the major findings was that historical joint aircraft programs have experienced so much higher rates of acquisition cost growth than single-service programs have that they have not saved overall LCC, despite any efficiencies from common efforts. Researchers also found that, nine years past Milestone B (MS B), the JSF program is not on the path to achieving the expected cost savings versus three separate notional, single-service fighter programs.

A summary of our major findings is as follows.

Historical joint aircraft programs have experienced higher rates of acquisition cost growth than single-service aircraft programs and have not saved overall LCC. We compared RDT&E and procurement cost-growth estimates for recent historical single-service and recent historical joint aircraft programs at the same points in their program histories following the beginning of full-scale development (MS B), adjusting for changes in procurement quantity. Cost growth was measured in dollars of constant purchasing power, so inflation effects were properly accounted for. We found that joint programs experience substantially higher cost growth in acquisition than single-service programs do.[4] Although joint aircraft programs may, in theory, save costs by sharing RDT&E resources and by achieving economies of scale in procurement and O&S, the maximum percentage theoretical savings in joint

[4] In general, the word *acquisition* loosely refers to the entire process of acquiring major defense systems. In our discussion of historical program costs and JSF costs, we use *acquisition* in the narrower technical sense as used by DoD cost analysts to refer to the combined RDT&E and procurement portions of a program. *Procurement* refers to the production phase of the program.

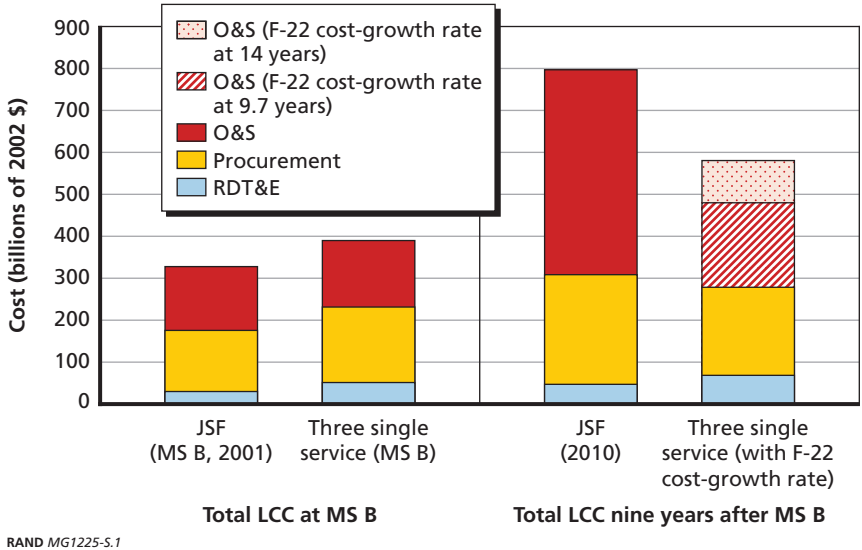
acquisition and O&S compared with equivalent single-service programs are too small to offset the historically observed additional average cost growth that joint aircraft programs experience in the acquisition phase.

JSF is not on the path to deliver promised LCC savings. In order to determine whether or not JSF is on track to deliver the originally promised LCC savings, we developed LCC estimates for three notional single-service fighter programs at MS B and nine years after MS B to compare with actual JSF LCC estimates at the same points in the JSF program.[5] We developed our estimates of LCC for three notional fighters based on conservative assumptions that favored JSF. We also recalculated our estimates of notional single-service fighter LCC using a different methodology to verify the robustness of our original production cost estimates. Although the JSF program was structured to overcome some of the problems encountered by past joint fighter programs, it faced the challenge of accommodating three substantially different sets of service requirements (along with international partner requirements) and ambitious technical and performance objectives (such as supersonic low observable short takeoff and vertical landing [STOVL] capability) into a single core aircraft design, with an 80-percent commonality goal among service variants. Our analysis of SAR data shows that, nine years past MS B, estimated JSF LCC are higher than if the services had pursued three separate fighter programs.

As shown in Figure S.1, at the beginning of development (using MS B program baseline data), JSF LCC theoretically would be 16 percent less than our estimate of the cost of three notional single-service fighter programs. However, the situation changes after nearly a decade. Nine years past MS B, SAR estimates of JSF LCC are higher than our LCC estimates for notional single-service fighters. As indicated by the stacked bars on the right of the figure, if we apply F-22 cost-growth percentages at MS C (9.7 years past MS B) to the notional single-service fighters' MS B estimate, then JSF LCC are 65 percent higher. JSF LCC are 37 percent higher if we calculate the notional single-service pro-

[5] Nine years after MS B was the most recent point in time with full SAR cost data available for JSF at the time the analysis was undertaken.

Figure S.1
Estimated Nine Years Past Milestone B, Life Cycle Cost for Joint Strike Fighter Would Be Higher Than Those for Three Notional Single-Service Programs (Assuming F-22 Cost-Growth Percentages)



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grams using the F-22 estimated O&S cost-growth percentage at initial operational capability (IOC), 14 years after MS B, when O&S costs were expected to be greater than in earlier estimates. Under none of the plausible conditions we analyzed did JSF have a lower LCC estimate than the notional single-service programs.

The difficulty of reconciling diverse service requirements in a common design is a major factor in joint cost outcomes. From the Tactical Fighter, Experimental (TFX)/F-111 program in the 1960s through the JSF program today, the attempt to accommodate multiple operating environments, service-specific missions, and differing performance and technology requirements in common joint fighter designs has increased programmatic and technical complexity and risk, thus prolonging RDT&E and driving up joint acquisition costs. At the same time, service-specific requirements and demands tend to produce less commonality and lead to more variants, thus reducing the main source of joint cost savings anticipated in procurement and O&S. Historically,

joint fighter programs have typically evolved toward distinct service variants with significantly reduced commonality. For example, the congressionally mandated joint Air Combat Fighter program in the early 1970s evolved from an original goal of 100 percent commonality into two distinct platforms with zero commonality: the Air Force F-16A/B and the Navy F/A-18A/B. In other cases, necessary design compromises left the services unsatisfied and sometimes resulted in one or more partners withdrawing from the program, as in the case of the Air Force/Navy F-111 program and numerous others. These factors work against the potential for joint cost savings, which depend on maximum commonality, and are a major contributor to the joint acquisition cost-growth premium identified in our cost analysis.

Joint aircraft programs are associated with a shrinking combat aircraft industrial base. Looking beyond cost considerations, the pursuit of joint aircraft programs in recent decades has coincided with a reduction in the number of major fighter aircraft prime contractors from eight in 1985 to only three today. Currently, Lockheed Martin is the only prime contractor actively leading a fifth-generation manned fighter/attack aircraft development and production program (JSF) for the foreseeable future. Such a situation reduces the potential for future competition, may discourage innovation, and makes costs more difficult to control. Whether the next fighter development program is joint or single service, acquisition decisionmakers will face the challenge of a smaller industrial base and must understand the impact of acquisition strategy on the long-term health of the industry.

Joint aircraft programs could potentially increase operational and strategic risk to warfighters. Having a variety of fighter platform types across service inventories provides a hedge against design flaws and maintenance and safety issues that could potentially cause fleet-wide stand-downs. Having a variety of fighter platform types also increases the options available to meet unanticipated enemy capabilities. For example, during the Korean War, the U.S. Air Force was able to rapidly upgrade one of its four jet fighters, the F-86 Sabre, to meet the surprise introduction of the Russian Mikoyan-Gurevich (MiG)-15, a Soviet-designed fighter that was more capable than any other U.S. fighter in the Air Force or Navy inventory. Had the Air Force and

Navy relied exclusively on a single joint fighter other than the F-86, it might not have been able to respond quickly to the unanticipated new threat posed by the MiG-15. The more the U.S. military employs joint fighters, the fewer options will be available to meet unforeseen threats and crises in the future, as well as unanticipated safety and reliability issues that can ground entire fleets of specific aircraft types.

Informed by these findings, we recommend that, unless the participating services have identical, stable requirements, DoD avoid future joint fighter and other complex joint aircraft programs.