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TECHNICAL REPORT

A Methodology for Comparing Costs and Benefits of Management Alternatives for F-22 Sustainment

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Prepared for the United States Air Force

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Summary

Background

The U.S. Air Force has changed its F-22 sustainment plans several times over the past two decades. The F-22 was originally intended to be an organically supported aircraft,¹ but its sustainment approach was changed to a contractor logistics support approach during the 1990s. Sustainment plans were subsequently changed to feature public-private partnerships using performance-based logistics (PBL). Under this approach, much of the hands-on depot repair work would take place at government depots, but Lockheed Martin would manage the supply chain and be responsible for overall sustainment of the air vehicle as the PSI. Pratt & Whitney would have similar responsibilities for the F119 engine. (See pp. 13–22.)

Public Law 105-261, Section 346 (and as amended by Public Law 106-65, Section 336) requires the military services to perform cost-benefit analyses before prime-vendor contracts for depot maintenance and repair can be awarded. After an internal Air Force analysis regarding the nature of the requirement, the F-22 System Program Office (SPO) (subsequently renamed the 478th Aeronautical Systems Wing, or ASW) asked PAF to conduct the congressionally mandated cost-benefit analysis to determine whether the proposed public-private partnership sustainment strategy would be less costly than an organic sustainment strategy. RAND conducted cost-benefit analyses comparing Lockheed Martin as the air vehicle PSI and Pratt & Whitney as the engine PSI to respective notional organic alternatives. These results were incorporated into a larger report produced by the SPO and delivered to Congress according to the requirements of the law. The Air Force also asked RAND to examine the process used for assigning the depot-level reparable (DLR) workload, a task that was not generated by the congressional requirement. This report describes the methodology used in that analysis, which was conducted from May to November 2007.² (See pp. 23–32.)

Methodology

Developing F-22 Sustainment Alternatives

Although the law implies that a cost comparison should be conducted, it does not specify what should be compared to the prime-vendor contract. As a result, the study team developed

¹ *Organic* refers to work managed in-house by the government.

² The analysis was originally supposed to be completed in July 2007 in support of an early fall contract award. However, the deadline was extended because of the additional time that the SPO needed for negotiations with the contractors and the concomitant lack of data available for this research.

notional government PSI alternatives for comparison to the Air Force's planned approach, evaluating two alternatives for both the air vehicle and the engine: the planned use of contractor-managed sustainment for the F-22 air vehicle with a notional government alternative and the planned use of contractor-managed sustainment of the F119 engine with a notional government alternative. In both cases, the analysis focused on the costs that would change under the different alternatives. (See pp. 23–32.)

We used existing sustainment organizations for fighter aircraft as analogies to develop the notional government PSI organizations. The existing F-22 air vehicle and engine program offices served as starting points for the management organizations. We used insights from interviews with personnel from multiple combat aircraft program offices (including the F-16, F-15, B-2, and F-117 SPOs) to learn about government management of sustainment. (See pp. 23–32.)

This approach included the following assumptions:

- The bulk of the F-22 air vehicle sustainment organization would move to Ogden Air Logistics Center (ALC) at Hill AFB, Utah. (See pp. 23–27.)
- Since its sustainment is conducted primarily at Ogden ALC, the F-16 sustainment organizations are the baseline for the F-22 air vehicle notional organic PSI, with adjustments for differences in the programs, including the absence of F-22 foreign military sales and increased F-22 technical complexity.³ (See pp. 28–31.)
- The majority of the F119 engine sustainment organization would be located at Oklahoma City ALC at Tinker AFB, Oklahoma. (See pp. 27–28.)
- The F100⁴ engine sustainment organization is the model to build the F119 notional organic PSI, with adjustments for differences in the programs. (See pp. 28–31.)
- Some characteristics of the planned sustainment approach would not change under either PSI approach. Most hands-on maintenance and repair work would still be done organically, and sustainment tasks traditionally performed by contractors, such as some of the sustaining engineering, would continue to be done by the contractors. (See pp. 31–32.)

Because the contractor management functions would not be eliminated entirely in the case of the organic PSI alternatives, it was necessary to assess the contractors' sustainment management structures and determine what workload would be retained, decreased, or eliminated with an organic PSI. This approach and the assumptions were vetted with the prime contractors. (See pp. 32–33.)

Timing

To present a realistic comparison, we compared the Air Force's 2007 plans to use Lockheed Martin and Pratt & Whitney as the air vehicle and engine program PSIs, respectively, against plans for a gradual transition from contractor PSIs to organic PSIs. We found that immediately

³ The F-16 sustainment organization at Hill AFB differed in structure from the F-15 sustainment organizations at Warner Robins AFB. The F-16 organization at Hill AFB was chosen as the most appropriate baseline because its structure allowed more straightforward assessments and adjustments of staffing and because it, like the F-22's sustainment organization, is based at Hill AFB.

⁴ The F100 is a turbofan engine that powers both the F-15 and the F-16. It is produced by Pratt & Whitney.

standing up organic sustainment organizations for the F-22 was unrealistic and focused on a more feasible case.

We also note that the F-22 and F119 programs are relatively immature. For example, when this research was being conducted, the F-22 air vehicle had not completed the 100,000 flight hours that typically signify weapon system maturity.⁵ (That milestone normally implies an increased level of certainty about a variety of aspects of system performance and maintainability, including many relating to costs.) This means that some predictions of future costs are currently relatively speculative; at the time of this research, the F-22 fleet had accumulated fewer than 40,000 total flight hours. (See pp. 32–33.)

Focus on Cost Differences

In addition to developing notional organic organizations to provide comparable functions while using different organizational structures, it also was challenging to develop comparable cost estimates for two organizations (contractor and organic) using very different cost accounting systems. (See pp. 35–40.)

To conduct this analysis, our approach focused on the cost *differences* between the two sustainment approaches, particularly those relating to sustainment management functions. Any activity that was estimated to remain constant under both approaches was not specifically analyzed, since it would not be a discriminator between the two approaches. Indeed, the majority of sustainment activities would remain unchanged regardless of the choice of PSI. This includes, for example, much of the engineering and technical support provided by the contractors as well as the hands-on maintenance and repair work that will take place on the flight line and at the ALCs. (See pp. 35–40.)

Summary of Selected Findings

We determined that schedule considerations preclude the rapid establishment of organic PSI organizations to manage F-22 air vehicle and F119 engine sustainment. Establishing an organic PSI would require multiple years to program and budget resources,⁶ followed by a number of additional years to hire the necessary organic workforce and develop the human capital needed to manage F-22 and F119 sustainment.⁷ As a result, it would be several years before the Air Force could reasonably expect to perform F-22 sustainment management organically. Under this notional alternative approach, the Air Force would continue with the planned contractor PSIs through most of the transition period, with no change in the initial years, building up organic capacity to manage all aspects of F-22 and F119 sustainment toward the middle of the transition phase before completing the transition to the organic approach. (See pp. 31–32.)

Based on this assumption for the transition to an organic PSI approach, costs would remain the same as in the contractor PSI case for the initial years of the transition phase. How-

⁵ System maturity at 100,000 hours is a common rule of thumb for aircraft. For example, see Tirpak, 2007.

⁶ It is possible to reprogram funding from existing programs during an FY, despite the resulting disruption to the affected program, and Air Force leadership could have done so in early FY 2008 to begin establishing an organic PSI. However, the results of this study, delivered to the Air Force at that time, provided no compelling reason for an immediate change in sustainment plans, as explained in the text.

⁷ A detailed list of what specific functions would move to the Air Force is available in Appendix A.

ever, government manpower costs would increase in the middle of the transition phase as the organic organizations stand up. Conversely, contractor manpower would start to decline near the end of the transition period. Personnel costs in these middle years are estimated to be half-year costs, reflecting the assumption that personnel will be phased in over the course of each year. In the final year of the transition, the organic PSI organizations are assumed to be fully staffed as they take over supply chain management responsibility from the contractor PSIs. (See pp. 41–42.)

An earlier RAND publication included a cost analysis comparing the notional organic and contractor PSI approaches.⁸ Our estimate separated the direct labor costs from the material and surcharge costs. For the contractor PSI cases, we used the direct labor costs that the contractors provided. For the organic PSI case, we assessed what portion of these direct labor costs would be eliminated if the PSI were moved. We decremented that portion from the original estimate and added in the amount of direct labor required in new government organizations. In both cases, the base material costs were provided by the contractors (we considered them to be the most reasonable estimates), and contractor and government surcharges were applied using the appropriate methodology for each case. (See pp. 41–42.)

It should also be noted that the direct labor charges cover different aspects of weapon system management under the two different approaches (contractor and organic), so they are not directly comparable. The surcharges also cover different aspects of costs, so the combined material and surcharge costs are also not directly comparable. (For example, more of the personnel costs of managing weapon system sustainment are direct charges under the contractor case, but in the organic cases, these are covered by surcharges on material costs.) The estimated total costs can be compared as bottom-line estimates. (See pp. 41–42.)

This report describes the portions of our findings that are available to the public. The estimated cost differences represent a small percentage of F-22 PSI annual recurring costs and are an even smaller percentage of overall F-22 sustainment costs, which include squadron maintenance personnel, for example. (See pp. 41–42.)

Benefits

We also assessed benefits claimed by representatives of the contractors and government sustainment organizations. Although it was not possible to validate and quantify the asserted benefits, if either the organic or contractor PSIs could prove to offer superior service, particularly in the form of any metric related to aircraft availability (such as better not-mission-capable-due-to-supply rates), the value of greater availability could overshadow the cost differences identified in our analysis. (See pp. 43–44.)

Potential PSI management benefits asserted by the contractor come from such initiatives as centralized asset management of spare parts, a combined supplier base (with other programs), better information systems and databases, integration of supply chain management with engineering, funding flexibility, and the ability of profits to motivate performance. Although we judge that some of these are, in fact, real benefits to the contractor (which can more quickly and flexibly invest in computer upgrades, for example), others did not offer an inherent advantage to either side because both could realize them (and, in some instances, were

⁸ The document is not available to the general public.

trying to do so). In any case, we were not able to monetize the benefits these would provide. (See pp. 44–54.)

Other Issues

Our analysis also uncovered a number of issues of interest to analysts. One of these involved so-called technical data rights. At the outset of this analysis, the cost of technical data rights was purported to be an important discriminator between the approaches. Further research revealed that the term *technical data rights* has several meanings; the most relevant definition for this study refers to repair instructions. Because the vast majority of the repair work is taking place at government depots, the government must pay for repair instructions no matter which alternative is selected.⁹ There is no strong evidence indicating that a contractor PSI would reduce these costs. (See pp. 55–60.)

The analysis of the F-22 process for assigning DLR workload revealed that most workload assignments were already largely determined by core and 50/50 requirements.¹⁰ Most of the effort in the depot partnering assessment was thus going into documenting already-decided outcomes (in which core limitations meant that work was required to be performed organically) or producing outputs that were informative but did not appear to affect outcomes. (See pp. 55–60.)

Recommendations

An important implication of the cost differences identified in our analysis is that the issue is worthy of further study involving a more detailed comparison.¹¹ *Hence, a full-scale business-case analysis that could more accurately assess costs of the two approaches should be started relatively soon.*¹² Such an analysis would improve the Air Force's ability to show that either contractor or organic management of F-22 air vehicle and F119 engine sustainment represents the best value for the Air Force and for the taxpayer. Given the time necessary to develop an organic capability, a later start to the business-case analysis will mean a later transition to organic support, should that be the option chosen. However, this must be balanced against the fact that starting

⁹ The payment is for the costs that the contractors incur in preparing the repair instructions in such a way that government workers can use them.

¹⁰ These are congressionally mandated limits on the sustainment work that can be done by contractors. The “core” requirement maintains the organic government skills necessary to perform the various classes of repair work deemed critical to the mission. Not all of this work has to be done in-house, but enough has to be done to maintain the capability. The 50/50 limit on contractor sustainment is another broad effort to maintain the capability in-house. The laws and their histories are explained in Cook, Ausink, and Roll, 2005.

¹¹ This could include a more specific count of individuals undertaking specific tasks instead of broad estimates based on analogies to other organic sustainment programs.

¹² The description of what is contained in a formal business case analysis can be found on Defense Acquisition University's website (see DAU, undated[a]). It is an extensive analysis, beyond the scope of this more limited study, which was specifically aimed at helping the Air Force meet certain legislative requirements in a time-constrained condition.

the business-case analysis later would mean that the program would be more mature and that more insight into future costs would be available.¹³ (See p. 61.)

Current plans to motivate contractor performance using a systemwide PBL contract will be challenging under an organic approach.¹⁴ No approaches have been identified to provide incentives to government workers or organizations as effectively as monetary awards can be used to motivate contractors. Government organizations cannot be paid an increased fee to perform more effectively. Individuals can get bonuses or “comp” time,¹⁵ but these are small incentives compared to those available in the private sector. *For PBL to work with an organic approach, efforts should be made to create new incentives for improved government performance.* (See p. 62.)

Along with providing incentives for better performance, the government could benefit by pursuing efforts to measure performance attributable to the logistics provider. An in-depth business-case analysis of the alternative F-22 sustainment providers should include logistics performance and, ideally, allow the comparative performance assessment of alternative logistics providers. The ability to assess logistics performance requires reliable data, as well as the expertise and methodologies necessary to assess the data. *We suggest that the Air Force invest in developing the data and analytic capabilities needed for better comparisons among logistics providers, not just for the F-22 and F119 programs but for all Air Force weapon systems.* (See p. 62.)

¹³ Shortly after this recommendation was made to the F-22 SPO, it began looking into it and subsequently awarded a contract for a business-case analysis to another organization.

¹⁴ The PBL approach suggests that cost control will lead to greater profit margins for the contractors in the near term. The goal is that savings (in the form of either negotiated lower contract costs or avoidance of contract cost growth) will accrue to the government when follow-on contracts are negotiated, although this is unpredictable. In addition, contracts theoretically can be structured so that profits or savings are shared in some proportion between the government and the contractor, allowing the government to realize savings immediately. However, managing effectively in this manner can be challenging, particularly if the government does not have insight into contractor costs and profit margins.

¹⁵ This was true at the time the research was conducted. One of our reviewers indicated that there are no longer any funds available for these bonuses.