Summary

The Department of Defense should stick with its winner-take-all strategy to develop and produce the Joint Strike Fighter (JSF)—which is slated to become the workhorse fighter for the Air Force, Navy, and Marine Corps. But as a hedge to ensure that later variants of this next-generation aircraft have the most effective and innovative mission systems, the Department of Defense (DoD) should consider spending money to keep a second developer and producer of these vital electronics components in the market. Such an investment in a second developer of mission systems—the electronic eyes and ears of the JSF—could be relatively modest. But it would provide future decisionmakers with the option to competitively develop a second-generation mission system source when and if it were needed.

So concludes this study of competitive strategies for the Joint Strike Fighter, performed over the summer and early fall of 2000. Constrained only by the available time (about four months), we examined both near-term and long-term competition options, some in more detail and more quantitatively than others. Throughout the study, we obtained critical information from the competing program contractors and the Joint Strike Fighter Program Office. While much of that information was considered competition-sensitive by the firms, in this report we present only our own analysis and conclusions, thus permitting unrestricted distribution.

The bottom line is that putting one company in charge of the overall production of the JSF makes the most economic sense. If two or more competitors develop and build this next-generation aircraft, the DoD likely would not see lower overall program costs. The high front-end investments, together with increases in recurring costs, needed for producing such a sophisticated weapon system probably would not be recovered through price reductions that might result from competitive forces.
At the same time, however, having several companies funded to develop and potentially produce later variants of the JSF mission system also may make sense. With technology changing at an increasing pace, the DoD could face the prospect of having its next-generation fighter employ less than the most innovative technologies. By funding competitive technology development at the mission system level, defense policymakers might be able to lessen that risk.

The Problem
The JSF program is a joint effort among the U.S. Air Force, U.S. Navy, and U.S. Marine Corps, with full partnership participation by the United Kingdom (UK). The program objective is to develop and deploy a family of strike aircraft to meet the operational needs of the Air Force, Navy, Marine Corps, United Kingdom, and other U.S. allies. The different variants are expected to have a high degree of commonality, thus reducing overall acquisition and support costs.

The JSF will be one of the largest acquisition projects in history, worth some $300 billion (then-year dollars), and the only new major fighter aircraft program planned for the next 30 years. Over the next several decades, these aircraft are slated to replace all F-16s, A-10s, and AV-8Bs in the U.S. inventory, the F/A-18C/Ds in the Marine Corps inventory, and Harriers in the UK inventory; and to augment the Navy’s F/A-18E/Fs. By 2026, some 3,000 of the jet fighters are planned to be integrated into U.S. and UK forces. The DoD expects that additional sales to U.S. allies could approach 3,000 aircraft.

In fall 2001, the DoD intends to grant one prime contractor the right to develop and produce all variants of the JSF. In 1996, the DoD named the Boeing Company and the Lockheed Martin Corporation as the JSF’s two finalist prime contractor competitors. Since then, each has been engaged in concept demonstration efforts, flown test vehicles, and pursued other extensive preliminary development efforts—all in hopes of winning the JSF contract.

The DoD has been using this “winner-take-all” approach for decades; it has been the preferred method of developing and producing sophisticated weapon systems. But as Boeing’s and Lockheed Martin’s
efforts have unfolded, senior DoD officials and members of Congress have voiced concerns that awarding the JSF to one company could lead to a situation in which the United States might be paying more for weapon systems or purchasing less technologically sophisticated platforms than it would under more robust competition.

What RAND Was Asked to Do About the Problem
In late July 2000, the Under Secretary of Defense for Acquisition, Technology and Logistics asked RAND to explore and identify opportunities and options to introduce competition during the production phase of the JSF. RAND researchers used as our principal criterion the likelihood that such competition would reduce the overall cost of JSF production. We made a more limited analysis of other plausible consequences, including savings in operations and support costs, reduction in cost growth, and improvement in product quality, to the extent possible within the study duration of approximately four months. We also explored how new competitive strategies might affect foreign participation in the JSF program.

How RAND Studied the Problem
The most direct approach to estimating the results of introducing competition would be to estimate the cost for a sole-source producer, then estimate the cost for a pair of competitive producers, and compare the two. Unfortunately, we have no data or cost-estimating relationships that would enable us to directly estimate production costs in a competitive environment. What we do have is some historical data showing the amount by which production costs changed when competition was introduced into ongoing sole-source production programs. Therefore, in this study we estimate the likelihood that the government would “break even” on the introduction of a competitive second source; that is, that the cost reductions would be great enough to pay for the incremental costs of introducing competition. If the likelihood is high, the government might reasonably elect to introduce competition in the expectation of achieving other potential benefits. Likewise, a low expectation of breaking even on production cost would discourage
the government from introducing competition, because the net dollar cost of production might increase enough to outweigh other possible benefits.

In our quantitative analysis, we developed a "break-even" model, which was based on previous RAND studies that examined how competition might be introduced into the development and production phases of a variety of weapon systems. Our model was developed specifically for the JSF program and takes into consideration the multiple, unique aspects of the program. Using this model, we were able to gauge the likelihood that the DoD would recoup its costs if it invested in a second JSF producer. In particular, the model allowed us to look at whether lower JSF production costs engendered by the presence of a second producer would offset DoD’s investment in bringing that second source into the picture. This quantitative analysis relied on three main sources of information:

- Proprietary estimates from Boeing and Lockheed Martin of their designs’ development and production costs, at a level of detail that enabled us to estimate costs under different production scenarios.
- JSF Program Office cost estimates for each variant, together with overall programmatic information on past and projected schedules of events, production quantities, and other information.
- RAND data on cost and cost-estimating relationships for development, production, and operation of U.S. fighter aircraft.

We augmented these sets of quantitative data with extensive discussions with both contractor teams and the project office staff regarding the feasibility and desirability of various competition strategies. This qualitative analysis allowed us to gauge whether the prospect of saving overall costs via a particular competition path was reasonable. We used the following to flesh out this part of our analysis:

- Studies and analyses on the results of prior efforts to introduce competition to a weapon production program. The time available for this study was limited. Therefore, our analysis of the historical record was limited to a review of secondary sources—
reports on previous studies of production-cost changes resulting from competition. We examined the DoD’s experience with introducing competition in 62 weapon system and component procurement programs between 1960 and 1990.

While useful, those reports rarely provided all of the information we needed to apply the historical results to the particular conditions presented by the JSF program. Nevertheless, we were able to assemble a body of historical data sufficient to support conclusions with useful confidence and precision.

Our Findings and Conclusions
Whether and how much a second producer of a weapon system generates cost savings for the DoD depends on the type of hardware or system that the competitors are developing and manufacturing. The potential for cost savings also depends on the time frame—near term or far term—in which the competition is taking place.

Our examination of the DoD’s past experience with introducing competition into weapon system procurements suggests that second producers of electronics have been more likely to generate savings in production costs than have second producers of missiles and ships. As Table S.1 shows, half of the DoD programs in our historical survey that involved two or more competitive producers of electronics were able to reduce overall costs by 30 percent, but only one in 10 competitive missile and ship production efforts was able to do so.

Table S.1
Fraction of Competitive Programs Examined That Achieved Savings

<table>
<thead>
<tr>
<th>Savings achieved (percent)</th>
<th>Missiles and ships</th>
<th>Electronics</th>
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<tbody>
<tr>
<td>&gt;0</td>
<td>7/10</td>
<td>9/10</td>
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<tr>
<td>&gt;10</td>
<td>5/10</td>
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<td>&gt;20</td>
<td>3/10</td>
<td>6/10</td>
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<tr>
<td>&gt;30</td>
<td>1/10</td>
<td>5/10</td>
</tr>
<tr>
<td>&gt;40</td>
<td>Nil</td>
<td>3/10</td>
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But such a 30-percent cost reduction is just the level of savings the DoD would need to achieve if it were to bring a second competitor into the JSF program. Our break-even analysis suggests that such a second competitor would need to offer the DoD this level of savings across a range of the JSF’s elements—forward, center, and aft fuselages; landing gear; ejection seat; wing; edges; empennage; and mission systems. Given DoD’s past experience with missiles and ships, we found that such savings from competition would be difficult, if not impossible, for the JSF program to achieve in the near term in any of these areas.

With the exception of the mission system, all these areas would be equally unpromising in the far term (a decade or more in the future). The mission system constitutes the eyes and ears of the JSF and provides a powerful contribution to its overall combat effectiveness. Many of the enabling technologies are evolving much more rapidly than most flight-vehicle technologies, and several major upgrades in mission systems are likely during the life of the JSF. It therefore makes sense to begin preparing now for the first upgrade. We suggest that the DoD investigate establishing a “shadow” industry team to begin developing system architectures and component technologies that would be tailored to the JSF but focused on technological advancement, cost reduction, and any new mission requirements that might emerge. That team would then be capable of competing to develop and produce an integrated suite of mission equipment for a future upgraded JSF.

Policy Implications That Derive from Our Findings

Our findings have two policy implications:

• Policymakers should stick with the winner-take-all strategy for near-term development and production of the JSF. Despite the potential advantages that might accrue, establishing a competitive production line for part or all of the JSF would require a front-end investment, together with increases in recurring costs, that probably would not be recovered through price reductions that might result from competitive forces.
• Policymakers should examine the costs and benefits of supporting a second industry team so that it could be capable of competing to develop and manufacture the next major upgrade of the mission system equipment. If implemented, this strategy would ensure that future managers have the option of a competitive second source, one that might not otherwise be available.

Our charter was to explore opportunities and options to inject competition into the JSF production program, with the principal criterion being the likelihood that such competition would reduce the overall cost of JSF production. Our analysis shows that introducing competition for future upgrades to the mission system presents the most attractive option. Within the scope of our study, we were unable to examine the idea in detail; we therefore recommend only that the notion be examined with an appropriate level of care and detail by the JSF management.