Between July and October 2000, RAND researchers analyzed options open to the Department of Defense to inject competition into various stages of production of the Joint Strike Fighter (JSF), the only new major fighter program planned for the next 30 years. Done quickly at the request of the Under Secretary of Defense for Acquisition, Technology and Logistics, this study examined ways that defense policymakers may be able to lower the aircraft’s costs or improve its quality by introducing competition during production.

Introducing competition into the JSF production process will not be easily or quickly done. The DoD intends in fall 2001 to grant one prime contractor the right to develop and produce all variants of the new fighter—a production run that could exceed 3,000 aircraft, extend to 2026 or beyond, and be worth $300 billion or more in then-year dollars. The DoD in 1996 selected Boeing and Lockheed Martin 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.

For decades, this winner-take-all approach has been the DoD’s 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.

The main focus of the study RAND was asked to undertake in July 2000 was estimating the likelihood that introducing competition would
reduce the overall cost of JSF production. To the extent possible within the study duration of approximately four months, 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. We also explored how new competitive strategies might affect foreign participation in the JSF program.

Background
The JSF will be one of the largest acquisitions in history, worth some $300 billion (then-year dollars) over the next quarter century. Some 3,000 aircraft—configured in a conventional takeoff and landing (CTOL) variant, a short takeoff and vertical landing (STOVL) variant, or a carrier variant (CV)—will be produced for the DoD. The JSF Program Office estimates that foreign customers could purchase an additional 3,000 aircraft.

The JSF was conceived in the early 1990s as an aircraft that would meet the long-term needs of the three major U.S. services that operate fighter aircraft by

- replacing U.S. Air Force F-16s and A-10s
- augmenting carrier-based U.S. Navy F/A-18Es/Fs
- replacing U.S. Marine Corps F/A-18C/Ds
- replacing U.S. Marine Corps AV-8Bs and United Kingdom (UK) Harrier aircraft.

The JSF will be the first fighter program that attempts to satisfy the needs of three services with one basic design of high commonality among multiple variants. The goal is to have some 70-percent commonality in structure and subsystems, a common core engine, and very high commonality in mission systems (avionics) across all three variants. In theory, this approach should make the JSF more affordable during production and throughout the service life of the aircraft. The DoD has established target flyaway costs for each variant: $28 million for the CTOL, $30–$35 million for the STOVL, and $31–$38 million for the CV (in 1994 $). Some strategies for achieving commonality are
depicted in Figures 1.1 and 1.2, the Boeing and Lockheed Martin variants of the platform.¹

The notion of a “common” design that would satisfy the diverse operational needs of Air Force, Navy, and Marine Corps poses an exceptional challenge to the designers. Only once before in recent history has an attempt been made to design one basic aircraft with variants that would perform land-based and carrier-based operations. That attempt failed when the carrier-based variant of the F-111 was abandoned.²

Figure 1.1—Boeing JSF Design

¹ The designs shown represent the pre-proposal versions of the operational JSF and do not necessarily reflect the JSF configurations that will be proposed by the two firms.

² Some carrier-based designs were later modified or adapted to land-based operations with great success—for example, the F-4 platform developed for carrier-based operations and subsequently adapted by the Air Force for land-based operations.
Those challenges have led to an unusually long and thorough period of requirements formulation, design analysis, and technology demonstration in the JSF program. As shown in the JSF program schedule in Figure 1.3, the contractors' concept demonstrations began in FY 97 and will continue until late FY 01. Both Boeing and Lockheed Martin flew test variants of their aircraft in late CY 00, and more test flights are slated through mid-2001.

Once the DoD chooses the JSF prime contractor, Engineering and Manufacturing Development will begin. Delivery of the first operational aircraft is expected in FY 08.

Study Objectives
RAND’s involvement with this issue and its study objectives stem from a June 2000 letter that then-Secretary of Defense William Cohen wrote to Representative Jerry Lewis, Chairman of the Subcommittee on...
INTRODUCTION

Requirements evolution/cost as an independent variable (CAIV)

Concept exploration
Concept development
Concept demonstration and flying demonstrators

High-level tech and demos
Structures and materials
Flight systems
Manufacturing and production
Mission systems
Supportability
Propulsion

Concepts X-32 and X-35

Engineering and manufacturing development
Block 1: Capability development and integrated flight test
Block 2: Development and integrated flight test
Block 3: Development and integrated flight test

First operational aircraft delivered


Figure 1.3—Joint Strike Fighter Program Schedule
Defense in the House Appropriations Committee. “The Department has examined a number of options for continuing the JSF program once concept demonstration is completed,” Secretary Cohen wrote. “These options all assume the selection of a single winning design. They range from winner-take-all to competition throughout production. We will continue to evaluate these options and to develop a comprehensive assessment that our successors can use as they make decisions on the future course of the JSF program. I have asked the RAND Corporation to review these options, including cost, and report back by December 1st.”

Sources We Drew Upon to Meet the Study Objectives
Our analysis was based on four main sources of information:

• First, each of the prime contractor teams provided its own (proprietary) estimates of development and production costs for its individual designs, at a level of detail that enabled us to estimate costs under different production scenarios.

• Second, the JSF Program Office provided its own cost estimates, together with overall programmatic information on past and projected schedules of events, production quantities for each variant, etc.

• Third, we drew on our own internal stores of cost data and cost-estimating relationships for development, production, and operation of U.S. fighter aircraft, and we augmented these sets of quantitative data through extensive discussions with both contractor teams and with the Program Office staff regarding the feasibility and desirability of various competition strategies.

• Fourth, we reviewed the body of literature on the results of prior efforts to introduce competition to a weapon production program. The short time available for this study (about four months from go-ahead to final briefing) limited our review of the historical record on the effects of competition on production costs to secondary sources—reports on previous studies of production-cost changes due to competition. 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. Nonetheless, we were able to assemble a body of historical data sufficient to support conclusions of useful confidence and precision.

Limitations on the Scope of the Study
Competition is generally expected to stimulate a wide variety of actions by the producers in attempting to make their product more attractive to the buyer. This study was almost entirely focused on two possible consequences of competition: changes in production costs and changes in operations and support costs. Several other possible consequences of production are briefly reviewed. They are factored into the overall conclusions, but only the costs of production and of operations and support are examined quantitatively.

Unfortunately, we have no historical or analytical methods for directly estimating production cost in a competitive environment. Instead, we estimated the incremental costs of introducing competition; then, drawing on historical evidence, we attempted to estimate the likelihood that competition would drive down the costs enough to permit recovering those incremental costs, thus allowing the government to at least break even on costs. The short time available for the study of previous competitive production programs limited us to a review of surveys done by others; we were unable to examine the original records of those past programs. We did not evaluate the engine competition, which is already an integral part of the JSF acquisition strategy.

Report Organization
The report is organized in ten chapters. Following this Introduction, Chapter Two describes the overall JSF project. Chapter Three discusses some of the special features of competition in production of weapon systems and presents the view of such competition as a balance between benefits and liabilities. Chapter Four summarizes the overall analysis process employed in this study. Chapters Five and Six describe
the results of our analysis of the effects of introducing competition on production cost and on operations and support costs, respectively. Chapter Seven briefly reviews some of the likely benefits of competition other than costs. Chapter Eight summarizes the near-term options for introducing competition in the JSF program, and Chapter Nine explores some options for introducing competition in later phases of the program and for competition from outside the program. Final conclusions and recommendations are presented in Chapter Ten.