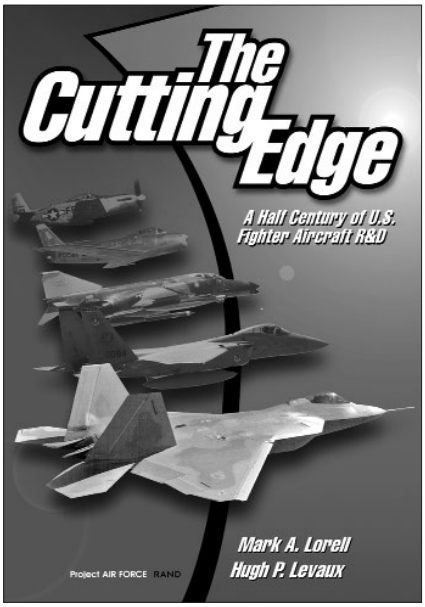
RAND Research Brief

Innovation and Technological Leadership

Fifty Years of Competition in U.S. Aircraft R&D

Declining military R&D budgets, few new program starts, and industry contraction have all raised serious questions about the ability of the United States to maintain a viable industrial base for military aircraft production. A newly released RAND report by Mark Lorell and Hugh Levaux, *The Cutting Edge: A Half Century of U.S. Fighter Aircraft R&D*, suggests that the dramatic contraction of the aerospace industry may indeed jeopardize the future design and production of innovative and cost-effective military fighter aircraft. Drawing on an extensive, historical database spanning the past 50 years of U.S. military aircraft production, the authors identified three factors crucial to the success of fighter aircraft R&D: experience, competition, and government-supported military research.



THE ROLE OF EXPERIENCE

Contractor experience appears to have played a significant role in the development of fighter aircraft. Successful contractors usually engaged in an uninterrupted progression of related R&D programs or design and technology projects, which honed their expertise in specific military systems or technologies such as supersonic interceptors or stealth capabilities. The leading fighter developers at the end of the Cold War—Lockheed, Northrop, McDonnell-Douglas, and General Dynamics—each possessed five decades of almost continuous experience in developing fighters or fighter-like aircraft. During times of normal technological evolution, the leading contractors were able to capitalize on this depth of experience: it often gave them an advantage in fighter R&D competitions, and it helped them to maintain their leadership positions in the industry hierarchy.

COMPETITION

Competition also played a significant role in the development of fighter aircraft. Because fighter aircraft contracts were lucrative, companies that had not won a contract for decades (such as Boeing and Rockwell) continued to invest significant corporate resources in maintaining and improving their fighter design and technology capabilities. The military services clearly benefited from this fierce competition: by encouraging it, sometimes well into the hardware-development stage, they greatly increased the likelihood that their fighter programs would prove satisfactory in terms of performance, cost, and schedule.

Competition benefited the military in yet another way: it appears to have been one of the key drivers in the evolution of military aircraft technology over the past five decades. Because "second rank" contractors were seldom able to compete successfully against the industry leaders on the basis of their depth of experience in existing technologies, they routinely tried to compete on the basis of their innovative designs. These aggressive, entrepreneurial companies often took technological risks and pushed the outer limits of engineering knowledge. During times of radical technological change (such as occurred with the introduction of jet propulsion, supersonic flight, and stealth capabilities), these "second rank" contractors were often able to capitalize on their novel technical designs and supersede the industry leaders. This phenomenon

occurred most recently during the 1980s, when Northrop and Lockheed were able to exploit their experience in stealth-related research to displace McDonnell-Douglas, General Dynamics, and Rockwell as the dominant leaders in fighter and bomber R&D.

GOVERNMENT-SUPPORTED RESEARCH

Historically, government-supported research provided the basis for most of the key technological breakthroughs applicable to military fighter aircraft. During the 1940s and 1950s, government researchers and contractors discovered many of the groundbreaking aerodynamic and propulsion principles that made supersonic flight possible. As revealed only recently, a sustained program of research throughout the 1950s and 1960s, in both government and industry laboratories, produced much of the basic science and technology that made genuinely stealthy aircraft possible. Similar technological breakthroughs, covering the spectrum from active phased-array radars to thrust vectoring, were achieved through sustained government support of basic and applied military research.

INDUSTRY CHANGES AND IMPLICATIONS FOR THE FUTURE

The three factors identified by Lorell and Levaux as critical to the success of military fighter R&D—experience, competition, and government-supported research—are all jeopardized by the dramatic downsizing of the aerospace industry. At the end of World War II, some 14 experienced prime contractors competed for government fighter and bomber R&D programs. By the turn of the millennium, there may be only two. Given the role that competition has played in the development and evolution of U.S. military aerospace technology, a dynamic military aircraft industrial base may require more than two or three prime contractors or specialized divisions. Thus, the current industry contraction could have serious, unanticipated long-term consequences for fighter aircraft R&D.

If experience is truly as important as the historical record suggests, the Department of Defense should consider options that will help maintain the experience levels of the remaining aerospace contractors during the increasingly long gaps between major R&D programs. Such strategies could focus on prototyping or technology demonstration. Alternatively, other types of military R&D programs, such as those related to reconnaissance aircraft, drones, long-range stand-off weapons, et cetera, may be able to contribute to the maintenance of fighter R&D capabilities. Reliance upon the commercial sector for the relevant experience base, however, may be unwise because commercial transport development by itself has not historically translated into successful fighter R&D.

A heavier dependence upon the commercial sector to replace government-funded science and technology may also be risky, because the technological requirements of commercial and military aircraft continue to diverge in many key areas. Whereas the commercial marketplace may be able to develop "dual-use" technologies for electronics and specific aircraft parts, it is unlikely to produce the basic methodologies and technologies for radical new developments in military capabilities, such as those represented by stealth and supermaneuverability.

In sum, defense planners should continue to consider various strategies for maintaining experience and promoting continued competition in the U.S. aerospace industry, including competitive prototype and technology-demonstration programs, further acquisition reform, selective exploitation of the commercial industrial base, and other innovative approaches.

RAND research briefs summarize research that has been more fully documented elsewhere. This research brief describes work done for RAND's Project AIR FORCE; it is documented in The Cutting Edge: A Half Century of U.S. Fighter Aircraft R&D*, by Mark Lorell and Hugh Levaux, MR-939-AF, 1998, 242 pp., ISBN 0-8330-2595-3, available from RAND Distribution Services (Telephone: 310-451-7002; FAX: 310-451-6915; or Internet: order@rand.org). Abstracts of all RAND documents may be viewed on the World Wide Web (http://www.rand.org). Publications are distributed to the trade by National Book Network. RAND is a nonprofit institution that helps improve policy and decisionmaking through research and analysis; its publications do not necessarily reflect the opinions or policies of its research sponsors.*

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