
**THE 1960s AND 1970s: ACQUISITION REFORM,
DOCTRINAL FERMENT**

INTRODUCTION

The first period of jet-fighter R&D, as discussed in the previous two chapters, can be characterized as a time of revolutionary technological change. The second period—which stretches from the early 1960s through the mid-1970s—also witnessed new technology developments and capability improvements, including fly-by-wire (FBW) flight-control systems, negative static stability, operational variable-geometry fighters, the beginnings of stealth, and sustained Mach 3+ flight. Nonetheless, none of these technological advances transformed the basic fighter platform to an extent comparable to that caused by the introduction of the jet engine and supersonic flight in the 1940s and 1950s. Despite great technological advances, the second period might best be broadly characterized as a time of unprecedented intellectual ferment, debate, and disagreement over basic fighter performance and design goals, mission roles, doctrine, and operational concepts. This debate led to a shift in emphasis from heavy, fast, multirole fighter-attack aircraft, to lighter, more agile, specialized air combat fighters. At the same time, escalating costs led to increasing attempts to reform the weapon-system acquisition process.

This intellectual ferment and debate were in part caused by dramatic changes in national security doctrine and weapon system procurement policies implemented by the Kennedy administration. Upon entering office, Kennedy's Secretary of Defense, Robert McNamara, almost immediately began implementing fundamental changes in doctrinal emphasis and procurement style from those of the 1950s. In the area of strategy and doctrine, the Kennedy administration placed increased emphasis on the importance of the "conventional option," stressing the ability of the armed forces to fight conventional and limited wars in a nonnuclear environment. McNamara and his "Whiz Kids" at the Pentagon were also determined to impose much greater discipline and rationality on the overall defense planning and budgeting process. The new Pentagon managers were particularly interested in reforming the pro-

cess by which the services generated new weapon-system performance requirements and developed and procured new hardware.¹

McNamara's push to rationalize the procurement process was in part a response to technology and cost trends in the 1950s. The rapidly increasing speed, weight, and technical complexity of first- and second-generation fighters and bombers resulted in a dramatic escalation in R&D and procurement costs, (see Tables 3.1 and 3.2). As jet aircraft engine and airframe technology passed out of the early innovation stage and began to mature, each new increment of improvement in speed and altitude capabilities became increasingly challenging technologically and much more expensive. The growing R&D costs and increasing technological difficulties encountered on such fighter and bomber programs as the F-105, F-106, and B-58 led analysts to question whether even more technologically ambitious programs, such as the Republic F-103, North American F-108, and XB-70, were really feasible and cost-effective.²

With costs rapidly mounting, defense planners concluded that the large number of full-scale development and prototype technology demonstration programs characteristic of the 1950s could no longer be financially sustained. The Pentagon sought to reduce what it considered to be inefficient duplicative R&D by the services. McNamara canceled numerous programs and encouraged the services to procure similar or identical aircraft. Indeed, shortly after entering office, McNamara pressured the Air Force to evaluate the Navy McDonnell F4H-1 Phantom II as an interim replacement for the Convair F-106, Republic F-105D, and McDonnell RF-101 Voodoo. After highly successful trials, the Air Force ordered a new version of the Phantom—the F-4C.³ The rising unit costs of military aircraft and the new emphasis on greater commonality of aircraft designs among the services tended to push procurement trends toward ever smaller numbers of even more complex and expensive fighters designed to offer multirole and cross-service capabilities.⁴

¹See Art (1968), pp. 30–34.

²A counterargument is that aircraft like the XB-70 were cost-effective because they forced the Soviets to allocate their even scarcer resources to matching these technologically ambitious programs.

³Beginning in June 1957, McDonnell began in-house studies of various Air Force variants of the Phantom II. Never having procured a fighter developed for the Navy, the Air Force initially showed little interest in these proposals. Flight tests in 1961 and 1962, however, showed that, in several key areas, the Phantom generally outperformed—often by a considerable margin—the F-106 in the interceptor role, the F-105 in the tactical fighter role, and the RF-101 in the tactical reconnaissance role. Not surprisingly, in March 1962, the Pentagon announced that the Air Force would procure a new version of the Phantom, called the F-110, as its standard tactical fighter. In September 1962, the Pentagon standardized all military aircraft nomenclature. At this time, the F-110 became the F-4C. See Francillon (1990b), pp. 180–181.

⁴As discussed later in this chapter, much of the fighter pilot community and a variety of defense reformers rebelled against this concept in the late 1960s, in part because of the relatively poor showing in Vietnam of large, heavy multirole U.S. fighters, such as the F-4, against smaller, more

For a relatively short period in the late 1950s, many observers predicted that the introduction of tactical and strategic missiles would soon make manned combat aircraft obsolete.⁵ While this belief proved to be wrong, the deployment of land-based and submarine-launched strategic ballistic missiles clearly reduced the relative importance of strategic bombers in the view of U.S. military planners of the period. Indeed, no new strategic bomber design was fully developed in either the 1960s or the 1970s. At the same time, medium bombers essentially disappeared as a distinct and separate category of aircraft, as their role was taken over by heavy multirole fighter-bombers, such as the F-4E Phantom, and tactical bombers, such as the F/FB-111.

The 1960s and 1970s witnessed shifts in the design emphasis and technology focus for new fighter aircraft designs as a result of changes in operational doctrine and other factors. The technological focus on increasing speed and altitude that dominated the 1950s disappeared in the following decade, replaced by a focus on maneuverability, maintainability, and system integration. Considered by many as the most capable fourth-generation fighter, the F-15 nonetheless boasted approximately the same empty weight, ceiling, and top speed as its immediate predecessor, the F-4. Other highly successful fourth-generation fighters, such as the F-16 and F/A-18, actually weighed less empty, had lower top speeds, and had only modestly higher ceilings than the last second- and third-generation fighters. However, many other performance characteristics, such as agility, turning capability and specific excess power, were vastly superior in the newer aircraft.

These changes came about because of the relative decline in the operational utility of ever-greater speed and ceiling and the growing cost and technical challenges of achieving them. The strategic and doctrinal shift toward limited tactical warfare implemented under President Kennedy—and lessons learned from air combat experience in the early years of the Vietnam War, during the Indo-Pakistan War of 1965, the 1967 Arab-Israeli War, and later Middle East engagements—led to a new design and technological focus for fighters. These emphasized maneuverability, agility, and advanced avionics. Air combat in

agile Soviet designs, such as the MiG 21. The F-15 and F-16 were subsequently designed as dedicated single-role air combat fighters. But the same cost trends discussed here, combined with a variety of other factors, led the F-16 to evolve toward a heavier multirole fighter during development, and even the F-15 program eventually produced multirole attack versions.

⁵Bright (1978), pp. 18–19. In Great Britain, the government issued a Defence White Paper in April 1957 that stunned the British aircraft industry. The White Paper reoriented British defense policy toward a heavy reliance on nuclear weapons and missiles. It called for the cancellation of all British fighter and bomber R&D programs then under way, predicting that, within 10 years, all Royal Air Force missions would be carried out by unmanned missiles and vehicles. See Gallois (1957). Although manned aircraft R&D programs continued for some years, nearly all national programs were canceled by the Labour government in the first half of the 1960s.



Photo 4.1—The McDonnell F-4 Phantom has been characterized as the most significant and successful Western fighter of the 1960s. First flown as a Navy fighter in May 1958, the F-4 was eventually procured in large numbers by the U.S. Air Force and several foreign air forces.



Photo 4.2—The Grumman F-14 Tomcat evolved out of the failed Grumman/General Dynamics F-111B program in the early 1970s to become the Navy’s most important fleet air-defense fighter.

Vietnam and in the Middle East revealed the limitations of early generation long-range air-to-air missiles and showed the importance of maneuverability and agility in winning dogfights with guns or early generation short-range infrared (IR) missiles. The initial experience with ground-attack missions in Vietnam indicated that fighter-bombers were vulnerable to surface-to-air missiles and other ground-based air defenses and were unable to deliver ordnance with the required accuracy against ground targets. As a result, designers and engineers concentrated on increasing maneuverability for air combat success and developing and integrating the avionics necessary to counter enemy threats and to deliver munitions more accurately and effectively. While proponents of lighter, more agile dogfighters hoped to bring down escalating costs, the need for more-sophisticated avionics and other complex subsystems meant that, in the end, the cost trends continued upward.

As a result of these cost, technology, and procurement trends, the 1960s and 1970s witnessed a significant decline in the number of new military manned aircraft R&D programs from that of the 1950s. By one accounting, the number of military aircraft designs that were developed and reached first flight during the 1960s fell by around two-thirds from the previous decade. The numbers declined even further in the 1970s.⁶ Figure 4.1 shows some of the major fixed-wing, missile, and space projects of this period.

These trends are clearly reflected in the narrower area of fighter R&D. During this second period, the feverish pace of fighter R&D evident in the 1940s and 1950s slowed considerably. Only two new Air Force and two Navy tactical fighters entered full-scale development—the F-15, F-16, F-14, and F/A-18. One tactical fighter-bomber also completed development—the F-111—but this large, heavy attack aircraft could hardly be considered an air-superiority fighter in the usual sense of the term. As a result, the field of leading fighter contractors shrank considerably, as more companies withdrew from the market. No new entrants came into the arena, not only because of the shrinking number of new programs, but also because the slower rate of overall technological change during the period provided fewer openings for new firms. Therefore, compared to the 1945–1961 period, the relative importance of special firm-specific knowledge relevant to fighter R&D appears to have declined.

System-specific experience appears to have risen in importance during the 1960s and 1970s, as many of the historic leaders in fighter R&D continued to excel. McDonnell-Douglas⁷ raised itself to a position of world leadership in

⁶See Drezner et al. (1992), pp. 29, 49. According to our data, there were 122 R&D programs for manned military aircraft in the 1950s, compared with 39 such programs in the 1960s and 1970s.

⁷The McDonnell Company merged with the Douglas Aircraft Company in January 1967.

	1960	1965	1970	1975
Boeing	(M) C-135* (C) 727	737 747 SST	E-3 (AWACS)	<u>AGM-86 (ALCM)</u> 757 767
GD	(M) F-111** RB-57F (C)	600-640	YF-16	F-16 CCV F-16 <u>BGM-109A/B, G (SLCM/GLCM)</u>
Grumman	(M) A-6* F-111B* E-2* C-2 E-A6A (C)	E-A6B	F-14	
Lockheed	(M) P-3* YF-12A SR-71 A-12* C-141 D-21 (C)	C-5	S-3 L-1011	XST F-117
McDonnell	(M) F-4* (C) DC-9	KC-10 DC-10	F-15	F/A-18** AV-8B MD-80
Northrop	(M) X-21 F-5A/B (C)		F-5E YA-9A YF-17	F/A-18** F-20
Republic	(M) (C)	Merlin & Metro F-228	YA-10 A-10	
Rockwell	(M) (C)	OV-10A Aero & Lark	B-1A Sabre & Aero 112	HiMat
Vought	(M)	A-7		

*Program began in the late 1950s. **Cooperative program with another contractor.

SOURCE: RAND database.

(M) = military; (C) = commercial; bold = fighters, bombers, and related programs; underlined = missiles; normal = X-planes, commercial aircraft, and miscellaneous.

NOTE: Aircraft placement approximates beginning of full-scale development. Some programs are not included in the database because of a lack of precise development dates.

Figure 4.1—Selected Major Fixed-Wing and Cruise Missile Programs, 1960–1980

tactical fighter R&D through the enormous success of the F-4 in both the Navy and Air Force inventories, followed by victory in both the Air Force F-15 and the Navy F/A-18 competitions (the latter with Northrop), as well as the AV-8B Harrier.⁸ General Dynamics (formerly Convair),⁹ remained a prominent Air Force developer by winning the F-16 R&D contract, as well as the F-111 fighter-bomber. Grumman maintained its dominant position in Naval tactical fighters by working on the F-111B development program and by developing the F-14.

However, at least three prominent leaders from the 1940s and 1950s were shut out of the mainstream fighter market during this period. Republic, North American, and Lockheed failed to win major fighter contracts and appeared to have permanently lost their historic positions as important Air Force fighter developers. On the Navy side, the number of dedicated fighter developers shrank to one: Grumman.¹⁰ Douglas had already effectively withdrawn from the fighter market well before the merger with McDonnell. After its success winning the A-7 development contract, Vought, now LTV, failed to garner new fighter R&D programs.¹¹

Despite this attrition, the remaining leading fighter R&D companies—McDonnell-Douglas, General Dynamics, and Grumman—were among those that had pioneered the development of jet fighters after World War II and possessed vast system-specific experience.

MCNAMARA AND THE TFX: ONE SIZE FITS ALL

The Tactical Fighter Experimental (TFX—later the F-111) program, as modified by the incoming Kennedy administration in 1961, not only clearly marks the beginning of the second era in the postwar history of fighter and bomber development, but also conveniently illustrates many of the issues in fighter R&D that dominated the entire era.

With the cancellation of the F-103, F-107, and F-108 in the late 1950s and the downgrading of the XB-70 bomber to a technology-demonstrator project, many contractors anxiously looked forward to three new anticipated R&D programs for a future Air Force tactical fighter-bomber to replace the F-105, a Navy fleet

⁸A development of the British Aerospace Harrier.

⁹Electric Boat and Canadair merged in 1952, forming General Dynamics. In 1954, General Dynamics acquired Convair. However, the main Ft. Worth facility was still routinely referred to as Convair until the early 1960s.

¹⁰McDonnell-Douglas, of course, remained a leading developer of Navy fighter and other combat aircraft but became increasingly involved in the development of fighters for the Air Force.

¹¹In 1961 Chance-Vought merged with other companies to form Ling-Temco-Vought, later called LTV. Aerospace industry observers, however, often continued to refer to LTV as Vought.

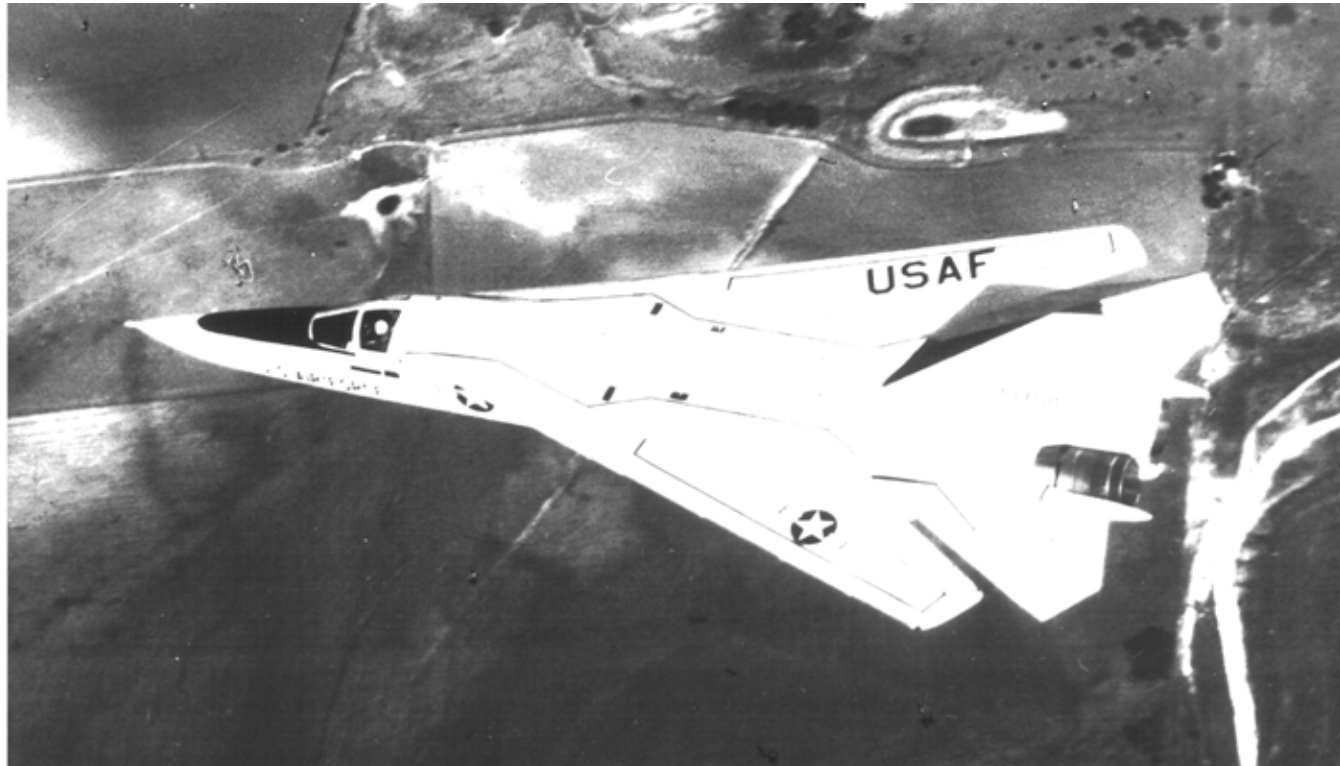


Photo 4.3—The General Dynamics F-111 caused considerable controversy in the early 1960s but eventually became a valuable attack asset in the U.S. Air Force inventory.

interceptor, and a close air support combat aircraft. Following the election of President Kennedy, however, Secretary McNamara quickly shattered these expectations. To the great consternation of both contractors and the services, the new Secretary of Defense sought to achieve added procurement efficiencies by combining these replacement requirements—minus close air support—into a single aircraft. Many industry and service officials objected vigorously to this approach, arguing that a single aircraft could not adequately satisfy the performance requirements for both types of missions. Ignoring these criticisms, McNamara forged ahead with his new quest for greater equipment commonality, as reflected in the TFX Request for Proposals (RFP) issued in September 1961. Calling for a 60,000-lb. gross takeoff weight and low-level supersonic dash capability for the delivery of nuclear and conventional weapons, the TFX requirement asked for a large multirole fighter-bomber in the same weight class as medium bombers, such as the B-57 and B-66.¹²

McNamara began pressuring the Air Force to procure the existing Navy McDonnell F-4 as an interim tactical fighter pending deployment of the TFX/F-111, expected the Navy to procure the F-111B version as its new fighter, and dramatically cut back on the XB-70 and B-58 bomber programs. As a result, the TFX rapidly emerged as the only major new program on the horizon for both fighter and bomber developers. In this new environment of declining new program starts, nearly all combat aircraft developers entered the TFX competition and fought extremely hard to win the contract. All the leading Air Force fighter developers submitted serious proposals, including General Dynamics, North American, Lockheed, and Republic, as did the leading Navy fighter developers, including Grumman, McDonnell, Douglas, and Chance-Vought. The bomber developers were there too. Having failed to win either the B-58 or the XB-70 strategic bomber competitions in the 1950s, Boeing was determined to win the TFX competition. The Seattle firm, along with many of the other contractors, realized that losing the TFX could lead to an involuntary exit from the combat aircraft industry.

To the surprise of many observers, the Air Force Selection Board and Navy representatives initially selected the Boeing design in January 1962, but the Air Force Council later rejected it. Boeing and the runner-up—General Dynamics, which had teamed with Grumman—then received follow-on study contracts. In June, the Air Force once again selected the Boeing proposal, but the Navy refused to approve it. Refined proposals were received in September, and once again the Air Force selected the Boeing design. To Boeing's great consterna-

¹²See Knaack (1978), pp. 223–224.

tion, however, McNamara overturned the decision of the uniformed services and gave the contract to General Dynamics.¹³

The Defense Secretary's decision caused a huge political scandal. Since General Dynamics was based at Ft. Worth, in the home state of Vice President Johnson, and was in serious financial trouble because of the major cutback in the B-58 program decided in December 1960, many observers thought the General Dynamics design had been selected over a superior Boeing design merely to save the Ft. Worth company from going out of business. Extensive congressional hearings were held on this issue, but no definitive conclusions were reached.

For our purposes, the most interesting information to come out of the hearings was the evidence of the technical strengths and weaknesses of the two proposals and a nonpolitical rationale explaining McNamara's decision. Testimony suggested that three key factors behind the secretary's decision were that the General Dynamics proposal showed more commonality between its Air Force and Navy versions, that the Texas firm's technical approach was more conservative and credible, and that General Dynamics' cost estimates appeared more reliable and believable. The second two factors appear to be a reflection of General Dynamics' far greater experience in the development of high-performance, supersonic combat aircraft. Although Boeing's design promised slightly greater performance on paper, General Dynamics' proposal—in the view of the Office of the Secretary of Defense (OSD) and many Air Force engineers—showed a much more realistic appreciation of the realities of supersonic combat aircraft development. Indeed, analysis of the two proposals suggested that only General Dynamics' design would be capable of sustained low-level supersonic dash. OSD engineers considered Boeing's use of top-mounted engine air inlets and maneuvering thrust reversers on its design to be particularly unrealistic on a Mach-2 fighter-bomber. Thus, according to extensive Department of Defense (DoD) testimony, General Dynamics won the contract because its design and its prospects for successfully developing it were indeed superior to Boeing's.¹⁴

This outcome is hardly surprising from the perspective of system-specific experience. By 1960, General Dynamics had accumulated a wealth of system-specific experience with supersonic combat aircraft unmatched by nearly any other contractor. With its F-102 and F-106 fighter development programs and its B-58 strategic bomber R&D effort in the 1950s, General Dynamics could be considered, along with North American, as the premier developer of USAF

¹³Knaack (1978), p. 225.

¹⁴Coulam (1977); Art (1968).

supersonic combat aircraft at the time. Boeing, on the other hand, had never developed any supersonic jet fighter or bomber whatsoever and had not developed a military aircraft of any type since the early 1950s.

Finally, General Dynamics was teamed with Grumman. Although Boeing had begun design studies on variable-geometry swing wings of the type to be used on the F-111 considerably earlier than had General Dynamics, Grumman had actually designed, developed, and flight tested a variable-geometry fighter prototype in the 1950s, the F10F. Grumman, of course, stood out as the historic industry leader in Navy fighter aircraft development. In short, it is certainly arguable that General Dynamics and Grumman won the competition because of their greater technical realism based on extensive experience in development of supersonic combat aircraft.¹⁵

Winning the F-111 contract assured General Dynamics a continuing role as a leader in the development of Air Force fighters and bombers. Air Force adoption of the F-4 Phantom around the same time catapulted McDonnell into the position of America's leading manufacturer of tactical fighters. The other leading fighter developers, however, seemed to be confronted with grim prospects. Although Grumman had won the lead position for the Navy version of the TFX—the F-111B—the New York firm was clearly subordinate to General Dynamics on the program. Far worse were the consequences of the TFX program for the other traditional leading Air Force fighter developers—Republic, North American, and Lockheed—as well as the Navy fighter developers Douglas and Vought.

Failure to win the TFX competition effectively ended the hopes of both Republic and Douglas to remain viable developers of fighter aircraft. Since the 1930s, Republic had specialized almost exclusively in developing large, heavy fighter-attack aircraft for the Air Force. With F-105 production ending in 1964 and General Dynamics selected as the developer of the follow-on to the Thunderchief, Republic appeared to have been squeezed out of its specialty market. The company won a reprieve in 1965 when it was purchased by Fairchild Corporation. Hopes for reentry into the fighter market soared briefly when Fairchild-Republic won a contract in 1966 for a new Air Force vertical takeoff and landing (V/TOL) fighter to be developed collaboratively with Germany. However, Secretary McNamara canceled the project in early 1968, once again leaving Republic with no aircraft contracts.¹⁶

¹⁵Indeed, General Dynamics was well aware of the unhappy consequences of technological overoptimism from its F-102/106 and B-58 programs and would suffer the consequences again on the F-111. For an exhaustive discussion of these issues, see Art (1968), pp. 115–132; Coulam (1977), pp. 62–65.

¹⁶See Stoff (1990), pp. 166–167.

Douglas found itself in a similar position regarding fighter aircraft as a result of McNamara's policies and General Dynamics' victory in the TFX competition. In July 1960, Douglas had won a hard-fought competition to develop the Navy's ultimate stand-off air defense fighter, the F6D-1 Missileer. This fighter was envisioned to be little more than a long-endurance subsonic missile launch platform. The Missileer was intended to loiter for hours out in front of the fleet and to launch the Bendix-Grumman XAAM-N-10 Eagle long-range missile at enemy bombers more than 150 miles away. McNamara canceled this program in April 1961, however, after folding the Missileer mission into the new TFX requirement. As a result, Douglas's survival became almost entirely dependent on its commercial aircraft sales. However, problems with both the DC-8 and DC-9 airliners led to a financial crisis in 1965. The next year, McDonnell bought out the ailing Douglas corporation.¹⁷ The Douglas division continued to design airliners, but this famous developer of the legendary carrier aircraft that won the Battle of Midway never again developed a Navy fighter or attack aircraft.¹⁸

North American, Lockheed, and Northrop found themselves with no prospects for a new first-line fighter program after the TFX decision, but these companies had other work to keep them busy. North American had increasingly specialized in space; high-speed test aircraft, such as the X-15; and supersonic bombers, such as the XB-70 and later the B-1A. Lockheed moved ahead vigorously in space; military and commercial transports; and specialized high-speed reconnaissance aircraft, including the spectacular Mach-3 SR-71, a version of which the Air Force briefly considered for procurement as the YF-12 fighter-interceptor. Northrop focused heavily on its highly successful lightweight export fighter, the F-5 Freedom Fighter, and the T-38 jet trainer on which it was based.

After the TFX decision, some hope lingered among these traditional Air Force fighter contractors, as well as Republic, that the Air Force requirement for a close-air support aircraft might lead to a new fighter-attack aircraft program. As the war in Vietnam began to heat up, many in the Air Force supported procurement of a version of the F-5, while others called for a specialized counterinsurgency aircraft. To the considerable consternation of the traditional Air Force contractors and many in the Air Force, McNamara once again pushed for greater service commonality by pressuring the Air Force to procure a version of the Navy Vought A-7 attack aircraft, which itself was a development of the Navy

¹⁷The merger between the companies was approved in January 1967.

¹⁸See Bright (1978), pp. 192–196. Douglas SBD Dauntless dive bombers played a central role in sinking four Japanese aircraft carriers at the decisive Battle of Midway in June 1942 and remained the most important carrier-based Navy attack aircraft of the war. Its creator, Ed Heineman, went on to design one of the most famous U.S. carrier-based attack aircraft of the jet era, the Douglas A-4 Skyhawk.

Vought F-8 Crusader. In early 1966, the Air Force agreed to procure an upgraded version of the A-7, ending once and for all the hopes of the traditional Air Force fighter contractors for a new program.¹⁹

Thus, by the mid-1960s, McNamara's push for greater service equipment commonality and the development of multirole fighters had produced a grim outlook for many traditional fighter developers. It appeared that all anticipated fighter and attack aircraft requirements for the Air Force and Navy would be filled by the TFX or by versions of existing aircraft. But increasing technical problems, cost growth, and schedule slippage on the TFX program, combined with growing Air Force and Navy dissatisfaction with anticipated TFX performance limitations in aerial combat, led to a dramatic turnaround of this situation in the late 1960s. In the end, new R&D efforts were launched that led to some of the most successful and capable conventional jet fighters ever developed by American industry.

¹⁹Gunston (1974), pp. 234-242.