IDA

INSTITUTE FOR DEFENSE ANALYSES

Joint Acquisition: Implications from Experience with Fixed-Wing Tactical Aircraft

David L. McNicol

September 2005
Approved for public release; distribution unlimited.
IDA Paper P-4049
Log: H 05-000594

This work was conducted under contract DASW01 04 C 0003, Task AO-7-2455, for the Office of the Director, Acquisition Resources and Analysis. The publication of this IDA document does not indicate endorsement by the Department of Defense, nor should the contents be construed as reflecting the official position of that Agency.

INSTITUTE FOR DEFENSE ANALYSES

IDA Paper P-4049

Joint Acquisition: Implications from Experience with Fixed-Wing Tactical Aircraft

David L. McNicol

PREFACE

The Institute for Defense Analyses (IDA) prepared this paper for the Office of the Director, Acquisition Resources and Analysis, under a task titled "Incentivizing Jointness in Department of Defense (DoD) Acquisition Programs." It explores what can be concluded about joint programs based on DoD experience with tactical aircraft programs since 1960. It fulfills the task objective of identifying ways to increase incentives for jointness, and removing obstacles to achieving it, in DoD acquisition programs.

Stanley A. Horowitz and Gene H. Porter of IDA were the technical reviewers for this paper.

TABLE OF CONTENTS

LIST OF TABLES

SUMMARY

This paper uses "joint acquisition program" to mean an acquisition program set up to acquire a single system design, or variants of a single design, for use by more than one of the military Services. The resources available for this paper did not permit the consideration of all Department of Defense (DoD) joint programs. Attention was limited to Defense Department fixed-wing tactical aircraft programs, which has a rich and uniquely well-documented history of joint programs. In particular, much of the discussion concerns the F-111 and the F-35 fighter aircraft programs, which are the only programs the Defense Department has undertaken to both develop and procure fixed-wing manned tactical aircraft for use by more than one of the Services.

The bulk of this paper is directly concerned with whether there are characteristic failure modes for joint acquisition programs. The central implications for this question of the main published analyses of the F-111 program and the other tactical aircraft programs of the 1960s and 1970s with joint aspects can be summarized in two principles:

1. A joint program to develop and procure a system to requirements significantly at odds with the doctrinal preconceptions of any of the participating Services will face severe problems due to detailed Service decisions taken during the course of the program and Service judgments on the results of operational testing.
2. If such a joint program is undertaken, to achieve the results desired, the Office of the Secretary of Defense (OSD) must be proactive in managing issues and, therefore, much more involved in management than it needs to be for a single-Service program.

These two principles suggest that within the basic organizational architecture of the Defense Department, joint development programs are difficult if not impossible to conduct successfully if the requirements established for the joint program seriously conflict with one of the participating Services' doctrinal preconceptions.

Experience with the F-35 points to the possibility of gaining consensus on requirements and, hence, of conducting successful joint acquisition programs. The main contrasts between the F-111 and the F-35 programs are summarized in Table S-1. The F-35 program has done better than the F-111 did on each of the three factors below the

heavy line. These three characteristics are not unique to joint programs, however, and presumably are no more or no less important to joint programs than to single-Service programs. The crucial factors are those above the heavy line. The third of these—arrangements for joint management—is the least important. The detailed record of the F-111 program does not indicate that weaknesses of its arrangements for joint management were a crucial cause of its failures.

Table S-1. Summary of F-111 and F-35 Program Contrasts

Program Characteristic	F-111	F-35
Lack of consensus on requirements	Yes	No
Reactive OSD oversight	Yes	Yes
Services not equally engaged in management and funding	Yes	No
Major flaws in acquisition strategy	Yes	No
Unrealistic cost and schedule estimates	Yes	TBD—less so
Technology does not permit achieving all requirements	Yes	TBD—less so

The much more important factor is whether or not consensus is obtained on requirements, and to the degree it is absent, there is active OSD oversight of the program to ensure that detailed program choices below the level of requirements remain consistent with the goals established for the program. There was not a consensus on the requirements for the F-111 program, and OSD oversight was reactive. OSD oversight of the F-35 program appears to be even less proactive than the F-111 program got with Robert McNamara as Secretary of Defense.[1] That is less a crucial fact for the F-35 program than it was for the F-111, however, because a reasonable consensus on requirements for the F-35 was achieved. Thus, while at its present stage the F-35 program's eventual success is still to be determined, it seems clear that it has avoided what seems to have been the crucial obstacle to success of the F-111 program.

Comparison of the F-111 program with the first 12 years of the F-35 program suggests the following conclusion: Joint programs are feasible if a reasonable consensus on the system to be acquired is achieved; otherwise, they may be infeasible within the current institutional arrangements for acquisitions.

---

1 Furthermore, performance contracting (used for the F-35 program) favors shifting responsibility and decisionmaking authority to the contractor and, accordingly, discourages proactive OSD intervention in decisions below the level of those involving trades among Key Performance Parameters.

The paper offers two closely linked recommendations based on the analysis:

1. Assign responsibility within OSD for regularly surveying opportunities for joint approaches to major acquisitions.
2. Establish a mechanism for making coordinated use of the tools OSD has to establish consensus on requirements for potential joint acquisition programs.

The first of these recommendations is motivated by the fact that a joint approach to a potential acquisition effectively is not a required part of formal DoD requirements, resource allocation, and acquisition processes. The second responds to the comparison of the F-111 and the F-35 acquisition programs. Imposition of requirements by the Secretary of Defense seems unlikely to produce a successful joint program, but the Office of the Secretary of Defense, working with the Joint Staff, may be able to orchestrate the consensus on requirements that seems to be a necessary ingredient for a successful joint program.

The Under Secretary of Defense (Acquisition, Technology and Logistics) (USD[AT&L]) has two readily available tools to use in attempting to establish a consensus on requirements for a joint acquisition program: projects established within the Defense Advanced Research Projects Agency and Advanced Concept Technology Demonstrators. As the F-35 program suggests, each of these can play a constructive role. A third tool that may be useful in some cases is the Joint Experimentation Program of the U.S. Joint Forces Command. Other, more specialized tools would be available for some particular types of systems.

The recommendations offered here would not require elaborate implementation. The tasks identified could be assigned to a senior OSD official—presumably USD(AT&L) or the Director of the Office of Program Analysis and Evaluation. The work could be done by an ad hoc team or teams with representation from the relevant OSD offices, the Joint Staff, and the Services. A detailed process specification would be inappropriate because sensible steps will differ significantly from one case to the next. The essential elements are: (1) periodic surveys to identify promising opportunities for joint acquisition programs; and (2) a flexible process for exploring these possibilities and, when warranted, developing a consensus on an Initial Capabilities Document for a joint acquisition program.

A. INTRODUCTION

This paper uses "joint acquisition program" to mean an acquisition program set up to acquire a single system design, or variants of a single design, for use by more than one of the military Services.

The Joint Strike Fighter (JSF) program (now the F-35) is a ready example of a joint acquisition program in this sense. The F-35 development program is to result in three distinct aircraft that will replace the Air Force's F-16s and A-10s, replace the Marine Corps's F/A-18C/Ds and A-V8Bs, and complement the Navy's F/A-18E/Fs. The three F-35 variants will have the same core avionics and the same engine; the airframes are currently projected to be about 60 percent common by weight.

The definition of joint programs used here excludes programs in which two or more Services operate distinct parts of what is properly viewed as a single system. The Joint Surveillance Target Attack Radar Systems (JSTARS) program is a good example of this sort of program. The JSTARS program as a whole includes both the airborne portion—the aircraft, the radar, and associated airborne equipment—and the Army ground station module. Programs like this are important and are likely to be more so in the future. They basically present issues of interoperability, however, and these are distinct from the issues considered here.[1]

Two criteria determine whether a joint acquisition, rather than a single-Service acquisition, is cost-effective: (1) costs of the alternatives in question; and (2) net effects of the alternatives on effectiveness. While other cases clearly are possible, the shape of the issue typically is assumed to be as follows:

- Joint acquisition involves compromises, so at least one of the participating Services obtains a system less capable than one optimized around its own requirements.
- A joint program, however, acquires the system at lower cost than the alternative single-Service programs.
- The funds freed by the cost avoidance can be used to acquire other capabilities.

---

1 The variants of a joint program are more likely to be interoperable in most important respects than corresponding single-Service programs would be. (That is, it is more likely that the Air Force version of the F-35 can readily communicate with the Navy variant than would be the case if the Air Force and the Navy had each developed a Service-unique aircraft.) However, there seems to be no reason to suppose that—to continue the example—the Navy variant of the F-35 is better able to communicate with other systems, both Navy systems and those of the other Services, simply because it was developed through a joint program.

In short, from an overall DoD perspective, the decision turns on whether the effectiveness forgone by the compromises required by the joint program is offset by the increment in capability bought with the savings. In some cases the joint program will be warranted, in others it will not.[2]

If the balance of costs and benefits seems favorable, one Service could voluntarily invite the participation of another in one of its acquisition programs. Similarly, a Service may request participation in an acquisition program initiated by another Service. In both cases the main attractions presumably would be the prospect of lower development and procurement costs and greater political support for the program. Other considerations, however, can dissuade a Service from voluntarily agreeing to a joint approach to an acquisition. First, it may be difficult to obtain agreement on the division of costs, and sometimes of benefits, among the participating Services.[3] Second, joint programs always entail some loss of control, adding to the perceived risks of the program. Third, joint programs can be expected to involve more management effort than single-Service programs. While some joint programs have been successful, it seems accurate to say that joint programs are usually regarded as more difficult to manage to a successful conclusion than single-Service programs. For these reasons, a Service will not necessarily adopt a joint approach even in cases in which, from the perspective of the Defense Department as a whole, it would be cost-effective for them to do so.

A joint program can, alternatively, be established by direction of the Secretary of Defense. As discussed below, this has happened in several instances. In none of the three relevant DoD decision support processes—requirements, acquisition, and resource allocation—is consideration of a joint approach to acquisition a mandatory part of the process, however. Consequently, ongoing DoD processes cannot be counted on to identify acquisitions that are promising candidates for a joint approach.

---

2 The JSF is an example of a program in which there was an explicit evaluation of the cost part of the tradeoff. At the time the JSF program was initiated, it was estimated the program would develop, in rough terms, three aircraft for the cost of developing two in single-Service programs. In today's dollars, the saving was estimated to be about $10 billion.

3 For example, the fact that units procured "off the end of the learning curve" typically are much cheaper than early production units can be a problem. Should each Service pay the average cost of the units it procures, or should each Service pay the unit average cost of the entire quantity acquired?

These comments point to several specific questions that are parts of the general question of whether and how the Defense Department could improve its acquisition performance by more frequently pursuing joint approaches:

- Does the Defense Department fail to undertake a significant number of joint programs that would be cost-effective?
- If so, why? What are the institutional barriers to joint programs and what incentives work against their adoption?
- Are joint programs more prone to failure than single-Service programs?
- If so, why? Are there characteristic failure modes for joint programs?
- Why have some joint programs succeeded while others have failed?

These questions are familiar. Remarkably, however, little comparative analysis that seeks to draw lessons from a set of joint programs apparently has been undertaken. In this respect, this paper attempts to go a step beyond most preceding studies of joint acquisition programs.

This paper touches on each of the questions listed above, but the bulk of it is directly concerned with the fourth—whether there are characteristic failure modes for joint acquisition programs. The resources available for this paper did not permit the consideration of all DoD joint programs. Attention was limited to fixed-wing tactical aircraft, which has a rich and uniquely well-documented history of joint programs.

Table 1 lists the U.S. manned, fixed-wing tactical aircraft programs that entered Engineering and Manufacturing Development (EMD) after 1959. Five of the 17 programs listed in the table had joint aspects:[4]

1. The F-4—a Navy-developed aircraft that the Air Force purchased in large quantities after then-Secretary of Defense Robert McNamara directed the Air Force to do so.
2. The A-7—another Navy-developed aircraft that Secretary McNamara directed the Air Force to procure. The A-7 program was less successful than the F-4 program, although the Air Force did procure a significant number of substantially modified A-7s (as the A-7D).

---

4 At Milestone II for the F-22, the Navy stated that it intended to eventually procure a version of the aircraft. Similarly, at Milestone II for the A-12, the Air Force stated that it intended to procure a land-based version of the A-12. Neither the F-22 nor the A-12 was a joint program in the sense that more than one of the Services played a major role in developing requirements or making decisions on the program.

3. The F-18A/B—developed from a prototype for the Air Force, the YF-17. The F/A-18A/B was a substantially different aircraft than the YF-17, and was procured only by the Navy.
4. The F-111A/B (TFX)—a program to develop and procure variants of a single fighter/bomber design for use by both the Navy and the Air Force.
5. The F-35 (JSF)—a program to develop and procure variants of a single multi-role fighter for use by the Navy, Air Force, and Marine Corps.

Table 1. U.S. Manned Fixed-Wing Tactical Aircraft Entering Engineering and Manufacturing Development, 1960–2004

Aircraft	First Flight[a]	Comment
A-6	1960	Prototype only
A-37	1963	Modified T-37
F-111A/B (TFX)	Dec 1964/May 1965	Joint
F-4C/D/E/G	May 1963	Air Force bought modified Navy aircraft
A-7D	Sep 1965	Air Force bought modified Navy aircraft
F-14	Dec 1970	—
F-15	Jul 1972	—
A-10/OA-10	Jul 1972	—
F-16	Jan 1974	—
F/A-18A/B	1978	Began with YF-17
F-15E	Jul 1980	—
F-117	1981	—
AV-8B	1981	—
A-12	Not applicable	—
F-22	1991	—
F/A-18E/F	1995	—
F-35 (JSF)	To be determined	Joint

[a] In most cases, first flight of a demonstrator or prototype; otherwise, first flight of an EMD aircraft.

The F-111 program (begun in 1961) and the F-35 program (begun in 1993) stand out against this background in that both were launched as joint development programs. The F-4 and the A-7 were cases in which the Air Force bought a Navy design (with substantial modification in the case of the A-7), and the F/A-18A/B was the result of a Navy development program that took as it point of departure a prototype developed for the Air Force. In contrast, the F-111 and F-35 programs were intended to both develop and procure variants of a single design for use by the Navy and the Air Force.[5]

5 The F/A-18 was acquired for use by both the Navy and the Marine Corps.

At least within the realm of fixed-wing tactical aircraft programs, the F-111 and the F-35 provide the bulk of the evidence on the key determinants of success and failure in joint acquisition programs. These two programs accordingly are the focus of most of what follows.

B. HISTORICAL OVERVIEW OF THE F-111 PROGRAM

In 1959 the Air Force began exploring requirements for a replacement for the F-105. The Air Force from the start had in mind a multi-mission aircraft; in particular, the new aircraft was to be:

- An air superiority aircraft, capable of defeating the most advanced Soviet fighters;
- A long-range penetrator, capable of delivering tactical nuclear weapons; and
- An aircraft able to provide close air support to ground forces.

The Air Force further wanted an aircraft capable of short take-off and landing on semi-improved airfields.[6]

These requirements presented one problem that was recognized from the start (Coulam, p. 38):

> The central problem was that TAC's [Tactical Air Command] requirements were aerodynamically contradictory. The TAC desire for transoceanic range, as well as its need for short take-off and landing capability from semi-prepared fields, required a relatively long, unswept wing for the proposed aircraft. However, its desire for high speed dictated a relatively short, sharply swept wing.

Recent advances in swing-wing technology promised a practical variable geometry wing that permitted development of an aircraft capable of both the air superiority and the penetration missions. Hence, although the close air support mission was eventually dropped from the TFX program, the other two missions were retained.

The air superiority mission led the Air Force to specify a high-altitude maximum speed for the TFX of Mach 2.5. The requirements specified for the penetration mission were as follows:

- Unrefueled ferry range of 4,180 nautical miles,
- Maximum speed at sea level of Mach 1.2, and
- A dash range (at Mach 1.2) of 210 nautical miles.

---

6 Unless otherwise noted, the specific facts cited in this section and the next concerning the F-111, the F-4, the A-7, the F-16, and the F/A-18 are taken from Robert F. Coulam, *Illusions of Choice*, Princeton: Princeton University Press, 1977.

Coulam notes that it was the penetration mission that drove Air Force requirements for the TFX, and it was the one on which the Air Force placed the highest priority. There is considerable irony in this fact because Defense Secretary Robert McNamara selected the Air Force requirements as the basis for the joint program on the incorrect assumption that they were consistent with his agenda of moving the Department of Defense to a flexible response strategy.[7]

About the same time the Air Force was exploring requirements for an F-105 replacement, the Navy was exploring requirements for a new aircraft for fleet air defense and close air support. The first and highest priority of these missions was driven by an emerging threat (Coulam, p. 43):

> [The Navy] feared that future enemy aircraft would be able to fire air-to-sea missiles at the fleet from unusually long ranges. To counter this threat, the Navy needed a new fighter that could identify the enemy planes and shoot them down at an extended range—that is, shoot them down before they fired their missiles at Navy ships.

There was agreement in the Navy that countering this threat required a highly capable, beyond-visual-range, air-to-air missile. About 1959 the Navy let a contract with Bendix to develop such a missile, called Eagle. The Phoenix missile, acquired from Raytheon in the 1970s, was eventually used for the long-range fleet air defense role.

Some within the Navy questioned whether the platform for delivering the missile should be a supersonic aircraft, rather than a subsonic aircraft. The subsonic option won out. In 1960 the Navy awarded Douglas Aircraft Company a contract to develop the Missileer aircraft. The Missileer was to be a carrier-capable, high-subsonic aircraft capable of carrying the Eagle missile and of loitering for 3.5 hours at a distance of 150 nautical miles from the fleet.

Note that the Missileer could be described as a long-range, high-altitude, high-subsonic aircraft that, moreover, had to be relatively large to carry the Eagle missile. Thus, on the face of the matter, it was not a stretch to regard the requirements for the Missileer to be a lesser-included subset of the requirements for the Air Force TFX.

---

7 Coulam (p. 121) reports that in a September 1966 meeting McNamara stated, "The failure to have [the conventional mission] specified from the outset was a DOD error...a fall-out from the day when emphasis was almost exclusively on tactical nuclear missions."

According to a detailed study of the establishment of the TFX requirements and the subsequent source selection:[8]

> [McNamara] reasoned that [a joint program] was possible because the primary Navy mission of fleet air defense and the primary Air Force mission of long-range interdiction, though different in their purposes, were nevertheless similar enough in the aerodynamic and operational features that each would require in a plane that one, not two, planes could be built to perform them both.

The initial step taken by Secretary McNamara toward establishment of a joint TFX program was as follows (Coulam, p. 52):

> Under McNamara's direction, Herbert F. York, Director of Defense Research and Engineering, on February 14 [1961] ordered the Navy and the Air Force to study the development of a joint tactical fighter. They were instructed to base their studies on the tactical fighter then under consideration by the Air Force. Following these joint studies, the Services were to prepare a single joint specific operational requirement and technical development plan for York's approval.

The Navy and the Air Force were not able to agree on a joint requirement. Secretary McNamara broke the impasse in a memorandum issued September 1, 1961. He left the Air Force TFX requirement intact but "specified additional criteria of performance and physical dimension that the proposed aircraft was to satisfy..." (Coulam p. 54). Among these was weight, which was crucial for the carrier suitability of the aircraft. In effect, "additional criteria" specified conditions under which an aircraft that met the Air Force requirements would also meet the Navy requirements. McNamara further specified that the Air Force would lead the TFX program; that it would be managed through normal Air Force acquisition channels; that changes to the design to meet Navy requirements should be minimized; and that the Air Force would provide all of the development funding.

The combination of the Navy and Air Force requirements presented another potential contradiction; the Mach 1.2 dash speed at sea level imposed stringent structural strength requirements, and this meant weight, which worked against carrier suitability. Thus, the memorandum embodied a key assumption: The state of the art permitted the

---

8 Robert J. Art, *The TFX Decision: McNamara and the Military*, Boston: Little, Brown and Company, 1968, p. 39. Consideration of a joint program began before Robert McNamara became Secretary of Defense. In late 1960, the outgoing Eisenhower administration, not wanting to commit the incoming administration to new major programs, halted development of the Missileer, directed the Air Force not to proceed with source selection for the TFX, and instructed the Director, Defense Research and Engineering, to "begin efforts to coordinate requirements of the services into a single, multi-service fighter." See Coulam, p. 45.

satisfaction of the Air Force requirements, within the conditions imposed by the Navy's requirements.

The TFX program entered the source selection phase in the fall of 1961 with the requirement established by Secretary McNamara. This phase of the program lasted approximately 1 year. At its conclusion, the source selection board, including its Navy member, unanimously recommended award of the development contract to Boeing. Secretary McNamara, however, overruled the source selection board and, in December 1962, awarded the development contract to General Dynamics.

The F-111A (the Air Force version of the TFX) had its first flight in December 1964. Serial production of the F-111A was authorized by letter contract in April 1965. The first flight of the Navy version (the F-111B) was in May 1965, and the Navy evaluation of the aircraft began in October 1965. Flight test continued through 1966 and into 1967. A series of problems with the F-111B was uncovered, and "fixes" were incorporated into the program. On at least two occasions, the Navy proposed halting the program for redesign of the Navy version. Secretary McNamara rejected these proposals, reportedly out of a concern that such a redesign would result in significantly reduced commonality and therefore smaller savings from the joint program.

It became apparent within a year or two of the start of EMD on the F-111 that the cost and schedule assumptions made at contract award were unrealistic. From a fairly early point in the test program it also became clear that the technical ambitions of the TFX program were beyond reach (Coulam, p. 83):

> In the heated debate surrounding the F-111 program, there was one issue on which all participants reached agreement: the formal performance requirements of the Air Force and the Navy were impossible to meet within the technical state of the art in the 1960s.

In short, as the program went along, estimated procurement cost increased dramatically, schedule slipped, and testing revealed shortfalls against requirements as well as other problems that required modifications of the aircraft.

Moreover, the perceived character of the threat changed in ways that challenged the relevance of the F-111 requirements. This change grew out of experience of air warfare in Vietnam, reinforced by the characteristics of some new Soviet fighters unveiled at an air show in July 1967. These resulted in a growing sense in the Navy (which the Air Force came to share) that an air superiority aircraft would require capabilities for close air combat, which the F-111B (and the F-111A) did not possess.

Nevertheless, with the specification and incorporation in the F-111B of an additional set of changes, the Navy in March 1967 formally acknowledged that it would be an acceptable aircraft. The Congress apparently did not entirely share this position. The Congress had cut long-lead funding for F-111B in 1966. Carrier suitability trials that were to have been completed prior to congressional action on the budget the following year were delayed until the spring of 1968. Consequently, in 1967 the Congress again cut long-lead funding for the F-111B (in action on the FY 1968 budget). This was a comparatively mild action; the Congress apparently had not moved to cancel the program in 1967 because there was no alternative program at the time to provide a fleet defense aircraft.

The situation the following year was different in a crucial way. In 1966 the Navy initiated the VFAX program to study aircraft designs that responded to the new perception of the threat, especially the need for an aircraft that could be successful against threat aircraft in close air combat. The VFAX program initially emphasized attack, with air superiority as a secondary role. By 1967, the primary emphasis had shifted to air superiority; the new aircraft was still to be able to carry the Phoenix missile but also to be capable of close air combat.

The DoD budget sent to the Congress in January 1968 recommended that the planned procurement of 30 F-111B for FY 1969 be reduced to 8, and that the funds freed up be devoted to elaborating the VFAX design. A choice between the VFAX and the F-111B was to be made in the course of FY 1969. In effect, the administration budget submission in FY 1969 implied that the Navy regarded the VFAX program as a viable alternative to the F-111B for the fleet defense role. Reportedly, the administration also indicated informally to the Congress that it would cancel the F-111B after the election.

On March 27, 1968, a month after Robert McNamara left office as Secretary of Defense, the Senate Committee on Armed Services voted to cancel the F-111B. The Congress accepted this action. The new Secretary and Deputy Secretary of Defense did not contest the congressional action and the Defense Department cancelled the F-111B program in July 1968. The VFAX program continued and evolved into the F-14.

The cost increases, schedule slips, and performance shortfalls that figured in the cancellation of the F-111B were also experienced by the F-111A. The Air Force was willing to accept the F-111A, however. By 1967 the F-111A was in rate production (although "fixes" and upgrades were still in process). The Air Force bought a total of 513

F-111s of various models. An electronic warfare version of the F-111 remained in service until 1996.[9]

C. WHY THE F-111 PROGRAM FAILED TO PRODUCE JOINT AIRCRAFT

In addition to being a joint program, the TFX had the following characteristics:

- Development was done under a competitively awarded fixed-price contract.
- The contract reflected unrealistically optimistic cost and schedule estimates.
- There was a high degree of concurrency between development and production.
- In order to meet schedule, it was necessary to begin the engineering and manufacturing phase while some key technologies were still immature.

From the perspective of acquisition policy as it evolved during the two decades after the TFX program, these characteristics are virtually a checklist of the most important "don't dos" of acquisition strategy. Moreover, as was noted earlier, the state of the art did not permit meeting all of the requirements that had been established for the TFX. This is to say that many of the problems encountered with the TFX program stemmed primarily from flaws in its acquisition strategy and technological overreach rather than its joint nature.

Navy opposition clearly was an important factor, however. Without any further explanation, "Service opposition" to a joint program would be generally understood to refer to: (1) explicit statements of opposition by senior military or civilian officials of the Service; and/or (2) bureaucratic obstruction by mid-level officials. Coulam explicitly rejects (Coulam, p. 310):

> ...a simplistic "Navy sabotage" argument to explain the F-111's demise. Many people in the Navy worked very hard to develop an F-111B suitable for Navy use. Yet these people were honestly dissatisfied with the program's results.... In spite of their best efforts, they could not see the F-111B as an adequate airplane....

Coulam reports instances early and late in the program in which senior Navy officials opposed the F-111B, but he sees these as reactions to events within the F-111B program rather than as initiatives by these officials.

Coulam's main contribution lies in his finding that the normal, ongoing activities of the program evoked the Navy's underlying skepticism about the F-111, buttressed it, and

---

9 The Air Force also initiated a program in response to the new perception of the threat. The program, designated the FX, evolved into the F-15.

provided appropriate occasions for its expression. The key to Coulam's analysis is recognition of the role that the doctrine of the relevant warfighting community plays in the acquisition process.

Service doctrine, threat assessment, and information on technological limitations and opportunities go into determination of the requirements placed on contract. The Secretary of Defense has the legal authority to specify requirements, and, as the TFX history shows, a determined Secretary can use this authority to impose requirements that differ from those that the Services involved would specify. Doctrine does not become irrelevant, however, if the Secretary does so and the requirements he directs have been placed on contract. To the contrary, prevailing Service doctrine provides the frame of reference that the Service war-fighting communities bring to the decisions that must be made once the requirements have been established and the program launched.

These decisions fall into two main groups. The first of these is decisions about detailed aspects of the program—that is, aspects that are below the level of major, formal requirements but that typically impinge on the likelihood that the system finally developed will meet requirements. Coulam points out several examples of this, including the following:

- The Navy insisted on a bomb bay large enough for the F-111B to carry two Phoenix missiles internally, in addition to the four to be carried externally. (pp. 262–263).
- The Air Force accepted design changes proposed by General Dynamics that offered the prospect of increasing the dash range to 200 nautical miles, from 135 nautical miles. (p. 113).

Both sets of changes, in different ways, reduced the likelihood that the F-111B would satisfy the requirements that had been established for it.

The likelihood of such decisions has important implications for the Office of the Secretary of Defense (OSD) oversight of joint programs. As Coulam points out in some detail, oversight of major acquisition programs by senior DoD officials tends to be reactive, and decisions are seldom taken until the need for them is solidly established. This practice often is problematical in single-Service programs and is virtually guaranteed to lead to unsatisfactory results in a joint program in which the participating Services (acting on their doctrinal preconceptions) are likely to take decisions that run counter to OSD goals for the program.

The second set of decisions are those stemming from testing. Each Service will determine, on the basis of tests it performs, whether it judges the system to be operationally suitable. As Coulam notes, most programs fail to fully meet all of the requirements that have been established for them. The issue then is: Are these shortfalls and problems with aspects of the system not explicitly covered by a formal requirement serious enough to sustain a judgment that the system is not operationally suitable? Coulam argues persuasively that these evaluations will be done in terms of the Service's doctrinal preconceptions, although other considerations, especially the prospects for obtaining funding, will also figure in the eventual decisions.

A crucial issue in tests of the F-111B was carrier suitability. This principally depended on the weight of the aircraft, its size, landing speed, how controllable the aircraft was at landing speed, and the ability of the aircraft to take a wave-off, and then come around and land safely, on one engine. The Navy felt that the requirements that had been established for the F-111B were the minimum that would permit it to be suitable for an aircraft carrier. Operational testing, as it went on, made the case that those requirements were not met by the F-111B, and hence made the case for the test pilot's judgments that it was not suitable for carrier operations.[10]

The core of Coulam's interpretation of the F-111 experience is encapsulated in the title of his book, *Illusions of Choice*. Secretary McNamara chose the requirements for the joint F-111 program. His decision on requirements, however, was not ultimately sufficient to choose the F-111B as the Navy's fleet air defense aircraft. It was not because the Navy's ongoing roles in program decisions and testing were conducted in terms of its doctrinal preconceptions. Secretary McNamara's decision did not reach these, and in the end, they proved to be a crucial determinant of the F-111B program's outcome.

It seems reasonable to suggest that Secretary McNamara's error was rooted at least in part in a relatively shallow understanding of the origins and roles of requirements for major weapon system acquisition programs. From an OSD perspective, the requirement (in one form or another) is the start of an acquisition and probably the largest single factor in shaping the program. From a Service perspective, a requirement is more a result than a start, and it is seen in the context of a constellation of factors—the threat, the capabilities of other systems, technology, organization of units, and training—all of

---

10 This was a particularly telling point for the Congress, coming at a time when the threat perceived changed and the Navy had some months before it initiated a program promising a more appropriate response to the new perception of what was required for effective fleet air defense.

which have a relationship with doctrinal conceptions. Thus, from a Service perspective, imposition of a requirement that runs strongly against its doctrines creates an anomaly, an element inconsistent in important ways with other elements that go into the creation of an effective military force.

Coulam buttresses his argument by contrasting the cancellation of the F-111B with the Air Force's procurement of the F-111A. The two versions of the F-111 showed about the same cost increases, and both failed to meet all requirements by more than nominal magnitudes. The difference was that the F-111A had the features the Air Force sought most, while the F-111B was inconsistent with the Navy's conception of a carrier-suitable aircraft. Similarly, a few years later, the Navy judged the F-14 to be operationally suitable, although it, too, fell short of some requirements and, in fact, was inferior to the F-111B in some respects. (See Coulam, pp. 247–248.)

Coulam notes that his interpretation of the F-111 program also is consistent with the three other programs of the 1960s and 1970s with some joint heritage—the F-4, the A-7, and the F/A-18. The F-4 and the A-7 were both developed by the Navy and, after they had been developed, the Air Force was directed to acquire them for use, respectively, as an air superiority aircraft and a close air support aircraft. The F-4 provided what the Air Force fighter community wanted in a fighter and it was procured, with only modest modifications, in substantial numbers. In contrast, the A-7 was a subsonic attack aircraft designed to provide close air support to ground forces. The Air Force had long downplayed the ground support mission. According to Coulam, the Air Force regarded the A-7 as "fundamentally unsuitable for its operations." In contrast to the Navy's situation with the F-111B, however (Coulam, p. 333):

> The A-7 did not...exist only on paper. Hence, the Air Force could not avoid procuring it by using performance deficiencies to suggest the plane's unsuitability. Instead, the Air Force did the next best thing: it made the A-7 over into an Air Force plane in ways corresponding to its doctrinal preconceptions....

The F/A-18 is a somewhat similar case. In the early 1970s, the Air Force ran what was called "the lightweight fighter competition." The single-engine aircraft selected as the winner developed into the F -16. The two-engine YF-17 lost the competition but was also regarded as a satisfactory aircraft. The Navy was directed by the Congress to join the Air Force in procuring the F-16 as a multi-role aircraft. The Navy, instead, selected the YF-17, presumably in no small measure because at the time the relevant communities within the Navy strongly favored twin- or multi-engine aircraft for aircraft carrier

operations. After extensive development, the YF-17 became the F/A-18A/B, which the Navy procured in quantity.

Coulam's analysis of the F-111 and the other tactical aircraft programs of the 1960s and 1970s with joint aspects can be summarized in two principles:

1. A joint program to develop and procure a system to requirements significantly at odds with the doctrinal preconceptions of any of the participating Services will face severe problems due to detailed decisions taken during the course of the program by the participating Services and Service judgments on the results of operational testing.
2. If such a joint program is undertaken, to achieve the results desired, OSD must be proactive in managing issues and, therefore, much more involved in management than it needs to be for a single Service program.

It seems reasonable to say that these two principles amount to a qualified conclusion that within the basic DoD organizational architecture, joint development programs are somewhere between difficult and impossible to conduct successfully if the requirements established for the joint program seriously conflict with one of the participating Service's doctrinal preconceptions.

D. ARE THE LESSONS OF THE F-111 PROGRAM STILL RELEVANT?

The Defense Department's three main decision support processes—requirements, acquisition, and resource allocation—all appear in Coulam's analysis of the F-111 experience, and all have changed substantially over the nearly four decades since the F-111B was cancelled. Consequently, it is necessary to examine whether the lessons that Coulam draws remain relevant.

Related sweeping changes were made in the requirements, acquisition, and resource allocation processes during FY2003–FY2004. The final report of the Joint Defense Capabilities Study Team, charged with recommending changes to the resource allocation process congruent with those underway in the requirements and acquisition processes, noted that:[11]

> Services dominate the current requirements process.... [They do] not consider the full range of solutions available to meet joint warfighting needs...."Jointness" is forced into the program late in the process during an adversarial and time-consuming program review.

---

[11] Joint Defense Capabilities Study Team, "Joint Defense Capabilities Study: Improving DoD Strategic Planning, Resourcing and Execution to Satisfy Joint Capabilities," Final Report, January 2004, p. iii.

The evident purpose of the constellation of changes introduced into the three processes is, then, to insure that programs are "born joint."[12]

"Born joint" is not used in the sense that "joint" is used here, however. The Joint Capabilities Integration and Development System (JCIDS) replaced the requirements generation process. In the new process, the Initial Capabilities Document (ICD) occupies the same niche as the old Mission Need Statement (MNS). The JCIDS analytical process is intended to ensure that all ICDs properly respond to needs that arise from established joint capabilities. In this context, a "capability" should be understood as a set of related DoD activities; for example, the mobility program or the strategic nuclear program. A "joint" capability is one needed to execute the operation plans of the Combatant Commanders (COCOMs).

Joint programs within the context of JCIDS are not joint acquisition programs in the sense of this paper—a single system design, or variants of a single design, acquired for use by more than one Service. In terms of the cases examined in this paper, it is possible that had the JCIDS operated during the relevant period, it would have generated a validated ICD for the Air Force TFX (in an air superiority role) and subsequently validated an ICD for the Navy's Missileer (as a long-range fleet air defense aircraft). JCIDS would not force the question—asked by McNamara—of whether the two requirements are sufficiently close that they should be met by variants of a single system design.

The documents describing the new processes, like their predecessors, contain some language that favors joint acquisition programs in the sense the term is used here. But while the new processes provide points at which it would be appropriate to consider the desirability of a joint approach, the documents describing them either skirt the issue or fail to address it at all. This point is well illustrated by the following language from the instruction that describes the operation of the new JCIDS:[13]

> The AMA [Analysis of Material Approaches] will determine the best material approach or combination of approaches to provide the desired capability or capabilities. The AMA will determine the best way(s) to use materiel approach(s)

---

12 Joint Defense Capabilities Study, p. 2–16. The characterization is applied specifically to the changes in the resource allocation process, but it seems clear from the context that it was intended to take in also the related changes made to the requirements and acquisition processes.

13 Chairman of the Joint Chiefs of Staff Instruction 3170.01A, "Operation of the Joint Capability Integration and Development System," March 12, 2004, Enclosure A, paragraph 4c, pp. A-3 through A-4.

> to provide a joint capability. Generally, it will not consider which specific "systems" or "system components" are the best. For example, the AMA may determine that a capability is best satisfied by an unmanned aerial vehicle (UAV) with a bomb vice approaches employing submarine launched missiles, artillery or air launched missiles. The AMA will not assess the best alternatives for UAVs or bombs. That analysis will occur in the analysis of alternatives (AoA) after the ICD.

The relevant document characterizes AoA, done during the concept development phase in the new process, as follows:[14]

> The focus of the AoA is to refine the selected concept documented in the approved ICD. The AoA shall assess the critical technologies associated with these concepts, including technological maturity, technical risk, and, if necessary, technology maturation and demonstration needs. To achieve the best possible systems solution, emphasis shall be placed on innovation and competition. Existing commercial off-the-shelf (COTS) functionality and solutions drawn from a diversified range of large and small businesses shall be considered.

Note that neither the AMA nor the AoA is designed to consider whether, for example, the Army and the Marine Corps should use the same unmanned aerial vehicle.

The Under Secretary of Defense (Acquisition, Technology and Logistics) (USD[AT&L]) could direct that the AoA consider whether a joint program would be cost-effective. This is not a routine part of the process, however. The policy section of DoD Directive (DoDD) 5000.1, "The Defense Acquisition System," makes no explicit mention of joint acquisition programs. Enclosure 1 to DoDD 5000.1 lists 29 elements of "Additional Policy." One of these (number 18, p. 6) directs Services (as well as other DoD components) to "consider and ...analyze" alternatives before proposing a Service-unique acquisition. One of the alternatives to be considered and analyzed is a joint (as opposed to a Service-unique) acquisition. There seems to be no provision for OSD review to ensure compliance with this provision, however. In particular, DoD Instruction (DoDI) 5000.2, "Operation of the DoD Acquisition System," does not require that the Service analysis be submitted as part of the documentation required for a Defense Acquisition Milestone A or B review. DoDI 5000.2 also does not list explicitly the possibility of a joint acquisition as one of the questions that must be answered before Milestone A or B authority is granted.[15]

---

[14] DoD Instruction 5000.2, Operation of the Defense Acquisition System, May 12, 2003, paragraph e.5.3, pp. 4–5.

[15] It is arguable that consideration of a joint acquisition is implicit in the requirement of paragraph 3.6.4.2 that the Component show that "...no alternative private sector or government source can better support the function." This language, however, is not directive.

Under the new acquisition process USD(AT&L) is responsible for leading development of Integrated Architectures (IAs) for capability areas, specified by the Joint Staff, which JCIDS is built around.[16] These IAs are to be used in JCIDS. They are also to be used by the Office of USD(AT&L) to "...guide system development, and define associated investment plans..."[17] The investment plans, in turn, are to be used as input to the Planning, Programming, Budgeting and Execution System (PPBES).

The key point to note is that the IAs evidentially are to be one step removed from investment plans. Consideration of whether particular acquisitions should be procured jointly presumably could come up in the context of the formulation of those investment plans. Again, however, the requirement that joint approaches to particular acquisitions be considered is not specified in the documents that define the acquisition process.

Our conclusion from a review of the relevant documents is that the new processes do not require careful consideration of adopting a joint approach (in the sense the term is used here) to particular acquisitions. Moreover, the new processes share two crucial characteristics with the processes they replace. First, the Services will generally initiate the process that can lead to the establishment of a new acquisition program, and have the initiative on funding acquisition programs.[18] Second, it is left to OSD to force consideration of a joint approach to acquisition in cases in which it is thought to be attractive. In short, the new processes do not mark a fundamental change in what the Defense Department does or fails to do about acquisition of a single system or variants of a single system for use by more than one Service; therefore, these changes do not render the lessons of the TFX program irrelevant

Two earlier changes, however, did modify features of the process on which Coulam's analysis depends. The first of these is the Congress's establishment in 1983 of the position of Director, Operational Test and Evaluation (DOT&E), in OSD. This goes to a crucial element of the analysis—the role of testing in making the case that, from the Navy's perspective, the F-111B was not operationally suitable. With the advent of DOT&E, OSD has a role in determining what tests are done. Moreover, DOT&E

---

16 USD(AT&L) leads development of all the IAs except that of the Financial Management Enterprise Architecture, which is the responsibility of the Under Secretary of Defense (Comptroller).

17 DoDI 5000.2, May 12, 2003, p. 4.

18 The needs that give rise to investment programs are to be those specified by the COCOMs, but, as noted, this would not automatically give rise to acquisition programs that are joint in the sense of that term used here—acquisition of variants of a single system for use by more than one Service.

provides the Secretary of Defense and the Congress with his own, independent assessment of the results.

The second change was the Defense Department's adoption of performance contracting in the mid-1990s.[19] The crucial elements of performance of the F-111 program clearly were: (1) the capability of the F-111A to perform the long-range, nuclear interdiction mission; (2) the ability of the F-111B in the fleet air defense mission; and (3) the cost savings achieved by acquiring the aircraft for these two missions through a joint program. Had a performance contracting regime been in effect circa 1962, specific measures of these key performance parameters (KPPs) would have been placed on contract rather than physical features (e.g., weight) or capabilities (e.g., speed) of the aircraft. The contractor would have been free (in this conception) to make trades so long as the KPPs were satisfied.

As a general proposition, the flexibility offered by performance contracting is apt to be especially important for a joint program. It would have been of practical importance for the F-111 program to the extent that there were trades that would have increased the performance of at least one of the variants while preserving substantial commonality savings. In fact, it appears likely that there were. To establish this point, it is necessary to recall that the state of the art at the time of the F-111 program did not permit the requirements of both the Air Force and the Navy to be met with a single aircraft. The requirement responsible more than any other for this state of affairs was that the aircraft be capable of flying at Mach 1.2 at low altitude. This was an Air Force requirement. The aircraft had to have great structural strength to meet this requirement, which translated into weight, which in turn was a major obstacle to achieving an operationally suitable Navy version of the aircraft.

The Boeing design responded to this dilemma by proposing that the F-111B use structural parts that were similar in shape to those of the F-111A, but with thickness (and therefore weight) not needed by the F-111A eliminated. This would have reduced commonality. However, it would have increased the chances that the F-111B would have been accepted by the Navy, and probably would have increased the savings achieved through a joint program. (Note that in the end the course pursued resulted in only one of the variants going into the force and yielded negative "savings.")

---

[19] Performance contracting was a major element of the acquisition reforms of this period.

In view of Secretary McNamara's preconceptions, it seems unlikely that adoption of a performance contracting approach would have avoided the mistaken technological assumptions built into the TFX program.[20] It does seem plausible to suggest that the use of a performance contract would have improved the chances of making a satisfactory recovery as it became clear that those assumptions were untenable.

The establishment of DOT&E provides OSD with an important tool to help in the management of joint programs to successful outcomes, and the use of performance contracts would make it easier to find a feasible solution to conflicting Service requirements. The history of the program provides no way to gauge whether the F-111 would have been successful had these two innovations been in place at the time, and an experiment like the TFX program has not been repeated. Hence, we cannot rule out the possibility that the tools OSD now has are enough to manage these problems successfully. Equally, experience does not indicate that these tools are adequate.

E. THE F-35 PROGRAM

We turn now to consideration of what contrasting or confirming evidence the F-35 program may offer. As was noted earlier, the F-35 is the only other major joint fixed-wing tactical development program that the Defense Department has conducted.

The origins of this program are strikingly similar to those of the F-111 program:

- It was initiated by a new administration early in its tenure.
- The decision to undertake a joint program was encouraged by developments in key technologies.[21]
- The joint program supplanted Service programs, then in their early stages, and these programs were cancelled.

The initial step to the F-35 program was a decision to launch the Joint Advanced Strike Technology (JAST) program. This decision was taken in September 1993 at the

---

20 As noted previously, McNamara believed that the Navy's requirements were a lesser included part of those of the Air Force and, hence, that the savings of the program were maximized by maximizing commonality.

21 In the mid-1980s the United States Marine Corps and United Kingdom Royal Navy began exploring a next-generation Short Takeoff/Vertical Landing (STOVL) aircraft. In 1989 the Defense Advanced Research Projects Agency (DARPA) in effect took over this project. The DARPA STOVL program gave rise to a distinct Common Affordable Lightweight Fighter (CALF) program. The CALF program examined the notion of modifying a STOVL design to obtain conventional takeoff and landing and aircraft carrier variants. Both the STOVL and CALF projects were folded into the Joint Advanced Strike Technology program during 1994.

conclusion of the Bottom Up Review (BUR) of the defense program undertaken by the Clinton administration, which had come into office the preceding January. It was also decided as a result of the BUR to:

- Continue the Air Force F/A-22 program, curtail procurement of the F-16, and cancel the Air Force's Multi-Role Fighter (MRF) program; and to
- Continue the F/A-18E/F, curtail F/A-18C/D procurement, and cancel the A/F-X program.

Taken together, the clear intent of these decisions was to eventually develop and procure:[22]

> ...a single basic airframe design with three distinct variants: Conventional Take-Off and Landing (CTOL) for the U.S. Air Force to complement the F-22 Raptor and replace the aging F-16 Fighting Falcon and the A-10 Thunderbolt; Short Take-Off/Vertical Landing (STOVL) for the U.S. Marine Corps to replace both the AV-8B Harrier and the F/A-18C/D Hornet; and a Carrier (CV) variant for the U.S. Navy to complement the F/A-18E/F Super Hornet.

The JAST program was renamed the Joint Strike Fighter (JSF) program early in 1996 and, at roughly the same time, was authorized to begin what was called the Concept Definition Phase (CDP). The CDP included a variety of efforts to mature the relevant technologies, and contracts with the Boeing Corporation and the Lockheed Martin Corporation to build flying demonstrators to show the feasibility of building CTOL, CV, and STOVL with appropriate capabilities that were variants of what was essentially a single airframe design. The Boeing and Lockheed Martin demonstrators were successfully flown in September 2000 and March 2001 respectively. Lockheed Martin was selected to continue the program, and in October 2001, what was then designated the F-35 program was authorized to begin System Development and Demonstration (SDD).[23]

The F-35 program currently is in the fifth year of the SDD phase. The first flight of the first variant (the CTOL) is less than a year in the future, and the start of low-rate initial production is only one year away. At this point, all we have to place against Coulam's analysis are three large ways in which the F-35 program differs from the F-111B program.

---

22 This language is taken from the Introduction to the history section of the F-35 program office Web site; see http://www.jsf.mil/IEFrames.htm. The characterization cited is offered as a description of the program in late 1994, but it is also a reasonable description of the evident implications of the decisions on tactical aircraft that emerged from the BUR.

23 SDD includes the later stages of what was formerly called Program Definition and Risk Reduction, all of what was called Engineering and Manufacturing Development, and low-rate initial production.

First, the F-35 entered SDD with a much greater degree of consensus on requirements than did the F-111. Recall that in February 1961, Secretary McNamara directed the Navy and the Air Force to agree on joint requirements for the TFX. They were unable to agree, and in September 1961 Secretary McNamara broke the impasse by directing the requirements for the TFX. In contrast, for the F-35 the three Services involved were able to reach an agreement on a Joint Operational Requirements Document (JORD) in significant part because technical requirements were not made definite until well into the risk-reduction phase of development.

Why consensus was reached for the F-35 but not for the F-111 is a relevant question. A much more detailed examination than this study can provide would be required to answer this question fully. It seems safe, however, to assert that a large part of the explanation is simply that a great deal of time, effort, and money went into the exploration of the relevant technologies that made this consensus possible. Other plausible elements of an explanation include the following:

- Senior OSD officials were more flexible in permitting variations in the design to accommodate differences in Service requirements than Secretary McNamara and his senior colleagues had been.
- The Joint Staff, rather than OSD, mediated the formulation of the F-35 JORD.
- Changed budget circumstances may have persuaded each of the Services that a joint program was their best prospect for acquisition of next-generation aircraft.

A second major difference is that the F-35 program probably was not burdened with the large flaws in the F-111 listed previously. Two of them definitely are absent:

- There is far less concurrency between development and production for the F-35 than there was for the F-111.
- The F-35 SDD work is being done under a cost type contract, with incentive features, rather than a fixed-price contract.

We cannot make such positive statements about the other two items—whether the F-35s requirements are within the present state of the art and the degree of optimism in the cost and schedule estimates adopted for the program when it entered SDD. It is certain, however, that the efforts made to ensure that the requirements for the F-35 are within the state of the art far exceed those made for the F-111. There is no analog in the F-111 program to the F-35's 6-year concept development phase, which included flying demonstrators, as well as extensive efforts to mature the technologies used in the aircraft's systems. Similar statements can be made for cost and schedule. DoD discipline on estimating the costs of major programs is far greater now than it was at the time of the

F-111. Furthermore, the efforts made to establish realistic costs (especially realistic procurement costs) for the F-35 went well beyond what the Defense Department requires.

Third, the management structure of the F-35 is different from that used for the F-111. Coulam describes the F-111 management arrangements as follows (Coulam, pp. 60–61):

> The program was to be managed through the regular Air Force development organization. A small number of Navy personnel would be added to the Air Force System Program Office (SPO) in Ohio. These Navy program officials were to be subordinated to the Air Force command in the SPO. They were, however, to cooperate with the Air Force on common concerns...and to maintain liaison with Navy technical bureaus.... All funds for the development of the F-111 airframe (both versions) and for the development of the TF-30 engines powering it would be budgeted by the Air Force.

The Navy and the Air Force provide F-35 development funding equally, and a Joint Program Office (JPO) manages the program. The position of F-35 program director rotates between the Air Force and the Department of the Navy, and the top three levels alternate between the two military Departments. When a Navy or Marine Corps officer is program director, the deputy program director is an Air Force officer. The Navy or Marine Corps program director reports to an Air Force Program Executive Officer (PEO) and the Air Force Service Acquisition Executive (SAE), who in turn report to the Under Secretary of Defense (Acquisition, Technology and Logistics) as the Defense Acquisition Executive. Conversely, when the program director is an Air Force officer, the deputy is a Navy or Marine Corps officer, and the program director reports to a Navy PEO and the Navy SAE.

These contrasts between the two programs are summarized in Table 2. The three characteristics below the heavy line are not unique to joint programs, and presumably are no more or no less important to joint then to single Service programs. All of these certainly worked against the success of the TFX, although they appear not to have been crucial, because they affected both variants equally, yet only the Navy version was unsuccessful. The F-35 has not been burdened with these sources of drag to nearly the same degree as was the TFX. It is a better structured program and, all else equal, more likely to succeed for that reason.

In Coulam's analysis the crucial factor is whether or not consensus is obtained on requirements, and to the degree it is absent, compensating OSD oversight of the program to ensure that detailed program choices below the level of requirements remain consistent with the goals established for the program. There was not a consensus on the

requirements for the TFX program, and OSD oversight was reactive. OSD oversight of JSF/F-35 appears to be even less proactive than the TFX got with Robert McNamara as Secretary of Defense.[24] That is less a crucial fact for the F-35 program than it was for the F-111, however, because a reasonable consensus on requirements for the F-35 was achieved. Thus, while at its present stage the F-35 program's eventual success is still to be determined, it seems clear that it has avoided what seems to have been the crucial obstacle to success of the TFX program.

Table 2. Summary of F-111 and F-35 Program Contrasts

Program Characteristic	TFX (F-111)	JSF (F-35)
Lack of consensus on requirements	Yes	No
Reactive OSD oversight	Yes	Yes
Services not equally engaged in management and funding	Yes	No
Major flaws in acquisition strategy	Yes	No
Unrealistic cost and schedule estimates	Yes	TBD—less so
Technology does not permit achieving all requirements	Yes	TBD—less so

F. RECOMMENDATIONS

This section considers what constructive recommendations can be extracted from the analysis offered above.

The history of the TFX program standing alone suggests that this is not a promising topic. Stripped of all nuisance, it shows that the Secretary of Defense's authority over requirements and source selection is sufficient to start a major joint acquisition program, but not sufficient to manage such a program to a successful conclusion. OSD has better tools now to manage joint programs, but we do not know that they are sufficiently better to effectively cope with the characteristic problems of joint programs brought out sharply by the TFX experience. Comparison of the F-111 and F-35 programs suggests a more optimistic conclusion: OSD may be effective in encouraging joint acquisition programs by orchestrating (across Service lines) consensus on capabilities to be sought. The two recommendations offered here are intended to increase OSD's involvement and effectiveness in doing so.

---

[24] Furthermore, performance contracting favors shifting responsibility and decisionmaking authority to the contractor and, accordingly, discourages proactive OSD intervention in decisions below the level of those involving trades among KPPs.

Recommendation 1: Assign responsibility within OSD for regularly surveying opportunities for joint approaches to major acquisitions

As was discussed above, consideration of a joint approach to a potential acquisition is not a required part of the formal DoD requirements, resource allocation, and acquisition processes.

Table 3 uses data on fixed-wing aircraft missions to suggest how a first "triage" stage of such an analysis might be approached. The rows list types of missions; an X indicates that the Service in question flies that mission. The table reflects the situation in the late 1990s. Earlier there would have been somewhat less specialization of missions; in particular, the Navy assumed responsibility for the electronic warfare mission about 1996 when the Air Force retired the last of its EF-111 aircraft.

Table 3. Aircraft Mission Types Flown by the Navy and the Air Force

	Air Force	Navy	Joint Program
Air superiority	X	X	—
Multi-role	X	X	JSF
Strike	X	X	JSF
Airborne early warning (AEW)/ command and control (C2)	X	X	—
Tanker	X	X	—
Primary trainer	X	X	JPATS
Bomber (medium, heavy)	X		—
Transport (inter-/intra-theater)	X		—
Electronic warfare		X	—
Long-range patrol		X	—

Only one or the other of the two Services flies the four shaded missions. These can be excluded as missions that provide opportunities for joint acquisition programs.[25] The next generation of aircraft in three of the mission categories—multi-role, strike, and primary trainer—are being acquired by joint programs. The remaining three missions—air superiority, AEW/C2, and tanker—cannot be rejected out of hand as possibly offering opportunities for joint acquisitions. All might be dismissed with relatively limited further analysis, however, as it is not entirely clear that there will be a next-generation manned

25 Note that distinct single-Service missions may entail the use of similar equipment. For example, the helicopters that the Navy employs for antisubmarine work have much in common with Army utility helicopters.

air superiority aircraft after the F-22, and the missions flown by Navy AEW/C2 and tanker aircraft differ substantially from those flown by the Air Force.

An analysis along the lines of this discussion could be done readily for major commodity types. The results would conclusively indicate the cases in which a joint program is not warranted (either because only a single Service has the mission or because joint systems are being procured.) The presumably small number of remaining cases would be possible candidates for joint programs. Much more extensive analysis would then be required to determine if a joint program appears to be worth pursuing.

Some of the more important areas for joint acquisition might not be uncovered by a search built around commodity types, particularly one limited to those commodity types into which major system acquisitions fall. Consequently, a search organized by commodity class probably should be supplemented by one organized by activities closely connected to warfighting done in each of the Services. The activities most important to consider for potential opportunities for joint acquisitions probably are Command, Control, Communication, Computing, Intelligence, Surveillance, and reconnaissance (C4ISR); chemical-biological defense; search and rescue; and in-theater logistics.

Recommendation 2: Establish a mechanism for making coordinated use of the tools OSD has to establish consensus on requirements for potential joint acquisition programs.

This second recommendation is a necessary counterpart to the first. It is likely that in only a comparatively small number of cases will a joint approach to an acquisition seem promising. For those in which it does, comparison of the F-111 and F-35 experiences suggests that the next step should be orchestration of a consensus on requirements.

USD(AT&L) has two readily available tools to use in attempting to establish a consensus on requirements for a joint acquisition program: projects established within the Defense Advanced Research Projects Agency (DARPA) and Advanced Concept Technology Demonstrators (ACTDs). As the earlier discussion of the F-35 suggests, each of these can play a constructive role. A third tool that may be useful in some cases is the Joint Forces Command (JFCOM) Joint Experimentation Program, which "develops and tests new warfighting ideas and technology."[26] Other, more specialized tools would be available for some particular types of systems.

---

26 U.S. Joint Forces Command Web site: http://www.jfcom.mil/about/experiment.html.

Orchestration of a consensus on a joint approach to an acquisition using such tools would begin outside JCIDS. The initial question is whether, within what is technologically achievable, there is enough common ground for a joint program likely to be cost-effective. The end result of a successful process would be an ICD, however. Hence, at some point it would be necessary to take the discussion into JCIDS. This would require designation of a sponsor, who would be responsible for initiating and funding the analyses required by JCIDS. For a prospective joint acquisition program initiated in OSD, the sponsor presumably would be USD(AT&L), acting on the authority of the Secretary of Defense.

Finally, it would be necessary to obtain the substantial commitment of funds that a major joint acquisition program would require. The three parts to this are:

1. What entity will manage the program, including financial management? This includes preparation of cost estimates and resources requests, among many other financial management tasks.
2. What vehicle will be used for funding requests and provision of funds?
3. What will be the sources of funding and, in particular, to what will the participating Services be directed to request funding for the program?

The TFX program, for which the Air Force served as the executive agent, provides one set of answers to these questions. An alternative set is provided by the F-35, which is managed by a joint program office, and both the Navy and the Air Force provide the funding for the program. Other instances of joint programs were, in effect, established as OSD activities and reporting was to USD(AT&L). In at least one instance, DARPA managed the early stages of what was intended to be a joint acquisition program.

G. CONCLUDING COMMENTS

The recommendations offered here would not require any elaborate implementation. The tasks identified could be assigned to a senior OSD official—presumably USD(AT&L) or the Director of the Office of Program Analysis and Evaluation. The work could be done by an ad hoc team or teams with representation from the relevant OSD offices, the Joint Staff, and the Services. A detailed process specification would be inappropriate because sensible steps will differ significantly from one case to the next. The essential elements are: (1) periodic surveys to identify promising opportunities for joint acquisition programs; and (2) a flexible process for exploring these possibilities and, when warranted, developing a consensus on an ICD for a joint acquisition program.

BIBLIOGRAPHY

Art, Robert J., *The TFX Decision: McNamara and the Military,* Boston: Little, Brown and Company, 1968.

Coulam, Robert F., *Illusions of Choice*, Princeton: Princeton University Press, 1977.

Department of Defense, Chairman of the Joint Chiefs of Staff Instruction 3170.01A, "Operation of the Joint Capability Integration and Development System," March 12, 2004.

Department of Defense, Chairman of the Joint Chiefs of Staff Instruction 3170.01D, "Joint Capabilities Integration and Development System," March 12, 2004.

Department of Defense Directive 5000.1, "The Defense Acquisition System," May 12, 2003.

Department of Defense Instruction 5000.2, "Operation of the Defense Acquisition System," May 12, 2003.

Joint Defense Capabilities Study Team, "Joint Defense Capabilities Study: Improving DoD Strategic Planning, Resourcing and Execution to Satisfy Joint Capabilities," Final Report, January 2004.

ABBREVIATIONS

ACTD	Advanced Concept Technology Demonstrator
AEW	Airborne Early Warning
AMA	Analysis of Material Alternatives
AoA	Analysis of Alternatives
BUR	Bottom Up Review
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CALF	Common Affordable Lightweight Fighter
CDP	Concept Definition Phase
COCOM	Combatant Commander
COTS	Commercial Off-the-Shelf
CTOL	Conventional Take-Off and Landing
CV	Carrier
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DOT&E	Director, Operational Test and Evaluation
EMD	Engineering and Manufacturing Development
FCB	Functional Capability Board
FY	Fiscal Year
IA	Integrated Architecture
ICD	Initial Capabilities Document
IDA	Institute for Defense Analyses
JAST	Joint Advanced Strike Technology
JCIDS	Joint Capabilities Integration and Development System
JFCOM	Joint Forces Command

JORD	Joint Operational Requirements Document
JPATS	Joint Primary Aircraft Training System
JPO	Joint Program Office
JSF	Joint Strike Fighter
JSTARS	Joint Surveillance Target Attack Radar System
KPP	Key Performance Parameter
MNS	Mission Needs Statement
MRF	Multi-Role Fighter
OSD	Office of the Secretary of Defense
PEO	Program Executive Officer
PPBES	Planning, Programming, Budgeting and Execution System
PPBS	Planning, Programming, and Budgeting System
SAE	Service Acquisition Executive
SDD	System Development and Demonstration
SLRG	Senior Leadership Review Group
SPO	System Program Office
STOVL	Short Take-Off, Vertical Landing
TAC	Tactical Air Command
TFX	Tactical Fighter Experimental
UAV	Unmanned Aerial Vehicle
USD(AT&L)	Under Secretary of Defense (Acquisition, Technology and Logistics)
VFAX	Carrier Fighter Attack Experimental

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
09-2005	Final	Aug 2004-Sep 2005

4. TITLE AND SUBTITLE
Joint Acquisition: Implications from Experience with Fixed-Wing Tactical Aircraft

5a. CONTRACT NUMBER
DASW01 04 C 0003

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S), Last Names First
McNicol, David L.

5d. PROJECT NUMBER

5e. TASK NUMBER
AO-7-2455

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Institute for Defense Analyses
4850 Mark Center Drive
Alexandria, VA 22311-1882

8. PERFORMING ORGANIZATION REPORT NUMBER
IDA Paper P-4049

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of the Director, Acquisition Resources and Analysis
Room 3D161
3020 Defense Pentagon
Washington, DC 20301

10. SPONSOR/MONITOR'S ACRONYM(S)
OUSD(AT&L)/ARA

11. SPONSORING/MONITORING AGENCY REPORT NUMBER

12. DISTRIBUTION AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Replaces cancelled IDA Document D-3122

14. ABSTRACT

This paper is concerned with identifying characteristic failure modes of joint acquisition programs. The paper approaches this topic through the Defense Department's experience since the late 1950s with fixed-wing manned tactical aircraft, because, of all commodity groups, fixed-wing manned tactical aircraft has a particularly rich, controversial, and well-documented experience with joint programs. The paper concludes that it is extremely difficult to impose requirements that run strongly against a Service's doctrines, and that senior Defense Department officials may be most effective in encouraging joint acquisition programs by orchestrating (across Service lines) consensus on capabilities to be sought within the limits of available technologies. The final section of the paper briefly points out how the Defense Department might apply this conclusion.

15. SUBJECT TERMS
Acquisition; Joint Programs; Department of Defense; Tactical Aircraft; F-111 Aircraft; F-35 Aircraft

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON (Last Name First)
a. REPORT	b. ABSTRACT	c. THIS PAGE			Irby, Wendell
Unclassified	Unclassified	Unclassified	Same as Report	40	19b. TELEPONE NUMBER *(Include area code)* (703) 695-9692