AD-A280 803

MENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	April 1994	FINAL

4. TITLE AND SUBTITLE
U.S. NAVY TACTICAL AIRCRAFT PROCUREMENT: INTO THE TWENTY-FIRST CENTURY

5. FUNDING NUMBERS

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
AIR WAR COLLEGE
325 CHENNAULT CIRCLE
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8. PERFORMING ORGANIZATION REPORT NUMBER
Unnumbered AWC research paper

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
N/A

11. SUPPLEMENTARY NOTES
PAPER IS WRITTEN TO FULFILL ACADEMIC RESEARCH REQUIREMNTS FOR AN IN-RESIDENCE SENIOR SERVICE PROFESSIONAL MILITARY SCHOOL.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

See page iii

94-19288

14. SUBJECT TERMS	15. NUMBER OF PAGES
Navy, Aircraft, Procurement, Century	49
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLAS	UNCLAS	UNCLAS	UL

AIR WAR COLLEGE

AIR UNIVERSITY

U.S. NAVY TACTICAL AIRCRAFT PROCUREMENT: INTO THE TWENTY-FIRST CENTURY

by

Kenneth T. Houck
Commander, USN

A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE CURRICULUM

REQUIREMENT

Advisor: Captain George M. Moore, USN

MAXWELL AIR FORCE BASE, ALABAMA

April 1994

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ABSTRACT

TITLE: U.S. Navy Tactical Aircraft Procurement: Into the Twenty-First Century

AUTHOR: Kenneth T. Houck, Commander, USN

The FA-18E/F has been selected by the U.S. Navy to be the aircraft which will lead its carrier based tactical aircraft community into the twenty-first century. Internal Navy mismanagement of the A-12 program resulted in the termination of that program in 1991. With too many of the tactical aircraft in the Navy's inventory reaching the end of their service lives at the same time, the Navy had no choice but to field an interim aircraft until an A-12 replacement, a next-generation stealth strike fighter, can be fielded.

The selection of the FA-18E/F as the interim aircraft has been met with some vocal opposition from within the Navy and elsewhere. Despite opponents claims to the contrary, a detailed analysis of both FA-18E/F capabilities and the requirements demanded by current Naval air power doctrine leads to the conclusion that the FA-18E/F is eminently qualified to perform virtually every tactical aircraft mission required in anticipated future scenarios.

Naval doctrine dictates that the Navy continue to procure multi-role aircraft which are especially capable in the air superiority, close air support, and air interdiction mission areas. Projected challenges to Naval forces operating in the littorals mandate that future Navy tactical aircraft be as stealthy as possible and that they are fielded with robust target identification and anti-cruise and anti-ballistic missile capabilities. In order to ensure that, in the future, both the Navy and the Air Force field the most capable tactical aircraft possible, declining military budgets and skyrocketing technology costs demand that the two services procure the same follow-on aircraft.

BIOGRAPHICAL SKETCH

Commander Kenneth T. (Ted) Houck graduated with the U.S. Naval Academy's Class of 1979, earning a B.S. in Ocean Engineering. He is an experienced Naval Aviator, having amassed over 3,500 flight hours, including more than 2,000 in the FA-18. He has completed four major deployments on three different aircraft carriers and has logged nearly 600 carrier landings. The highlight of Commander Houck's career was his participation as a carrier air wing strike leader in Desert Storm, where he flew 33 combat missions from the deck of U.S.S. Midway and for which he was awarded an individual Air Medal, three strike/flight Air Medals, and the Navy Commendation Medal. He is a graduate of both the Navy Fighter Weapons School (Topgun) and the Naval Strike Warfare Center's Strike Leaders' Advanced Training Syllabus (SLATS). Commander Houck is a graduate of the Air War College, class of 1994.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

For a variety of reasons, the U.S. Navy has chosen the FA-18E/F as the platform which will lead its aircraft carrier based tactical aircraft (TACAIR) community into the twenty-first century.[1] Many Naval officers and Naval Aviation proponents feel strongly that the selection of the FA-18E/F as the service's TACAIR priority could sound the death knell for U.S. Naval Aviation.

Navy plans are to replace both the A-6E Intruder medium attack aircraft and the F-14 Tomcat fighter by using the FA-18E/F as a gap filler until the Navy can field a next-generation stealth strike fighter. While some members of the Navy's F-14 community are opposed to the FA-18E/F because it was chosen rather than a highly modified upgrade to the F-14D, other FA-18E/F opponents have voiced more substantial grievances. Critics point out, and Navy officials openly acknowledge, that the FA-18E/F will not possess the combat radius, payload, or all-weather low altitude ingress/egress capabilities of the A-6E, one of the aircraft which it will replace. Other opponents claim that the cost of the FA-18E/F does not justify the "modest" gains in performance which will be realized over current FA-18C/D models.

Opponents argue that the FA-18E/F program should be terminated and that the resulting budgetary savings should be instead allocated toward advanced research and development for a next-generation, stealthy, all-weather, "deep strike" capable naval aircraft. It is further argued that A-6E service lives should be extended via wing re-manufacturing programs, etc. and that the venerable Intruders continue in service to fill the gap until the next-generation aircraft is delivered to the fleet.

Indeed, it would appear that the U.S. Navy has been left behind in the area of aircraft stealth technology. While the Navy plans to field the FA-18E/F at the turn of the

century, the U.S. Air Force has fielded or is in the process of fielding up to five stealth platforms: F-117, B-2, F-22 and, according to various open-source press reports, possible SR-71 and F-117 replacements. It would appear that the FA-18E/F's lack of stealth threatens to make Naval air irrelevant.

The purpose of this paper is to review the considerations involved and the reasoning behind the Navy's controversial decision to procure the FA-18E/F. Following an exploration of Naval air power doctrine, this paper will evaluate how well the FA-18E/F should be able to fulfill Naval Aviation's doctrinal requirements. Finally, based upon Naval doctrine, projected threats to Naval forces, advances in technology, and affordability considerations, this paper will offer recommendations for the future procurement of Navy tactical aircraft.

CHAPTER TWO

THE DECISION TO PROCURE THE FA-18E/F

Since 1991, four landmark events have greatly impacted the procurement of future aircraft for the Navy's aircraft carriers: (1) the 1991 cancellation of the Navy's top TACAIR procurement priority, the A-12; (2) Desert Storm combat experience; (3) a fundamental shift in the Navy's vision, as articulated in the White Paper "...From the Sea"; and, (4) the Defense Department's Bottom-Up Review and its associated program cuts. These events have combined to leave the Navy relying upon the FA-18E/F to take its TACAIR community into the twenty-first century.

A-12 Cancellation

On January 7, 1991, Secretary of Defense Richard Cheney canceled the U.S. Navy's number one TACAIR procurement priority, the A-12, which was scheduled to reach initial operational capability (IOC) in 1996. This controversial move came in the wake of findings that Navy program officials and aircraft contractors had withheld information concerning cost overruns and schedule slippage during a major review of the program conducted by the Pentagon in April 1990.[2] Following disciplinary action taken by the Navy against the officers involved, the Secretary canceled the program. By making an "example" of the A-12 program, the Secretary was able to send a clear signal to the services and to all potential U.S. military contractors that this sort of conduct would not be tolerated. This action dealt a stinging blow to the Navy, which had hung all of its TACAIR modernization hopes on the A-12. A brief review of the events which had unfolded to place the Navy in this predicament is appropriate.

In the mid-1980s the Navy generated two separate operational requirements for aircraft to replace both the A-6 and the F-14. The A-6 replacement was known as the Advanced Tactical Aircraft (ATA). The F-14 was to be replaced with a "navalized" version of the Advanced Tactical Fighter (ATF), a program which the Air Force had generated as a replacement for its F-15 fighter. The Navy placed the ATA at the top of its TACAIR priority list, but had solid plans to procure both new aircraft types. The Air Force made similar plans, but placed the ATF at the top of its priorities.

It appeared for a while that the services would be involved in two major joint TACAIR procurement programs, with the Navy having the lead in the ATA and the Air Force leading the ATF program. Unfortunately, inter service disagreements arose in the ATF program from the outset: the Navy wanted a two-seat aircraft; the USAF wanted a single-seater. Impressed by the displayed prowess of its new single-seat FA-18A's, the Navy eventually concurred with the choice of a single seat aircraft, but other problems soon arose. The Air Force adamantly refused to procure an air superiority airframe which would, in their view, be forced to compromise on performance by being handicapped by the extra structural weight required by a naval carrier aircraft. With the Office of the Secretary of Defense moderating, the services eventually reached an agreement of sorts: the ATF program was restructured so that, while retaining common engines, radars, avionics and subsystems, or about 80% commonalty overall, the two services would actually procure two different airframes. The Navy designated its specialized airframe the NATF (Naval Advanced Tactical Fighter).

In the ATA program, the fiscal realities of attempting to fund both the ATA and the ATF, on top of priority B-2 and C-17 programs, forced the Air Force to withdraw from its lower priority ATA program. The Air Force found itself in the fortunate position of being able to delay fielding an advanced strike aircraft, due to its recent procurement of both the F-117 and the F-15E. Also, its F-111's still had several years of remaining service life. Faced with funding the entire ATA program on its own, and the

rising costs of the NATF program caused by the need to build separate Navy and Air Force airframes, the Navy was later forced to withdraw in favor of its higher priority ATA program. In December 1987, the Navy awarded the ATA full scale engineering contract to the team of McDonnell-Douglas/General Dynamics. Shortly thereafter the ATA was redesignated as the A-12.[3]

The 1991 cancellation of the A-12 program left the Navy with no stealthy, long range strike capability on the horizon, and any long range strike capability at all tied to the service life of its aged A-6E Intruders. Navy leaders feared that this lack of capability could undermine the future of Naval Aviation, and therefore immediately began an aggressive campaign to remind the Secretary of Defense that the Navy retained the requirement for this capability. Evidently Navy efforts were successful: shortly thereafter, the Secretary directed that all funds previously allocated to the A-12 be allocated instead to a new Navy advanced strike aircraft program which became known as AX. Unfortunately, more than just the program name had changed: the cancellation of the A-12 and the establishment of the AX in its place moved the aircraft's planned IOC back almost ten years, to 2005.[4]

Desert Storm

Desert Storm combat experiences taught the Navy numerous lessons in a multitude of disciplines. Perhaps the most important lesson learned by the Navy in Desert Storm was that it should no longer procure single role aircraft. Following the first several days of Desert Storm, after which there was virtually no air opposition, carrier air wings equipped with single role F-14 air superiority fighters found themselves with about one third of their TACAIR assets (approximately 20 out of 60) unable to contribute to air-to-ground operations. Conversely, the sole carrier air wing without F-14's (U.S.S. Midway's) was able to apply its full complement of approximately 36 FA-18's and 24 A-6's to power projection missions, Fleet defense tasking not withstanding. Naval leaders

speculated that future scenarios might be more dependent on Naval air power than was the case in Desert Storm. Faced with an aircraft carrier airframe capacity limitation of roughly 60 weapons-employing aircraft and approximately 20 support aircraft, Desert Storm taught Naval leaders that maximizing the aircraft carrier's power projection capabilities mandated that all Naval aircraft possess multi-role flexibility. Dual role (air-to-air and air-to-ground) capability was validated on the first day of the air war when two FA-18's flying from an aircraft carrier in the Red Sea achieved the Navy's only air-to-air fixed-wing kills of the war (two MiG-21's). Following the kills, the Hornets continued past the flaming wreckage to decimate their Iraqi ground targets with general purpose bombs.

Subsequent to Desert Storm, the Navy took two significant steps with regard to the procurement of multi-role aircraft. First, in August 1992, it redesignated the AX program the AFX,[5] and added the requirement that the aircraft possess an air-to-air capability. In addition to the stealth attack requirements of the AX, the AFX would incorporate much of the next-generation air-to-air capability which the Navy had been forced to abandon when it withdrew from the NATF program. Second, aware of the planned 2005 IOC of the AFX and the age and limitations of both the A-6 and F-14, the Navy chose the multi-mission FA-18E/F to serve as a replacement for those aircraft while the Navy awaited the arrival of the AFX to the Fleet.

The Emergence of the FA-18E/F

While most Naval Aviation proponents agreed that the Navy needed an interim aircraft to fill in for the A-6 and the F-14 while awaiting the delayed IOC of the AFX, the selection of the FA-18 E/F as the interim aircraft was not met with unanimous approval. Navy A-6 air crews pointed out that the FA-18E/F would not have either the range, payload or terrain following radar (TFR) capability of the A-6. F-14 proponents

felt that a significantly enhanced aircraft based on the F-14D would be a better choice. FA-18 pilots generally remained silent, believing that the proper choice had been made.

As mentioned earlier, Desert Storm lessons learned and a declining budget demanded that the interim aircraft have dual role capabilities. Upgrades to the A-6E to make it a dual role aircraft were never seriously considered. It was believed impossible to upgrade the subsonic Intruder with any significant air-to-air capability.

The battle for selection of the Navy's interim strike fighter eventually came down to a choice between the FA-18E/F and a significantly upgraded version of the F-14D, the F-14D "Quickstrike". After a long period of intense debate within the Navy TACAIR community, the FA-18E/F was eventually selected over the "Quickstrike". Historical FA-18 superiority over F-14 models in the areas of reliability and maintainability were some of the many reasons for the FA-18's selection. The FA-18E/F was also less expensive than the "Quickstrike" F-14. Additionally, earlier FA-18 models had already displayed the aircraft's capability to employ HARM, Maverick, Harpoon, and SLAM air-to-surface missiles, the Walleye stand off precision glide bomb, and underwater mines. The proven multi-mission capabilities of the FA-18, its night attack system, plus the imminent (and now fielded) capabilities of self-contained laser-guided bomb (LGB) delivery, the AMRAAM air-to-air missile, and an upgraded radar warning receiver, made the FA-18E/F the hands-down winner. Navy leaders involved in the choice of the interim aircraft apparently decided that it would be more prudent, and less expensive, to increase the range of an aircraft with a long list of proven capabilities, rather than attempt to add a long list of capabilities to the F-14D in order to configure it into its "Quickstrike" version.

There were quite a few Navy TACAIR proponents who questioned the decision to buy an interim aircraft at all. In their view, the Navy's decision was short-sighted and the FA-18E/F's capabilities did not justify its approximately $50 million price tag. In fact, they charged, its only significant increase in capability over $35 million FA-18C/D

models was its promised 40% increase in range.[6] They held that, even with this increase, it still did not possess the range of the Navy's venerable A-6, nor did it have the payload or TFR capabilities of the Intruder. Opponents further contended that the FA-18E/F was an aircraft of the last generation and that the Navy should move on to a stealthy, next-generation strike aircraft. They argued that the money that would be put toward the FA-18E/F would be better spent expediting the arrival of the AFX to the fleet. There were even rumors floating around Washington that McDonnell-Douglas had been awarded the FA-18E/F contract as a back door attempt to help the corporation recoup some of its losses from the canceled A-12 program.[7]

Arguing the other side, FA-18E/F proponents felt that, although short of the 735 nautical mile (NM) combat radius of the A-6, the FA-18E/F's advertised 640 NM radius would be sufficient in most scenarios.[8] Lessons learned in Desert Storm combat led program proponents to discount several of the other alleged shortcomings of the aircraft. Although the FA-18E/F would not be capable of carrying as great a payload as the A-6, Desert Storm had clearly displayed the value of precision weapons. Proponents therefore dismissed this criticism, citing the diminishing importance of massive bomb payloads. In another Desert Storm lesson, the large number of combat losses incurred while flying at low altitude by both coalition Tornado aircraft and Navy A-6's cast a great deal of doubt upon the utility of TFR in many future tactical scenarios.

The overriding factor in the decision to procure an interim aircraft was, however, the Navy's aging aircraft inventory. The Navy could not afford to gamble on service life extension programs to keep its flight decks full of A-6's and F-14's until the arrival of the AFX. Although the Navy's decision to procure the FA-18E/F was not entirely popular within the Navy, to many, the selection of the FA-18E/F as the interim carrier aircraft and the eventual "low end" aircraft in the "high / low" AFX / FA-18E/F mix was perceived as the first sign of good news in Navy TACAIR procurement in a long time.

"...From the Sea"

In September 1992 the Navy published the White Paper "...From the Sea" which articulates the vision of the Navy as it prepares to enter the twenty first century. "...From the Sea" announced that the Navy is shifting its emphasis from unilateral combat on the sea, to joint operations from the sea. Emphasizing that it will retain its traditional capabilities of strategic deterrence, sea lift, sea control and flexibility, the Navy used "...From the Sea" to announce some changes in the ways it will organize, train, and equip its power projection forces in reaction to the changing threat. "...From the Sea" declared that fiscal realities are forcing all of the services to emphasize joint operations. The services are thus focusing their efforts on identifying and eliminating or reducing areas of inter service redundancy.

"...From the Sea" emphasized the unique capabilities which the Navy can bring to a theater of operations. In addition to an unchallenged ability to control the seas, "...From the Sea" argues that the Navy can make numerous contributions to the air/land battle. In littoral areas, the Navy/Marine team contends that it can act as an "enabling" force, perhaps in conjunction with Special Operations Forces and Army airborne troops, to provide maneuver from the sea to seize ports and/or airfields. Friendly control of the ports and airfields would subsequently allow for the introduction into the theater of heavier Army ground forces and Air Force units. Once Army and Air Force units have been introduced, Navy and Marine forces could once again conduct maneuver warfare from the sea, or they could contribute to air and land battles, fighting along side their Air Force and Army brothers, as appropriate.

Some contend that the role envisioned for Naval aviation in "...From the Sea" eliminates the requirement for a Naval "deep strike" capability. "...From the Sea" scenarios call upon Naval TACAIR to first establish air superiority over the littoral region. It is expected that Naval aviation will then be tasked to provide large numbers of tactical aircraft to fly as many sorties as possible in support of relatively lightly armored

Marines conducting "forcible entry" amphibious operations. The emphasis in "...From the Sea" on the littorals and the apparent lack of emphasis placed upon conducting "deep strike" missions caused many FA-18E/F opponents to hail "...From the Sea" as the last nail in the coffin for carrier aviation. They cynically argued that "...From the Sea" was an acknowledgment by Navy leaders that the FA-18E/F would not be able to strike "deep", therefore the Navy had changed its strategy to reflect the realities of its inability to procure a "deep" strike aircraft. They further contended that tasking for all future "deep" strike missions would therefore fall to USAF bombers, and that this would surely undermine much of the justification for carrier aviation.

The Bottom-Up Review

In September 1993 Secretary of Defense Les Aspin announced the results of the Bottom-Up Review (BUR), a study conducted to determine force level requirements for the armed forces in light of the diminished global Soviet threat. The BUR was based upon the assumption that instead of organizing, training, and equipping forces for the Soviet threat, forces would be reduced to the minimum level required to fight and win two near-simultaneous major regional conflicts.

In force structure, Navy carrier aviation survived the cuts much better than most other areas throughout the services. The BUR retained eleven active and one reserve/training aircraft carriers, and ten active and one reserve carrier air wings. Many judged the ability of the carriers and carrier air wings to emerge from the BUR relatively unscathed as a reaffirmation that aircraft carrier air power is expected to play a major role in the execution of national defense policy in the new post-Soviet threat era.

Unfortunately, in the area of TACAIR procurement, the Navy was faced with yet another setback when the BUR canceled the AFX. The BUR also canceled the USAF's Multi-Role Fighter (MRF) program, the planned replacement for the F-16. It was directed that the two services combine the AFX and MRF programs into a Joint

Advanced Strike Technology (JAST) program, with the goal of fielding advanced strike aircraft around the year 2010.[9] Like the ATF/NATF program of the mid-1980s, the JAST concept does not envision that Navy and Air Force airframes will be exactly the same. Instead, the intent is for the services to economize by using common engines, radars, avionics and subsystems to achieve approximately 80% overall commonalty.

The BUR additionally endorsed the FA-18E/F and reaffirmed it as the Navy's top near-term aircraft procurement priority, a necessity to fill the gap until JAST aircraft arrive. In an additional move to help the Navy maintain a credible striking force while awaiting the IOC of JAST, the BUR provided for upgrading Navy F-14's to give them the capability to deliver LGBs. Similarly, the BUR directed the USAF to incorporate a precision air-to-ground weapons capability into the F-22, beginning with the first production lot of aircraft.

The announcement of the BUR's cancellation of the AFX did not come as a surprise to many members of the Navy TACAIR community. The more cynical of the FA-18E/F opponents believed that they had seen the handwriting on the wall when the Navy signed up for the short-range, littoral mission articulated in "...From the Sea". They cursed the FA-18E/F, blaming it for yet another delay in the arrival of next-generation stealth technology to Naval aviation.

The reality was, however, that shrinking budgets coupled with increasing AFX program costs had made the purchase of the AFX unaffordable, even if the FA-18E/F program was canceled.[10] The Navy could not afford to fund such a major aircraft procurement program on its own, i.e., without the money that might otherwise be available if the Navy and Air Force were to collaborate on a joint program. Hence, the birth of JAST.

F-22N?

In separate deliberations conducted during the same time frame as the BUR results were released, the Senate Appropriations Sub-Committee (SASC) recommended that the Navy investigate procuring a "navalized" F-22 in order to achieve a stealthy, long range precision strike capability at an earlier date than JAST would allow.[11] (The F-22 is currently scheduled for an IOC around 2003,[12] with a production rate of 24 aircraft per year.)[13] The SASC similarly recommended that the Air Force look into procurement of the FA-18E/F as its MRF.[14]

Embarking on a program to procure a "navalized" F-22 has some interesting advantages. One scenario would immediately cancel the FA-18E/F program which has a scheduled IOC of 2001. The Navy would instead enter into the F-22 program with the Air Force and procure a "navalized" version (F-22N) 80% common with the Air Force's aircraft. The Air Force F-22 program schedule calls for an IOC of 2003. Therefore, a Navy F-22N program would optimistically pay only a two year penalty in IOC over that of the FA-18E/F. Although the cost to the Navy would be greater than for the FA-18E/F, joint participation in the F-22 program would lower unit costs of engines, radars, avionics, subsystems and components and would result in substantial Department of Defense (DOD) savings over similar single-service programs, especially when one considers the additional capabilities (stealth, next-generation air superiority, etc.) which would be gained by the Navy by procuring the F-22N. Since the F-22's BUR-mandated air-to-ground capability may be limited to LGB delivery, in this scenario the Navy would continue as an active participant in the JAST program. Via JAST, the Navy would seek to procure a more robust strike platform, capable of employing the whole gamut of air-to-ground munitions, including HARM, Harpoon, underwater mines, and other direct attack and stand-off weapons. This F-22N scenario envisions the carrier air wing of the future composed of two tactical aircraft types: the F-22N and the JAST. Both would be multi-role aircraft, with the F-22 especially robust in the air-to-air arena, and the JAST

conversely more focused toward the air-to-ground role. In order to account for the expiring service lives of F-14 and A-6 aircraft and keep flight decks full until IOC of the newer aircraft, the Navy would continue with F-14 air-to-ground upgrades as directed in the BUR, and would keep the FA-18C production line open a few years longer to account for the delay in F-22N IOC over that of the FA-18E/F.

Although the F-22N proposal sounds quite enticing, it is unfortunately not without risk. The September 27, 1993 issue of *Defense Week* speculated that the Air Force would more than likely attempt to delay the IOC of JAST beyond its current 2010 introduction in order to protect the F-22, which could be viewed as a competitor to JAST.[15] Additionally, the December 13, 1993 issue of the *Wall Street Journal* reported that after a review of potential threat capabilities, the General Accounting Office had recommended that procurement of the F-22 be delayed so that IOC would not be achieved until 2010.[16]

Based upon its unfortunate experiences resulting from the long series of delays and cancellations which have plagued the ATA / A-12 / AX / AFX / JAST program, one can only assume that an aircraft procurement program similar to the F-22N scenario was considered too risky by the Navy and thereby rejected.

The FA-18E/F Choice

In the end, the Navy's decision to procure the FA-18E/F was driven by both fiscal and operational considerations. The Navy strongly desired to field a next-generation stealth multi-role tactical aircraft, but found that competing budget priorities (V-22, CVN-76, submarine and ship modernization , etc.) left the Navy unable to unilaterally fund the AFX program. Additional considerations involved in the Navy's decision were the need to replace two airframes (A-6 and F-14) with one, and the operational requirement to maximize carrier air wing lethality by procuring only multi-role aircraft.

It would appear that, based upon the declining global threat, the Navy felt that it could risk waiting for next-generation stealth aircraft until the fielding of AFX / JAST. However, faced with the urgent need to replace its aged A-6 and F-14 aircraft, the Navy was not willing to risk its future by attaching itself to any aircraft program (such as the F-22) which might be subject to even further delays.

CHAPTER THREE

NAVAL AIR POWER DOCTRINE

The Navy's decision to procure the FA-18E/F, although driven largely by fiscal considerations, would appear to place future Naval commanders at a disadvantage. Because the FA-18E/F does not possess the A-6's TFR, payload, or "deep strike" capabilities and due to its lack of true stealthiness, one would deduce that the fielding of the FA-18E/F will leave the Navy unable to perform many of its required missions.

Is this a valid conclusion? We cannot begin to answer this question until we determine what missions and capabilities are required of Naval tactical aircraft. To determine the requirements of Navy TACAIR, we must explore Naval air power doctrine.

Written Naval Doctrine

> In a military service where many intellects must cooperate towards a single aim and where the stress of events forbid [sic] the actual interchange of ideas when the need is most felt, there must be a governing idea to which every situation may be (referred) and from which there may be derived a sound course of action. It is only then that the full driving power of an organization can make itself felt.
>
> Commander Schofield, USN, 1915 [17]

Despite the fact that some members of the U.S. Navy have been stressing the importance of doctrine for most of the past century, the Navy has steadfastly avoided placing any of its higher level doctrine into print. Although publications of tactical doctrine abound, the Navy has no counterpart to the Air Force doctrinal publication, AFM 1-1. Its doctrine must be largely inferred from items scattered throughout several publications which guide naval force employment. Additionally, there is no Naval air power doctrine separate from Naval doctrine.[18] For decades, Naval officers have

avoided the publication of doctrine, believing that indoctrination leads to inflexibility. For example, regarding joint air operations in the Solomons in World War II, a recently retired U.S. Navy Admiral writes, "The hallmarks of the campaign were flexible command arrangements and the willingness to sacrifice service force employment doctrine to carry out the task at hand."[19]

Although Naval doctrine has rarely been put into print, in many cases an historical analysis of force structure developments can lead one to deduce the inferred force employment doctrine of the day. We will use this technique to augment what little is in fact written down, as we review the evolution of today's Naval air power doctrine beginning with World War II.

World War II

Naval air power came of age during the war in the Pacific, beginning on December 7, 1941. The infamous, yet brilliantly executed attack on Pearl Harbor thrust U.S. aircraft carriers, literally overnight, into position as the primary means of the Navy's attack.[20] Aside from validating carrier aviation as a long range and devastating weapon, the Japanese attack had destroyed a significant portion of the U.S. Pacific battleship fleet. The Navy had no other option but to center fleet firepower around the carriers.

Based upon combat experience gained first at Coral Sea and later at Midway, Naval doctrine of the day held that "prerequisite to control of the sea was control of the air above it".[21] The lethality of air power and the vulnerability of surface forces to air attack led Naval leaders to mandate that the Fleet's highest operational priority would be the establishment of air superiority. Evidence of the increasing emphasis placed on air superiority can be seen by the changes in composition of the Navy's carrier air wings as the war in the Pacific progressed. In early 1942, U.S. aircraft carriers were assigned 18 fighters, 18 dive-bombers, 18 torpedo-bombers, and 18 scout aircraft.[22] This mix reflected an initial understanding that combat operations would demand all four naval air

power capabilities, but none would receive any more emphasis than another. Following the sinking of U.S.S. Lexington by Japanese aircraft at the Battle of the Coral Sea, the Navy began deploying more and more fighters to its carriers. By the end of the war, air wing composition would be modified to bring as many as 73 fighters to the fast carriers with 15 dive bombers and 15 torpedo bombers making up the balance of the air wing. Similarly, many light carriers were outfitted with nothing but fighters (36 F6F or F4U aircraft)! At the same time, considerable efforts were being made to improve fighter direction capabilities.

Air superiority became considered a prerequisite for every other naval objective, including both sea control and amphibious operations. In addition to performing air superiority missions, carrier air remained flexible throughout the war in its ability to respond decisively to widely varying tasking. Other missions performed by carrier aircraft in World War II included:

1) Destruction of enemy ships, submarines, aircraft and their bases.
2) Destruction, or containment in port via mining, of the enemy's merchant fleet.
3) Air support of U.S. Marines while conducting amphibious landings to secure key objectives.
4) Protection of allied transport and supply ships.

"In naval warfare, the necessity for complete integration of aviation with the other naval forces was completely demonstrated in the conflict with Japan." 23

The Cold War

Naval doctrine during the Cold War adhered to the tenants set forth in an official Department of the Navy document entitled, The Maritime Strategy. Although the first edition was not published until 1982, The Maritime Strategy aptly described the Naval

force employment doctrine which remained essentially unchanged from the 1950's until the 1991 collapse of the Soviet Union.[24]

During the Cold War, the Navy's primary mission was sea control. The decisive theater in a global war versus the Soviet Union was expected to be the central European front. The Navy's primary role in such a war was to protect key allied sea lines of communication (SLOCs) to ensure that vital supplies and reinforcements could flow to the NATO central front and other land campaigns. To achieve successful sea control, naval forces were to conduct anti-submarine warfare (ASW) and anti-surface warfare (ASUW) against the Soviet Fleet, and anti-air warfare (AAW) against Soviet long range bombers. Naval forces were, in effect, tasked with forming a protective "bubble" around allied sealift and naval forces. The number one priority for aircraft carrier air wings was to provide the AAW air umbrella for surface and airborne ASW assets. Navy attack submarines rounded out the combined arms teams, enabling the Navy to play a critical, if not center stage role in the NATO theater.[25]

If the Navy was successful in its primary mission of sea control and was able to establish overwhelming maritime superiority, The Maritime Strategy called for Naval forces to carry the fight to the enemy, moving forward to provide increased support to allied land and air campaigns at key locations along the Soviet and Warsaw Pact flanks.[26] Naval forces were expected to project power ashore via carrier-based tactical aircraft and, after the mid-1980s, via Tomahawk cruise missiles. It was envisioned that amphibious operations might be called for in Norway and in support of the defense of key naval choke points such as the Dardanelles.[27]

Had a global war initiated however, it was considered fairly unlikely that the Navy would be able to devote much effort to these secondary, power projection missions of strike and amphibious warfare. The overwhelming size and capabilities of the Soviet submarine fleet and Soviet land based naval aviation, in all likelihood would have kept the carriers busy with their primary mission of sea control.

Despite the overwhelming emphasis on AAW and ASUW during the Cold War, U. S. Naval aviation did continue developing the capabilities to project power ashore. Expecting to confront the Soviet fleet in the open ocean, Cold War Navy attack aircraft were generally able to strike from long range, since even coastal targets might be more than 500 miles from the decks of Navy carriers conducting blue water sea control missions.

Additionally, real world tasking during the Cold War more often than not called for Navy air wings to conduct power projection missions rather than sea control. During both Korea and Vietnam, virtually all of Naval aviation's combat experience was in power projection. The 1980s brought similar tasking in Lebanon, Grenada, and Libya.

By the early 1980s, Naval aviation's emphasis, perhaps only unofficially, had clearly shifted away from sea control and toward power projection. Power projection was officially given increased emphasis when the Naval Strike Warfare Center (NSWC) was established in the mid-1980s. While the Navy Fighter Weapons School (Topgun) was responsible for tactics development and for training Navy air wings for air superiority missions, NSWC had similar responsibilities with regard to power projection missions. It is interesting to note that the Navy has no counterpart school or weapons center for ASUW.

"...From the Sea"

As discussed earlier, in September 1992, the Navy published the White Paper "...From the Sea" which articulated the vision of the Navy as it enters the twenty first century. The concepts presented in "...From the Sea" are self-described as a "fundamental shift away from open-ocean war fighting on the sea toward joint operations conducted from the sea".[28] With the demise of the Soviet Union, "...From the Sea" concludes that the U.S. Navy now possesses the unchallenged ability to control the seas wherever operations may be anticipated.[29] As a result, Naval forces are being re-shaped

and "right-sized" for operations in the world's "littorals" or coastal regions. From the littorals, U.S. Navy and Marine Corps forces will project power ashore and conduct maneuver warfare from the sea.[30] "...From the Sea" tells Navy and Marine Corps personnel, "Our job during a regional conflict is to control the ocean adjacent to the littoral battlefield, the ground from the shore to our objectives, and the skies above both".[31]

As evidenced by the above quote, the littoral mission described in "...From the Sea" is predicated upon sea control, which remains the Navy's raison d'être. "...From the Sea" is based on the assumption that regional adversaries will not be able to challenge friendly SLOCs on the open ocean, only at their termini in the littorals. As the Navy moves into the littorals to protect these SLOCs, its proximity to the adversary's coastline will therefore allow Naval forces to simultaneously project power ashore.

Prior to conducting power projection missions, "...From the Sea" dictates that Naval forces will first establish "battlespace dominance". "Battlespace dominance means that we can maintain access from the sea to permit effective entry of equipment and resupply. This dominance implies that Naval forces can bring to bear decisive power to bear on and below the sea, on land and in the air ... Naval forces must also have the capabilities to deny access to a regional adversary, interdict the adversary's movement of supplies by sea and control the local sea and air ... Battlespace dominance is the heart of naval warfare."[32]

With the littoral battlespace dominated, "...From the Sea" envisions Navy and Marine Corps forces projecting power ashore. "Power projection from the sea means bombs, missiles, shells, bullets and bayonets."[33] Naval tactical aircraft are considered a major power projection asset in their own right. Additionally, when Marines go ashore, "Naval aviation aboard aircraft carriers...will provide them sustained, high volume tactical air support".[34] "High-intensity power projection from the decks of our carriers ...(is) critical."[35]

Aside from introducing the Naval service to the concept of battle space dominance and officially upgrading the priority given by the Navy to the power projection mission, "...From the Sea" points out that operations in the littorals offer some unique challenges to Naval forces:

1) Difficulty in discriminating between friends, adversaries and neutrals.

2) Concentrated and layered defenses.

3) Well-"hidden" coastal anti-ship missile batteries.

4) Mines.

5) Sea-skimming cruise missiles.

6) Tactical ballistic missiles.[36]

Doctrinal Requirements of Navy Tactical Aircraft

Although "...From the Sea" itself cannot be considered Naval doctrine, the Navy White Paper did in fact announce that Naval doctrine would be developed consistent with the new direction and focus. On 12 March 1993, the Naval Doctrine Command was formally established, with the mission to translate the vision and strategy contained in "...From the Sea" into doctrinal reality.[37] As of this writing, the initial version of the Naval Doctrine Publication dealing with Operations (NDP-3) has yet to be published. Therefore, the following paragraphs are the author's attempt to translate the vision and strategy of "...From the Sea" into doctrinal requirements of Naval tactical aircraft.

Based upon the concepts articulated in "...From the Sea", it is clear that Naval tactical aircraft must be able to perform a wide variety of battlespace dominance and power projection missions.

The Navy divides its mission into the following war fighting areas:

1) Anti-Air Warfare (AAW)

2) Anti-Submarine Warfare (ASW)

3) Anti-Surface Warfare (ASUW)

4) Strike Warfare (STW)

5) Amphibious Warfare (AMW)

6) Mine Warfare (MIW)

7) Space and Electronic Warfare (SEW)

Most of these warfare areas encompass operations conducted via both battlespace dominance and power projection missions. For example, AAW would include the protection of friendly battlespace against any potential enemy air attack. On the other hand, fighter escort aircraft tasked with the protection of a strike package are also considered to be conducting AAW. STW and AMW are the exceptions to this rule. All STW and AMW operations fall under the category of power projection.

Navy warfare areas are, for the most part, broken down based upon the classification of the intended target: AAW- aircraft; ASW- submarines; ASUW- ships; STW- land targets. The remaining warfare areas are defined by the types of weapons or forces used to conduct such warfare: AMW- Navy and Marine amphibious forces; MIW- mines and mine countermeasures equipment; SEW- space and electronic warfare systems.

The U.S. Army and U.S. Air Force use other definitions to more precisely describe specific aircraft missions. These definitions are widely understood and used, if unofficially, in the Navy as well. In order to more clearly define Naval tactical aircraft missions, unless otherwise indicated, the following discussion uses terms found in Army Field Manual 100-5, Operations.

Battlespace Dominance Requirements

In order to achieve battlespace dominance, Navy tactical aircraft will be tasked to perform the following missions:

1) Defensive Counter Air (DCA) - The interception and destruction of enemy air assets that attempt to attack friendly forces or penetrate friendly airspace.

2) Offensive Counter Air (OCA) - The destruction, inside enemy airspace, of enemy air forces and the infrastructure supporting enemy air operations. OCA includes attacks against airborne enemy aircraft as well as enemy air bases. OCA is often flown in conjunction with power projection missions to ensure those missions can be conducted effectively without interference from enemy fighters.

3) Suppression of Enemy Air Defenses (SEAD) - The destruction or temporary degradation of enemy air defense systems by both physical and electronic warfare. SEAD is often flown in conjunction with power projection missions to ensure those missions can be conducted effectively without interference from enemy air defenses.[38]

NOTE - DCA, OCA and SEAD are collectively classified as Air Superiority missions.

4) Anti-surface air operations - Air operations conducted in an air/sea environment versus enemy surface forces.[39] (For our purposes - the interception and destruction of enemy naval surface vessels that attempt to attack friendly forces or penetrate friendly battle space.)

Power Projection Requirements

TACAIR power projection missions derived from "...From the Sea" are:

1) Strategic Attack (SA) - Attacks versus enemy centers of gravity, which may include national command elements, war materiel production assets, and supporting infrastructure (i.e., energy, transportation and communication assets).

2) Air Interdiction (AI) - Air operations conducted to delay, disrupt or destroy an enemy's military forces before they can be brought to bear effectively against friendly forces. AI may target enemy surface forces; lines of communication; Command, Control and Communications

networks; and combat supplies. (For our purposes, AI includes the attack of enemy naval forces and supply ships outside friendly battlespace and the offensive mining of enemy ports.)

3) Close Air Support (CAS) - The attack of hostile targets close to friendly ground forces.[40]

Requirements to Respond to Littoral Challenges

Responding to the littoral challenges articulated in "...From the Sea", Navy tactical aircraft of the future must incorporate the following capabilities:

1) Onboard identification (ID) capability - TACAIR must be able to determine the identity of all potential targets, including aircraft, ships, and mobile land forces (tanks, vehicles, etc.).

2) Survivability enhancements - To decrease vulnerability to the enemy's potentially concentrated and layered defenses, TACAIR must seek improvements in signature reduction and electronic, infrared, and optical countermeasures.

3) Anti-missile capability - To decrease the vulnerability of friendly forces to attacks from tactical ballistic missiles (TBM) or sea-skimming cruise missiles, TACAIR must pursue improvements in capabilities to locate and destroy TBM launchers and to detect and destroy inbound ballistic and cruise missiles, to include counter-stealth capabilities.

CHAPTER FOUR

A DOCTRINAL EVALUATION OF FA-18E/F CAPABILITIES

FA-18E/F Capabilities

The FA-18E/F is a significant upgrade to existing Hornet models. Whereas the 1988 FA-18C/D upgrade from the FA-18A/B was mainly an avionics upgrade, the FA-18E/F is largely an airframe modification. Building upon the combat-proven capabilities of the FA-18C/D, the FA-18E/F has been modified with the intention of enhancing range, payload, bring back (the ability to land aboard the carrier with unused weapons), survivability, and growth potential. Major airframe changes include:

1) The fuselage length has been increased by 34 inches to allow for 3,600 more pounds of internal fuel.

2) The wing area has been increased by 25%.

3) The airframe has been modified to accommodate larger, more powerful engines.

4) An additional weapons station has been added under each wing .[41]

Independent studies estimate that FA-18E/F airframe and engine changes will result in a 50% increase in range, an 80% increase in endurance, a 22% increase in payload, and a 300% increase in bring back over FA-18C/D models.[42]

FA-18E/F avionics will be largely carried over from later FA-18C/D models, including the night attack system, the new APG-73 radar, the ALR-67G advanced radar warning receiver, Havequick/Sincgars radios, Global Positioning System (GPS), advanced mission computers, and a photo reconnaissance capability.[43]

Although not a true stealth platform, the FA-18E/F is incorporating survivability enhancements, including "improved countermeasures and materials technologies and

reduced vulnerable areas. (As a result the FA-18E/F)...will be harder to detect, hit, and disable than current Hornets".44

Evaluation

This impressive multi-role aircraft, in a single airframe, has been embodied with the capabilities to perform virtually every mission required of Navy tactical aircraft. The FA-18C/D's proven air-to-air capabilities will only be enhanced by the FA-18E/F's airframe and avionics improvements, resulting in outstanding capabilities in the counter air mission areas. The Hornet's proven capability to reliably and accurately deliver a wide variety of precision air-to-surface weapons will only be improved with the FA-18E/F's enhancements in range and survivability. As has been demonstrated by predecessor FA-18 models, The FA-18E/F version will excel at every air-to-surface mission, which includes OCA, SEAD, anti-surface air operations, SA, AI (including mine warfare), and CAS.

While the Navy continues to seek solutions to the littoral challenges of target identification and TBM and cruise missile attack, the FA-18E/F's enhanced growth potential should facilitate the incorporation of future technological counters to these threats. The FA-18E/F has already made advances in one of these areas: it will be fielded with the onboard capability to reliably identify airborne targets.

The FA-18E/F's lack of stealth may, in fact, be its only significant limitation. As stated earlier, the FA-18E/F has incorporated significant survivability enhancements, including signature reduction and improved countermeasures. The FA-18E/F is not, however, a true stealth aircraft. In order to reduce radar cross section (RCS) to a minimum, true stealth airframes result in some very non-traditional shapes, as evidenced by the designs of the F-117, B-2, F-22, and A-12. The FA-18E/F airframe is simply a "stretched" version of the FA-18A/B/C/D. There is only so much stealth technology that

can be later applied to an existing airframe design. One can only surmise that there are limitations to how much RCS reduction might be achieved in the FA-18E/F.

Response to the Critics

As opponents of the program have pointed out, the FA-18E/F will not possess the range, payload, or TFR capabilities of the A-6, one of the aircraft which it will replace.

Range

To any tactical aviator, aircraft range is like aircraft speed, or money: more is better! However, the fact that the FA-18E/F does not possess the range of one of its predecessors, the A-6E, does not necessarily mean that the FA-18E/F has insufficient range capability to perform its missions. Many members of the Navy's A-6 community declare that the FA-18E/F's 640 NM combat radius (compared with the A-6E's 735 NM radius) [45] does not give it the ability to conduct "deep strike" missions.

Unfortunately, these same critics are unable to define "deep strike". To the USAF, "deep" would probably be measured in thousands of miles. Although the A-6 community claims that "deep strike" is a Navy TACAIR mission, there is no doctrinal evidence to back up this claim. An historical trace of the development of Navy air power doctrine since World War II finds no mention of such a mission mandated for Navy TACAIR. One would thereby conclude that "deep strike" is not, nor has it ever been, a Naval mission.

Regardless, the champions of the "deep strike" mission continue to argue its cause, despite the fact that they are unable to quantify how deep Naval tactical aircraft must be able to strike. One must assume from the source of the criticism however, that A-6E's have been able to conduct "deep strike" missions and that the FA-18E/F will not. One might conclude then, that "deep strike" capability requires a combat radius greater than 640 NM, but less than 735 NM.

As the Navy eagerly points out, 70% of the world's population (and therefore presumably 70% of Navy TACAIR's potential targets) lie within 100 NM of the world's coasts. The Navy has been directed to "focus on complimenting the capabilities of the other services, examining ways to minimize duplicative capabilities"[46] while focusing its efforts on the littorals. Of course, it is true that aircraft range equates to aircraft carrier stand-off range and that long range Navy aircraft would therefore allow aircraft carriers less exposure to littoral threats. The FA-18E/F's range compares favorably with that of the A-6E and should allow aircraft carriers to stand off well outside the range of most littoral threats while being able to project power far inland. Any mission requiring the capability to strike deeper would be better serviced by tasking USAF B-2's.

Payload

Desert Storm combat dramatically highlighted the value of precision weapons on the modern battlefield. Levels of target destruction which would have taken tens of sorties dropping hundreds of non-precision bombs were achieved with single sorties dropping only one or two precision weapons. On one sortie, the FA-18E/F will have the capability to deliver four 2,000 pound precision weapons, while also carrying a load of four air-to-air missiles for self defense.

Of course, some targets are more effectively destroyed by employing a large number of weapons over a large area. The FA-18E/F's capability to employ multiple cluster munitions, including weapons using the Brilliant Anti-Tank (BAT) submunition, will help to offset its alleged payload shortcoming. Using a similar logic to that presented in the earlier discussion of aircraft range, any mission requiring more payload than can be delivered by an FA-18E/F would be better serviced by USAF bombers, which have the ability to deliver four to five times as much ordnance as an A-6E.

Terrain Following Radar

All-weather weapons delivery is an essential Navy TACAIR performance requirement. A terrain following radar (TFR) gives an aircraft the ability to fly at low

altitude regardless of the weather, day or night. The FA-18E/F's night attack system which incorporates night vision goggles (NVGs), a forward looking infrared (FLIR) pod for navigation and a targeting FLIR pod, gives the aircraft the ability to ingress/egress, and deliver precision ordnance from under the weather, day or night.

All aircraft, whether TFR-equipped or not, must be under the weather to employ today's precision weapons. The aircraft must maintain clear line of sight to the target throughout weapons' time of fall. All aircraft, whether TFR-equipped or not, are unable to deliver today's precision ordnance from within or through "the weather" (i.e. clouds). Capability in this environment is limited to the relatively inaccurate radar delivery of non-precision weapons. The future fielding of Joint Direct Attack Munitions (JDAM) will bring all-weather precision capability to both the Navy and Air Force. The FA-18E/F will be fully capable of JDAM employment.

The only capability possessed by TFR-equipped aircraft but not enjoyed by the FA-18E/F is the ability to ingress or egress at low altitude in the weather. The tactical utility of this capability is doubtful at best. Technological advances in air defense may have made low altitude ingress incompatible with aircraft survival. The integrated air defense systems (IADS) of most potential enemies have been optimized to detect and defeat low flyers. Additionally, anti-aircraft artillery (AAA) fire, which is effective only at lower altitudes, has historically proven to be the most deadly defense against combat aircraft.

Low altitude ingress in the weather subjects the aircraft to even greater danger. Flying in the weather while inside the weapons envelopes of enemy air defense systems prevents pilots from seeing and reacting appropriately to surface-to-air missile (SAM) launches or AAA fire. The high loss rates of TFR-equipped aircraft flying at low altitude in Desert Storm (i.e., Navy A-6's, Royal Air Force Tornado's, etc.) only serve to emphasize the doubtful utility of TFR for tactical aircraft in future threat scenarios.

FA-18E/F - The Final Verdict

The FA-18E/F's multi-role flexibility gives it the capability to perform virtually every mission required of Navy tactical aircraft. Its sole shortcoming is its lack of stealthiness. Given the aircraft's long list of attributes, coupled with today's receded global threat, the decision to procure the FA-18E/F was the correct choice for the Navy.

In fact, as terrible as it might have seemed at the time, history should prove that the cancellation of the A-12 was a blessing for the Navy. Although the stealthy A-12 could have performed many crucial missions for the Navy, including destroying enemy air defenses from within their envelopes so that other TACAIR assets might thereafter operate unhindered, the A-12 had significant limitations. Able to operate only at night and only in the air-to-surface role, a significant portion of already limited carrier air wing assets would be unavailable for crucial missions such as air-superiority and daytime CAS. The A-12 would not have been compatible with many of the "...From the Sea" concepts.

The decision to field the FA-18E/F as soon as possible and to procure AFX/JAST at a later date was a classic example of a decision involving trade-offs between modernization, new technology development/maturity, and readiness. With aging A-6E's and F-14's making up a large portion of the Navy's carrier air wings, the Navy had to modernize, but could not afford to commit to procuring any aircraft that might not be fielded promptly. The readiness of the carrier air wings was at stake. The compromise procurement of the FA-18E/F struck an excellent balance between modernization and readiness. The Navy TACAIR community should rest well at night , knowing that the FA-18E/F is being procured for the fleet. A thorough analysis of its capabilities, cost, and ability to be fielded quickly lead to the conclusion that the FA-18E/F is the only logical answer to the Navy's near term TACAIR needs.

CHAPTER FIVE

RECOMMENDATIONS FOR THE FUTURE PROCUREMENT OF NAVY TACTICAL AIRCRAFT

Doctrine-Based Recommendations

Based upon the Naval air power doctrinal requirements of tactical aircraft, the following recommendations are offered:

1) Continue procuring flexible, multi-role aircraft. Deck space on aircraft carriers is always at a premium. The Navy must maximize carrier air wing lethality by procuring aircraft whose capabilities are always in demand.

2) When trade-offs must be made, ensure air superiority (including both counter air and SEAD) capabilities receive priority. The carrier air wing's ability to project power is of utmost importance, but battlespace dominance is prerequisite to all other operations. Of the battlespace dominance missions, air superiority must receive priority over anti-surface air operations due to the speed, long range and lethality of enemy air power and the reduced reaction times available to friendly forces to counter such threats. Air superiority ensures that all other missions can be conducted without interference from enemy fighters or surface-based air defenses.

3) When trade-offs must be made among power projection missions, ensure CAS receives priority over AI, and AI over SA. In many "...From the Sea" scenarios, USMC ground forces will be dependent upon U.S. Navy carrier based air for fixed-wing air support during the crucial initial stages of forcible-entry amphibious operations. Historically, CAS has proven to be critical to the success of amphibious operations. Additionally, AI can have significant affects on the outcome of any ground combat action, by attacking enemy forces before they can be brought to bear against friendly ground forces.

SA is an essential element of any air campaign. Its effect on the enemy ability to wage war however, is rarely immediate. The expected short duration of forcible entry operations, to be conducted by Marine maneuver elements from the sea, may result in the completion of the operation by the time the enemy begins to feel the impact of strategic attacks.

Threat-Based Recommendations

Based upon projected threats to naval forces operating in the littorals, the Navy should continue its efforts to enhance TACAIR capabilities in the following areas:

1) Identification of friends, adversaries, and neutrals. Systems should be developed to allow tactical aircraft to accurately identify aircraft, ships, and mobile land targets (tanks, vehicles, etc.) from ranges greater than or equal to maximum weapons employment ranges.

2) Capability to operate within concentrated and layered enemy defenses. Continue efforts in aircraft signature reduction (i.e., stealth), including the reduction of electronic emissions. For example, a low probability of intercept (LPI) radar is mandatory for future strike fighters. Efforts should continue to improve electronic, infrared, and optical countermeasures complementary with achievable levels of stealth.

Enhancements to tactical aircraft range should continue to be sought. Aircraft range is important: the FA-18E/F upgrade was initially conceived as a solution to FA-18A/B/C/D range inadequacies. Increasing aircraft range reduces Navy dependence upon USAF tankers. Longer range aircraft will also allow more Navy tactical aircraft to be available for weapons delivery missions, because less will be required to perform organic tanking missions. Perhaps most importantly, increased aircraft range equates to increased aircraft carrier stand-off range and a corresponding reduction in aircraft carrier exposure to littoral threats. Range enhancements should not be realized however, at the expense of stealth, or by trading off air superiority or CAS capabilities.

3) Anti-missile capability. Continue efforts to develop systems and interfaces to allow Navy tactical aircraft to locate, target, and destroy TBM launchers. Study the feasibility of using tactical aircraft weapons systems to destroy inbound ballistic missiles. If feasible and practical, develop this capability for Naval tactical aircraft.

Continue efforts to give Navy tactical aircraft the capability to detect and destroy sea-skimming cruise missiles. Development of the counter stealth capabilities required in this area will only serve to enhance Naval air superiority capabilities against potential future enemy stealth aircraft.

Technology-Based Recommendation

Based upon advances in friendly technology, the following recommendation is offered:

Eliminate terrain following radar from the requirements for future Navy tactical aircraft. The purpose of TFR is to allow for all-weather low altitude (and therefore presumably undetected) ingress. Stealth technology will provide future Naval aircraft with the ability to ingress undetected at all altitudes, negating the need to fly through deadly enemy AAA envelopes. Additionally, JDAM will provide an all-weather precision attack capability from any altitude. In summary, technology has eliminated the requirement for TFR.

Fiscally-Based Recommendations

Declining military budgets, competing DOD and Navy procurement programs, and rising costs of technology are the hallmarks of today's fiscal climate. Such circumstances demand that the Navy invent or discover new ways to deliver state-of-the-art combat capabilities at the lowest possible cost to the taxpayer. In order for the Navy and DOD to get more "bang for the buck", the following recommendations are offered:

1) The Navy and the Air Force should jointly procure the same tactical aircraft. In order to field the most effective tactical air forces (land or carrier based), both the Navy and the Air Force must actively embrace joint aircraft procurement programs. The Navy and Air Force will never again be afforded the luxury of fielding 12 different types of tactical aircraft as was done for Desert Storm (USAF: A-10, F-4G, F-15C, F-15E, F-16, F-111, F-117 / USN/USMC: A-6, A-7, AV-8, F-14, FA-18). The Navy has discovered that it cannot afford to unilaterally fund more than one major new aircraft procurement program at a time. While procuring the V-22 for the Marines, the Navy found itself unable to fund the AFX, even if the FA-18E/F program were canceled. Similarly, the Air Force was unable to participate in the Navy's ATA program due to competing Air Force programs (B-2, C-17) and the requirement to unilaterally fund the F-22.

Incorporating the latest technology is extremely expensive. Initial research and development (R & D) costs are astronomical for any new tactical aircraft. Current fiscal reality and projections for the future point to an extremely limited number of DOD new aircraft program starts. At best, the future tactical air forces of the Air Force and the Navy can hope to fly only two aircraft types apiece. In order to maximize the capabilities of future tactical aircraft, the services must agree to pursue only joint aircraft procurement programs.

In addition to the sharing of the large up front R & D costs, the larger quantity aircraft purchase resulting from joint procurement allows the services to get "more bang" for their collective "bucks" by lowering unit costs, and costs for spares and support equipment. Additional economies can be realized by inter service consolidation of training, logistics and depot level repair activities.

None of the services can afford to unilaterally fund programs as is currently being done with the V-22, T-45, FA-18E/F and F-22. Programs such as the V-22 and T-45

should never have gone forward without the participation of the Army and the Air Force respectively. Perhaps the same is true of the FA-18E/F and F-22 programs.

The most common argument against joint Navy/Air Force tactical aircraft procurement programs is that the USAF is unwilling to compromise on performance by being handicapped by the extra structural weight required by a naval carrier aircraft. This argument however, does not withstand the scrutiny of history. One of the most successful aircraft in the histories of both services was the F-4 Phantom II, originally designed for the Navy. Today, USAF F-16C and Navy FA-18C are virtually "interchangeable" aircraft. Each of these multi-role aircraft is highly respected in its own right. Each has certain attributes superior to the other, but overall, an FA-18C could effectively perform most F-16C missions and vice versa. It would therefore appear that the FA-18's extra structural weight has not significantly compromised its performance. Modern materials technology appears to have developed to the point where there is no significant performance penalty paid by aircraft capable of carrier operations.

If the Navy and the Air Force were to agree to jointly procure all future tactical aircraft, tremendous operational capabilities could be realized as well. Some of the money saved could be used to increase aircraft capabilities to levels that could not have been afforded by the individual services engaged in unilateral procurement programs. The Navy and Air Force of the future may fly only two airframe types, but the resultant savings from joint programs could result in the following scenario:

> Both airframes would be highly capable, next-generation multi-mission stealth "strike fighters". One would specialize in air-to-air combat, but would retain a credible and flexible capability in strike warfare. The other would specialize in the strike mission, but would have complete air-to-air self-defense capability and would be a formidable air superiority machine in its own right. The basic "strike" specialized airframe would be modified to produce a third

variant which would perform the "Wild Weasel" Defense Suppression and/or Electronic Warfare missions.

2) The Navy and the Air Force should begin joint procurement of tactical aircraft as soon as possible: commencing with the F-22 and JAST programs.

The joint procurement scenario described above is within the near term reach of the services. Embarking on joint tactical aircraft procurement, regardless of when the effort is commenced, will require a one time budgetary inefficiency to allow the services to synchronize their procurement schedules. Both services are involved in JAST and therefore no further synchronization of procurement schedules would appear to be required for that program. However, to get the two services completely into synch would require the services to significantly alter existing procurement plans. Either the Navy should cancel the FA-18E/F program and instead procure a Naval F-22, or the Air Force should cancel the F-22 and get into the Navy's FA-18E/F Program.

The Navy obviously cannot cancel the FA-18E/F and wait for a possible 2010 IOC for the F-22. On the other hand, the Air Force can be expected to reject any joint procurement plan which would require the cancellation of the F-22 program.

A compromise solution would be for the Navy to continue procuring the FA-18E/F to fill the gaps left behind on its carrier flight decks by retiring A-6E's and F-14's. Once the F-22 has begun production, currently planned to cover a twenty year period, the Navy would enter the F-22 program with the goal of fielding a navalized F-22 at about half way through the production run. The FA-18E/F program would be terminated once the fielding of Navy F-22's was assured. At the end of the twenty year production run, the two services would have their procurement schedules synchronized. All subsequent aircraft programs would procure identical airframes for both services.

Although a one-time synchronization of the two services' procurement schedules would be somewhat inefficient and expensive in the short term, it would be up to Navy and Air Force leaders to convince the civilian leadership that joint procurement will

eventually provide tremendous long term cost savings while maximizing the military's overall combat capability.

CHAPTER SIX

CONCLUSION

The FA-18E/F was not in the Navy's original aircraft procurement plans. In the mid-1980s the Navy planned to replace its F-14's and A-6's with aircraft resulting from two joint procurement programs: the ATF and the ATA respectively. Inter service squabbling and differing priorities, competing programs, and misalignment of the two services' procurement schedules led each service to participate in (and unilaterally fund) only its higher priority program. The Navy's critical decision to procure the ATA without USAF participation would eventually lead to the necessity to procure an aircraft like the FA-18E/F.

In hindsight, the decisions which resulted in the Navy's unilateral participation in the ATA program were flawed from both financial and doctrinal perspectives. Navy leaders apparently did not appreciate the expense involved in fielding state-of-the-art technology. They were evidently caught by surprise to find out that replacing two aircraft types on a one-for-one basis was unaffordable. The subsequent decision to give priority to fielding the single role ATA was contrary to doctrinal priorities established since World War II and ignored the successes of existing multi-role aircraft such as the F-16 and FA-18. It is possible that a different decision might have been rendered had Navy leaders had access to and had reviewed written Naval air power doctrine prior to making this decision.

The cancellation of the A-12 in 1991 actually gave the Navy a reprieve from a bad decision. The ten year delay in IOC for the A-12 replacement, the AX, demanded that the Navy field some interim aircraft as a replacement for large numbers of A-6 and F-14 aircraft whose service lives were rapidly expiring. A new crop of Navy leaders, with perhaps a better understanding of Naval air power doctrine and using lessons learned

from Desert Storm, chose to procure the multi-role FA-18E/F in the interim, while the Fleet awaited the fielding of the AX. Additionally, Navy leaders redefined the AX program, requiring that the aircraft possess a true multi-role capability, which in turn led to the redesignation of the program as AFX.

Unfortunately, competing Navy programs and declining defense budgets eventually forced the Navy to admit that it could not afford to unilaterally fund the AFX, even if it were to cancel the FA-18E/F. The Department of Defense's BUR decision to cancel AFX in deference to the joint JAST program was made with the full concurrence of Navy leadership. The Navy thus finds itself relying upon the FA-18E/F to lead its TACAIR community into the twenty-first century.

The FA-18E/F should prove to be an extremely capable and flexible multi-role tactical aircraft. In future scenarios, as envisioned in "...From the Sea", the FA-18E/F should have the capability to effectively perform virtually every mission required of Navy tactical aircraft. Despite apparently unfavorable comparisons with one of its predecessor aircraft, the A-6E, the differences in the capabilities of the two aircraft do not necessarily equate to less capability of the FA-18E/F to perform assigned missions. When evaluated in light of the requirements demanded by current Naval air power doctrine, the FA-18E/F's only significant shortcoming appears to be its lack of stealth. Regardless, the FA-18E/F's around-the-clock availability and its multi-role capability to conduct air superiority, close air support and air interdiction missions, give it the potential to make more contributions to the "...From the Sea" Navy's mission than the A-12 might have.

Despite the numerous attributes of the FA-18E/F, the Navy cannot afford to rest on the laurels of these capabilities. The procurement of next-generation aircraft must be actively pursued in order to maintain the technological means to defeat potential enemies in their regional backyards. The Navy TACAIR community must heed the direction contained in "...From the Sea" and concentrate on improving capabilities which are

essential for successful combat in the world's littorals. Procuring multi-role aircraft with robust air superiority, close air support and air interdiction capabilities is essential.

Anticipated near term advances in the air defense capabilities of potential adversaries demand that the Navy's next generation aircraft possess as much stealthiness as is technologically feasible. Additional capabilities demanded by operations in the littorals should be as aggressively pursued, including target ID and anti-missile capabilities.

Perhaps most importantly, projected budgetary constraints demand that the Navy and the Air Force enter into joint tactical aircraft procurement programs. Fiscal realities will not allow the services to replace existing aircraft types on a one-for-one basis. Current Navy plans call for necking down from three tactical aircraft types (A-6, F-14, FA-18C) to two (FA-18E/F, JAST). Similarly, it is projected that the Air Force will eventually find itself required to neck down from seven airframes (A-10, F-4G, F-15C, F-15E, F-16, F-111, F-117) to two (F-22, JAST).

Follow-on technology is anticipated to be even less affordable. Joint procurement is the only way to maximize capabilities in the face of declining budgets and rising technology costs. As evidenced by comparing same generation F-16C and FA-18C aircraft, materials technologies have advanced to the point where aircraft capable of performing in the structurally demanding aircraft carrier environment do not suffer any significant associated performance penalties. Future advances in material technologies should only serve to improve matters.

All future procurement of tactical aircraft must be done via joint Navy and Air Force programs in order to achieve the most military capability possible with the minimum cost to the taxpayer. Our nation's defense deserves nothing less.

NOTES

1. For the purpose of this paper, the term "tactical aircraft" is used to describe aircraft which have the primary mission of weapons employment against air and surface targets. Although equally important to the Naval mission, the requirements for rotary wing and fixed-wing Naval carrier aircraft such as the EA-6, E-2, S-3, tankers, or surveillance and reconnaissance aircraft will not be discussed herein.

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GLOSSARY

AAA	Anti-Aircraft Artillery
AAW	Anti-Air Warfare
AI	Air Interdiction
AMRAAM	Advanced Medium Range Air-to-Air Missile
AMW	Amphibious Warfare
ASUW	Anti-Surface Warfare
ASW	Anti-Submarine Warfare
ATA	Advanced Tactical Aircraft
ATF	Advanced Tactical Fighter
BAT	Brilliant Anti-Tank (submunition)
BUR	Bottom-Up Review
CAS	Close Air Support
DCA	Defensive Counter Air
DOD	Department of Defense
FLIR	Forward Looking Infrared
GPS	Global Positioning System
HARM	High Speed Anti-Radiation Missile
IADS	Integrated Air Defense System
ID	Identification
JAST	Joint Advanced Strike Technology
JDAM	Joint Direct Attack Munitions
LGB	Laser-Guided Bomb
LPI	Low Probability of Intercept
MIW	Mine Warfare

MRF	Multi-Role Fighter
NATF	Naval Advanced Tactical Fighter
NM	Nautical Miles
NSWC	Naval Strike Warfare Center
NVGs	Night Vision Goggles
OCA	Offensive Counter Air
RCS	Radar Cross Section
R&D	Research and Development
SA	Strategic Attack
SAM	Surface-to-Air Missile
SASC	Senate Armed Services Committee
SEAD	Suppression of Enemy Air Defenses
SEW	Space and Electronic Warfare
SLAM	Stand-off Land Attack Missile
SLOCs	Sea Lines of Communication
STW	Strike Warfare
TACAIR	Tactical Aircraft
TBM	Theater Ballistic Missile
TFR	Terrain Following Radar