

2

AD-A240 595



UNCLASSIFIED

NAVAL WAR COLLEGE
Newport, R.I.

THE ROLE OF STEALTH IN NAVAL AVIATION AND
JOINT/COMBINED OPERATIONS (U)

by

Mark P. Grissom

CDR USN

DTIC
REFLECTE
SEP 12 1991
S D D

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: *Mark P. Grissom*

20 May 1991

Paper directed by COL Theodore L. Gatchel
Chairman, Department of Operations
LtCol William R. Spain
Planning and Decision Making Moderator

Approved by:

This document has been approved for public release and sale; its distribution is unlimited.

Faculty Research Advisor Date

UNCLASSIFIED

91 9 12 014

91-10406



REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE		4. PERFORMING ORGANIZATION REPORT NUMBER(S)	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION OPERATIONS DEPARTMENT	6b. OFFICE SYMBOL (if applicable) C	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) NAVAL WAR COLLEGE NEWPORT, R.I. 02841		7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) THE ROLE OF STEALTH IN NAVAL AVIATION AND JOINT/COMBINED OPERATIONS (U)			
12. PERSONAL AUTHOR(S) Mark P. Grissom CDR, USN			
13a. TYPE OF REPORT FINAL	13b. TIME COVERED FROM TO	14. DATE OF REPORT (Year, Month, Day) 1991, May 20	15. PAGE COUNT 27
16. SUPPLEMENTARY NOTATION A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations. The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College of the Department of the Navy.			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
		Low observable technology; Naval missions--Power Projection Presence, Deterrence, Sea Control; AirLand battle; Combined Operations.	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) The low observable (stealth) technology holds great promise in increasing the effectiveness of Naval Aviation in support of the Maritime Strategy and joint/combined operations. Although at first look it may seem that stealth is a panacea for nearly all tactical missions, its use needs scrutiny, particularly in strategic implications. This paper will look at stealth and its applicability in each of the four naval missions of Power Projection, Presence, Deterrence and Sea Control, as well as several supporting warfare areas such as anti-air warfare and anti-surface warfare. Lastly, the operational and strategic implications of its use in representative joint/combined operations is addressed. It will be found that stealth reduces the risk of many power protection missions and needs less tactical support than conventional strike aircraft. The technology is not required in all missions however, since the risk level of the mission may not justify the cost of stealth or the mission requires high power electromagnetic energy emissions which are counter to the reason for having stealth. Low observable aircraft can support joint operations such as the AirLand Battle Doctrine of the Army, although there are limitations. Combined ops are supported tactically for the same reasons naval warfare missions are.			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL CHAIRMAN, OPERATIONS DEPARTMENT		22b. TELEPHONE (Include Area Code) 841-3414	22c. OFFICE SYMBOL C

Abstract of
**THE ROLE OF STEALTH IN NAVAL AVIATION
AND JOINT/COMBINED OPERATIONS**

The low observable (stealth) technology holds great promise in increasing the effectiveness of Naval Aviation in support of the Maritime Strategy and joint/combined operations. Although at first look it may seem that stealth is a panacea for nearly all tactical missions, its use needs scrutiny, particularly in strategic implications. This paper will look at stealth and its applicability in each of the four naval missions of Power Projection, Presence, Deterrence and Sea Control, as well as several supporting warfare areas such as anti-air warfare and anti-surface warfare. Lastly, the operational and strategic implications of its use in representative joint/combined operations is addressed. It will be found that stealth reduces the risk of many power projection missions and needs less tactical support than conventional strike aircraft. The technology is not required in all missions however, since the risk level of the mission may not justify the cost of stealth or the mission requires high power electromagnetic energy emissions which are counter to the reason for having stealth. Low observable aircraft can support joint operations such as the AirLand Battle Doctrine of the Army, although there are limitations. Combined operations are supported tactically for the same reasons naval warfare missions are, but the risk of loss of allied aircraft and crews must be properly managed to avoid dissension among the 'haves' and 'have nots' of stealth technology.

TABLE OF CONTENTS

CHAPTER	PAGE
ABSTRACT	11
I INTRODUCTION	1
II THE CONCEPT	4
III THE TECHNOLOGY BEHIND STEALTH	6
IV THE EFFECT OF TECHNOLOGY ON THE NAVY'S MISSIONS	9
V THE ROLE OF STEALTH IN NAVAL WARFARE	10
Power Projection	11
Deterrence and Presence	12
Sea Control	14
VI STEALTH IN JOINT OPERATIONS SUCH AS AIRLAND BATTLE	17
Air Interdiction	17
Battlefield Air Interdiction	18
Close Air Support	18
VII ...IN COMBINED OPERATIONS	19
VIII CONCLUSION	20
NOTES	22
BIBLIOGRAPHY	24

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Availability for Special
A-1	



**THE ROLE OF STEALTH IN NAVAL AVIATION
AND JOINT/COMBINED OPERATIONS**

CHAPTER I

INTRODUCTION

Low observable technology (commonly referred to as 'stealth') has captured the attention of virtually everyone--scientists because of its high technology design and construction, Congress and the public because of its extraordinary cost, and military personnel because of its great potential in armed conflict.

The basic premise from which all the capabilities of stealth emerge is that of aircraft signature reduction to a level that is not detectable, or at least not at sufficient range to engage the aircraft with radar-guided weapons. This capability would only permit strike aircraft to be tracked by IFF (Identification Friend or Foe) transponders--not by radar returns from the skin of the airframe. Therefore, if the transponder was turned off for tactical missions, the aircraft would theoretically be nearly immune to detection and attack.

If the capability is as good as it sounds, perhaps it will finally allow bomber aircraft to live up to Giulio Douhet's lofty assessment written in 1921, 'Nothing man can do on the surface of the earth can interfere with a plane in flight, moving freely in the third dimension. All the influences which have conditioned and characterized warfare from the beginning

are powerless to affect aerial action.'¹

But is reducing RCS and IR signatures really a panacea that will allow commanders to task stealth aircraft for any mission? And even if we assume that the low-observable technology does give the commander nearly risk-free tasking of stealth aircraft in any threat environment, are there employment problems for the CINC (Commander in Charge) at the joint and combined force level?

This paper will scrutinize the low observable technology in naval aviation. First the concept will be discussed and the technology explained, then the potential benefits will be addressed in the context of the four Navy missions and joint/combined operations.

who once stated, "The rule of thumb is that you forgo 200 of the existing generation of fighters to pay for the research to obtain a new one,"* would be short of the mark when it comes to stealth!) The answer lies in reducing risk--reducing the risk of losing tactical aircraft and aircrew in combat, and reducing the risk of political embarrassment resulting from failed military operations.

The ability to operate aircraft safely in a battlefield environment of current-technology detection and tracking systems greatly increases the chance of success of the operational commander's tasking. For example, the stealth airframe could have a multi-role capability including high speed reconnaissance for photointelligence, battle damage assessment or ESM (Electronic Surveillance Measures), and of course it can provide the option of precision guided munitions delivered in heavily defended positions in the center of civilian populations as was seen during the recent Iraq war. It can also increase the options available to the operational commander, allowing him for example to conduct surface search of an area of the sea without revealing the presence of the carrier due to the stealth aircraft's decreased risk of detection.

CHAPTER III

THE TECHNOLOGY BEHIND STEALTH

Recent front line tactical aircraft such as the F-4 Phantom, A-7 Corsair, F-15 Eagle and F-14 Tomcat have all been designed without much consideration to RCS or IR signature suppression. The super-secret 'Have Blue' program in the late 1970's, precursor to the F-117A, marked the beginning of the application of low observable technology to tactical aircraft.¹

The stealth property of low RCS is produced in three primary ways; airframe shape, airframe internal construction, and RAM (Radar Absorbing Material) coatings. Airframe shape and internal construction are closely tied in the low observable design and can produce a small RCS even without a RAM coating. And RAM paints can produce some reduction of RCS when applied over 'non-stealth' airframes. So although these three components can be divided into two mutually independent techniques, they each can play a part in the stealth effort.

The basic premises of RCS-reduction design include avoiding boxy, angular airframes with parts joined at right angles; large, open, engine air intakes; and flat, nearly perpendicular surfaces such as planar radar antennas.² Externally carried weapons and fuel tanks, and cockpits not protected by specially treated canopies are also well-known sources of radar reflectivity.

IR signature reduction has been achieved in part through composite technology used in the airframe structure. Carbon

composites such as carbon grain and ultradense carbon foam have excellent infrared radiation dissipation qualities, for example. However, continuing improvements in IR search and track capabilities may pose a detection threat to the stealth aircraft.

But the intriguing scientific techniques used to foil the various detection systems often causes the most basic detection method of all to be overlooked--that of visual sighting. Tactical aircraft have long used various paint schemes for two purposes; to help reduce visual detection range and to confuse or delay determination of aircraft aspect/direction of turn. Reduced detection range schemes have ranged from such basics as flat grey upper surfaces and white lower surfaces to more exotic camouflage patterns in the specific colors of the battle arena. A recent Navy experiment used water-based paint in various flat, blendable colors for application on F-14s to produce camouflage patterns nearly instantly adaptable in color to any overland environment. Even this 'fix' was not completely successful in that no one pattern or color is effective throughout even a single mission. Attempts at deception have included angular patterns designed to prevent resolution of aspect angle, and the painting of canopy silhouettes on the bottom of the fuselage to confuse direction of turn. All these techniques have been effective to some degree, but none are perfect--we cannot make an aircraft invisible.

The stealth design does have some drawbacks which should be briefly mentioned; the fact that *anything* carried externally

will destroy the low-observable properties of the airframe drives the requirement for internal bomb bays in stealth. This in turn produces much lower drag than conventional airframes with exposed bomb racks and weapons, but internal bomb bays result in either a smaller payload (as compared to the same airframe with externally carried ordnance) or a larger airframe. And ironically, due to airframe structure requirements for the rigors of flight, it requires more weight to make a space in the airframe to accommodate weapons. Therefore, in order to carry the same payload, a larger, heavier aircraft is required in the low observable design.

CHAPTER IV

THE EFFECT OF TECHNOLOGY ON THE NAVY'S MISSIONS

In 1970, then-CNO Admiral Elmo Zumwalt listed four U.S. Navy missions: Strategic Deterrence, Sea Control, Projection of Power and Naval Presence.¹ These missions have been reaffirmed by subsequent Naval leaders, most recently evidenced by Secretary of Defense Cheney's comment on Projection of Power, "The United States needs to maintain the capability to project power through the use of naval strike forces."² So even though the missions have not changed over the years, technology has changed the *instruments* used to carry out the missions. We have progressed through a series of increasingly capable and expensive aircraft, missiles and weapons systems with which to achieve mission success. In general, technology has given us more reliable aircraft carrying larger payloads of more accurate weapons (including precision-guided munitions), and the capability to deliver weapons in an all-weather environment. "Technology, as evidenced by new weapons and improved means of delivery, has a profound effect on how a nation's military forces plan to do their business,"³ as one author so aptly put it. We have also specialized support aircraft to provide electronic jamming, air-air refueling and airborne early warning. How and why then does stealth apply to the Navy's missions?

CHAPTER V

THE ROLE OF STEALTH IN NAVAL WARFARE

Within the aforementioned four overarching Naval missions lie many individual warfare areas, generally accomplished by specific aircraft types. Not all these mission/aircraft pairings would benefit from the low observable concept. For example, ASW (Anti-Submarine Warfare) with the S-3, AEW (Airborne Early Warning) with the E-2, and electronic jamming with the EA-6 all must radiate electromagnetic energy to fulfill their mission requirements which negates a principle of the stealth concept. Additionally, the ASW and AEW missions generally are not conducted in a threat environment that justifies the cost of stealth.

Less obvious and certainly more contentious will be the assertion that current-design fighters performing as Combat Air Patrol and Strike Escort would not gain enough from stealth in their mission accomplishment to justify the cost of developing a low observable replacement. Any mission in which the tasking includes enemy aircraft detection and prosecution at long range requires the fighter to use its radar for support of its radar-guided missiles. The emissions of these high power radar transmitters are detectable and identifiable at extremely long ranges and are inconsistent with the purpose of stealth. The passive infrared search and track system installed in the F-14D is consistent with stealth and produces very impressive detection ranges, but because it produces no radar returns, it

cannot support the radar guided AIM-54 Phoenix or AIM-7 Sparrow missiles. Where then, does the costly low observable technology support naval warfare?

Power Projection

The "power" in Power Projection culminates in the strike aircraft reaching the target and putting ordnance on target, whether it be Mk 80 series bombs or precision-guided munitions. It could be argued that the ability to enter the enemy's airspace undetected, deliver the weapon(s) of choice, then return unscathed to home base is sufficient reason in itself to procure and employ the stealth concept, regardless of cost.

Because any high value target is sure to be surrounded by a layered defense including fighter aircraft, surface to air missiles and anti-aircraft guns, today's tactical doctrine calls for creation of a "sanctuary" in which the strike aircraft can operate and reasonably expect to reach the target and deliver its weapons. Creation of this sanctuary is a scenario-dependent, complex operation involving Suppression of Enemy Air Defenses (SEAD) by electronic jamming, deception, anti-radiation missiles such as Shrike or HARM (High speed Anti-Radiation Missile) and fighter escort of the strike aircraft. Although this description of SEAD is grossly over-simplified, it shows that the effort requires a high "overhead" in support aircraft, thereby increasing the overall risk of the mission and increasing the support-to-bomber ratio. If however, all radar-dependent enemy air defenses were rendered ineffective through

stealth strike aircraft, the strikers would have their 'sanctuary' built in, and only bombs on target would be left for mission success.

In that it is probably unreasonable to postulate a perfect sanctuary through stealth, some level of SEAD would be prudent. While electronic jamming would still be provided by the EA-6, a stealth launch platform would be the most effective way to employ the HARM. In that the stealth would presumably be undetected, optimum ranges and timing for missile launch could be obtained, increasing the probability of success for the SEAD effort and the entire power projection mission.

As impressive as the stealth technology sounds as presented here for the strike and SEAD missions, there is a potential detection drawback. If the strike is conducted at night or in bad weather, then the use of any emitter in the attacking aircraft, whether it be radar altimeter, terrain following radar or target acquisition radar transforms our aircraft into a detectable electromagnetic energy producer. There are Low Probability of Intercept radar altimeters to help alleviate part of this problem, but the point is that the stealth technology is not yet a panacea for all-weather strike scenarios.

Deterrence and Presence

If we assume that the planned Navy A-12 replacement (currently designated the A-X) will achieve comparable radar and IR signature reductions, the CINC will have an aircraft that is

all but invisible to current detection systems, and operates in enemy airspace with near impunity. But now where is Naval Presence? Or the psychological effect of scores of aircraft displayed on every long range radar screen within hundreds of miles? Would stealth aircraft, detectable only through IFF, have had the same 'presence' as the non-stealthy F-14s during Freedom of Navigation operations off Libya?'

If we take the problem a step further, let us assume tensions are increasing in some relatively unimportant (in the context of global politics) third world brushfire; could the very property of stealthiness be destabilizing? For example, would a nervous weapons system operator or fire control officer take preemptive action (e.g., missile launch) against spurious radar indications, thinking that ~~maybe~~ it was the barely detectable radar return of an attacking stealth aircraft, thus unnecessarily escalating tensions? Of course, none of this can be stated with certainty, but quite possibly the property of stealthiness which we have pursued with so much money and effort, could work in a destabilizing manner, increasing the chances of armed conflict rather than deterring it.

The counterpoint to this rather bleak outlook is supported by the well-publicized operational success of the F-117A in Iraq which should serve notice to the rest of the world--particularly those with Soviet designed IADS (Integrated Air Defense Systems)--that our low observable aircraft have the capability to penetrate radar-guided defenses and deliver weapons. Perhaps it will be a deterrent for a potential enemy just to know that we

have the capability to deliver conventional or nuclear weapons undetected. As one author put it, "The crucial element in deterrence is the foreknowledge by the potential aggressor that if he starts anything this is how it will end."²

Iraq does not provide us insight to the effect of stealth on Deterrence and Presence. Future low observable aircraft will have to be deployed on the carrier and operate undetected in or over a potential trouble area before we will be able to gauge stealth's influence on these missions.

Sea Control

The role of stealth so far has been fairly straightforward, relating directly to the mission at hand. But can stealth benefit sea control, the precursor to all other missions? Before assessing stealth's role, this dynamic and complex mission needs to be discussed.

First, although the Mahanian "command of the sea" concept of sea control is neither required nor possible in today's plethora of widely-spread third world threats, the fact is that local sea control must be achieved and maintained in our area of operations. The proliferation of high technology weaponry, previously concentrated in only a handful of powers has now spread to include 15 countries with ballistic missiles, 51 with anti-ship cruise missiles and 26 with diesel submarines.³ Even if we assume that the Soviet threat is diminished for the near future, the aforementioned third world weapons availability is not only a substantial threat, but perhaps is more difficult

than the Soviet threat in that relations with the Soviets are relatively predictable and the two countries have a history of interaction at the highest levels of government. Not so with third world powers such as Libya, Iraq and Syria for example. Quite simply, the proliferation of high tech weapons throughout the littoral nations of the world must be considered a very real and widespread threat to our fleet and its ability to achieve local sea control.

Second, this 'transition' from the U.S./Soviet open-ocean battle for maritime superiority, to the coastal threat has taken the CVBG closer to shore where the littoral nations' new weapons are even more effective. And closer to shore means a compressed defense in depth, requiring quicker response to incoming threats.* The end result? The need for local sea control becomes even more acute.

Lastly, achieving sea control includes the requirement for air superiority over the supported land operation, whether it be an amphibious landing, noncombatant evacuation or power projection ashore.

At the operational level, given accurate targeting stealth gives the commander the ability to preemptively attack surface combatants, missile launch sites, port facilities, etc., all with a generally high probability of mission success and low risk of loss. Although a Soviet Kirov-class destroyer with its SA-N-6, -4 and -9 surface to air missiles and 30mm guns* would certainly present a more formidable threat, it is a near certainty that the stealth aircraft armed with the proper

weapons such as Harpoon, can provide local sea control in the ASUW (Anti-Surface Warfare) mission.

It can also complement the ASUW mission while providing some ASW capability by dropping mines. Although low observable aircraft are not required for mine warfare, the mining capability of the airframe does give the operational commander additional flexibility with the available airplanes on the flight deck.

Air superiority can be gained similarly, through preemptive attacks on airfields, hardened bunkers, etc. In the AAW mission, the ability to reach missile firing ranges undetected by enemy Ground Control Intercept or fighter radars would result in uncontested air supremacy. Although the use of air intercept radar in the stealth aircraft is detectable by Radar Warning Receivers, in local sea control and air superiority missions it would not be a significant factor. In an open-ocean maritime superiority battle with the Soviets however, stealth would lose much of its advantage since the mission would require radar support of missiles at long range, thus giving away the location of the stealth platform through ESM.

CHAPTER VI

STEALTH IN JOINT OPERATIONS SUCH AS AIRLAND BATTLE

The properties of low observable aircraft that will make it so successful in supporting the Maritime Strategy can also be applied to joint operations. Whether operating from aircraft carriers or forward deployed bases, stealth has the potential to effectively support offensive joint actions such as those found in the AirLand battle.

One expert in land combat in discussing the development of the helicopter in deep battle writes, 'This ability to place mobile firepower (protected by an appropriate combination of armour, speed and agility, and counter-measures) rapidly at any desired position of advantage has had two fundamental effects,' at which time he goes on to show how it has opened up the scope of operational maneuver and how flexibility and tempo are affected.² Surely if helicopters can aid the land battle in such a way, one would assume there is also a place for stealth in AirLand battle, probably in the interdiction role.

Air Interdiction (AI)

Although carrier-capable stealth aircraft will carry bomb payloads perhaps one-fifth the size of a B-52, the ability to penetrate IADS without large support packages and reliably reach the most critical enemy targets increases its tactical effectiveness in AI. Deep interdiction with precision delivery of weapons directed against tanks and personnel could be tasked and

accomplished with confidence. Whether or not deep interdiction will remain as a viable tactic for the theatre commander is apparently a matter of debate, as evidenced by one opinion, "...deep interdiction strikes against lines of supply and reinforcement may appear less profitable when those lines are well spread laterally and when there is less reliance on reinforcement after battle has commenced." The fact remains however, that stealth gives the commander the *choice* of deep interdiction.

Battlefield Air Interdiction (BAI)

Similar benefits accrue in BAI, with the added advantage that stealth could loiter outside visual range of the enemy, attacking when directed by the Air Component Commander, thus preserving the element of surprise on the enemy.

Close Air Support (CAS)

The primary benefit in CAS is the reduced risk of stealth vis-a-vis the A-10 and other conventional design aircraft in that radar-guided AAA and missile systems would be less effective. The CAS mission is best performed by aircraft flying relatively slowly and armed with a gun of at least 30mm. However, these performance/armament characteristics may not be consistent with the design requirements of a multi-role carrier-based strike fighter. Therefore, the CAS mission is probably not supported as well by stealth as AI and BAI.

CHAPTER VII

... IN COMBINED OPERATIONS

Low observable potential in combined operations need not be revisited as it is the same as in the maritime strategy missions. However, there may be unique problems facing the unified commander in tasking his available forces if the stealth technology is not held by all allies.

It is safe to assume that the U.S. will not export low observable technology for fear of either losing it to unfriendly countries or having it exploited for a detection method. This means then we must consider carefully how missions are tasked in a combined effort, because if the level of risk and number of missions flown are held constant for all participants, the U.S. would certainly have lower losses than our non stealth-capable allies.

Possible solutions exist of course, including tasking stealth with the high risk missions involving layered WDS, relegating the allies to the low risk missions. The point is however, the 'haves' versus the 'have nots' could become a contentious issue where aircraft/aircrew losses and national pride are at stake.

CHAPTER VIII

CONCLUSION

The low observable concept manifests itself as a viable tactical advantage in many warfare areas that support the Navy's four missions. The most obvious utilization of stealth involves tasking which has a high risk from radar-guided defenses. For example, strike warfare, photo reconnaissance, anti-surface warfare and deep interdiction missions all have much to gain from stealth.

Not all warfare areas lend themselves so well, however. Anti-submarine warfare, electronic jamming and to some extent anti-air warfare do not justify stealth's high cost for one reason or another. So, although this new technology has been in development for over twenty years at a cost of untold billions, it is not a panacea for every warfare area.

Stealth has application for joint operations such as the AirLand battle missions that are similar to Power Projection. It is not perfect for every task of AirLand battle, as the aerodynamic characteristics of strike aircraft are generally not well suited for Close Air Support.

Obviously all the aforementioned warfare tasks that are supported by stealth remain so in combined operations. But assuming the United States does not export stealth, the reduced risk associated with low observable aircraft means that allies may well suffer greater losses. Considering the delicate balances that may be involved in some alliances, (as in the

recent Gulf war) the issue of combat losses and national pride should be a serious concern for the theatre commander.

NOTES

Chapter I

1. Guilio Douhet, The Command of the Air (New York: Coward-McCann, 1942), p. 9.

Chapter II

1. Webster's Third New International Dictionary, 1981 ed., p. 2232.
2. David F. Bond, "Risk, Cost Sway Airframe, Engine Choices for ATF," Aviation Week and Space Technology, 29 April 1991, p. 20.
3. John F. Lehman Jr., Maritime Strategy in the Defense of NATO (Washington: Georgetown University. Center for Strategic and International Studies, 1986), p. 12.

Chapter III

1. "Declassified Photos Show 'Have Blue' F-117A Predecessor," Aviation Week and Space Technology, 22 April 1991, p. 30.
2. Joseph Jones, Stealth Technology: The Art of Black Magic (Blue Ridge Summit PA: Tab Books 1989), p. 14.

Chapter IV

1. Roger W. Barnett, "The Origin of the U.S. Maritime Strategy, Part II," Naval Forces, vol. 10, no. 5, 1989, p. 59.
2. John D. Morrocco, "Navy Weighs Alternatives After Cheney Kills Avenger 2," Aviation Week and Space Technology, 14 January 1991, p. 18.
3. Grover E. Myers, Indivisible Air Power and U.S. Air Force Basic Doctrine (Maxwell AFB, AL: Air University Press, 1985), p. 27.

Chapter V

1. Fred Hiatt, "Four U. S. Navy Jets Challenge Libya's Sovereignty," The Washington Post, 27 July 1984, p. 1.
2. James P. Sterber, The Ethics of War and Nuclear Deterrence (Belmont, CA: Wadsworth, 1984), p. 169.

3. Chief of Naval Operations, "Meeting the Challenges of a Dynamic World: Naval Policy for the 90's and Beyond," Slide 56 of Draft Brief, U.S. Naval War College, Newport, RI: 19 April 1991.

4. Ibid.

5. Richard Sharpe, ed., Janes' Fighting Ships 1988-89 (New York: Janes, 1989), p. 569.

Chapter VI

1. Richard Simpkin, Deep Battle (New York: Brassey's Defence, 1987), p. 252.

2. Neville Brown, The Future of Air Power (New York: Holmes and Meier, 1986), p. 99.

BIBLIOGRAPHY

- Barnett, Roger W. "The Origin of the U.S. Maritime Strategy, Part II." Naval Forces, vol. 10, no. 5, 1989, p. 59.
- Bond, David F. "Risk, Cost Sway Airframe, Engine Choices for ATF." Aviation Week and Space Technology, 29 April 1991, p. 20.
- Brown, Neville. The Future of Air Power. New York: Holmes and Meier, 1986.
- Chief of Naval Operations. "Meeting the Challenges of a Dynamic World: Naval Policy for the 90's and Beyond." Draft Brief. U.S. Naval War College, Newport, RI: 19 April 1991.
- "Declassified Photos Show 'Have Blue' F-117A Predecessor." Aviation Week and Space Technology, 22 April 1991, p. 30.
- Douhet, Giulio. The Command of the Air. New York: Coward-McCann, 1942.
- Hiatt, Fred. "Four U.S. Navy Jets Challenge Libya's Sovereignty." The Washington Post, 27 July 1984, p. 1.
- Jones, Joseph. Stealth Technology: The Art of Black Magic. Blue Ridge Summit, PA: Tab Books, 1989.
- Lehman, John F., Jr. Maritime Strategy in the Defense of NATO. Washington: Georgetown University. Center for Strategic and International Studies, 1986.
- Morocco, John D. "Navy Weighs Alternatives After Cheney Kills Avenger 2." Aviation Week and Space Technology. 14 January 1991, p. 18.
- Myers, Grover E. Indivisible Air Power and U.S. Air Force Basic Doctrine. Maxwell AFB, AL: Air University Press, 1985.
- Sharpe, Richard, ed. Janes' Fighting Ships 1988-89. New York: Janes, 1989.
- Simpkin, Richard. Deep Battle. New York: Brassey's Defence, 1987.
- Sterber, James F. The Ethics of War and Nuclear Deterrence. Belmont, CA: Wadsworth, 1984.
- Webster's Third New International Dictionary. Springfield, MA: Merriam-Webster, 1981.