EFFECTS OF MODERN TECHNOLOGY

ON

AIRPOWER AND INTELLIGENCE SUPPORT

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APRIL 1992

NATIONAL WAR COLLEGE

Report Documentation Page	*Form Approved OMB No. 0704-0188*

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
APR 1992	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Effects of Modern Technology on Airpower and Intelligence Support	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Defense University National War College Fort McNair Washington, DC 20319**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**48**	

PREFACE

This paper examines the effects of modern technology, specificially stealth and precision weapons, on airpower and the required intelligence support.

This paper begins with a short review of the F-117 stealth fighter bomber in DESERT STORM. Next, follows a brief discussion on the basics of stealth and how we develop this technology. Finally, this paper concludes with recommendations on both employment of stealth and precision weapons, and intelligence support.

TABLE OF CONTENTS

Section One
Out of the Darkness

"The F-117A 'Stealth' aircraft demonstrated during Operation DESERT STORM that stealth technologies add an entirely new dimension to the art of war. Stealth has returned the factor of surprise to air operations, as F-117s struck at heavily-defended targets repeatedly and with impunity."

National Defense Authorization Act
for FY 92/93

It was a nearly moonless night as Major Greg "Beast" Feest guided his F-117 stealth fighter into Iraqi airspace during the late night hours of 17 January 1991, opening a new era in air warfare. Within an hour, millions around the world would watch their TV sets, spellbound at the "sound and light show" coming from Baghdad as the stealth and precision guided weaponry accomplished their deadly mission with incredible accuracy and effect. What few would realize or appreciate was the lengthy, complex process that enabled the pilot, aircraft ordnance, targeting information and intelligence support to come together to make this possible.

Initial concept development of the F-117 began in the late '70s. Development of the precision guided munitions (PGMs) it would carry began in the mid-sixties. The system was exhaustively tested against simulated and real threat environments before fielding. Intelligence had carefully assessed the ingress/egress routes over Iraq to provide the safest possible paths, giving Major Feest the confidence to fly his aircraft unescorted hundreds of miles inside enemy territory. The target had been carefully selected based on the Commander's Intent and the air campaign strategy. A careful systemic evaluation of the critical nodes in the Iraqi integrated air defense network resulted in the target selection as part of a nationwide coordinated strategic attack. The availability of precise coordinates, the identification of critical target aim points and estimates of physical vulnerability resulted in the selection of the munition and its fuzing.

At 0300 L, Major Feest reached the target undetected, lased the aim point, and released his weapon. As the PGM guided silently in on the point designated by the laser toward the air defense operations center in the heart of Iraq, intelligence collectors were ready to determine the extent of physical damage and the overall effect on the Iraqi air defense system. We crossed a new threshold that night in the centuries old game of "cat and mouse" between attacker and defender. This time the attacker attained an advantage seldom equaled in the history of warfare.

These twin developments of stealth and PGMs fundamentally changed the doctrine and tactics of air warfare, system acquisition and infrastructure support necessary to ensure continued effectiveness of future high technology weapon systems. Significantly, these technological breakthroughs have coincided with the disolution of the Soviet Union and the attendant "new world order," providing the U.S. with military superiority unmatched since we held the monopoly on atomic weapons for a few years following World War II.

Section Two
Stealth – The Magic Unveiled

Experience in low observable design has netted one major lesson: The maximum benefit of low observable technology is best achieved by beginning the project from day one with stealth as the primary design criteria. In doing so, all elements of detection are controlled in a balanced fashion. While older aircraft can benefit from stealth add-ons, gains are marginal and usually centered on one particular aspect of the vehicle, such as nose-on engagements. As to the impact of stealth on a weapon system's effectiveness, testing and experience continue to prove an unquestionable advantage. Defensive systems designed to operate against vehicles with conventional signatures are now either ineffective or operate within a narrow margin of utility.

Because aircraft low observable technology is just beginning to enter open literature, it is important to understand the motivation, lexicon, and experiences to date. Much of what has occurred in the past ten years has established the scientific methodology used to develop, test, and produce low observable technology aircraft.

This section will begin with an introduction of the aspects of air defense. This will include the chain of events necessary to have a successful engagement. Next, to serve as motivation for this advanced technology, the aspects of engagement with stealth aircraft are covered followed by a discussion of development concepts. Having shown the reason for incorporating low observables on aircraft and the lexicon of low observables, the development process is discussed in detail, including developmental experiences from previous programs.

AIR DEFENSE CONSIDERATIONS

The first step to understand why this country has invested such a large amount of resources in low observable technology is to understand the effects of stealth on current defensive systems.

The process of downing a target involves a chain of four events, all of which must function properly for success. The first step is surveillance involving the

search and detection of possible targets. Once detected, a possible target is tracked and classified as friend or foe; thereafter, responsibility for its destruction assigned to the appropriate weapon system. Detection should occur at a sufficient range to allow the remaining events to take place.
(12, 6) (see Figure 1)

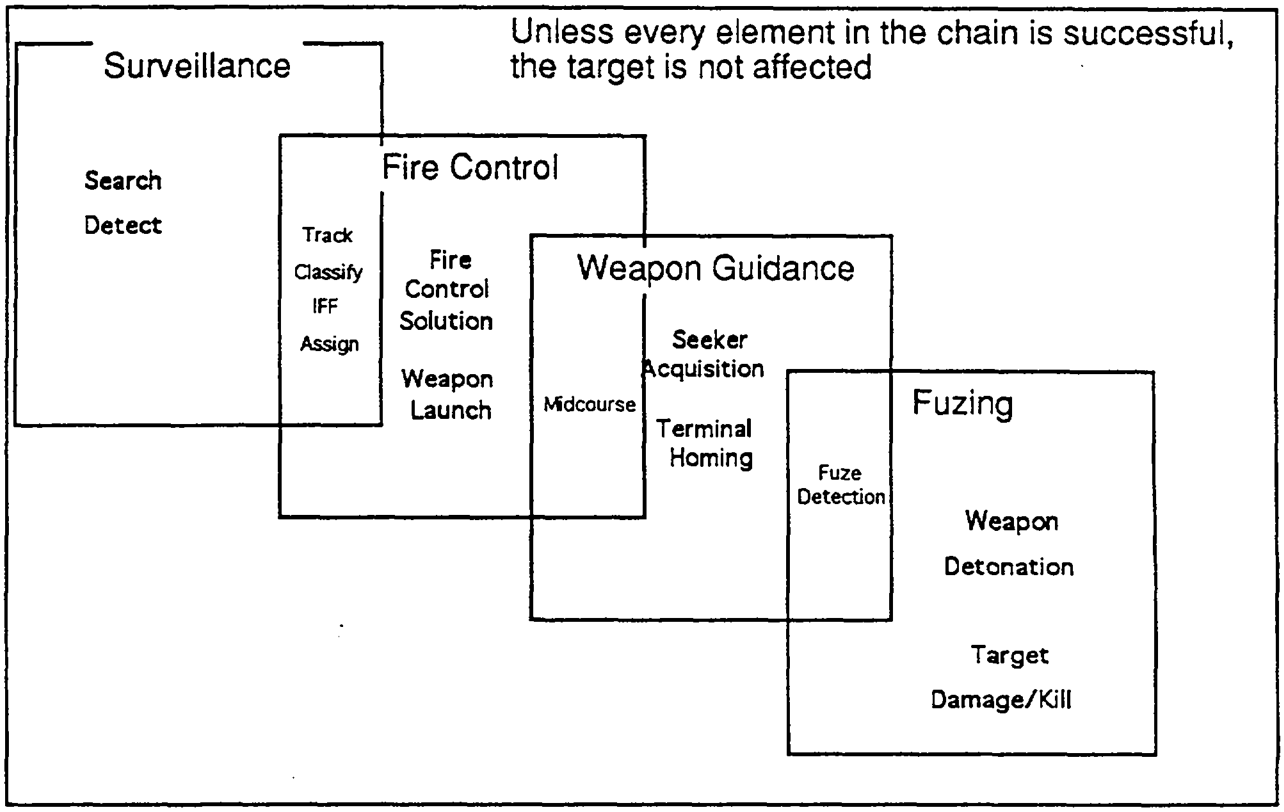


Figure 1: Air Defense Elements

Next the weapon solution is calculated and weapon firing takes place. Timing is of the essence, otherwise the weapon will not reach its intended target in time. In the air, the weapon is either provided guidance information from the ground, develops its own guidance information through onboard sensors, or a combination of both. The final event is to fuze the weapon. This could be either a proximity fuzing which detonates near the target or a kinetic-energy one which impacts the target.

Adequate time must be available for all elements or the intercept cannot take place. Stealth, unlike other forms of counter air defense, affects all elements of the air defense event chain.

There are four primary methods of tracking and guidance: radar, visual, infrared, and acoustic. The environment in which air defense takes place varies widely and while any one of these methods could perform the air defense function, except for radar, the others are limited. Because of radar's robustness, it serves as the primary foundation of most air defense systems. Regardless of the method used to find a target, energy is involved. Some techniques require energy for the detection while others exploit natural or unintentional energy emissions. Using a radio or radar altimeter is considered an unintentional technique.

The type of detection, passive or active, is key to how the target position is exploited. In passive detection, an aircraft may be unaware it is being tracked. Conversely, for active detection, the aircraft is well aware of radar's activity before the radar can track it.

The start of modern air defense systems placed in motion a constant struggle against manned aircraft for survival. Throughout this struggle, tactics and/or electronic counter-measures were used. The introduction of low observable technology represents a new phase in this struggle, a phase which goes beyond tactics and electronic countermeasures. (12, 9) (see Figure 2)

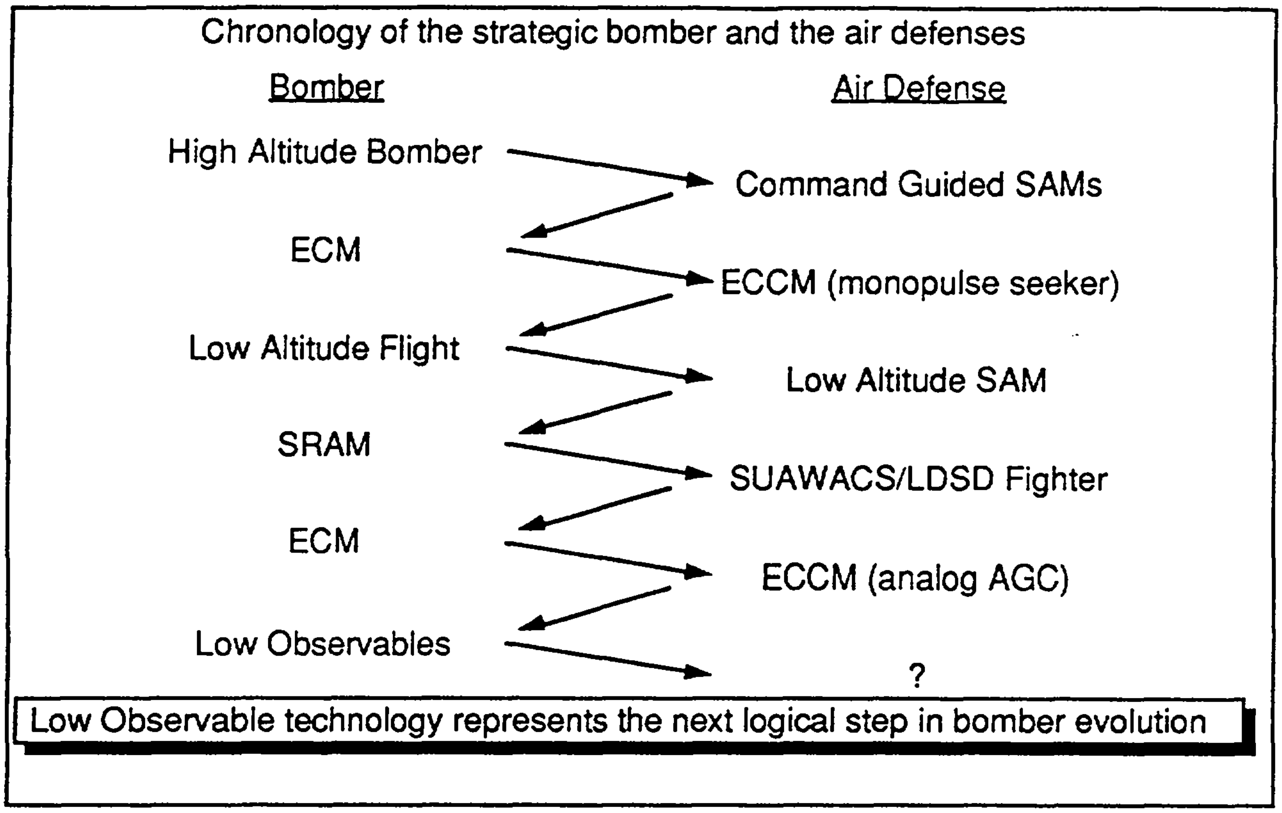
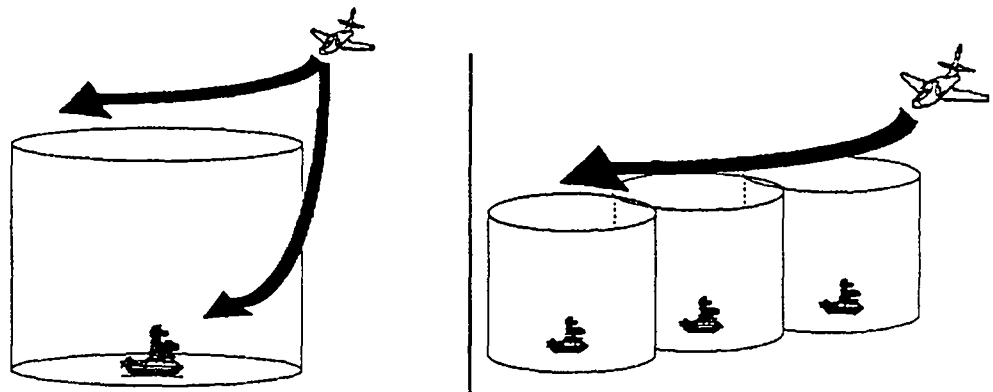


Figure 2. Why Stealth Technology Now?

For conventional aircraft, threat avoidance involves three basic tactics: overflight, avoidance by distance, and speed. The essence of the first two tactics, overflight and avoidance, is to stay out of the air defense's zone of influence. If the threat is netted to form a fence, overflight is the only alternative because going around is impossible. (12, 11)

For some aircraft, speed can provide a third alternative. Using speed to lessen the air defense's reaction time reduces the distance at which the aircraft can overfly or pass by the threat. The greatest impact of speed is to begin to defeat overlapping defenses, but speed uses fuel much more rapidly and can only serve as a short term tactic. The bottom line is that modern air defense systems greatly limit the operational flexibility of aircraft. (12, 11) (see Figure 3)



One-on-One Engagement:
Against a single threat, using a priori knowledge, an aircraft will avoid by either overflying (if possible) or simply going around.

One-on-Many Engagement:
Against the threat employment tactic of forming a "fence," an aircraft's options are reduced to basically overflying. This assumes the fence completely surrounds the desired target.

Figure 3: Threat Engagement and Avoidance

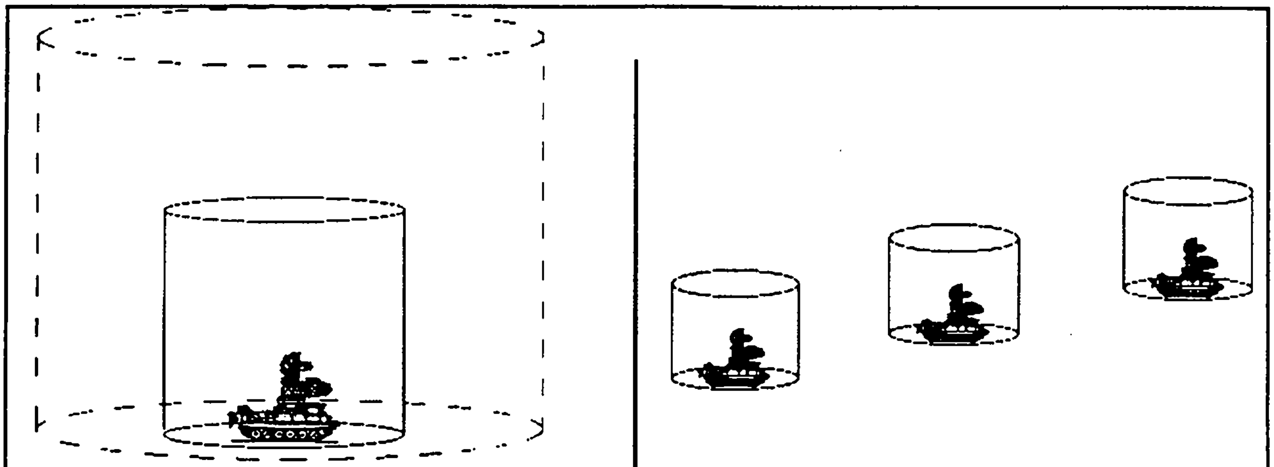
In the chronology of the aircraft and air defense system's struggle for supremacy, low observable or stealth technology has evolved as the next advancement. Because stealth derives its effectiveness solely from physical modification of the aircraft and an active electronic system, its impact on the operation of air defense systems is difficult to overcome.

The following example will serve as an illustration of the component effects of air defense. Air defense with an airborne interceptor usually employs a ground acquisition radar. This ground acquisition radar establishes a preliminary track with a known uncertainty volume. As long as the interceptor's radar capability is greater than the acquisition uncertainty volume, the probability of intercept is high. However, using radar signature reduction, reduces the interceptor's radar capability (stealth), reducing the probability of success. Determining system survivability involves using this type of information to predict the probability of survival.

The first step in determining the survivability of an aircraft requires applying mission planning commensurate with its ability. Speed, low altitude flight, aircraft signature (stealth), use of stand-off munitions, and threat avoidance are all part of the mission planning function. Survivability is calculated by playing the aircraft specific mission plan against expected air defenses. Individual system capability, both air defense and attack aircraft, and an assumed probability of success or failure, determine the engagement outcome. Given the complex nature of air defense systems and the difficulty in replicating air defense systems for flight test verification, the only acceptable method for performing survivability analysis for an attacker versus defender scenario is through computer modeling. Again, the important part to remember is that a combination of stealth, mission planning, and weapons decreases the probability of success for the air defense system.

Successful air defense involves many elements and components working in concert with one another. Many factors can affect the outcome of an engagement. Predicting a system's effectiveness, (aircraft or air defense system), involves complex computer modeling. However, experience shows that if the modeling is accurate and supported by individual component testing, the results are accurate.

The first noticeable impact of low observables is the dramatic reduction in the operating range of zone of influence of the air defense system. This reduction is dramatic because the signatures of low observable aircraft are at a level so much lower than conventional aircraft. For defensive systems deployed to form a fence, this reduction in capability produces large holes. Whether the defensive systems are large and immobile or easily moved, now the only way to overcome these gaps is to add defensive systems. (12, 13) (see Figure 4)



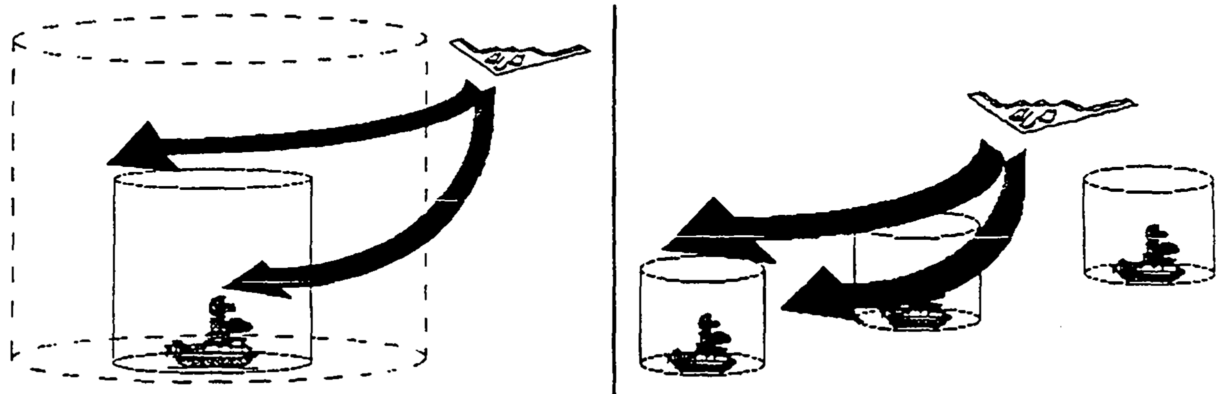
Zone Of Influence:
Low observables reduce the operating capability of an individual threat thereby reducing the surveillance area covered.

Employment Concept:
This reduction in coverage provides "holes" in the fence. Presently, the only method to eliminate these holes is more threat systems.

Figure 4: Low Observables Threat Engagement

Reducing the zone of influence does not change the operational tactics available, it merely buys back the loss in flexibility. More space is added to the aircraft's operating range by subtracting an equal amount from the air defense system. For those systems deployed to form a fence, there are no more ways to penetrate. Unless air defense systems are added to compensate for this reduction in the zone of influence, the aircraft gains back the loss in capability-gaining flexibility in the mission planning options. (12, 14) (see Figure 5)

Applying radar cross section techniques can make a large vehicle appear small. While the exact techniques for controlling radar cross section (RCS) are many, they fall into three groups; shaping, radar absorbent material, and transparency. The affects of applying shaping for RCS control is clear when looking at aircraft like the F-117 and B-2. The unique shape of these vehicles controls the direction of the reflected energy. Where shaping cannot be used or where it is impractical, radar absorbent material (RAM) is used to minimize the reflected energy. The final method to control reflections is by making an object invisible to radar through transparency. (12,22)



Zone Of Influence:
The low observable vehicle tactic against a single threat is the same as a conventional aircraft except there is now more maneuvering room.

Employment Concept:
This added maneuvering room plus the "holes" in a once solid defensive fence greatly increases the possible routes to a target.

Bottomline: The mission planning options are greatly enhanced

Figure 5: Low Observables Impact on Threat Performance

STEALTH DEVELOPMENT

As a design discipline, low observables began in the late '70's although some will argue that stealth technology for aircraft has been in existence since the late 1950s. When compared to the levels in signature reduction being achieved, the tools and techniques have only existed for a little more than ten years. Throughout this process the maturity of the design and the understanding of its physical behavior increases.

Low observable development follows the same scientific process as any technology development. This means that while early tests against operational parameters may provide some answers, any problems which might occur would be unexplainable. This is because the physical behavior of the vehicle has not been established nor is it understood. Additionally, the physical behavior of any vehicle is indifferent to the source of electromagnetic energy. The bottom line is that threat testing is necessary because it provides "man-in-the-loop information.

The development process involves three test phases: laboratory, developmental, and survivability. In laboratory testing, early predictions of the vehicle's signature begin to be confirmed by model and component testing. A signature budget allows the designer to allocate portions of the signature to individual components then design and test them separately. This process continues through several iterations until the predicted design satisfies the design goals. At this point, the full-size vehicle enters flight test. Testing is performed against instrumentation quality radars which accurately and very finely measure the vehicle's signature through a variety of frequencies, polarizations, and aspects.

The final phase tests against actual threat systems. The goal of this testing is to understand the effects of threat system netting and man-in-the-loop behavior. Throughout this process, the information contained in models which are used to predict "real world" behavior are constantly updated. (12, 30) (see Figure 6)

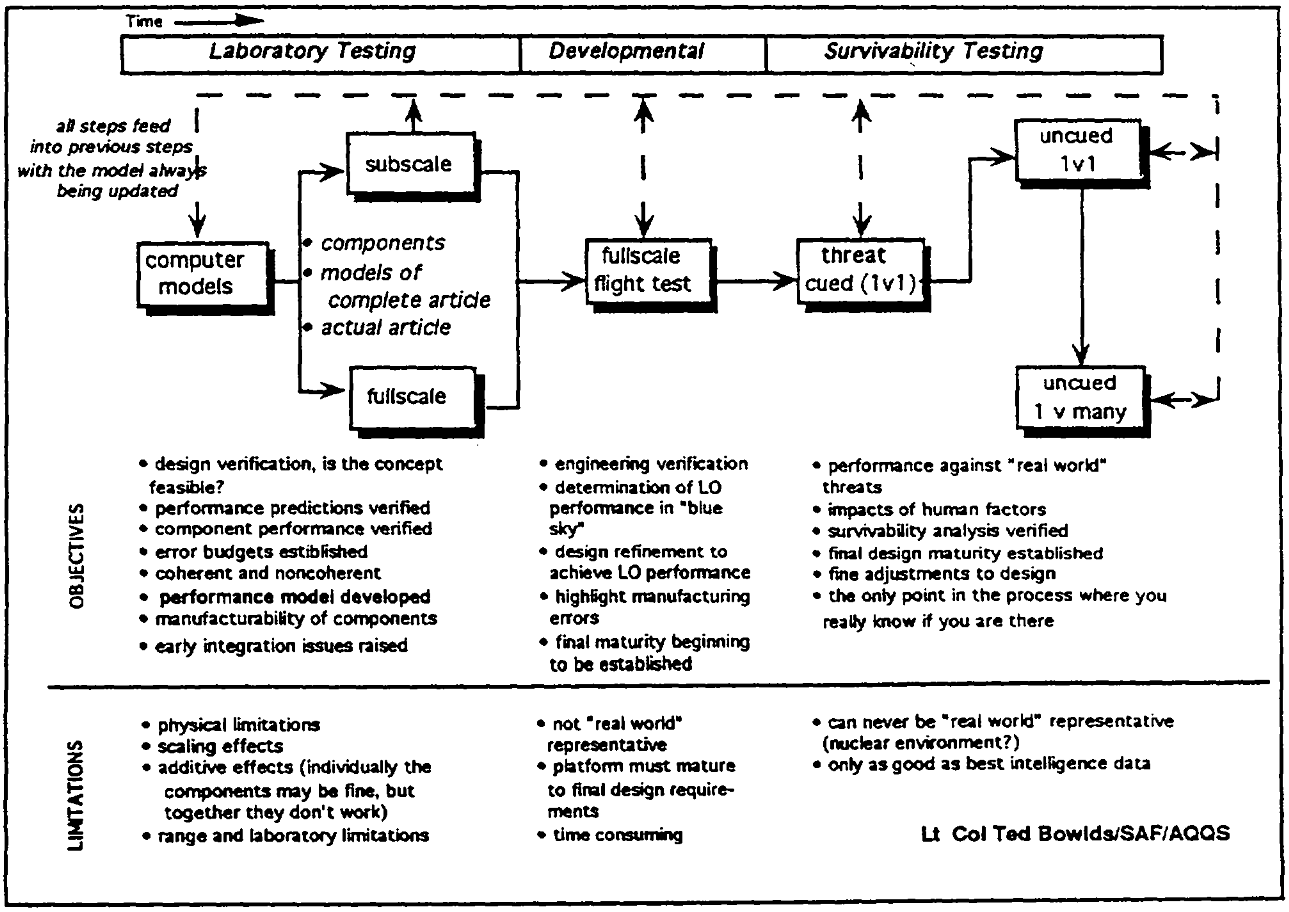


Figure 6: Low Observables Development Flow

From day one of a development, the low observable performance of an aircraft is constantly predicted. These predictions start as pure computer models and grow in fidelity as laboratory testing begins. (12, 32)

Engineering models predict the vehicle's physical performance to electromagnetic energy. There is no attempt to estimate the performance against operational threats with this modeling. This task is performed using campaign models that play the predicted vehicle performance against operational threats, both friend and foe. Throughout this process, the design is refined to achieve the desired probability of survival. (12, 32) (see Figure 7)

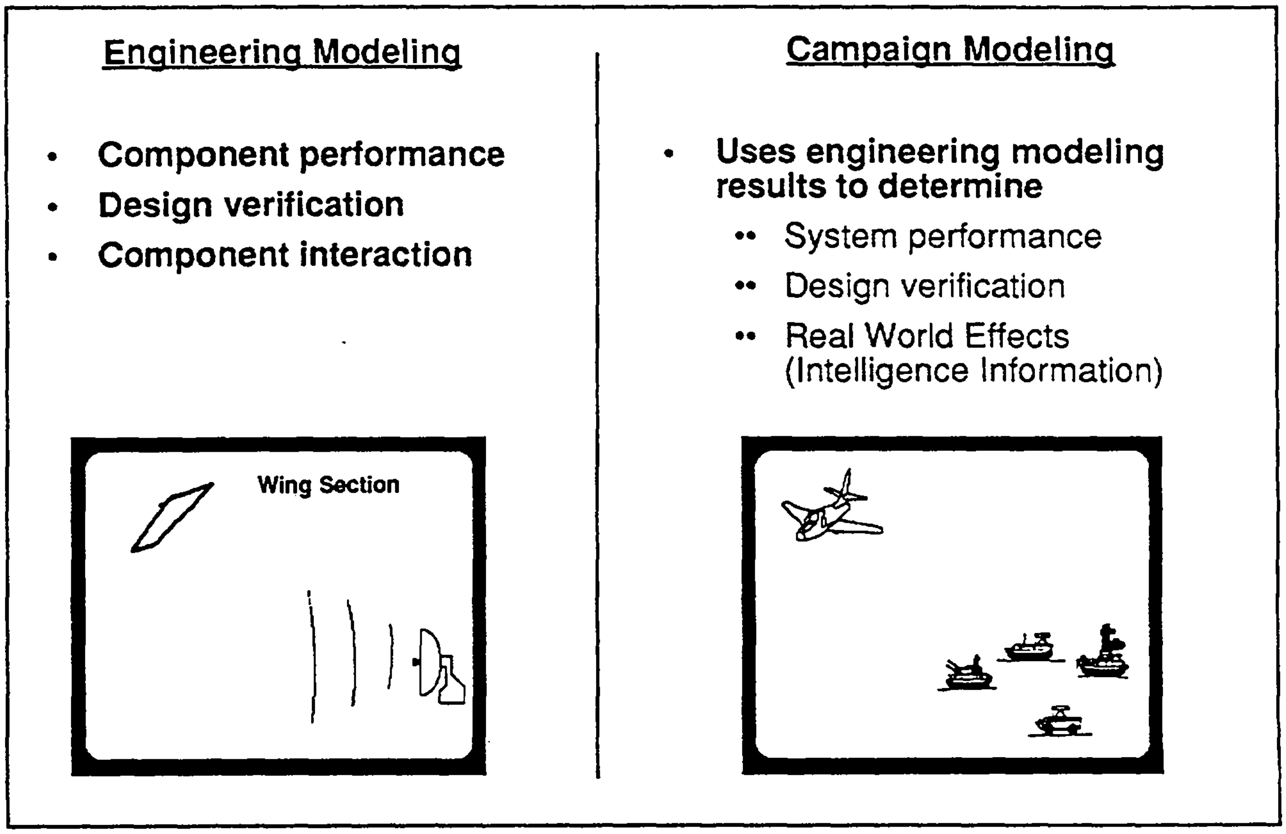


Figure 7: Laboratory Testing, Computer Modeling

During developmental flight tests, the vehicle flies against a measurement quality or instrumentation radar. This radar must have a fine resolution in both frequency and beam width and have the necessary range instrumentation for post-mission processing. Range instrumentation includes tracking radars for time, space position information and onboard instrumentation for recording vehicle attitude (roll, pitch, and heading). Throughout this phase, the information used in the engineering and campaign models is refined with test results. (12, 35)

Once the vehicle low observable performance behavior is well understood, the vehicle is tested against real, simulated, and surrogate threat systems. The first step is to test the vehicle against a single cued threat. During this testing, the threat operator receives a priori information about the location and track of the vehicle. This allows comparison of actual threat detection to predictions. This cued testing, although it is performed against operational radars, mainly supports engineering development. Since the test is unrealistic, the threat generally doesn't know a target's precise position. The next step is to repeat the same one-on-one testing in an uncued mode. This time, operator or man-in-the-loop response is evaluated. Finally, one-on-many testing is performed. This provides not only man-in-the-loop information, but also the effects of how the threats are integrated on their ability to acquire, track, launch, and fuze a weapon. (12, 37) (see Figure 8)

The development methodology used to produce low observable vehicles uses a discipline process like other technologies. The tools and techniques undergo constant refinement and upgrade once the technology begins. Throughout this development, models used to predict vehicle low observable performance are constantly updated with test results, either component or full scale flight tests.

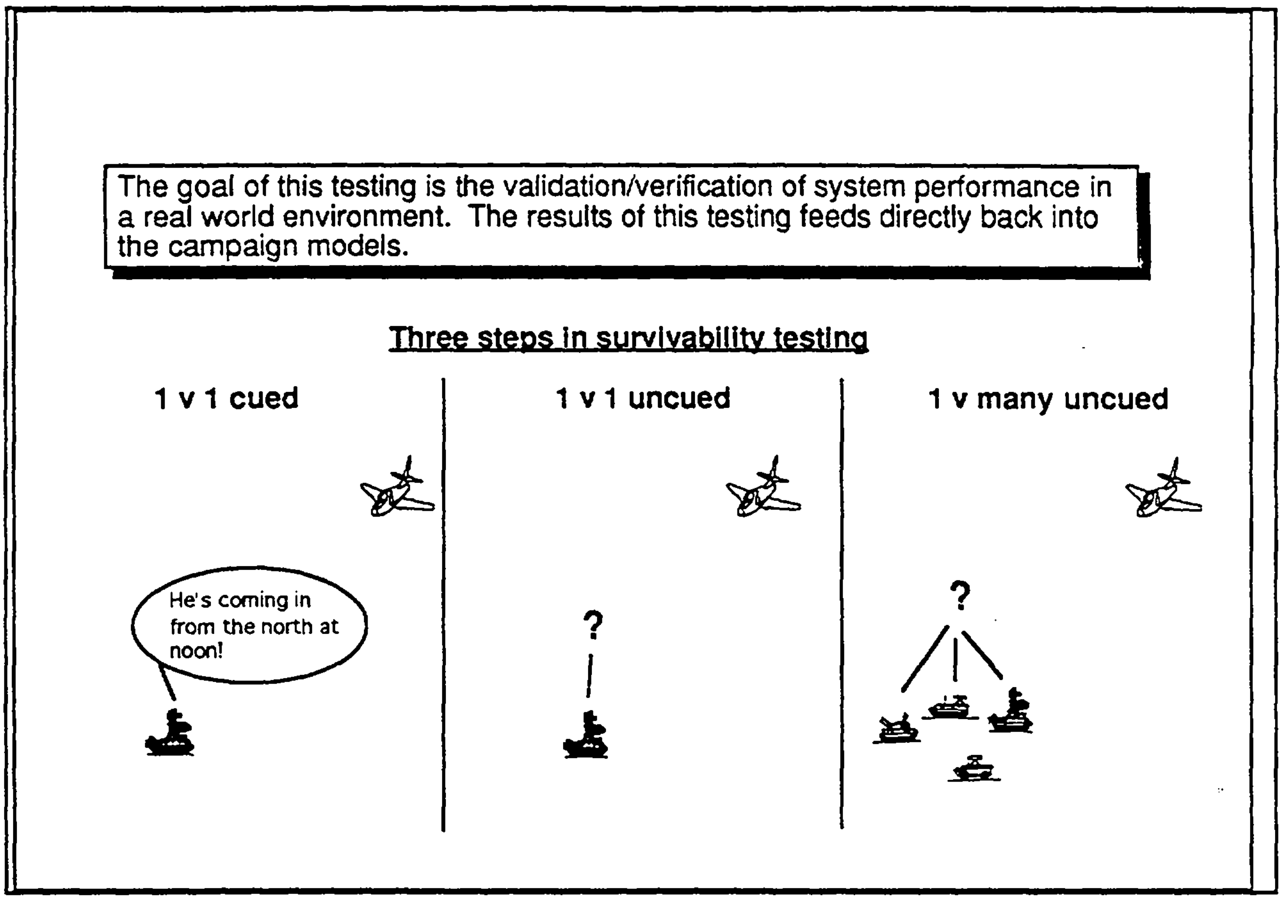


Figure 8: Survivability Testing

Development of low observable vehicles is highly dependent upon the engineering and campaign models. Intelligence agencies such as the CIA, DIA, and the Foreign Aerospace Technology Center, are instrumental in achieving model accuracy. Unless the threat is accurately modeled, the results are suspect. (12, 40) (see Figure 9).

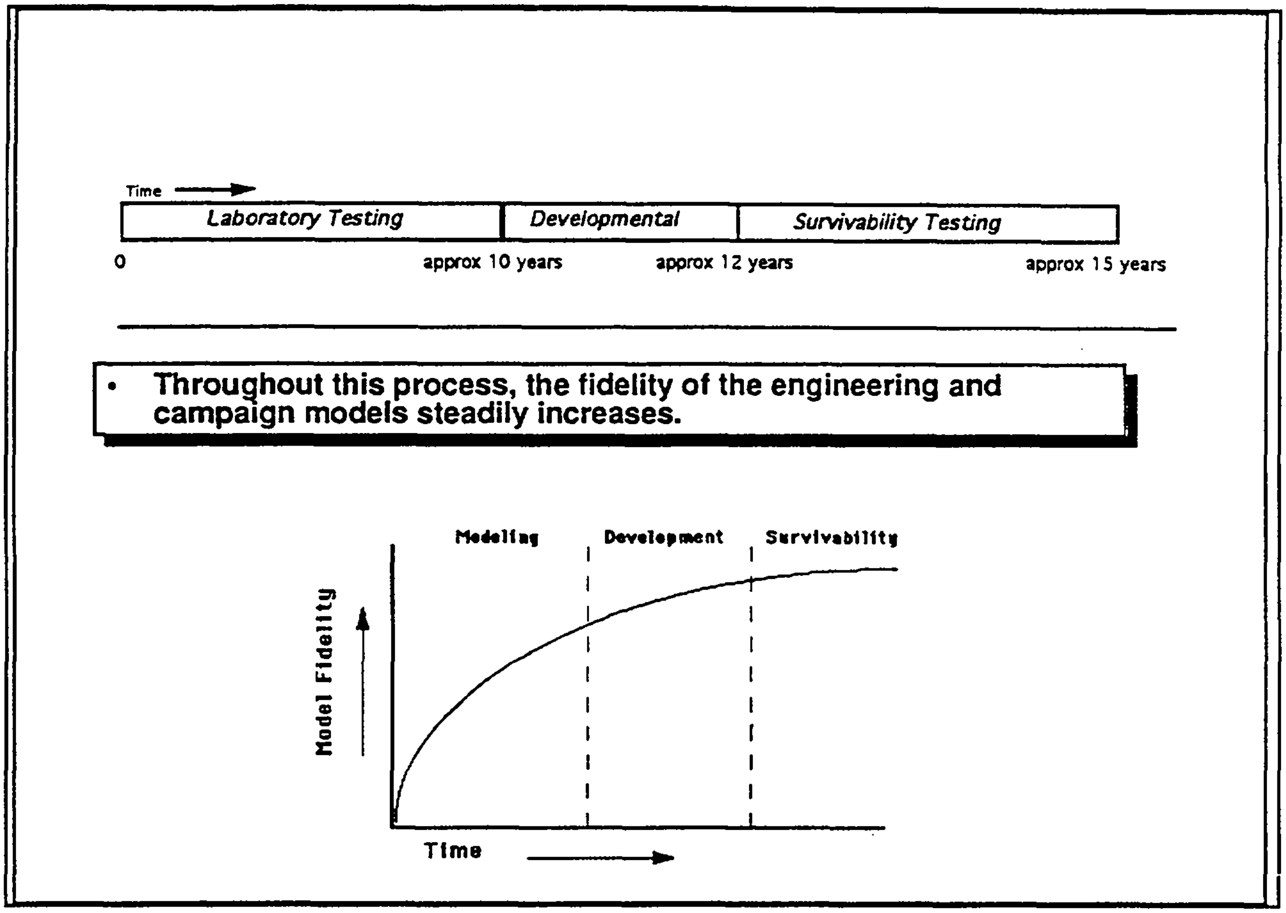


Figure 9: Development Testing Key Points

THE RED TEAM

Early in the stealth program in 1982, the Air Force set up a "Red Team" to search for and investigate potential air defense counters to stealth air vehicles. The investigations of this group included cruise missiles, fighters and bomber aircraft. At that time there was considerable interest in the survivability of the ALCM and Tomahawk cruise missiles and survivability testing was on going. There was a strong DARPA program in cruise missile survivability and in advanced cruise missile technology leading to stealthy cruise missiles. The group was made up of individuals who were involved in these programs for about five years, so at the outset the team already had considerable experience in cruise missile survivability testing, data analysis, and modeling. (19, 4)

The team was set up independent of the stealth program industrial contractors and reported directly to the Headquarters Air Force leadership. They had free and direct access to data on the various stealth programs and sufficient funding to do major experiments as well as analysis. These factors allowed the attraction and retention of a talented cadre of PhD-level scientists and engineers. This team also received substantial help and insight from interested scientists and engineers throughout government, industry, and academia during its investigation of stealthy air vehicle survivability. (19, 4)

A most important feature of this Red Team was the ability to do substantive experiments in areas where our knowledge was uncertain or the interactions were very complex. Such experiments guard against fooling oneself with oversimplified or inaccurate views of the interaction between air defenses and stealthy air vehicles. Thus, this experimental approach provided additional confidence in the Red Team survivability assessments. (19, 4)

Section Three
Caution -- High Tech at Work!

Now that the reader has a basic understanding of how the DoD acquisition system functions and how stealth works to defeat the enemy defenses, this chapter will look at current stealth, precision weapons and intelligence support concepts. This review will include lessons learned from Operation DESERT STORM.

The use of high technology equipment to increase force effectiveness and reduce loss of U.S. lives, has been a basic tenet of post World War II U.S. doctrine. As the F-117A 'stealth' aircraft demonstrated so well during DESERT STORM, stealth technologies, combined with innovative and effective doctrine, added an entirely new dimension to the art of war, dramatically increasing the effectivenes of our forces. This was the first large scale exploitation of the new technological possiblities of the "military-technological revolution." The technological revolution encompassed several broad areas: stand-off precision weaponry and the sensors and reconnaissance capabilities to make their targeting effective; and stealth for surprise and survivability. The F-117 is a night, clear weather, limited-range, limited-payload aircraft designed for selective attacks against high-value fixed targets. Nevertheless, during the first few days of DESERT STORM, the F-117s were assigned against 31 percent of all the targets attacked, although making up only 2 1/2 % of the coalition's aircraft. During the entire war, not one F-117 was lost or even scratched by enemy fire. (2, 62)

Stealth aircraft enhanced the coalition's strategy to neutralize enemy air defenses early, thus allowing the coalition's non-stealthy aircraft to be widely used with minimal combat losses. The continuous aerial bombardment that this allowed accelerated the deterioration of enemy ground forces, setting the stage for unprecedented success with minimal casualties in the ground campaign.

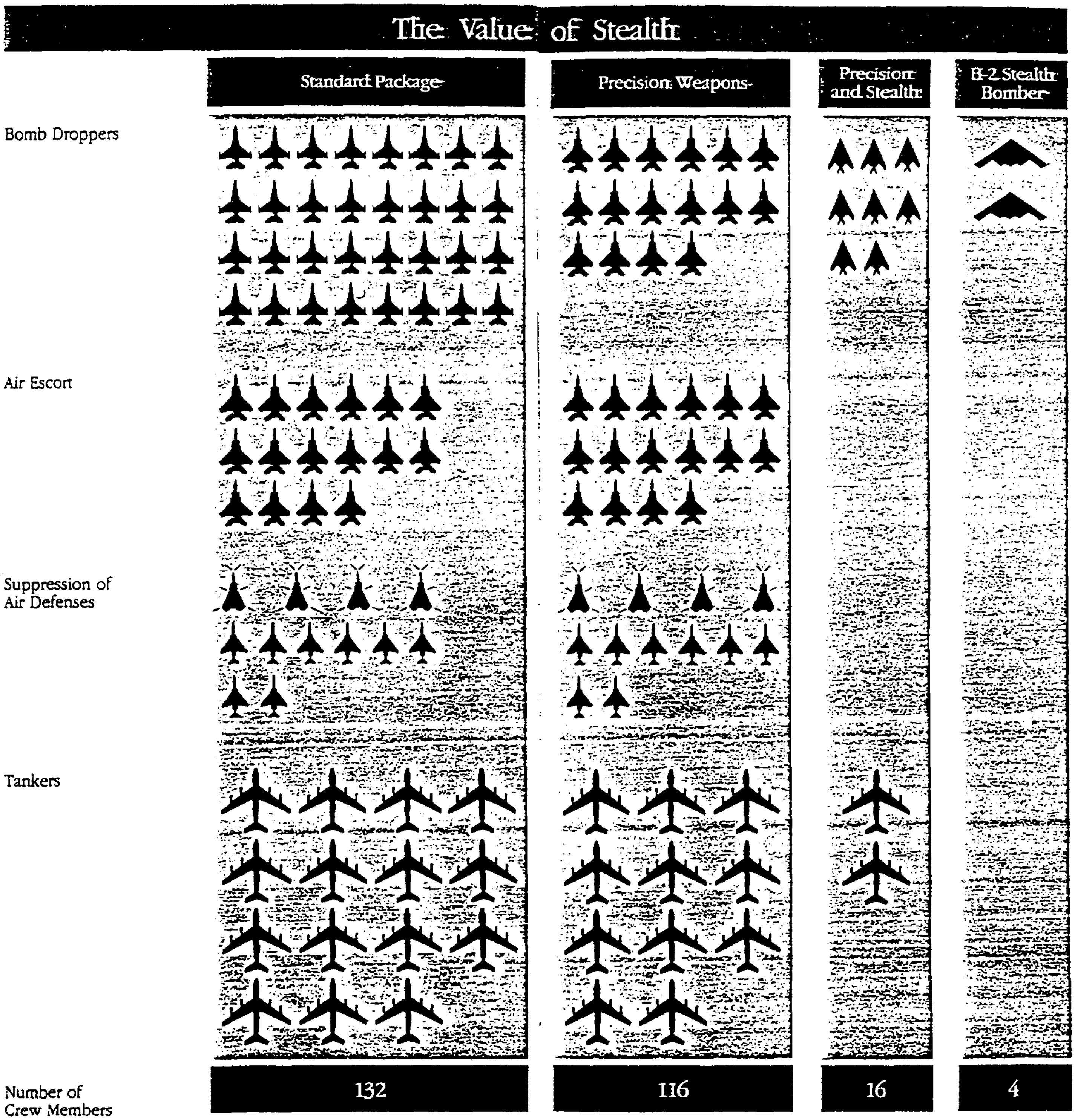
The B-2 offers all the advantages of the F-117 and more: greater range, significantly more payload, more comprehensive low observability, day/night/all-weather capability, and enormous growth potential. However, what that means for combat under various scenarios is largely unexplored.

In explaining the value of stealth aircraft, the most recent Air Force testimony to the Senate Armed Services Committee on Operation DESERT STORM shows four strike packages of aircraft that are of roughly equal capability in attacking a set of high-value, heavily-defended targets deep in enemy territory (see Figure 10 on following page entitled "The Value of Stealth").(2, 62)

The difference between the first and second strike package on the chart, all using non-stealthy aircraft, is the use of either unguided weapons ("dumb bombs") or precision-guided weapons. In addition to the attack aircraft, both packages include fighter aircraft, to escort and defend the attack aircraft, plus EF-111 and F-4G "Wild Weasel" aircraft to disrupt and attack enemy air defenses, and aerial refueling tankers to refuel the package. The strike package using the "dumb bombs" contains 75 aircraft; using precision-guided weapons reduces the size of the package down to 55 aircraft.

By contrast, the same damage could be done by only eight F-117s, refueled by two tankers, and no fighter escort, no EF-111s, and no F-4Gs. Finally, the same mission could also be done by only two B-2s, with no support aircraft. (This understates the advantage of stealth, since, in fact, the non-stealthy strike package was unable to achieve the desired battle damage in the face of strong Iraqi defenses, and the F-117s had to be substituted before the target set was destroyed.) (2,63)

The Air Force estimates for the operation and support (O&S) costs for the two non-stealthy packages for 20 years total $4.2 billion and $3.4 billion, respectively, while the 20 year O&S cost for the two B-2s is only $308 million. Thus, to keep the non-stealthy strike packages in the inventory costs 11 to 13 times as much as the two B-2s in terms of support costs. This is not to advocate that we do not require the non-stealth aircraft. There are many situations where fighters and attack aircraft are still required; even more so now that the program only funds 20 B-2s.(2, 64)



Source: U.S. Air Force

The results of Operations DESERT STORM - in particular, the extremely low casualty rates among allied air and ground forces - have created new public expectations about future conflicts that may be hard to meet. The two non-stealth strike packages, show respectively, 132 and 116 aircrew lives at risk in the air; the F-117 option has only 16, and the B-2 option only 4. However, as the tragic SCUD attack on the U.S. barracks at Dhahran reminds us, even support personnel in rear areas may be subject to attack in future conflicts. All three non-B-2 options require both air bases and support staffs in the theater. These are very important considerations in a force projection scenario. Another issue concerns timeliness of response. The three non-B-2 options have to wait for their support packages to be airlifted to the theater and made operational before they can begin sustained operations. The B-2 option is ready for offensive operations anywhere in the world within hours. It does not require in-theater bases and infrastructure, it does not compete for airlift with deploying ground forces; it does not deplete in-theater fuel stocks, it does not put support personnel at risk in-theater, and it minimizes the number of airmen operating near and over enemy territory. The quicker and further the projection, the greater the advantage of stealth, especially the B-2.

EARLY ATTACK AND PRECISION WEAPONS

Non-stealthy aircraft are much less likely to achieve tactical surprise than are stealthy aircraft because of their larger radar signatures. For this reason, stealth aircraft could begin to attack targets from the outset of the campaign, without waiting for air superiority. Moreover, they can use the favored mid-altitude flight regime, relying on stealth for surprise and for survival. The mid-altitude flight regime allows optimum use of on-board sensors and PGMs. The constraint with this type of early attack is that it puts a tremendous demand on the intelligence community to provide near real time updates on the situation. Ideally, these updates would be transmitted to the aircrew enroute to the target area. Additionally, as we saw during DESERT STORM, the advent of precision weapons calls for a marked increase in detailed target photos for each aircrew to determine exact aim points. This placed an even larger workload on the intelligence staff supporting the operation.

A vital aspect of the offensive counterair effort was the campaign to destroy the Iraqi Air Force in its hardened aircraft shelters. Coalition aircraft, predominantly F-117s and F-111s, employing penetrating precision guided munitions, destroyed or severely damaged over 300 hardened aircraft shelters according to preliminary estimates.

Stealth will restore the capability of U.S. bombers to penetrate heavily defended strategic and tactical targets and survive. It will also enhance the element of surprise in the use of airpower on the conventional battlefield. If enemy forces cannot detect U.S. airpower before its arrival, they must either remain in protected shelters or risk exposure knowing that attack could come at any time. This uncertainty results in either immobility or additional vulnerability. Either result represents a tactical advantage for U.S. forces.

The dramatic television coverage of DESERT STORM brought home the tremendous advantages of high technology weaponry when employed by a well-trained, coordinated team. Intelligence played an important role in that team. The effectiveness of high technology was perhaps best embodied in the effectiveness of stealth and precision guided munitions (PGMs). Today's high tech environment challenges the intelligence support structure, from collection through analysis to dissemination, in ways that have never been experienced. In turn, the ability of the intelligence system to respond adequately to these challenges directly affects the performance of the weapon system. Having inaccurate or untimely intelligence has much the same effect as a defective fuze on weapon system effectiveness; it is an integral, critical weapon system parameter.

Denying the enemy sanctuary has always been a goal of airpower, and magnifies the effectiveness of an air campaign. Aircraft get you to the target area, but effective munitions destroy the targets. Vital centers of industrial power are vulnerable to pinpoint attack. Tons of PGMs were delivered with deadly effectiveness during DESERT STORM. The GBU-24s and GBU-27s destroyed critical targets that included aircraft shelters, bunkers, chemical, biological, and nuclear storage areas, bridges, and other strategic targets.

Precision munitions highlight the total effectiveness of modern airpower. The combination of PGMs and stealth are a very deadly package. Certainly, we cannot afford to use PGMs on every target. The ability to use the correct bomb on the right target allowed us to mold the final outcome of the air campaign. The F-117s over Baghdad showed the world that we can take the enemy's eyes out while at the same time minimizing collateral damage.

Aerospace doctrine is what we believe is the best way to perform our mission. Doctrine provides the broad conceptual basis for our understanding of the best way to fight and win a war. It is more a guide based on past experiences rather than a strict rule book or checklist to be followed.

EMPLOYMENT RECOMMENDATIONS

Stealth has added a new dimension to the equation for a military planner. It allows more than speed and range and gives us a decided advantage heretofore not seen. We are just beginning to understand the true advantage that stealth gives us and we need to concentrate studies on these advantages.

Precision weaponry requires precise intelligence and effective command and control. Achieving the full potential of aerospace power requires timely, tailored intelligence and sufficient command and control assets to permit commanders to exploit its speed, range, stealth, flexibility, and versatility. There was a definite problem with the overwhelming demand on the intelligence community to produce useable products for employing precision weapons in the Gulf War. We need to improve the data flow rates of information, be better able to provide this data near real time to the crews, and at the same time ensure quality target predictions are provided.

Stealth influences air campaign employment. The nature of the enemy defines the enemy's center of gravity, how the enemy will fight, and thus the threat the enemy poses to the achievement of friendly objectives. These factors affect the focus of a campaign and determine aerospace mission priorities. Understanding the enemy requires effective intelligence organizations, capabilities, and procedures.

Since the enemy cannot react in time to prevent a surprise attack from a stealth aircraft, we need to relook at the way we fight into and out of the target area. In other words, if we know the true center of gravity, a successful stealth PGM attack can be made by flying directly to the target rather than fighting their way into the target area. In essence the stealth aircraft are creating their own "air superiority." This would be particularly important in another Gulf-like situation where long range stealth bombers could go deep into the enemy's center of gravity well before fighter forces could establish air supremacy.

Stealth aircraft employed independently, attacking any facet of the enemy's power, contribute to the overall strategic objective of the campaign. Parallel action against several target sets creates a synergy that quickly compounds the enemy's ability to respond. Stealth increases the freedom of action and thus compounds the defender's problem of leaving no location immune to attack.

Aerospace control is normally the first priority of aerospace forces. Attaining air superiority means eliminating enemy forces that can interfere with air operations. Stealth aircraft can maneuver over the enemy and strike vital targets before air superiority is established. Stealth and precision weapons aggressivly defeat enemy aerospace forces by attacking hardened aircraft shelters, hardened C3I facilities and other critical nodes in the enemy's integrated air defense system.

The success of the F-117 in Operation DESERT STORM suggests a relook at the basic concepts of modern warfare. The traditional approach was first to defeat enemy forces in the field, and once these forces were pushed back, go after enemy centers of gravity. Only when these centers of gravity are threatened or attacked will final victory be achieved. Under this traditional approach, we must seize and control territiory because it provides access to the enemy's centers of gravity. F-117s "going downtown" the first night of the war to put the enemy's center of gravity at risk invalidated this traditional approach to warfare. The entire Iraqi power structure came under simultaneous or parallel attack around the clock -- giving no respite and no place to hide. Airpower proved successful in attacking strategic, operational and tactical targets in parallel operations. Stealth aircraft were instrumental in support of this parallel effort by their attacks on the enemy.

This method of attacking with "1,000 points of light" in parallel is a new holistic approach by trying to collapse the enemy's ability to respond almost simultaneously. This is a new way of thinking about aerospace doctrine, and stealth aircraft form the backbone for this type of attack. Attacking the enemy at all critical points simultaneously causes him to spread his defenses. This prevents him from concentrating his forces or he will have to chose to leave some areas less well defended. Initial offensive actions should include attacks on enemy warning and control systems. Actions should deny the enemy access to surveillance, reconnaissance, and intelligence-gathering systems. The employment of the F-117 using precision weapons against the Iraqi C3I is a good example of these type of actions.

Usually, combat power is increased by the use of precision weaponry, which allows a higher operational tempo, reduces risk, and decreases collateral damage. Again, the employment of stealth with precision weapons allows the efficient destruction of many targets with little or no collateral damage. Aim point determination is not complicated by concerns with avoiding enemy fire. Precision weapons take out the target on the first pass and significantly reduce the revisit to heavily defended targets as we did in Vietnam. Stealth strike packages properly employed in small numbers combine to give a significant improvement to the operational tempo by increasing the total targets destroyed on the first attack wave. This places a large demand on the intelligence community to provide accurate and timely target predictions and photos for proper aim point identification. Intelligence systems and architecture must be properly developed and funded to support this type of operation.

Strategic attacks must be carried out against an enemy's center of gravity including command elements, war production assets, and supporting infrastructure. Strategic attacks should be designed to be persistent and coordinated to affect the enemy's capability and possibly his will to wage war. Thus, strategic attacks should affect the entire war effort rather than just a single campaign or a single battle. Stealth aircraft can successfully attack such targets as electrical grids, C3I facilities, communication nodes, and key points along transportation routes (bridges, tunnels, etc.) to support this philosophy.

Stealth provides surprise -- surprise is aerospace power's strongest advantage. Properly employing stealth aircraft gives the theater air commander the luxury to choose the time, the how, and the place of every attack without the enemy being able to respond until it is too late. Stealth gives the commander the initiative and allows for even more versatility of aerospace power.

The need for a stealth technology aircraft for long-range conventional missions is pressing. Stealth is far more cost-effective for a wide range of tasks, both nuclear and conventional, than other well-accepted approaches.

The common denominator across all steath platforms is effective mission planning, which greatly enhances mission survivability. One area requiring improvement is mission planning. The mission planning system for the F-117A was developed around small attack packages and a few targets. Operation DESERT STORM required a system that could handle many aircraft targeted against numerous targets. The mission planning system needs improvements in flexibility, speed, and the user interface. Investigation into these improvements has already begun. This investigation needs to tie in the intelligence loop to provide near real time updates to mission planning systems even after takeoff enroute to the target area, and also to provide battle damage assessments back, perhaps through the same loop.

INTELLIGENCE SUPPORT RECOMMENDATIONS

The multiplicity of targeting requirements likewise increases the number of intelligence collection requirements. The need for extremely detailed intelligence analysis also places a more stringent load on the collection systems for higher resolution imagery and greater accuracy in locating electronic threat equipment. Stealth and PGMs need a wide-area, medium resolution, near real time imagery system that can survive in a medium to high threat air defense system. The need for the most up-to-the-minute intelligence for enroute defenses, stresses the entire intelligence system and has an impact on the intelligence communications structure. Increasingly, the requirement for detailed target information can only be obtained by human intelligence (HUMINT) sources. This brings to bear a whole set of problems, including the long lead time necessary to establish HUMINT sources, communicating with the source, determining the accuracy of his/her reporting, etc. To take maximum advantage of stealthy platforms and PGMs, we need to begin now to develop the necessary HUMINT collection capability in likely trouble spots.

The ability of stealth platforms to strike targets deep inside denied territory removes many restrictions on targeting options, greatly increasing the number of targeting options to be analyzed. For ingress-egress planning, stealth platforms require a more detailed and up-to-date route threat analysis. The accuracy of PGMs in turn demands a much more detailed and accurate assessment of the individual targets.

In the past, it might have been sufficient to identify a key installation with a quarter mile degree of accuracy. Now we must identify the critical element within that installation and identify its location to a one arc-second degree of accuracy. Additionally, the physical vulnerability of the target critical element must be computed to determine the exact munition and fuzing required.

The increasing need for identification of critical target elements within complex target sets places new demands on intelligence analysis. More and more the complexity of the targets themselves are increasing as underdeveloped third world countries, where many of our weapon systems are being employed, become less underdeveloped. These target sets often include industrial sites such as oil refineries, power generating plants, communications complexes etc. Identification of critical elements within these targets requires indepth knowledge of their workings and a system approach to determine what portions of a system need to be eliminated to achieve military objectives. This systems approach must be applied to sophisticated integrated air defense systems and command control and communications systems. This analysis demands indepth technical knowledge as well an appreciation for the military considerations of the target. Such specialized knowledge does not come easily and as intelligence personnel cuts take effect, the demands for specialized knowledge among intelligence analysts increase. Further, fewer civilian analysts bring military experience to the job and military intelligence analysts frequently lack expertise in the increasingly technical fields. This poses an increased challenge to our intelligence training establishment.

Additional target mapping charting and geodesy (MC&G) information is required. The lack of information in third world countries is notable, although work is ongoing to complete the MC&G data base. The ability of stealth to strike deep with minimum time to arrange support, places a premium on rapid response targeting by intelligence support elements.

Battle Damage Assessment (BDA) presented some particularly daunting problems during DESERT STORM. The multiplicity of targets, some of which were struck multiple times, rapid pace of air strikes, combined with the bunkered/buried targets and use of PGMs which left little in the way of clues to their effects, made BDA extremely difficult.

In a multi-polar world, the potential threats against U.S. interests will be more dispersed and could likely increase in number. This will multiply the need for precise targeting information and precise threat information to support high technology weapon systems. The spread of high technology weapon systems inevitably requires a more sophisiticated system approach to intelligence analysis. This is particularly true when analyzing integrated air defense systems and C3 systems.

The ever-quickening pace of battle and the volume of detailed intelligence required by stealth and PGMs, placed a tremendous load on the dissemination and distribution systems. This demands a new look at the timely provision of evaluated, tailored intelligence to the warfighter. This is an organizational as well as dissemination problem. In functional areas where time is the overriding factor, a more horizontal, decentalized organizational approach should be examined. Areas such as follow-on targeting and battle-damage-assessment are likely candidates. In those functional areas requiring a more thorough, careful analysis where time is not the over riding factor, e.g., long range estimates, a more studied and integrated process may be warranted.

With the loss of many of our overseas bases, particularly in the Far East, force projection will become a critical concern for strategists. These projected forces will require a robust intelligence support structure to provide the critically needed intelligence in a timely manner.

Electronic dissemination really came of age during DESERT STORM. It speeded delivery of imagery, text and data to remote field locations. It worked best from the U.S. to land based theater locations. However, transmission to at sea locations and dissemination within theater was less than desired. Electronic dissemination does place a considerable load on the communications system, a factor to keep in mind if the next crisis of this size were to occur in a less advanced communications environment.

Deploying intelligence support teams to provide direct support to the warfighter is a concept now embodied in DIA's National Military Intellgence Support Team (NMIST), NSA's Tributary and CIA's Joint Intelligence Liaison Element (JILE). Warfighter needs, perhaps theater specific, should be examined and deployable intelligence support equipment modified accordingly. Design factors should include; modular design to provide tailored and flexible capability, mobile communications to supply ADP, data, voice and imagery output. Use of reservists should be explored to support these deployments, particularly over longer periods. At the least, the equipment should be interoperable to reduce the space and cost needs.

Precise coordinate information is a critical need for today's high tech weapon systems. In response to this, a field deployable system that quickly derives precise target coordinates from imagery sources is being developed and was successfully tested in the Fall of 1991. This system will greatly help the timely provision of critical intelligence information needed by tomorrow's stealth and PGM weapon systems.

Widely dispersed intelligence production elements posed a real problem during DESERT STORM and this will likely continue to be a concern in the future. From an organizational level, the need to provide an end-to-end, requester-collector-producer-dissemination managment system is essential. This system needs to be deployable, interoperable, able to support joint and combined operations, provide near real time feedback to the customer regarding the status of his request as well as confirmation to the producer that his product was received.

With fewer and fewer combat assets of increasingly high cost, the need to protect them and their technology will become a far greater concern in both their deployment and employment. The isolated basing of F-117s during DESERT STORM is an example.

Another targeting issue involves the timely and accurate provision of Battle Damage Assessment (BDA) to warfighters in the field as well as decision makers in Washington. An elaborate system was designed and exercised no less than 13 times prior to the commencement of hostilities during DESERT STORM. It did provide valuable BDA information; however, a number of areas were identified for improvement. The BDA problem is a very complex one involving timely communications, rapid feedback on Air Tasking Order (ATO) execution, responsive collection system tasking and feedback, trained intelligence analysts employing an all-source approach to BDA, and an organizational scheme to ensure accomplishment of customer objectives. We must pay particular attention to the organizational level of responsibility for BDA production. It must also be understood that BDA analysis will be competing for scarce intelligence resources which are also being used for current and future targeting and other intelligence taskings. The nature of PGM targets and the relatively small warheads employed, make the production of accurate BDA assessment very difficult and at times, nearly impossible.

CONCLUSIONS

As the 21st century rapidly approaches, we must support our vision of the future by making the tough investment decisions today. The following thoughts capture the advantages that stealth offers the U.S. for deterrence for the 21st century:

- Knowledge of low observables effects is still in its infancy and can well change the landscape of the way we will fight.
- There is no turning back now; stealth technology is here - the battlefield has changed.
- Low observable platforms will change the stategic landscape affecting the employment concepts, logistics support, and deterrence.

- Large U.S. investment has already been committed and is producing results, we need to take advantage of this technology lead.

Stealth aircraft should operate at night or within cloud formations to escape even chance encounters with airborne enemy fighters or ground observation. On the other hand, stealth aircraft should use their ability to fly over the target area, above the low altitude air defenses, and use their on-board sensors to identify particular aim points and deliver weapons with precision. These two desires could easily come into conflict, a conflict only resolvable in the context of the relative priorities obtaining in the particular mission.

For example, in the theater, as opposed to strategic nuclear missions, there is specific knowledge from AWACS and intelligence, about the current disposition of friendly and enemy fighters. There is also the ability to plan air attacks on enemy fighter airbases to suppress fighter take-offs at particular times. Taken together, these factors allow the stealth bombers and fighter-bombers to both know and control, to some degree, the air-to-air threat facing them on any mission.

These difficult trade-offs are enormously eased when the stealth aircraft has an imaging, synthetic aperture radar (SAR) as does the B-2. If so, then many of the targets can be identified and located with the SAR alone. This allows for flights above and in the clouds. For other targets, the SAR can only serve as a cuing device, showing where more discriminating sensors such as imaging infra-red sensors, must be pointed.

These infra-red sensors, of course, do not see through clouds, though they do work at night, and their use may, therefore entail deliberate flight at relatively low altitude to get below the clouds. Again, whether this exposure to low-altitude ground defenses is wise will depend upon; 1) the degree of tactical surprise that is expected, 2) the strength of the low-altitude defenses and 3) the urgency of the mission.

In DESERT STORM we had a combination of 1) imaging infra-red sensors (a technology available in quantity only to U.S. airpower) that could find earth-covered tanks and 2) precision air-to-surface weapons that could kill armored vehicles with one shot. Together, such high-technology advances made these dug-in vehicles vulnerable to air attack. The ability to find and attack dug-in armor from the air, efficiently, is a novelty of the current era. It comes about through the combination of 1) mid-altitude flight regimes, 2) high quality, imaging infra-red sensors on board the aircraft, 3) crew identification of the weak, uncertain and variable signatures, and 4) crew-served, precision guided munitions. Without this combination, this type of attack is too inefficient to pursue.

What is feasible is to disrupt the functioning of individual members of a target set for a while. Most damage induced with conventional munitions, even (or especially) with precision guided munitions, can be repaired. Most target sets are so large that many days are needed to cover them - during which time the victim will adapt and change the nature and value of the target set if he possibly can. That is to say, the effective size of the target set depends on the intensity of the attack. The more intense the attack, the smaller the target set to be damaged to accomplish the intended purpose. The less intense the attack, the larger the target set to be damaged.

At the lower end of the intensity scale the whole concept of a target set faces another issue. Unless the attack intensity (defined as the time rate of damage of the target set) is sufficiently high to prevent effective repair or adaptation, then the attack of a target set is, at most, useless. The caveat "at most" is to capture the common reaction of victims of insufficiently intense bombardment -- they become stronger and more determined to resist. The Battle of Britain in 1940 illustrated this phenomenon clearly. This is just the opposite of the conventional war in the first place, to force accomodation, to reduce the will to resist. (13, 5)

But the lesson is clear -- if invasions are to be stopped with airpower, in part at least, then the intensity of the air attack on the ground forces is central. Enough attrition and disruption must be imposed on the invading forces so the defending ground forces remain effective and so the defending governments do not weaken in their will to resist the invasion. (13, 7)

Section Four

Technology -- The Key to Airpower's Future

In the realm of military strategy, we confront dangers more ambiguous than those we previously faced. What type and distribution of forces are needed to combat not a particular, poised enemy but the nascent threats of power vacuums and regional instabilities?...How does the proliferation of advanced weaponry affect our traditional problem of deterrence? How should we think about these new military challenges and what capabilities and forces should we develop to secure ourselves against them?

National Security Strategy of the United States, August 1991

NATIONAL SECURITY OBJECTIVES

The likelihood that U.S. forces will be called upon at some time and place to defend U.S. forces is high - but now more than ever, the time and place are difficult for our intelligence indications and warning system to predict.

While U.S. interests in regional conflicts will vary, there is no doubt many will potentially endanger vital U.S. foreign policy and economic interests. When adversaries contemplate attacking U.S. interests, the U.S. needs capable forces to deter and, if necessary, defeat them. A flexible long-range projection force, capable of rapidly and precisely delivering conventional weapons against an enemy's most valued assets anywhere on the globe, can help prevent or delay potential escalation and achieve our national security objectives over a wide range of conflict levels.

The tremendous reach of air power reduced U.S. reliance on foreign bases when forward bases are becoming less accessible to U.S. forces. Furthermore, stealth will help the U.S. avoid political sensitivities concerning overflights through plausable denial. Fortunately, Saudi Arabia had the facilities to support a large U.S. air contingent. Few other nations do. That will put an even greater premium on survivable stealthy aircraft that can project firepower from longer ranges.

The revolutionary advantage stealth technology offers will allow the nation to enter the 21st century with continued national credibility. The bottom line is that stealth and precision weapons offer deterrence across the spectrum; nuclear, conventional and unconventional.

To support the continued credibility of our nuclear and conventional deterrence, as well as maintaining a robust crisis response capability, the United States should continue to pursue a vigorous exercise schedule with our allies. Intelligence should play an important part of any exercise, not only in the scripting and control element, but as a true participant. Exercising intelligence systems, from national through tactical, will educate the commanders as to what intelligence can and cannot do as well as uncover weaknesses in the system. The forward deployment of stealth aircraft and use of PGMs will need to be accompanied by deployable intelligence support systems with a robust secure communications link to CONUS. Combined exercises with allies will greatly ease the way if and when a genuine crisis arises, as we learned in DESERT STORM. We must build these relationships over time.

Reconstitution of stealth aircraft is prohibitively lengthy meaning that we had better have what we need in our force structure. PGMs are somewhat easier to generate; however, adequate supplies must be maintained based on our short term needs. If DESERT STORM is any indication, these needs will be larger, rather than smaller, based on probable crisis scenarios. Intelligence studies of likely crisis scenarios can play a major role in developing targeting strategies and resultant PGM and stealth platform needs.

ACQUISITION

We must do everything possible to protect the technical lead we now enjoy in the areas of stealth and PGMs. At the same time we must continue to mount a vigorous scientific and technical intelligence analysis function to avoid technical surprise. In today's uncertain world and rising weapons costs, we literally cannot afford to do less.

Simulations and modeling will likely be increasingly employed to design future systems, requiring more comprehensive and detailed intelligence data base support. This is a very man-power intensive effort, which will no doubt require shifting of analytical resources to properly support the effort. However, these resources can also be used to support intelligence analytical models which can in turn improve the efficiency and effectiveness of the analytical community. Due to the enormity of the task, a centrally managed program of distributed production should be employed to eliminate duplication and maximize efficiency.

To improve the efficiency of the acquisition process and recognizing the smaller manpower base, military and civilian, several actions must be taken. Periodic basic threat assessments should be provided to civilian R&D contractors as early as possible, e.g., a "Soviet Military Power" style R&D publication. Release of "NOCONTRACT" information should be streamlined to ensure timely receipt of needed information while continuing to protect it.

Intelligence support needs are being considered at the beginning of the acquisition cycle; however, the mechanisms to ensure this happens must be strengthened. The Air Force plan provides an excellent basis for other services and defense agencies to follow. DIA's Functional Managers should play a key role in assessing the integrated intelligence support system needs for all services ensuring maximum effectiveness, efficiency and interoperability of these expensive systems. This Functional Management support to acquisition should be integrated into the General Defense Intelligence Program (GDIP) and the Tactical Intelligence and Related Activities (TIARA) program development.

We need to take a hard look at streamlining the weapon system acquisition process. It now takes 10-15 years for a program to enter production from the concept development phase. Thirty-five documents are required to support a major program acquisition. Most of these reports are required at multiple milestone reviews. In fact, a total of 112 reports are due throughout the acquisition cycle. Not only do these have to be generated by weapon systems developers, many must also be validated by intelligence staffs. This documentation process is an onerous drain on already scarce and dwindling acquisition staff. A thorough review of these report requirements should be conducted by DoD with an eye toward streamlining and ensuring a strong joint/interoperable discipline is maintained. A final report should be submitted for review and approval by the appropriate Congressional committees.

Particular attention should be paid to joint development of stealth and PGMs. Considerable cost savings are likely and the advantage of sharing technology is obvious. The Air Force "Red Team" concept to ensure rigorous testing of stealth should also be extended to joint programs.

EMPLOYMENT

The revolutionary capability of stealth and PGMs will open up new operational possibilities. We must fully explore these new opportunities by experimenting with new tactics, strategies, techniques, and weapons. Innovative possibilities for stealth could include attacking relocateable targets such as Scud missiles; attacking enemy AWACS and associated ground based radars; armed reconnaissance; covert overflight; CAS/BAI without air superiority; and covert special operations. As the Air Force shrinks from a peak of 38 wings to 26 wings by 1996, we will have to find ways to maximize the capabilities within that smaller force. Stealth weapon systems such as the F-117, B-2, F-22, and AX with tremendous combat capabilities and survivability, can free non-stealthy tactical forces for other tasks. Additionally, a much greater efficiency will be achieved by freeing support assets for other missions, thus helping the Air Force adjust to a smaller tactical force structure.

Effectiveness of stealth and PGMs can only be fully realized if the intelligence analysis is also of the highest order. The intelligence community must continue to develop expert analysts who can approach their discipline in a systemic, critical node concept. This will require additional training and, in some cases such as electrical power, petroleum industry, C3, etc., greater specialization. The increased sophistication of the targets and the deep strike capabilities of the stealth platforms make a "global" analysis essential to developing the most effective targeting strategy. To this end, operational planners and intelligence analysts must work more closely together to ensure the commanders needs are met.

Due to the nature of the platform, stealth mission planning requires greater up-to-the-minute information on air defenses and their integrated operation. This will place a greater responsibility on the intelligence community to be able to provide this relatively sophisticated level of support. The need for timely updates, combined with likely long force projection profiles will require in-flight intelligence updates, forward deployment of intelligence support systems and attendant robust secure communications. We are currently short in all three areas in any high intensity scenario. PGMs can provide incredibly accurate strikes; however, intelligence needs to provide the proper aim points. This requires an abundance of medium-to-high resolution target imagery, before and after the strike. The ingress-egress route analysis and detailed target analysis require a survivable, broad area, synoptic, medium-to-high resolution imagery platform with a near-real-time digital downlink for timely support. An expanded HUMINT capability in likely trouble spots should also be developed. They can provide detailed target information needed by PGMs and could even be used to designate targets for them.

After the strike, battle damage assessment (BDA) becomes a critical need for target planners. Improvement in this area is needed. Operational forces need to provide projected Air Tasking Order (ATO) information in a timely fashion such that collection systems can be cued and after the strike, actual ATO information must also be provided. Intelligence analysts selected for BDA work must be highly trained and organized at the proper echelon to carry out their mission. In most instances this should be at the Joint Task Force or Theater level where national, theater and tactical collection systems come together to provide a timely and as complete a picture as possible. In a large scale, ongoing battle such as DESERT STORM, comprehensive BDA cannot be done at the national level.

INTO THE BRAVE NEW WORLD ORDER

As we leave our comfortable house of containment and step outside into the unfamiliar new world order, we must ensure that we are adequately armed and prepared to do battle with unforeseen enemies. We must keep our intelligence eyes and ears tuned to these threats that lie ahead and act in harmony and coordination to support our new found strength in stealth and PGMs. With innovation and vigor, the partnership of stealth, precision guided munitions and intelligence can see us safely through the unknowns that lie ahead as we journey into the 21st century.

Final Thoughts

Stealth and precision guided munitions will play a central role in protecting U.S. interests at a time of tremedous change and instability. The end of the age of containment and superpower nuclear standoff has been replaced by the rise of nationalism, regional and ethnic conflict, proliferation of weapons of mass destruction and a continued terrorist threat. The likelihood that U.S. forces will be called upon to defend U.S. interests is high, but the time and place will be difficult for our intelligence indications and warning system to predict. A flexible, long-range projection force, capable of rapidly and precisely delivering conventional weapons against an enemy's most valued assets anywhere on the globe, can help prevent or delay potential escalation and achieve our national security objectives over a wide range of conflict levels.

This capability will allow us to extend the concept of nuclear deterrence to include conventional deterrence. The combination of stealth and PGMs is a milestone in the development of airpower, comparable to the jet engine and radar. We are challenged to develop a force structure and employment doctrine to make the most effective use of this tremendous capability which can provide a powerful force multiplier at a time of defense cutbacks. By the same token, these systems cannot function effectively without equally robust intelligence support to provide the targeting, threat and BDA assessments necessary for these high tech systems to accomplish their mission.

Economic constraints and the fast pace of technological development dictate that the acquisition process be carefully reviewed to maximize efficient and timely weapon system development, including intelligence support systems. Use of simulations and modeling, protection of U.S. technical lead, and enhanced cooperation with the civilian R&D community will challenge intelligence support to the acquisition process.

ACKNOWLEDGEMENTS

The authors would first like to thank Col "Buzz" Mosely and Mr. Jim Dixon of the National War College Faculty. As the sponsors and advisors on this endeavor, they offered guidance and encouragement, always with the aim of enriching our academic and professional experience at the National War College. In this, they hit the target with precision, but not always with stealth.

Col Arnold would like to acknowledge the help from SAF/AQQS(B), Lieutenant Colonel Ted Bowlds, Major Paul Miller, and Major Jim Whitney. Additionally, Mr. Daryl Thompkin, ANSER Corporation provided much needed support.

Mr. Vitrikas would like to thank Mr. Brian Long and Mr. Cyril May, DIA/ODT-AS, for their patience in answering endless questions and pulling together stacks of source material. Additionally, Mr. Chris Ferguson, AFISA/INAA provided invaluable insight into the Air Force intelligence role in acquisition support and Major Bob Butler, AF/INXX shed much light on the future of Air Force Intelligence support to the acquisition process.

Lastly, we would like to thank our wives, Tina Arnold and Ruth Vitrikas for putting up with us clattering away at our word processors rather than going to bed at a civilized hour.

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GLOSSARY

COST AND OPERATIONAL EFFECTIVENESS ANALYSIS (COEA) - An analysis of the estimated costs and operational effectiveness of alternative material systems to meet a mission need and the associated program for acquiring each alternative.

CRITICAL INTELLIGENCE PARAMETERS (CIPS) - A threat capability or threshold established by the program, changes to which could critically impact the effectiveness and survivability of the proposed system.

CRITICAL INTELLIGENCE PARAMETERS THREAT STATUS (CTS) - The status of threat programs, technologies and research efforts relative to the CIPs. It will include a projection of threat capabilities and potential for breaching CIP thresholds.

HIGHLY SENSITIVE CLASSIFIED PROGRAM - An acquisition special access program which complies with the policies and procedures specified in reference b. for the acquisition category of programs with equivalent dollar value. Specific deviations to these policies and procedures must have the concurrence of the milestone decision authority who may waive milestone documentation requirements. System Threat Assessment Reports (STARs) and other threat-related documents prepared for highly sensitive classified programs are handled administratively in the same manner as other programs unless special security arrangements are necessary. Special access clearances for these programs shall be kept to a minimum.

HOSTILE FOREIGN INTELLIGENCE COLLECTION THREAT - The potential of a foreign power, organization, or person to collect information overtly or covertly about a U.S. acquisition program's technologies, capabilities and methods of employment which could be used to develop a similar weapon system or countermeasures to the U.S. system or related operations.

INTEGRATED PROGRAM ASSESSMENT (IPA) -A document prepared by the supporting staff or review forum of the milestone decision authority to support Milestone I, II, III, and IV reviews. It provides an independent assessment of a program's status and readiness to proceed into the next phase of the acquisition cycle.

INTEGRATED PROGRAM SUMMARY (IPS) -A DoD Component document prepared and submitted to the milestone decision authority in support of Milestone I, II, III, and IV reviews. It succinctly highlights the status of a program and its readiness to proceed into the next phase of the acquisition cycle.

INTELLIGENCE PRODUCTION REQUIREMENT (IPR) - An IPR states a need for the production of intelligence for a general or specific subject, or to support a program, system or weapon. IPRs should be initiated by a DoD component whenever there is a perceived information gap. IPRs cover current, mid-term, or long-range intelligence requirements which cannot be satisfied by the resources of the requester.

LIFE CYCLE COST ESTIMATE - The total cost to the Government of acquisition and ownership of a system over its useful life. It includes the cost of development, acquisition, support and, where applicable, disposal. Unique intelligence support requirements will be identified, evaluated and included in the estimate.

MAJOR DEFENSE ACQUISITION PROGRAM - An acquisition program that is not a highly sensitive classified program and that is designated by the USD(A) as a major defense acquisition program.

OPERATIONAL REQUIREMENTS DOCUMENT - The ORD is submitted to the milestone decision authority in support of Milestone I through IV reviews. The ORD summarizes the threat to be countered and the projected threat environment. The threat will be derived from the DIA-validated System Threat Assessment Report (STAR) for all ACAT I programs through Milestone I and for ACAT IS programs for Milestone II-IV. The START will be referenced in the ORD.

PROGRAM PROTECTION PLAN (PPP) - The PPP will identify Essential Program Information, Technologies, and Systems to be protected, and to create a management plan outlining the measures necessary to protect the system throughout the acquisition process. The plan must integrate all security disciplines, operations security, counterintelligence and other defensive methods to deny hostile collection efforts and prevent unauthorized disclosure.

PROGRAM PROTECTION THREATS AND VULNERABILITIES - The program protection threats include life cycle protection threats, foreign hostile intelligence collection efforts and program vulnerabilities resulting from unauthorized disclosure of essential program information, technologies, and systems during the acquisition process.

PROJECTED THREAT - A best intelligence estimate based on historical trends, evidence of continuing research and development, postulated military requirements, technological capabilities and economic capacity.

REACTIVE THREAT - The changes in hostile doctrine, strategy, tactics, force levels and weapon systems that an enemy might reasonably be expected to incorporate as a result of the disclosure of technical information or the development and deployment of U.S. system.

REGIONAL THREAT - The threat in a region comprised of all weapon systems, doctrine, strategy, tactics, organization, equipment and military forces regardless of origin, which U.S. systems may encounter during deployment/employment in regional conflicts.

SYSTEM MATURITY MATRIX (SMM) - is an appendix to the Test and Evaluation Master Plan (TEMP), outlines the testing milestones and expected capabilities of a new weapon system as it matures.

SYSTEM THREAT ASSESSMENT REPORT (STAR) - The basic authoritative threat assessment, tailored for and focused on, a particular (i.e., single) U.S. major defense acquisition program. It describes the threat to be countered and the projected threat environment. The threat information should reference DIA-validated documents.

TECHNOLOGICALLY FEASIBLE THREAT - A technologically feasible threat is a projected threat intended to provide decision authorities with a basis for judgment about the impact on a specific U.S. system if the threat evolves in a direction other than that considered most likely by the Intelligence Community. The technologically feasible threat must be consistent with a country's economic capability, technology, and production capacity.

TEST AND EVALUATION MASTER PLAN (TEMP) - The basic planning document for all tests and evaluations (T&E) related to a particular system acquisition which is used by OSD and all DoD Components in planning, reviewing, and approving T&E. The STAR will be the primary threat reference used in developing of threat-related aspects of the TEMP.

TEST PLANS (TPs) - Specific test scenarios and events are covered by TPs. TPs include test objectives, measures of effectiveness, planned scenarios, and threat simulation. The STAR will be the primary threat reference used in development of threat-related aspects of the TPs.

THREAT - The sum of the potential strengths, capabilities and strategic objectives of any adversary which can limit or negate U.S. mission accomplishment or reduce force, system or equipment effectiveness.

THREAT ENVIRONMENT PROJECTION (TEP) - The TEP is an overview of the operations, physical, and technological environment in which the system will have to function during its lifetime. Developments and trends which can be expected to affect mission capability should be projected out to the end of the system life cycle. Areas covered should include: enemy doctrine, strategy, and tactics affecting system, mission, and operations. Threat content and emphasis will vary based on the program or area of interest being addressed.

THREAT INTELLIGENCE SUPPORT COUNCIL (TISC) - The primary forum used by DIA and the DoD Components to resolve issues, provide and obtain guidance, and make recommendations to the Director, DIA. and the Service Intelligence Chiefs concerning intelligence support to defense acquisition.

THREAT RISK MANAGEMENT - Managing the flexibility and, in some cases, growth potential that is designed into a weapons system to react to the changing threat in a timely manner, rather than requiring a major redesign if the threat breaches one of the CIPs. There must be a constant ongoing dynamic between cost, schedule, technology, threat and security risk. These are interactive and must be managed in concert rather than as separate risk issues.

THREAT STEERING GROUP (TSG) - A group formed by a DoD Component (or lead Component for a joint program) to address threat for a specific system acquisition program. This group may also be known as a Threat Coordinating Group or Threat Working Group.

THREAT TEST SUPPORT PACKAGE (TTSP) - the TTSP is an Army document (or group of documents) that provide(s) a comprehensive description of the replicated threat to a U.S. system that is being tested and the targets that the system will engage.

THREAT VALIDATION - The substantiation of threat documentation for appropriateness and completeness of the intelligence, reasonableness of the judgment, consistency with existing intelligence positions and logic of extrapolations from existing intelligence.