

BATTLESPACE DOMINANCE IN THE FIRST DAYS OF THE NEXT WAR: CRUISE MISSILES OR BOMBERS?

**A MONOGRAPH
BY
Major Charles E. Forshee
Infantry**



**School of Advanced Military Studies
United States Army Command and General Staff
College
Fort Leavenworth, Kansas**

First Term AY 96-97

Approved for Public Release Distribution is Unlimited

DRUG & ALCOHOL INHIBITION

19970505 186

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE		3. REPORT TYPE AND DATES COVERED MONOGRAPH
4. TITLE AND SUBTITLE BATTLESPACE DOMINANCE IN THE FIRST DAYS OF THE NEXT WAR: CRUISE MISSILES OR BOMBERS?				5. FUNDING NUMBERS
6. AUTHOR(S) MAJOR CHARLES FORSITEE				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) School of Advanced Military Studies Command and General Staff College Fort Leavenworth, Kansas 66027				8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Command and General Staff College Fort Leavenworth, Kansas 66027				10. SPONSORING/MONITORING AGENCY REPORT NUMBER
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE DISTRIBUTION UNLIMITED.				12b. DISTRIBUTION CODE
13. ABSTRACT (Maximum 200 words) SEE ATTACHED				
14. SUBJECT TERMS				15. NUMBER OF PAGES 57
				16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED	

Abstract

BATTLESPACE DOMINANCE IN THE FIRST DAYS OF THE NEXT WAR: CRUISE MISSILES OR BOMBERS? By MAJ Charles Forshee, USA, 51 pages.

This monograph compares sea-launched cruise missiles to heavy bomber delivered munitions performing the battlespace dominance mission in the first five days of a major regional contingency (MRC). Battlespace dominance is a Navy doctrinal term. The paper uses the projected year 2006 cruise missile and bomber force structure each attacking the same hypothetical target list.

The paper examines two cases. The first case compares both cruise missiles and bombers without sensor fused weapons (SFW) and brilliant anti-tank (BAT). The second case posits that SFW and BAT munitions are in the force structure for the two means of delivery.

Both systems have advantages and disadvantages. Bombers are better able to deliver a wide variety of munitions against many different targets with persistence. Cruise missiles are particularly well suited for attacking integrated air defense systems and other counterair targets.

SCHOOL OF ADVANCED MILITARY STUDIES

MONOGRAPH APPROVAL

Major Charles Forshee

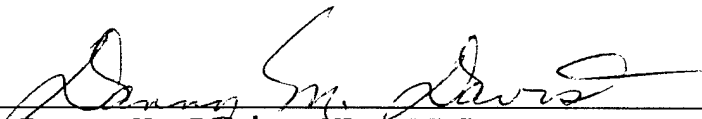
Title of Monograph: *Battlespace Dominance in the First Days of
Next War: Cruise Missiles or Bombers?*

Approved by:



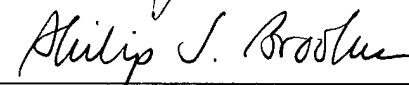
Richard M. Swain, Ph.D.

Monograph Director



COL Danny M. Davis, MA, MMAS

Director, School of
Advanced Military
Studies



Philip J. Brookes, Ph.D.

Director, Graduate
Degree Program

Accepted this 20th Day of December 1996

**Battlespace Dominance In The First Days
Of The Next War: Cruise Missiles Or
Bombers?**

A Monograph

by

Major Charles Forshee

Infantry

**School of Advance Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas**

First Term

Abstract

BATTLESPACE DOMINANCE IN THE FIRST DAYS OF THE NEXT WAR:

CRUISE MISSILES OR BOMBERS? By MAJ Charles Forshee, USA, 51 pages.

This monograph compares sea-launched cruise missiles to heavy bomber delivered munitions performing the battlespace dominance mission in the first five days of a major regional contingency (MRC). Battlespace dominance is a Navy doctrinal term. The paper uses the projected year 2006 cruise missile and bomber force structure each attacking the same hypothetical target list.

The paper examines two cases. The first case compares both cruise missiles and bombers without sensor fused weapons (SFW) and brilliant anti-tank (BAT). The second case posits that SFW and BAT munitions are in the force structure for the two means of delivery.

Both systems have advantages and disadvantages. Bombers are better able to deliver a wide variety of munitions against many different targets with persistence. Cruise missiles are particularly well suited for attacking integrated air defense systems and other counterair targets.

Table of Contents

I. INTRODUCTION	1
PROBLEM AND BACKGROUND	1
METHODOLOGY	5
ASSUMPTIONS	9
II. DOCTRINE.....	11
III. THE SCENARIO.....	14
IV. ASSETS AVAILABLE	19
CRUISE MISSILES.....	19
HEAVY BOMBERS	23
V. ANALYSIS AND EVALUATION	28
CRUISE MISSILE SUCCESS	28
HEAVY BOMBER SUCCESS.....	31
COMPARISON	36
VI. CONCLUSION AND SUMMARY.....	38
VII. ENDNOTES.....	40
VIII. Bibliography.....	48

LIST OF TABLES AND FIGURE

Figure 1: Decision Tree	8
Table 1: Ratio of Targets Comprising Target Lists.....	16
Table 2: MRC Target List With Target Elements.....	17
Table 3: Target Definitions	18
Table 4: Ships Capable of Delivering TLAM.....	21
Table 5: Hypothetical Numbers of Ships Available for MRC.....	22
Table 6: Bomber Delivered Munitions	27
Table 7: Optimal TLAM Strikes Per Missile, Minimizing TLAM Expenditure.....	29
Table 8: Required TLAM Strikes to Destroy Each Target Element	30
Table 9: Bomber Results Day 1, Case 1	31
Table 10: Bomber Results, Day 2, Case 1	32
Table 11: Bomber Results, Day 3, Case 1	33
Table 12: Bomber Results, Day 1, Case 2	34
Table 13: Bomber Results, Day 2, Case 2	34
Table 14: Bomber Results, Day 3, Case 2	34
Table 15: Bomber Results, Day 4, Case 2	35
Table 16: Bomber Results, Day 5, Case 2	35

I. Introduction

Problem and Background

Our current National Military Strategy calls upon the Department of Defense to execute two nearly simultaneous major regional contingencies (MRC).¹ Central questions for each of the possible scenarios involve deciding which forces to use and determining how the appropriate force will deploy in time to be effective. One of the key requirements for deploying the selected force is the creation of local zones of superiority that enable follow-on forces to enter the theater. The Navy has coined the term *battlespace dominance* to describe the object of this essential operation.²

Very early in most MRC scenarios, the first battle is a combination of offensive counterair, strategic attack, and air interdiction missions. The purpose of the offensive counterair effort is to gain air superiority.³ The intended effect of strategic attack is to cause paralysis to both the enemy's decision and war making abilities.⁴ Finally, air interdiction will isolate a selected portion or portions of the theater to facilitate future maneuver.⁵ From an operational perspective, this first battle is not intended to be a single decisive struggle to defeat the adversary. The first battle will be but the first blow of a series of intended blows.⁶ This first battle should set the conditions for victory.

This MRC that this paper will discuss is hypothetical. The presumed opponent has 10 mechanized or armored divisions, a moderate integrated air defense system, and a credible air threat. The aggressor possesses 4,000 tanks and armored personnel carriers,

2,000 artillery pieces and 750 combat aircraft. The United States intelligence services have provided sufficient warning for U.S. forces to have 48 hours to prepare.

The Navy's concept of *battlespace dominance* is articulated in naval doctrine.⁷ For regional conflict, the Navy claims to be prepared to "conduct precision strikes against key targets, actions to disrupt communications and secure ports and airfields, and measures to interrupt an adversary's command and control."⁸ Naval forces have strike aircraft and tomahawk cruise missiles to carry out this mission.⁹ This paper will assume that the carrier-based aircraft will engage principally in close air support, some air interdiction, and force protection in the first critical days.

The Air Force is main provider of air superiority, air interdiction, and strategic attack. The Air Force has those missions written into their doctrine. The Joint definitions of the three missions, in fact, have their origin in Air Force Manuals.¹⁰ Very early in an MRC, the Air Force has claimed that the heavy bomber may be the first and only force on the scene.¹¹ In addition to its own cruise missile capability, the Air Force wants a larger and better bomber force to penetrate closer to the desired targets to drop a variety of bombs.

Why is penetration necessary? Why use bombers at all? Why not employ just sea-launched cruise missiles? Is the current force structure of heavy bombers more capable than the Navy's cruise missiles for battlespace dominance in the first five days of a major regional contingency? The implications are far reaching. If sea-launched cruise missiles are better, the United States may be ready to take human beings out of harm's way. Bombing is one of modern combat's most dangerous functions. But, bombers still may be better able to dominate the battlespace than other systems. If that is true, the

Navy's current size and structure may be adequate for tasks other than establishing battlespace dominance ashore.

The Air Force has offered the heavy bomber as the best force to provide strategic attack, offensive counterair, and air interdiction for the first battle of the MRC. The Air Force makes this claim using what it calls the Bomber Road Map. The Air Force used the Road Map to justify conversions of their heavy bomber fleet for conventional munitions delivery. The Bomber Road Map specifically states, "Strategic bombers may be the only means available to strike enemy targets early in a conventional conflict."¹²

Air Combat Command (ACC) Commanding General Joseph W. Ralston stated recently, "Our most significant shortfall in ACC is precision weapons for our bombers... Getting those munitions is absolutely our top priority."¹³ General Ralston also said that "large payloads are less important than they were in the past."¹⁴ The Air Force states that the bomber uniquely attacks enemy conventional forces, key nodes of command and control, air defense assets, and other offensive capabilities.¹⁵ These are all battlespace dominance missions. The bomber has many advantages over other systems, including the ability to search for a target that has moved. Additionally, launched with very little warning, bombers can fly from the continental United States to bomb anywhere in the world and return.¹⁶

The Navy, for their part, already has a robust cruise missile capability on 135 ships and submarines using vertical launch systems. The latest version of cruise missile is the Tomahawk Land Attack Missile-D (TLAM-D) which can attack up to 12 targets with cluster bomb type munitions.¹⁷ As a means of comparison, the Army Tactical Missile System (ATACMS) delivers five times the bomblets over a larger area with each missile.¹⁸

Large targets, such as stationary or moving armored formations, will likely require multiple missile strikes. With a 500 mile range, the Navy can strike targets almost anywhere in the world using TLAM by approaching the shore lines. The only sites out of range of the TLAM are certain parts of central Asia.¹⁹ An advantage of TLAM over bombers is that air crews are not in danger during a TLAM strike. Because of the missile's accuracy and reduced risk, these improvements may make the TLAM more attractive for use in the strike role.

The Navy further argues that situations like Mogidishu, Liberia, and Rwanda all dictate that someone be capable of being directly on the scene. Because of this, the Navy is constantly patrolling the high seas and is in position to apply force in the littoral regions. The Navy does not need a visa and does not require basing permission.²⁰ Interestingly, these are similar arguments to those the Air Force uses when justifying long range heavy bombers. Both systems have the advantage of not needing permission to stage from an overseas base and then attack. Neither requires local land presence.

The Navy also has plans to build an arsenal ship. The concept for the arsenal ship, SC-21 class, is solely to provide a missile platform for Tomahawk and Army Tactical Missile System (ATACMS). Each ship would have up to 500 launch cells for either kind of missile.²¹

The Navy is not suggesting that guided missile cruisers, the newest destroyer, or the arsenal ship will replace aircraft carriers. Aircraft carriers are the Navy's principle means of delivering multi-role fighters as air interdiction assets in an MRC. Multi-role fighters are also the Air Force's principle means of performing air interdiction. To dominate the battlespace in the critical first days will require a huge strike capability. This

paper seeks only to compare sea-launched cruise missiles to bomber delivered munitions in this strike role.

Getting the right tools is obviously the key to success in major regional conflict scenarios. Perhaps we have the right tools now. The existing fiscal environment in which we select the tools is also important. All the services are under severe cost constraints. The Air Force and Navy's most important question today may involve determination of which long-range battlespace dominance tool is the best within the planned force structures.

Methodology

The evidence that supports this study comes from a number of open sources. Congressional testimony and public statements by senior service officials and members of the Defense Secretariat are one source. The Gulf War Air Power Survey and various Government Accounting Office studies provide data useful for establishing a benchmark for future MRCs. Open source information provides accuracy and lethality data. Joint publications and service manuals provide doctrinal definitions and concepts.

The Bomber Road Map states hypothetically that the United States will need to destroy 238 high value targets in the first five days of a conflict in order to facilitate future operations. 1250 target elements, such as specific buildings or industrial complexes, make up the 238 priority targets.²² Various unclassified sources, including the Gulf War Air Power Survey, provide possible target lists. By comparing target ratios with other lists, and interpolating, developing a type MRC target list is possible.

The refined list represents what the Air Force would attempt, hypothetically, at the beginning of an MRC. This paper equates the sum of the Air Force missions with the Navy's battlespace dominance mission. The list then will set a standard by which to judge the comparative effects of the two competing systems.

The study will evaluate two cases. The first case portrays a force structure based on the conventional upgrades currently planned for bombers and cruise missiles without the advantages of Brilliant Anti-tank (BAT) and Sensor Fused Weapons (SFW) technologies. U. S. Forces will commit cruise missiles and bombers against the MRC target list. The carrier air wing and any available multi-role Air Force fighters will engage a posited enemy armored invasion. The study will not analyze the results of that series of engagements.

The second case is that BAT and SFW do work and do exist in the force structure. The primary responsibility of the bombers and missiles will be to stop the armored invasion. The scenario then commits the remaining cruise missiles or bombers to the MRC list. Because BAT is under development, its effectiveness has not yet been proven. The progress made thus far remains classified. As a measure of effectiveness, Jane's reports show that the U.S. Navy is intending a capability of "2,000 armored kills in the first day of a war and another 2,000 by day 4" using two arsenal ships.²³

Persistence of the posited attack is another factor to consider. Reloading TLAM on an arsenal ship would require the ship to return to a port. That port would need 1000 TLAM either pre-positioned or close enough to an airport capable of receiving the cargo aircraft for a complete reload. It is debatable whether we would want 1000 TLAM in a theater, or whether we will have sufficient cargo airframes available to haul them.

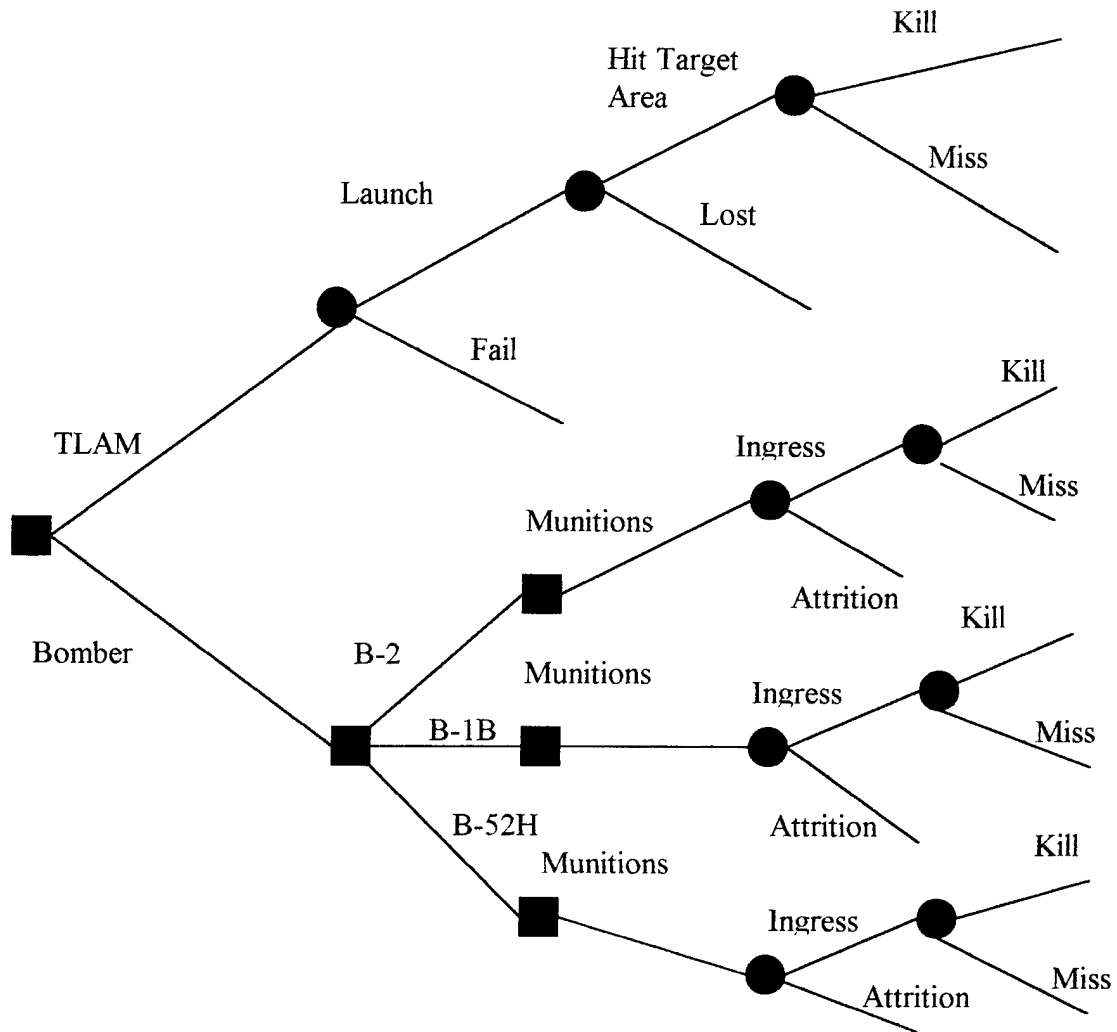
Because of this, the scenario will not consider TLAM reload. The paper will, however, consider multiple missions for bombers because the Air Force would realistically employ them several times in this scenario.

The assets to be evaluated will be heavy bombers, such as the B-1B, the B-52H, and the B-2 using precision stand-off weapons; and cruise missiles (TLAM-C and D) launched from naval platforms. The paper will examine each system with regard to type of munitions delivered and likely success. The numbers of systems, further limited to the number of launch platforms likely to be available in 2006, will limit the number of attacks on the target list's high value targets.

Ship and aircraft availability data will come from open source information as well. *Jane's Fighting Ships* publishes the numbers of warships in commission. The number of warships posited to be available in a given theater is conjectural. The number of warships are based on the usual operations of the U.S. Navy. General Loh, USAF, has provided an estimate of the likely number of bombers available for an MRC.²⁴ Predictive data for likely availability of types of bombers is also available from different studies.

After establishing the type of munitions and likely success of a particular platform attacking a target, it will be possible to compare the assets using the same evaluation criteria for each system. The method of comparison will be the use of a decision tree (see Figure 1). This comparison will support conclusions about which system is better in the first five days of the MRC. The study will judge the system that destroys the most of the 238 targets as superior. The system that destroys 238 targets first will be better in the case that both systems are adequate to do the job.

Figure 1: Decision Tree



Assumptions.

1. Major Regional Contingency.
 - a) Destruction of 248 high value targets during the first five days of a major regional contingency is a top priority of the National Command Authority and in concert with theater objectives.
 - b) The target mix for the air interdiction portion of an air campaign in the first five days will be similar to historical experience and training. Historical experience will be that found in Desert Storm. Selected training exercises used by agencies of the Department of Defense will serve as training examples.
 - c) 48 hours of strategic warning will be used to reposition ships, select targets, arm bombers and otherwise prepare.
 - d) The priority of destroying the targets defined on the list is the suppression of air defense and offensive counterair. This will provide air superiority and enable the U.S. forces to suffer reduced attrition.
2. Munitions.
 - a) Joint Direct Attack Munition (JDAM), Joint Air to Surface Standoff Missile (JASSM), Tomahawk Land Attack Missile

- D (TLAM D) with Block IV improvements is available,
and the TLAM-C has a hard target penetration capability.

3. Bombers. The bomber mix envisioned by the Air Force in 2005 will be available.
4. Naval Vessels.
 - a) A Surface Action Group (SAG) and Carrier Battle Group (CVBG) are available in theater.
 - (1) The SAG will be assumed to be five ships. Two cruisers and two destroyers.
 - (2) The CVBG will be assumed to have two cruisers and three destroyers. The air wing of the CVBG will not attack targets on this list
 - b) Ten attack submarines will be assumed to be available in the theater.
 - c) Two Arsenal ships, SC-21 will be available in the theater.

II. Doctrine

The Army, Air Force, and Navy all recognize the same three levels of war. In Air Force Manual 1-1, the tactical level of war is defined as translating “potential combat power into success in battles and engagements through decisions and actions that create advantage when in contact or in proximity to the enemy.”²⁵ It further explains that “combat is not an end in itself; it is the means to achieve goals set at the operational level.”²⁶

The Navy defines the tactical level of war as involved in “the details of individual engagements,” while “the operational level concerns forces collectively in a theater.”²⁷ This paper will be limited to actions at the tactical level of war by dealing with destruction of those targets that will meet goals that facilitate success in the early phase of an MRC.

Air interdiction is defined in Joint Pub 1-02 as:

Air operations conducted to destroy, neutralize, or delay the enemy’s military potential before it can be brought to bear effectively against friendly forces at such distance from friendly forces that detailed integration of each air mission with fire and movement of friendly forces is not required.”²⁸

Offensive counterair is defined as, “An operation mounted to destroy, disrupt, or limit enemy air power as close to its source as possible.”²⁹ “Offensive counterair ranges throughout enemy territory and (is) generally conducted at the initiative of the friendly forces.”³⁰ The naval equivalent of counterair is antiair warfare.³¹

Strategic attack is defined in Joint Pub 3-0 as:

JFCs [Joint Forces Commanders] seek to extend operations through-out the breadth and depth of the operational area. JFCs conduct sustained operations when a “coup de main” is not possible... During one major operation, one component or major category of operations, such as air operations, might be the main effort, with others

in support. When conditions change, the main effort might shift to another component or function. Strategic attack and interdiction continue throughout to deny the enemy sanctuary or freedom of action. When prevented from concentrating, opponents can be attacked, isolated at tactical and operational levels, and defeated in detail. At other times, JFCs may cause their opponents to concentrate, facilitating their attack by friendly forces.³²

The Joint Doctrine further anticipates these missions by defining Joint Interdiction Operations. These operations are “actions to divert, disrupt, delay, or destroy the enemy’s surface military potential before it can be used effectively against friendly forces.” Joint interdiction can significantly affect the course of war. “It contributes by interfering with the enemy’s ability to mass, maneuver, withdraw, supply, command, and reinforce his combat power and by weakening him materially and psychologically.”³³

The notion of battlespace dominance used in this paper is a Navy term that describes how the Navy intends to facilitate their force projection. Battlespace dominance seeks freedom of action for land, sea, and air operations. Navy Doctrinal Pub 1 states,

We maintain our protective zones of superiority around us, establishing them not just upon arrival, but enroute to our objective area. The battlespace moves with the force. By extending zones of superiority over landing forces, naval commanders protect those forces while they are accomplishing their missions and establishing their own defensive zones.³⁴

There is an overlap in the Joint Doctrine and the Navy Doctrine. Joint Doctrine sees the three missions of counterair, strategic attack, and air interdiction as different activities. Yet, when put into practice in the first days of a campaign, these three missions can meld into a single operation. It is precisely during the first days of an MRC that the Navy would seek battlespace dominance to ensure the safety of their ships and facilitate

future operations. The overlap is not born of intention, but from the nature of the assets involved and the capabilities of those assets.

This paper will deal with tactically applied assets to targets that meet the criteria of affecting the enemy's ability to mass, maneuver, withdraw, supply command, and reinforce his combat power. Strategic attack and counterair targets are included with those more immediately focused on battlespace dominance.

The targets posited for the MRC would be high on any target list at the beginning of any campaign. This is because aerospace control and other strikes will enable the interdiction missions to operate to their best potential and will facilitate future operations.³⁵

III. The Scenario

The National Security Strategy calls for the Armed Forces of the United States to be prepared to fight and win, nearly simultaneously, two major regional contingencies (MRC).³⁶ This study uses a scenario that does not mirror any particular country; but is a composite of several. For this MRC, the United States is fighting an aggressor country that possesses a medium density air defense network throughout the country, with high density air defense around high value targets. Further, that nation possesses 10 Armored or Mechanized divisions, 10 infantry divisions, and a credible air threat. In total, the aggressor nation has 4,000 tanks and armored personnel carriers, 2,000 artillery pieces, a surface to surface missile capability, and 750 combat aircraft.³⁷

These are the parameters for the MRC because it presents the most challenging scenario the Armed Forces are likely to face. Today, only Russia and China have armies larger than the parameters in this study. Ukraine, India, Syria, North Korea, and Belarus have armies analogous to these parameters. Argentina, Vietnam, Libya, Brazil, Cuba, Ethiopia, Iran, Iraq, Jordan, and Yemen have armies that are slightly smaller than the 4,000 armored vehicles, 2,000 artillery, and 750 aircraft threshold.³⁸

Little or no notice makes the problem of response in a timely manner even more difficult. The above named nations have mobile armies capable of striking quickly. These problems may restrict the early use of Air Force multi-role fighters.

Of these different forces, the armored divisions present the greatest threat to the security of the designated battlespace. This paper posits that U.S. Forces must be able to

destroy at least three of these divisions. The destruction of three divisions threshold was selected because rapid losses of this magnitude will likely halt or at least give pause an enemy's attack.³⁹

The primary target set in this MRC, then, is the armored divisions that are either attacking or about to attack. These targets are the ground forces on the list below. Although there are 10 Armored or Mechanized divisions, only 3 divisions must be destroyed to meet the success criteria. Destruction being defined as 50% loss of the attacking forces' armored vehicles and artillery.

The remaining target set that the cruise missiles and the bombers will engage is analogous to the Bomber Road map. Five target set examples permit development of a model of the target types and distribution. The first two sources are the target lists used for planning Operation Desert Storm. These lists are, respectively, those which were approved by Central Command Air Force (CENTAF) and by Central Command (CENTCOM).⁴⁰ Two other sources are notional lists used in staff college exercises in the past year. These target lists were developed for Exercise Prairie Warrior 96 and a Middle Eastern (Libyan) scenario used by the Joint Doctrine Air Campaign Course. The Prairie Warrior target list was developed by the Command and General Staff College, Fort Leavenworth, Kansas. The College Of Aerospace Doctrine, Research, And Education (CADRE), Maxwell AFB Alabama, wrote the Joint Doctrine Air Campaign course. The final source list is the strike counts by Master Target List categories actually flown in Operation Desert Storm.⁴¹ The ratio of the target categories is similar in all the lists.

Table 1: Ratio of Targets Comprising Target Lists

Targets	Average	PW	Libya	CENTAF	CENTCOM	ODS	Target List
Airbase/ AF	0.197	0.135	0.2	0.17	0.198	0.278	47
C3	0.106	0.047	0.23	0.078	0.086	0.087	26
Power	0.101	0.303	0.14	0.028	0	0.03	25
Stores	0.147	0.04	0.11	0.101	0.277	0.204	35
POL	0.049	0.035	0	0.101	0.065	0.044	12
Seaport	0.038	0.016	0.05	0.033	0.059	0.032	10
IAD	0.142	0.169	0.12	0.331	0.014	0.074	34
Trans	0.143	0.232	0.04	0.115	0.27	0.054	35
Tanks (AA)	0.013	0	0.06	0	0	0.004	4
GF	0.01	0	0.02	0	0.028	0	3
NBC	0.029	0	0.02	0.014	0.007	0.102	7
Terror	0.002	0	0.01	0	0	0	1
TBM	0.034	0.027	0.01	0.033	0	0.098	9
Totals	1.011	1.004	1.01	1.004	1.004	1.007	248

By averaging the percentages, we may then have a proportional makeup of the 238 targets by target category. These percentages then form a ratio coefficient to derive numbers of targets for the list. The same process derives the numbers of target elements associated with them. Because of rounding, the number of targets in this scenario is 248.

Table 2: MRC Target List With Target Elements

Targets	Target Listed	AVG TE	Target Elements
Airbase/ AF	47	11.5	541
C3	26	2	52
Power	25	1	25
Stores	35	4.5	158
POL	12	1	12
Seaport	10	1	10
IAD	34	3	102
Trans	35	1	35
GF (AA)	4	1	4
Ground Forces	3	4	12
NBC	7	1	7
Terror	1	1	1
TBM	9	1	9
Totals	248		968

Table 3: Target Definitions

Target Category	Explanation
Airbase/ AF	Airbase to include hardened shelters, maintenance areas, runways and aircraft. This category is further subdivided into a soft AB/AF element that is aircraft and fuel stations and hard AB which are runways, revetments and hardened shelters.
C3	Command, control and communications, including the category the ODS planners entitled leadership
Power	All electrical producing and distribution facilities
Stores	Military support facilities, factories, depots and warehousing operations
POL	Petroleum, oils, lubricants, facilities for producing, storing and distributing
Seaport	Seaport facilities
IAD	Integrated air defense, including that category entitled strategic air defense by the ODS planners.
Trans	Transportation assets including bridges and other transportation nodes.
GF (AA) Ground Forces Assembly Areas and Staging Areas	Tank and other ground forces assembly areas. This category only includes the combat support assets associated with those areas. The tanks, fighting vehicles, and artillery pieces will be addresses separately.
Ground Forces	Ground forces command and control nodes.
NBC	Nuclear, biological and chemical storage, production and distribution.
Terror	Terrorist camps
TBM	Tactical ballistic missiles.

IV. Assets Available

Cruise Missiles

There are several variants of the cruise missile. They fall into two broad categories, the Air Launched Cruise Missile and Sea Launched Cruise Missile. Both missiles can deliver either conventional or nuclear munitions. For purposes of comparison, the study will address Air Launched Cruise Missile as a particular munition delivered by the B-52. Of the Sea Launched Cruise Missiles, there are two basic categories, the Tomahawk Anti-Ship Missile (TASM) and the Tomahawk Land Attack Missile (TLAM). This paper will deal with the TLAM C and D models and will not address the nuclear capable model, the TLAM-N. The TLAM-C can attack a single target with a conventional warhead. The TLAM-D has the ability to attack multiple targets with submunitions.⁴²

Cruise missiles can fly at low altitude, with a small radar cross section, and are extremely accurate.⁴³ Cruise missiles are useful to attack C2, radar, fuel dumps, SAM sites, early warning, and ground control units.⁴⁴ This list encompasses virtually everything that is small, high value, and stationary. There are certain drawbacks to using TLAM that is also inherent to other strike methods.

One of these drawbacks is that TLAM will likely alert air defense systems. Thus, a coordinated strike may move the ADA system to a heightened state of alert; leading to additional cruise missile attrition during subsequent strikes.⁴⁵ Despite this, the TLAM is an excellent weapon for suppression of air defenses in advance of an air strike because no pilot is in danger while the strike is going in.⁴⁶

As stated above, timing is crucial as air defense systems are likely to recover and heighten alert postures. Some parties have also argued the TLAM is effective in stopping armored formations, artillery, trucks, and having an offensive counter-air mission by attacking airfields, and runways.⁴⁷ The Sea-launched cruise missile has the potential to support ground combat units. Although it was designed for the deep strike mission, with the currently planned modifications, it may be ready to take on a new role.⁴⁸

The TLAM-C is the predecessor of the more capable TLAM-D. The C model carries a 1000 pound unitary warhead. The Navy used TLAM-C to conduct tests for the navigation and propulsion aspects of the missile.⁴⁹ It is highly accurate and can attack command and control nodes, air defense systems, and air fields.

The TLAM-D has a submunitions dispenser that consists of packs of BLU-97 combined effects bomblets with seven bomblets per pack. The dispenser in the missile allows a weaponeer to attack a greater number of targets with a single missile thereby decreasing the number of missiles required for an attack. TLAM-D can attack up to 12 different targets by programming the missile's guidance system to fly to and attack each target sequentially. Optimizing effects on the target, the missile is best employed attacking three targets⁵⁰. However, as Table 7 in section V demonstrates, the maximum success for minimum missile expenditure is 8 target attacks per missile. The tradeoff is fewer munitions per target.

The TLAM uses a system of terrain following, electronic mapping to navigate. These systems are called the Terrain Contouring (TERCOM) and Digital Scene Matching Area Correlator (DSMAC).⁵¹ In the near future, the Navy will plan TLAM missions

aboard ship and use global positioning satellites (GPS) to aid its terrain following system.

These improvements will make cruise missile planning time analogous to that required for manned aircraft.⁵²

Table 4: Ships Capable of Delivering TLAM

Class of Ship ⁵³	Numbers Ships in 2005 ⁵⁴	Number of TLAM Probably Available ⁵⁵
Virginia CGN 38 class	Probably will not serve as a TLAM carrier.	0
Ticonderoga CG 47 class (CG 47-51 w/o TLAM)	22 available with VLS launchers.	122 cells, 1/3 to 1/2 would be TLAM depending on the mission. 61 TLAM Assumed.
Spruance DD 963 class	25	61 cell, 9/10 would normally be loaded with TLAM, again mission dependent. 54 TLAM Assumed.
Arleigh Burke DDG 51 class	32	90 cells for the Flight I ship and 96 cells for the Flight II ship. 56 TLAM assumed from Jane's.
Seawolf	3	Boat capacity is for 56 missiles or torpedoes. 30 TLAM assumed
New SSN	At least 3	20 TLAM assumed
Los Angeles SSN 688	58	20 TLAM assumed to be on the boat.
Arsenal Ship SC-21	6 planned	500 TLAM

For purposes of study, this paper assumes that one carrier battle group (CVBG) and one surface action group (SAG) will be available for the MRC. The CVBG would normally have five escorts of two cruisers (Ticonderoga class) and three destroyers of either Spruance or Arleigh Burke classes. Fleet commanders normally organize a SAG with three to five ships. The ships are always a mix of destroyers, cruisers and frigates. This paper will assume two cruisers and two destroyers are available in the SAG. The paper will further assume a similar ratio of submarines in commission to that available for

the MRC cruisers and destroyers. In one case, the two arsenal ships will also be available. The following table illustrates 739 Tomahawk missiles available for the MRC with little or no notice with the current fleet. 1739 TLAM become available with the addition of the two arsenal ships.

Table 5: Hypothetical Numbers of Ships Available for MRC

Class	CVBG	SAG	SSN	Arsenal Group
Cruiser (CG47)	(2) 122	(2) 122		
Destroyer (DD 963/ DDG 51)	(3) 177	(2) 118		
All SSN			(10) 200	
SC 21				(2) 1000
Totals	299	240	200	1000
TLAM available for MRC: 1739 with Arsenal Ship				

By 1997, each deployed CVBG will have the Afloat planning system (APS) that will enable the group to plan its own TLAM strikes, reducing planning time.⁵⁶ With the GPS aided navigation and afloat planning, the TLAM is afforded some of the mission flexibility and responsiveness of a bomber without exposing the crew to danger. TLAM-D does have the potential to attack several targets and a wide variety of targets as well. This missile shows promise; but what about bombers?

Heavy Bombers

Bombers, since their inception, have held some promise for either ending or shortening a war. This is especially true for the heavy bomber. Giulio Douhet wrote in The Command of the Air that the trend for military aviation would be toward increased bomb loads and an extended radius of action. Further, he opined that, “no logical defense can be very effective when confronted by an aerial offensive...”⁵⁷ While bombers have not always lived up to their idealized potential, they have provided decisive contributions in past wars. Some examples of these contributions include: the Allied bombing of Nazi petroleum production and Japanese industry during World War II, employment of strategic bombers in preparation for Operation Cobra, Operation Linebacker II in Vietnam, and the B-52’s role in the Gulf War.⁵⁸

The heavy bomber can deliver tons of bombs in a single strike or over several strikes. Bombers can carry a variety of different weapons giving them great flexibility. Bombers also have the ability to confirm that they are dropping their ordnance on the intended target to a much greater degree than a ship captain launching a cruise missile.⁵⁹ The obvious drawback is that relative to the sea-launched cruise missile, the bomber crew must fly into harm’s way to deliver their bombs.

To attain accuracy, the planners for bomber strikes are usually faced with a dilemma. To maximize bombs on the target, the bomber must be directly over the target. This exposes the bomber to danger from enemy air defenses. If some stand-off weapon is employed, the trade-off for the range in the weapon is not only weight of ordnance on the

target, but also degraded accuracy. Comparison of the B-52H, using the conventional air-launched cruise missile (CALCM), with the same bomber delivering M117 gravity bombs, illustrates the problem. The B-52 normally launches the missile well out of air defense ranges, and thus the bomber is not exposed to danger. To deliver gravity bombs the bomber must be almost directly over the target. The B-52 can carry up to 20 CALCM or 51 M117, 750 lbs bombs.⁶⁰ The tradeoff in explosive weight carried to the target is 20,000 pounds delivered by the CALCM versus 38,250 pounds with the M117. But the explosive load is only half the problem. The explosive must also hit the target to be of any use.

The closer the B-52 can fly to the target, the more M117 bombs it will drop on the target. The closer the bomber flies to the target, the better the crew are able to confirm the target and adjust their attack. But, the closer the bomber is to the target, the more bomber is in danger. The CALCM does not have this problem, its range to the target is immaterial to the ordnance it delivers. But, because it is air-launched, it is only half as accurate as the sea-launched version of the same cruise missile.⁶¹ This is a serious problem when attacking hardened targets.

The Air Force intends to fly three bombers into the next century: the B-2, the B-1B, and the B-52 H. The Air Force is also converting the entire bomber fleet to have a robust conventional weapons capability. The Air Force intends the B-2 to penetrate and destroy heavily defended high value targets (HVT). The B-2 can operate alone. The B-1B will be workhorse for standoff or penetration. Of all three bombers, the B-1 has greatest speed and payload. The Air Force will use the B-52H primarily as a standoff platform unless it is operating in a low threat environment.⁶²

The B-52 is a long-range, heavy bomber that is capable of many missions. The bomber can fly at high subsonic speeds at altitudes up to 50,000 feet. It can carry nuclear or conventional ordnance with worldwide precision navigation capability. In a conventional conflict, the B-52 can perform air interdiction, offensive counterair and maritime operations. During Desert Storm, B-52s delivered 40 percent of all the weapons dropped by coalition forces.⁶³ The B-52 may remain in the Air Force inventory until 2045.⁶⁴

The B-52 can deliver 8 types of general purpose gravity bombs weighing 500-2000 pounds, 6 types of cluster munitions, 2 types of chemical, 2 types of laser-guided bombs, 12 different sea mines, and 2 special purpose leaflet/chaff bombs.⁶⁵ Equipped with GPS, the B-52 can launch conventional air launched cruise missiles (CALCM) accurately from 650 miles from the target.⁶⁶

All B-52s are equipped with advanced television sensors to augment the targeting, battle assessment, flight safety and terrain-avoidance system. This system further improves the bomber's combat ability and low-level flight capability to get to the target. What the B-52 lacks, however, is stealth. The B-52's size and radar cross section make it relatively easy to detect and engage by modern air defense systems.⁶⁷ For this reason, the Air Force intends to use the B-52H primarily in the standoff role. When provided air superiority, it can also deliver precision strikes and massive bomb loads.⁶⁸

The newer B-1B is a multi-role, long-range bomber, capable of flying intercontinental missions without refueling, then penetrating present and predicted sophisticated enemy defenses. It can perform a variety of missions, including that of a conventional weapons carrier for theater operations.⁶⁹ Crew endurance is the only

limitation to the range of the bomber. With in-flight refueling, the bomber can literally fly around the world.⁷⁰ The B-1B uses radar and inertial navigation equipment that provides for worldwide navigation and precision bombing without the use of external updates.⁷¹

The Air Force plans the B-1B to deliver 2000 pound gravity bombs, the Joint Service Stand-off Attack Missile (JSSAM), the Joint Direct Attack Munitions I and III, the Joint Stand-off Weapon (JSOW), and Sea mines. With its smaller radar cross section, the B-1B is able to penetrate farther into an enemy's air defense network than the older B-52. The B-1B can probably penetrate a country's terminal air defense capability (5-15 nautical miles).⁷²

The B-2 Spirit is a multi-role bomber capable of delivering both conventional and nuclear munitions. The B-2 represents a huge jump forward in technology. The B-2 can bring massive firepower to bear, in a short time, anywhere on the globe through previously impenetrable defenses.⁷³ The B-2's unrefueled range is approximately 6,000 nautical miles (9,600 kilometers). With refueling, crew endurance is the only limit to the range of B-2.⁷⁴ The Air Force designed the B-2 for the precision strike mission with a minimum danger in mind. It has the capability to detect ground targets and other aircraft that combine many of the capabilities found on JSTARS and AWACS.⁷⁵

The Air Force plans the B-2 to deliver 2000 pound gravity bombs, the JSSAM, JDAM I and III, and sea mines.⁷⁶ It is able to penetrate even terminal air defenses. This feature allows the B-2 to deliver munitions more or less directly on the target. As noted above, older bombers must normally achieve standoff by trading off part of the bomb load for missiles to deliver the warheads to target. This standoff is necessary in both the B-1B and the B-52 because of those aircraft have less ability to penetrate air defenses than the

B-2. However, even the stealth technology of the B-2 does not provide invulnerability. It reduces the range that radar can detect the aircraft and has features that make it difficult to track once acquired.⁷⁷

The numbers of bombers available for the MRC is dependent upon the crisis situation that the nation is facing. But we may approximate the numbers of bombers available. General Loh states that 184 bombers provide a force of 100 bombers available for an MRC after deducting some not available for maintenance and nuclear reserves.⁷⁸ The RAND Corporation, in their book, The New Calculus, posits that with the programmed B-1B force, that 64 B-1B would be available for an MRC.⁷⁹ A likely usage profile for the B-2 provides only 7 B-2 available for an MRC as well.⁸⁰ This leaves 29 B-52 to round out the 100 that General Loh posits.

Table 6 provides a brief synopsis of the different munitions used in this study that bombers could deliver. The list is by no mean inclusive of all bomber delivered munitions.

Table 6: Bomber Delivered Munitions

Munition	Description	Warhead	Range
CALCM (AGM-86) ⁸¹	Air launched cruise missile	1000 lbs unitary warhead	650 Nm
Joint Air to Surface Standoff Missile (JASSM) ⁸²	Improved cruise missile	1000 lbs, hard target kill capability	Greater than 50 Nm
JDAM ⁸³	GPS aided bomb	2000 lbs high explosive	18 Nm from high altitude
Mk 82 ⁸⁴	Gravity bomb	500 lbs high explosive	None

V. Analysis and Evaluation

Cruise Missile Success

The First Case. Brilliant anti-tank munitions are not available for the TLAM. Consequently, the study will restrict attacks on enemy ground forces to his combat service support, transportation nodes, and lower level command and control facilities. The posited cruise missile strike will perform offensive counterair, strategic attack, and air interdiction missions. The cruise missile targets are the enemy's integrated air defenses, air bases, transportation facilities, and logistics capability as defined by the target list.

Previous assumptions provide a total of 1,739 TLAM missiles of either type available for the MRC. TLAM C with a penetrator is best for attacks against hard targets such as command and control nodes, air base runways, transportation nodes, and NBC storage and production facilities. The TLAM D is better suited against soft targets such as integrated air defense assets, aircraft parked without protection, ground forces combat service support assets, petroleum storage, stores, power facilities, materiel stockpiles, seaport facilities, and terror bases. The following table illustrates the optimum number of missiles to allocate against a target set using TLAM D against the integrated air defense set posited to exist in the MRC. An 8 attack per TLAM D profile yields the best result.

Table 7: Optimal TLAM Strikes Per Missile, Minimizing TLAM Expenditure

Target	# Tgt Ele	# Attks /missile	P(Launch) ⁸⁵	P(Hit) ₈₆	P(Kill) ⁸⁷	P(Success)	# Strikes (n)	# Missiles Used
			0.98	0.35				
IAD	101	12	0.98	0.35	0.30	0.10	965	80
	101	10	0.98	0.35	0.51	0.18	571	57
	<i>101</i>	8	<i>0.98</i>	<i>0.35</i>	<i>0.66</i>	<i>0.23</i>	<i>443</i>	<i>55</i>
	101	6	0.98	0.35	0.75	0.26	390	65
	101	4	0.98	0.35	0.84	0.29	348	87
	101	2	0.98	0.35	0.88	0.30	332	166

Italics show minimum missile expenditure to destroy 101 target elements (8).

Where:

$P(s) = P(\text{Success})$

$P(h) = P(\text{Hit})$

$P(k) = P(\text{Kill})$

$P(s) = P(h) * P(k)$ Table 7 shows $P(s)$ is .23 for soft targets. Table 8 shows $P(s)$ for C3 as .09 and for Airbase (AB) as .31. These two factors are different because they use TLAM-C, with a unitary warhead to attack the target elements. The source data for $P(h)$ for the TLAM-C is the same as in $P(h)$ in Table 7.

Strikes = n

Attacks / missile = a

Missiles Used = $\frac{n}{a} C_i$ is the confidence in destroying a target, always .8 in this paper.

The equation $C_i = 1 - (1 - P(s))^n$ derives n.

With 1,739 missiles available at the start of the MRC, the TLAM destroy the following number of targets.

Table 8: Required TLAM Strikes to Destroy Each Target Element

Target	# Tgt Ele	P(Success)	# Strikes (n)	Req Strike	Req TLAM	Cumulative TLAM
IAD	102	0.23	6	612	77	77
C3	52	0.09	17	884	884	961
AB/AF	408	0.23	6	2448	306	1267
AB	133	0.31	4	532	532	1799
GF(AA)	4	0.23	6	24	3	1802
GF	12	0.23	6	72	9	1811
Trans	35	0.23	6	210	27	1838
POL	12	0.23	6	72	9	1847
NBC	7	0.23	6	42	6	1853
TBM	9	0.23	6	54	7	1860
Power	25	0.23	6	150	19	1879
Stores	158	0.23	6	948	119	1998
Seaport	10	0.23	6	60	8	2006
Terror	1	0.23	6	6	1	2007

There are not enough TLAM available to destroy every target on the list. This scenario requires 2007 TLAM to destroy each target. This represents an additional 268 missiles to destroy all the identified targets. By reducing the allocation of strikes against the command and control (C3) set, the attack destroys 937 of the total target elements. By reducing the attack on C3, roughly 40% (21 target elements) of their command and control function remain in place. Clearly, the attack would do significant damage.

The Second Case. Brilliant Anti-tank (BAT) munitions are available and in theater on the Arsenal ship. The ground forces of the enemy army thus become the top priority target set.

Successfully defeating an attack is defined as destroying 3 of the enemy armored divisions. This is defined for this paper as equaling destruction of 1080 armored vehicles and 600 artillery pieces. Using the 4 vehicles killed per missile expenditure cited by

Jane's (see above on page 6), this attack only requires 420 missiles. The number of missiles required assumes the target footprint is within the system parameters. This leaves 580 additional missiles available on day 1 of the MRC. By not attacking the C3 target set, there are sufficient TLAM to destroy the other target elements. There are only enough missiles remaining in this case to destroy 7 C3 target elements in this case.

Still, the missiles do destroy most of the enemy's ability to wage war. What remains is his command and control structure. With the arsenal ship and BAT, the air interdiction campaign is still successful.

Heavy Bomber Success

The first case. Sensor fuzed weapons (SFW) and brilliant anti-tank munitions that make the bomber effective against armored formations are not available. Attacks against the target list are restricted to ground forces in the same manner as the first cruise missile case. The bombers will perform offensive counterair, strategic attack, and air interdiction missions.

Table 9: Bomber Results Day 1, Case 1

Pri	Target	# Tgt Ele	Type Acft	Munitions	Avail Sorties	# MUNIT ⁸⁸	P(In) ⁸⁹	P(Kill) ⁹⁰	Req Strike	TE Dest	Attrition
1	IAD	102	B-2	JDAM	7	16	1	0.98	102	112	0
		0	B-1B	JDAM	0	16	1	0.98	0	0	0
		0	B-52H	CALCM	0	16	1	0.98	0	0	0
2	C3	52	B-2	JDAM	1	10	1	0.98	52	10	0
		42	B-1B	JASSM	64	12	0.98	0.05	1386	24	3
		18	B-52H	JASSM	29	12	0.92	0.05	630	10	5

Where: Pri is the priority of destroying the target. Assigned by the Commander in Chief of the theater.

Target is the type of target.

Tgt Ele is the number of target elements in that target.

Type Acft is the type of air frame being flown on the mission.

Munitions are the bomb load the air craft is carrying.

Avail Sorties are the number of sorties that are available each day for each type of aircraft.

Munitions are the number of smart munitions that the aircraft can carry. In the case of gravity bombs, such as the Mk 82 and Mk 84, it represents how many target elements the bomber can attack with a gravity bomb load. For example, the B-1B has 3 bays, one bay of gravity bombs expended for each target.

P(In) is the probability of Ingress

P(Kill) is the probability of destroying the target element

P(s) = P (Success)

P(s) = P(In) * P(Kill)

Req Strikes is the required number of strikes on a target element to have confidence of success. Req Strikes = n

C_i is the confidence in destroying a target, always .8 in this paper.

The equation $C_i = 1 - (1 - P(s))^n$ derives n.

TE Dest is the number of target elements that may be reliably assumed to be destroyed with the given amount of sorties and bomb load out.

Attrition is the number of aircraft assumed to be lost in that mission.

Table 10: Bomber Results, Day 2, Case 1

Pri	Target	# Tgt Ele	Type Acft	Munitions	Avail Sorties	# MUNIT	P(In)	P(Kill)	Req Strike	TE Dest	Attrition
2	C3	8	B-52H	JASSM	24	12	0.92	0.05	280	9	2
3	AB/AF	408	B-2	MK 82	7	36	1	0.95	408	252	0
		156	B-1B	JASSM	61	12	0.98	1	156	732	1
		0	B-52H		0	0	0	0	0	0	0
4	AB	133	B-2		0	0	0	0	0	0	0
		133	B-1B	JASSM	48	12	0.98	0.05	4389	18	1

Table 11: Bomber Results, Day 3, Case 1

Pri	Target	# Tgt Ele	Type Acft	Munitions	Avail Sorties	# MUNIT	P(In)	P(Kill)	Req Strike	TE Dest	Attrition
4	AB	115	B-2	JDAM	7	16	1	0.98	115	112	0
		3	B-1B	JASSM	6	12	0.98	0.05	99	3	1
4	GF (AA)	4	B-1B	Mk 82	1	84	0.7	0.95	8	42	0
5	GF	12	B-1B	Mk 82	1	84	0.7	0.95	24	42	0
6	Trans	35	B-1B	Mk 82	1	84	0.7	0.95	70	42	0
7	POL	12	B-1B	MK 82	1	84	0.7	0.95	24	42	0
8	NBC	7	B-1B	MK 82	1	84	0.7	0.95	14	42	0
9	TBM	9	B-1B	MK 82	1	84	0.7	0.95	18	42	0
10	Power	25	B-1B	MK 82	1	84	0.7	0.95	50	42	1
11	Stores	158	B-1B	MK 82	4	84	0.7	0.95	316	168	2
12	Seaport	10	B-1B	MK 82	1	84	0.7	0.95	20	42	0
13	Terror	1	B-1B	MK 82	1	84	0.7	0.95	2	42	1

The bomber is clearly successful. By day three, the bombers have destroyed every target element. The cost in terms of bomber attrition is 10 B-1B and 7 B-52H or 17 total aircraft. 17% attrition is high by any bombing campaign standard. But, the bomber force is not only viable, it is still on hand to continue to prosecute the war.

The second case. Sensor Fused Weapons are available. The scenario uses the B-2 exclusively to destroy the enemy armored advance. According to a RAND study, "The Use of Long Range Bombers in a Changing World: A Classic Exercise in Systems Analysis", 27 B-2 sorties will be needed to destroy the maneuver brigades of the three divisions attacking. The B-2 attacks will take four days and allocate the remaining fifth day to attack the artillery systems.⁹¹

Table 12: Bomber Results, Day 1, Case 2

Target	# Tgt Ele	Type Acft	Munitions	Avail Sorties	# Munit	P(In)	P(Kill)	Req Strike	Req Sorties	TE Dest	Attrition
IAD	102	B-1B	JASSM	9	12	0.98	0.98	102	9	108	1
IAD	0	B-52H	CALCM	0	16	1	0.98	0	0	0	0
C3	52	B-1B	JASSM	55	16	0.98	0.05	1716	108	27	3
C3	25	B-52H	JASSM	29	12	0.92	0.05	875	73	10	6
AB/AF	408	B-1B	JDAM	0	16	0.98	0.98	408	26	0	1

Table 13: Bomber Results, Day 2, Case 2

Pri	Target	# Tgt Ele	Type Acft	Munitions	Avail Sorties	# Munit	P(In)	P(Kill)	Req Strike	TE Dest	Attrition
2	C3	15	B-1B	JASSM	49	12	0.98	0.05	495	18	1
2	C3	0	B-52H	JASSM	0	12	0.92	0.05	0	0	0
3	AB/AF	408	B-1B	JASSM	11	12	0.98	1	408	132	1
3	AB/AF	276	B-52H	JASSM	23	12	0.92	1	276	276	2

Table 14: Bomber Results, Day 3, Case 2

Pri	Target	# Tgt Ele	Type Acft	Munitions	Avail Sorties	# Munit	P(In)	P(Kill)	Req Strike	TE Dest	Attrition
4	AB	133	B-1B	JASSM	45	12	0.98	0.38	532	135	1
4	AB	0	B-52H	JASSM	0	12	0.92	0.38	0	0	0
4	GF(AA)	4	B-1B	Mk 82	4	84	0.95	0.7	8	168	1
5	GF	12	B-1B	Mk 82	9	84	0.95	0.7	24	378	1
6	Trans	35	B-52H	HAVE- NAP	21	8	0.8	0.98	70	84	2

Table 15: Bomber Results, Day 4, Case 2

Pri	Target	# Tgt Ele	Type Acft	Muniti ons	Avail Sorties	# Munit	P(In)	P(Kill)	Req Strike	TE Des t	Attrition
7	POL	12	B-1B	Mk 82	12	3	0.95	0.7	24	18	1
8	NBC	7	B-1B	JDAM	7	3	0.95	0.7	14	11	0
9	TBM	9	B-1B	Mk 82	9	3	0.95	0.7	18	14	0
10	Power	25	B-1B	Mk 82	25	3	0.95	0.7	50	38	1
11	Stores	158	B-1B	Mk 82	2	3	0.95	0.95	158	6	0
11	Stores	152	B-52H	MK 84	19	2	0.95	0.95	152	38	0

Table 16: Bomber Results, Day 5, Case 2

Pri	Target	# Tgt Ele	Type Acft	Muniti ons	Avail Sorties	# MUNI T	P(In)	P(Kill)	Req Strike	TE Dest	Attrition
11	Stores	93	B-1B	MK 84	31	3	0.95	0.95	93	93	2
12	Seapo rt	10	B-1B	MK 84	10	3	0.95	0.95	10	30	0
13	Terror	1	B-1B	MK 84	1	3	0.95	0.95	1	3	0

Again the bomber is successful in destroying the targets on the list. Because the second case diverts the B-2 to the armored formations, the bombers require the full five days to destroy each target on the list. Bombers have also borne a much heavier load in the war by destroying the three armored divisions. But the price is very high in bomber attrition. The Air Force would lose a total of 24 bombers: 14 B-1B and 10 B-52H.

To put the attrition in perspective, the Allies in World War II felt that 10% was the greatest attrition they could accept. When faced with the 12-16% attrition in October 1943, they curtailed deep clear weather raids.⁹² On the other hand, the loss of 24 air

crews over five days has provided the United States with what is probably the condition for victory in an MRC. These losses are probably acceptable for the five day period.

Comparison

For attacking soft targets, Tomahawk is clearly a good solution to many of the target requirements in this scenario. For even a slightly larger scenario, the United States would require thousands more cruise missiles. The Gulf War was such a case. The greatest restriction to having more missiles is the need to have something to launch them. The numbers in this study do not suggest it practical to go after hard targets with cruise missiles except in cases where the enemy defends the target extremely well and some other means of penetration is not available. In that case, we must be prepared to attack it with many missiles to ensure success. The C3 category in this study demonstrates how many missiles the Navy must shoot to destroy the target set.

To boosters of the cruise missile, the answer may be in more arsenal ships. The drawback of arsenal ships is that 1000 cruise missiles on two ships is a very lucrative target. The Navy has invested fantastic sums to protect one or two aircraft carriers in the same vicinity. Two or four more arsenal ships in one place will increase the need to protect these valuable assets and hence increase the need for more cruisers, submarines, and other escorts.

With precision guided munitions and large bomb loads, the bomber is a great option for tough targets. The difficulty of course, is getting the bombers close enough to the target and not suffer too much attrition.

Another advantage that the bomber has is persistency. After bombers complete this target list, they are ready to take on another mission and continue to take the fight to the enemy. However, the Air Force cannot attack at the pace of this study for weeks on end. With maintenance on the aircraft and rest for the crews, the Air Force can keep up significant pressure at a somewhat reduced rate.

Additionally, the bomber can adjust where it will deliver its bomb load if the enemy has moved the target element. This is a likely situation with mobile air defense assets. Bombers can also take the final moments before launch to confirm that the target is exactly where it was thought to be and adjust their aim if it is not.

VI. Conclusion and Summary

Within the parameters of this study, planned force structure, and fighting a hypothetical MRC, the bomber would appear to be the better system. The United States does not appear yet to be able to take a human being out of harm's way to conduct air interdiction or strategic interdiction.

In the first case, The bomber not only destroyed all the elements on this target list, but they are likely prepared to begin to fight the second required MRC. Arguably, the Nation has not expended its stock of cruise missiles. The Navy could do more with more missiles. More will be available in a subsequent theater as well; but the limited number of launchers will have the same problems providing the desired effects. The missile's greatest problem is that there cannot, in the parameters of this study, be enough of them.

In the second case, the bomber is still superior. Cruise missiles, capable of delivering the BAT munition, are capable of destroying tank formations. However, when configured to do so, they are not available for other uses. The issue in this case is one of flexibility. The bomber does not need to be reconfigured to carry out the anti-armor mission on one day and strategic attack the next. The bomber needs only to loaded out differently.

Does this conclusion infer that cruise missiles or even arsenal ships are not a good idea? No, the U.S. can use cruise missiles against many of the targets in this scenario that are soft, a likely high payoff and well protected. The level of protection is obviously the greatest determinate in bomber attrition. If a new scenario used cruise missiles

against the soft target categories of integrated air defense (IAD) and air bases, it would have required a total TLAM expenditure of 383 missiles. Using cruise missiles frees bombers to attack other targets and saves them attacking the really difficult ones. This may have saved up to 15 bombers because as the bombers then attacked the hard, well-protected C3 targets; the air defense and counterair systems would have been ineffective.

The cruise missile also shows promise in an anti-armor air interdiction role. In the case where the U.S. cannot have immediate air superiority, the cruise missile is an attractive alternative to stop an armored attack. What it does not seem capable of doing is stopping all the armored attacks or even a second echelon attack. The Navy force structure simply does not support that many missiles.

Together, the capabilities of the two systems put the doctrinal overlap issues into perspective. What seems to put the Navy's sea-launched assets in competition with Air Force bombers is in fact a parallel need. Both services need to establish air superiority, interdict enemy forces, and attack the enemy's vulnerabilities. Both, in short need to dominate the battlespace. The best use of these systems is together and not competing. They have many different qualities and shortcomings which together have complementary effects. Together, they create a synergy that will set the conditions for victory.

VII. Endnotes

- 1 U.S. President, National Security Strategy (NSS), (Washington, D.C.: White House, February, 1995), p. 9.
- 2 Department of the Navy, Naval Warfare, Naval Doctrinal Publication 1 (NDP-1), (Washington, D.C.: Government Printing Office, 28 March 1994), p. 63-4.
- 3 Department of Defense, Joint Doctrine for Theater Counterair Operations, Joint Pub 3-01.2, (Washington, D.C.: Government Printing Office, 1 April 1986), p. III-1.
- 4 Department of the Air Force, Basic Aerospace Doctrine of the United States Air Force, Air Force Manual 1-1, Vol II, (Washington, D.C.: Government Printing Office, March 1992), p. 10.
- 5 AFM 1-1, Vol I, p. 12.
- 6 Department of Defense, Doctrine for Joint Operations, Joint Pub 3-0, (Washington, D.C.: Government Printing Office, 1 February 1995), p. xi.
- 7 NDP-1, pp. 63-6.
- 8 Deputy Chief of Naval Operations, Resources, Warfare Requirements and Assessments, Force 2001, A Program Guide to the U.S. Navy, (Washington, D.C.: U.S. Navy, 1995), pp. 11.
- 9 Ibid, p. 32-35.
- 10 AFM 1-1, Vol II, pp. 6-7.
- 11 General Accounting Office, Strategic Bombers, Adding Conventional Capabilities Will Be Complex, Time-Consuming, and Costly, (Washington, DC: Government Printing Office, February 1993), p. 28. Hereafter cited as GAO, Feb 93.
- 12 Quoted in GAO, Feb 93, p. 28.
- 13 Joseph W. Ralston quoted in John A. Tirpak, "Heavyweights for the New Strategy," Air Force Magazine, Vol 78, No. 10, (October 1995), p. 32.
- 14 Ibid.
- 15 GAO, Feb 93, pp. 28-9.

16 U.S. Congress, House, Committee On Appropriations, National Security Subcommittee, "Bomber Modernization Report" Prepared By Paul G. Kaminski, Under Secretary Of Defense For Acquisition And Technology. 104th Congress, 2d Sess., May 17, 1995, p. 4.

17 General Accounting Office, Cruise Missiles: Proven Capability Should Affect Aircraft and Force Structure Requirements (U), (Washington, DC: Government Printing Office, 20 April 1995), p. 14. Hereafter cited as GAO, Apr 95.

18 U.S Army Field Artillery School, LTC Wiley, Unpublished Fact Sheet, Subject Multiple Launch Rocket Systems, ATSF-RMS, 25 September 1995.

19 GAO, Apr 95, pp. 8, 55, and 57.

20 Christopher M. Wode, CDR, "Beyond Bombers Versus Carriers -- What is Really at Stake in the Services' Turf Battle", Armed Forces Journal International, Vol 132, no 9 (Apr 95) pp. 29-30.

21 Jon P. Walman, LT, USN, "The 'New Generation' of Combatants: SC-21, Arsenal Ship Reflect 21st Century Vision", Surface Warfare, Vol 20, No 6 (November/December 1995), pp. 2-8.

22 Quoted in GAO, Feb 93, p. 28.

23 Scott C. Trover, "Floating Arsenal to be 21st Century Battleship," Jane's International Defense Review, Volume 29, July 1996, p.45.

24 Air Force News Agency, "Bomber Force Projection", Air Force Update, (Kelly AFB, TX,: U.S. Air Force, February 1994), p. 15.

25 AFM 1-1, Vol II, p. 47.

26 AFM 1-1, Vol II, p. 47.

27 NDP-1, p. 17.

28 Department of Defense, Department of Defense Dictionary of Military and Associated Terms, Joint Pub 1-02, (Washington, D.C.: U.S. Government Printing Office, 29 March 1994), p. 16.

29 Joint Pub 1-02, p. 298.

30 Joint Pub 1-02, p. 100.

-
- 31 Joint Pub 3-01.2, p. I-1.
- 32 Joint Pub 3-0, p. IV - 7.
- 33 Department of Defense, Doctrine for Joint Interdiction Operations, Joint Pub 3-03, (Washington, D.C.: U.S. Government Printing Office, 11 December 1990), p. II-1 to II-2.
- 34 NDP-1, p. 64.
- 35 AFM 1-1, Vol I, p. 10.
- 36 NSS, p. 9.
- 37 Christopher Bowie, and others, The New Calculus: Analyzing Air Power's Changing Role in Joint Theater Campaigns, (Santa Monica, CA: RAND Corporation, 1993), p. 16.
- 38 Glenn C. Buchan, "The Use of Long-Range Bombers in a Changing World: A Classical Exercise in Systems Analysis" reprinted from New Challenges for Defense Planning: Rethinking How Much is Enough, edited by Paul K. Davis, (Santa Monica: RAND, May 1994) p. 397. Hereafter, cited as "Buchan, Long Range Bombers".
- 39 Glenn Buchan, Dave Frelinger, and Tom Herbert, "Use of Long-Range Bombers to Counter Armored Invasions", RAND Corporation White Paper, (Santa Monica, CA: RAND, March 1992), p. 2, et al. Hereafter cited as Buchan, Bombers, Mar 92.
- 40 Thomas A. Keaney and Eliot A. Cohen, Revolution in Warfare?, (Annapolis, MD: Naval Institute Press, 1995), p. 26.
- 41 Keaney and Cohen, p.266.
- 42 GAO, Apr 95, pp. 2 and 14.
- 43 Roy A. Griggs, "Can the Navy's Tomahawk Land Attack Missile - Conventional (TLAM-C) Be Used in Support of the Army's Airland Battle?" (Masters Thesis, Naval War College, 1987), p. 5.
- 44 Griggs. p. 12.
- 45 Dennis G. Morral, CDR, USN, "Conventional Tomahawk Land Attack Missiles: Issues Concerning Tomahawk's Tactical Use and Integration With Attack Aviation", (Masters Thesis, Naval War College, Newport RI, 1989), p. 18.

46 Robert J. Balaconis, CDR, USN, "Integrated Strike Warfare High Fidelity Simulation: Cruise Missiles and TACAIR support of Airland Battle", (Masters Thesis, Naval Postgraduate School, Monterey, CA: 1989), p. 62 and Griggs, p. 11.

47 (S) Institute for Defense Analysis, "Soviet Defense Against Conventionally Armed Land Attack Cruise Missile (U)", Prepared for Office of the Under Secretary of Defense for Research and Engineering (Strategic and Theater Nuclear Forces) and (Tactical Warfare Programs), IDA Report R275, June 1984, DTIC: AD-C035-065. Cited material is unclassified, p. 1.

48 Dennis A. O'Brien and James J Malloy, "Use of TLAM in Support Of Joint Operations", (Masters Thesis, Monterey, CA, Naval Postgraduate School, 1991), DTIC AD-B159 611L, p. 8.

49 Thomas J. Phalon, LCDR, USN, "Optimal Targeting for the Tomahawk-D Cruise Missile," (Thesis, Naval Postgraduate School, 1988), p. 8.

50 Ibid., p. 8.

51 O'Brien, p. 12.

52 (S) Commander, Operational Test and Evaluation Force, USN, "Follow-on Operational Test and Evaluation (OT-IIIT) of the Tomahawk Weapon System With Combat Control System Mk 1 With Programmed C4.2 (Rev 1) (U)" DTIC: AD-C051-167. Cited information is unclassified. Also, GAO, Missiles APR 1995, p. 5.

53 Captain Richard Sharpe, OBE, RN, ed., Jane's Naval Weapon Systems (JNWS) Dec 95, Issue 19.

54 Captain Richard Sharpe, OBE, RN, ed., Jane's Fighting Ships, 99th edition, (1996-7), (Surrey: Jane's Information Group, 1996), pp 796-814.

55 Ibid and personal interview with LCDR George Bonsall, USN. LCDR Bonsall was a U.S. Army Command and General Staff College student at the time, but had served on a Spruance Class Destroyer and as a planning officer for Tomahawk strike missions. Interview was conducted on 17 October 1996. Hereafter cited as Bonsall.

56 Bonsall, 17 October 1996.

57 Giulio Douhet, The Command of the Air, trans. Dino Ferrari (New York: Coward-McCann, 1942; reprint, Washington, D.C.: Office of Air Force History, 1983), pp. 55 and 65.

58 For additional information about Operation Cobra and the Allied bombing of Nazi Germany see B.H. Liddel Hart, Strategy, 2nd. Ed, Rev ed. (London: Faber and Faber, 1954; reprint, New York: Signet, 1974), pp 286, 259, 302. Bombing's contribution to ending the war with Japan is documented in the U.S. Strategic Bombing Survey, Summary Report (Pacific War), (Washington, D.C.: U.S. Government Printing Office, 1946), pp 25-6. For information about Linebacker II see Earl H. Tilford, Jr., Crosswinds, (College Station, TX: Texas A&M University Press, 1993), 167-72. Information about the bombers contribution to the Gulf War see Thomas A. Keaney and Eliot A. Cohen, Gulf War Air Power Survey Summary Report, (Washington, D.C.: U.S. Government Printing Office, 1993), 15 - 24.

59 Robert B Kline, and Gregory A. Whaley, "Attacking Relocatable Targets with the B-1B: A Methodology for Analyzing the Effectiveness of Alternative Weapons" (M.S. Thesis., Air Force Institute of Technology, Air University, 1986), pp. 9, 19, and 20.

60 Air Force Detachment, U.S. Army Command and General Staff College, Prairie Warrior 96, Air Component Command, Air Power Guide, (Fort Leavenworth, KS: U.S. Army Command and General Staff College, 15 April 1996), p. 108. Hereafter cited as Air Power Guide.

61 GAO, Apr 95, p. 5.

62 Air Force News Agency, "Bomber Force Projection", Feb 94, p. 1.

63 Air Combat Command, "B-52 Stratofortress," Air Force Fact Sheets, USAF Fact Sheet 96-11, (Langley AFB: Office of Public Affairs; 115 Thompson Street, Suite 211; April 1996), p. 1. Hereafter cited as USAF Fact Sheet 96-11.

64 USAF Fact Sheet 96-11, p. 1.

65 GAO, Feb 93, p. 3.

66 Ibid., p. 17.

67 Buchan, "Long Range Bombers", p.427.

68 Air Force News Agency, "Bomber Force Projection", Feb 94.

69 Air Combat Command, "B-1B Lancer", Air Force Fact Sheets , USAF Fact Sheet 92-65, (Langley AFB: Office of Public Affairs; 115 Thompson Street, Suite 211; October 1992), p. 1. Hereafter cited as B-1B Fact Sheet.

70 B-1B Fact sheet.

71 B-1B Fact Sheet.

72 Buchan, "Long-Range Bombers", p.428.

73 Air Combat Command, "B-2 Spirit," Air Force Fact Sheets, USAF Fact Sheet 95-05, (Langley AFB: Office of Public Affairs; 115 Thompson Street, Suite 211; July 1995), p. 1. Hereafter cited as B-2 Fact Sheet.

74 B-2 Fact Sheet.

75 Buchan, "Long-Range Bombers", p.436.

76 GAO, Feb 93, p. 31.

77 Buchan, "Long-Range Bombers", p.428-9.

78 General Loh quoted in Air Force News Agency, "Bomber Force Projection", Feb 94, p. 15.

79 Bowie, p. 50.

80 David L. Eggers, LTC USAF, "The B-2 Bomber: A Strategic Assessment", (Thesis, Industrial College of the Armed Forces, National Defense University, Fort McNair, Washington DC, 1992), p. 26.

81 GAO Apr 95, p. 2.

82 Assistant Secretary of the Air Force (Acquisition), Precision Guided Munitions Investment Strategy White Paper, (Washington, D.C.: Department of the Air Force, Directorate of Fighter, C2 and Weapons Programs, 1060 Air Force Pentagon, April 25, 1995), p. 8.

83 Buchan, "Long Range Bombers", p.424.

84 Air Power Guide, p. 63

85 GAO, Apr 95, p. 2. "288 tomahawk attacks, 282 transitioned to cruise flight." Using these numbers, 98 % probability of launch is extrapolated.

86 Ibid., p. 5.

87 Phalon, p. 33. This thesis is an operations research project that assessed probability of kill given a certain number of bomblets over a given area. It assumed the missile reached the target and states that the single biggest factor for TLAM is accuracy and not bomblet

dispersion. (p. 19) The study did not address TERCOM or DSMAC accuracy or reliability associated with the missile (p. 17).

88 AF Fact Sheet, 92-65 for B-1B Gravity Bomb Load. Remaining loads are from Air Power Guide, p. 108.

89 Tirpak, p. 9 for the B-2 Ingress. B-1 ingress is from Glenn Buchan, Providing an Effective Bomber Force for the Future, (Santa Monica, CA: RAND, May 1994), p. 9, 30.

90 Buchan, Providing an Effective Bomber Force for the Future, p. 6 and 13.

91 Glenn Buchan, Dave Frelinger, and Tom Herbert, Use of Long-Range Bombers to Counter Armored Invasions, (Santa Monica, CA, RAND Corporation: March 1992) p. 28.

92 John Warden III, The Air Campaign, (Fort McNair, National Defense University Press, 1988), p.69.

Bibliography

Books

Bowie, Christopher, Fred Frostic, Kevin Lewis, John Lund, David Ochmanek, and Philip Proper. The New Calculus: Analyzing Air Power's Changing Role in Joint Theater Campaigns. Santa Monica, CA: RAND Corporation, 1993.

Buchan, Glenn C. "The Use of Long-Range Bombers in a Changing World: A Classical Exercise in Systems Analysis." Chap in New Challenges for Defense Planning: Rethinking How Much is Enough. Edited by Paul K. Davis, Santa Monica, CA: RAND, May 1994.

Douhet, Giulio. The Command of the Air. Trans. Dino Ferrari. New York: Coward-McCann, 1942; reprint, Washington, D.C.: Office of Air Force History, 1983.

Keaney Thomas A. and Eliot A. Cohen, Revolution in Warfare? Annapolis, MD: Naval Institute Press, 1995.

Liddell Hart, B.H. Strategy. 2nd. Ed, Rev ed. London: Faber and Faber, 1954; reprint, New York: Signet, 1974.

Sharpe, Richard Captain, OBE, RN, Edited by. Jane's Fighting Ships. 99th Edition (1996-7). Surrey: Jane's Information Group, 1996.

Tilford, Earl H. Jr. Crosswinds. College Station, TX: Texas A&M University Press, 1993.

Warden, John III. The Air Campaign. Fort McNair, National Defense University Press, 1988.

Thesis or Dissertations

Balaconis, Robert J. CDR, USN. "Integrated Strike Warfare High Fidelity Simulation: Cruise Missiles and TACAIR support of Airland Battle". Masters Thesis, Naval Postgraduate School, Monterey, CA: 1989.

Eggers, David L. LTC USAF. "The B-2 Bomber: A strategic Assessment." Industrial College of the Armed Forces, National Defense University, Fort McNair, Washington DC: 1992.

Griggs, Roy A. "Can the Navy's Tomahawk Land Attack Missile - Conventional (TLAM-C) Be Used in Support of the Army's Airland Battle?" Masters Thesis, Naval War College, 1987.

Kline, Robert B. and Gregory A. Whaley. "Attacking Relocatable Targets with the B-1B: A Methodology for Analyzing the Effectiveness of Alternative Weapons." Masters Thesis, Air Force Institute of Technology, Air University, 1986.

Morral, Dennis G. CDR, USN, "Conventional Tomahawk Land Attack Missiles: Issues Concerning Tomahawk's Tactical Use and Integration With Attack Aviation". Masters Thesis, Naval War College, Newport RI, 1989.

O'Brien, Dennis A. and Malloy, James J. "Use of TLAM in Support Of Joint Operations". Thesis, Naval Postgraduate School, Monterey, CA, 1991.

Phalon, Thomas J. LCDR, USN. "Optimal Targeting for the Tomahawk-D Cruise Missile." Thesis, Naval Postgraduate School, Monterey, CA, 1988.

Articles, Interviews, and Excerpts

Air Force News Agency. "Bomber Force Projection." Air Force Update. Kelly AFB, TX, February 1994.

Bonsall, George, LCDR USN. Interview by MAJ Charles Forshee, 17 October 1996. Interview notes are in the possession of the author.

Buchan, Glenn C. "The Use of Long-Range Bombers in a Changing World: A Classical Exercise in Systems Analysis" reprinted from New Challenges for Defense Planning: Rethinking How Much is Enough. Edited by Paul K. Davis. Santa Monica, CA: RAND, May 1994.

Buchan, Glenn; Frelinger Dave; and Tom Herbert. "Use of Long-Range Bombers to Counter Armored Invasions". RAND Corporation White Paper. Santa Monica, CA: RAND, March 1992.

Sharpe, Richard, B., Captain, OBE, RN, editor. Jane's Naval Weapon Systems (JNWS). Dec 95, Issue 19.

Tirpak, John A. "Heavyweights for the New Strategy." Air Force Magazine. Vol 78, No. 10, (October 1995).

Trover, Scott C. "Floating Arsenal to be 21st Century Battleship." Jane's International Defense Review. Vol 29, July 1996.

Walman, Jon P. LT, USN. "The 'New Generation' of Combatants: SC-21, Arsenal Ship Reflect 21st Century Vision". Surface Warfare. Vol 20, No 6 (November/December 1995).

Wode, Christopher, M, CDR. "Beyond Bombers Versus Carriers -- What is Really at Stake in the Services' Turf Battle". Armed Forces Journal International. Vol 132, No 9 (Apr 95).

Government Documents

Executive Branch and Department of Defense.

U.S. President. National Security Strategy. Washington, D.C.: White House, February, 1995.

Department of Defense. Department of Defense Dictionary of Military and Associated Terms, Joint Pub 1-02. Washington, D.C.: U.S. Government Printing Office, 29 March 1994.

_____. Doctrine for Joint Operations, Joint Pub 3-0. Washington, D.C.: U.S. Government Printing Office, 1 February 1995.

_____. Joint Doctrine for Theater Counterair Operations, Joint Pub 3-01.2. Washington, D.C.: Government Printing Office, 1 April 1986.

_____. Doctrine for Joint Interdiction Operations, Joint Pub 3-03. Washington, D.C.: U.S. Government Printing Office, 11 December 1990.

(S) Institute for Defense Analysis. "Soviet Defense Against Conventionally Armed Land Attack Cruise Missile (U)". Prepared for Office of the Under Secretary of Defense for Research and Engineering (Strategic and Theater Nuclear Forces) and (Tactical Warfare Programs) IDA Report R275. June 1984. DTIC: AD-C035-065.

Keaney, Thomas A. and Eliot A. Cohen. Gulf War Air Power Survey Summary Report. Washington, D.C.: U.S. Government Printing Office, 1993.

U.S. Strategic Bombing Survey. Summary Report (Pacific War). Washington, D.C.: U.S. Government Printing Office, 1946.

U.S. Air Force.

Assistant Secretary of the Air Force (Acquisition). Precision Guided Munitions Investment Strategy White Paper. Washington, D.C.: Department of the Air Force, Directorate of Fighter, C2 and Weapons Programs, 1060 Air Force Pentagon, 25 April 1995.

Department of the Air Force, Basic Aerospace Doctrine of the United States Air Force, Air Force Manual 1-1, Vols. I and II. Washington, D.C.: Government Printing Office, March 1992.

U.S. Air Force, Air Combat Command. "B-1B Lancer." Air Force Fact Sheets USAF Fact Sheet 92-65. Langley AFB: Office of Public Affairs, 115 Thompson Street, Suite 211; October 1992.

_____. "B-2 Spirit." Air Force Fact Sheets USAF Fact Sheet 95-05. Langley AFB: Office of Public Affairs, 115 Thompson Street, Suite 211; July 1995.

_____. "B-52 Stratofortress." Air Force Fact Sheets USAF Fact Sheet 96-11. Langley AFB: Office of Public Affairs, 115 Thompson Street, Suite 211; April 1996.

U.S. Air Force Detachment, U.S. Army Command and General Staff College. Prairie Warrior 96 Air Component Command. Air Power Guide. Fort Leavenworth, KS: U.S. Army Command and General Staff College, 15 April 1996.

U.S. Army.

U.S. Army Field Artillery School, LTC Wiley, Unpublished Fact Sheet, Subject: Multiple Launch Rocket Systems, ATSF-RMS, 25 September 1995.

U.S. Navy.

Department of the Navy. Naval Warfare, Naval Doctrinal Publication 1 (NDP-1). Washington, D.C.: Government Printing Office, 28 March 1994.

Deputy Chief of Naval Operations, Resources, Warfare Requirements and Assessments. Force 2001, A Program Guide to the U.S. Navy. Washington, D.C.: U.S. Navy, 1995.

(S) United States Navy, Commander, Operational Test and Evaluation Force. "Follow-on Operational Test and Evaluation (OT-IIIT) of the Tomahawk Weapon System With

Combat Control System Mk 1 With Programmed C4.2 (Rev 1)" (U) DTIC: AD-C051-167.

Legislative Branch.

General Accounting Office. Cruise Missiles: Proven Capability Should Affect Aircraft and Force Structure Requirements (U). Washington, DC: Government Printing Office, 20 April 1995.

General Accounting Office. Strategic Bombers, Adding Conventional Capabilities Will Be Complex, Time-Consuming, and Costly. Washington, D.C.: U.S. Government Printing Office, February 1993.

U.S. Congress, House, Committee On Appropriations, National Security Subcommittee. "Bomber Modernization Report." Prepared By Paul G. Kaminski, Under Secretary Of Defense For Acquisition And Technology. 104th Congress, 2d Sess., May 17, 1995

U.S. Congress, Senate, Armed Services Committee. "Providing an Effective Bomber Force for the Future". Prepared by Glenn C. Buchan and David R. Frelinger, RAND Corporation. 104th Congress, 1st Sess., May 5, 1994.