Projecting American Airpower

Should We Buy Bombers, Carriers, or Fighters?

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Abstract

The purpose of this thesis is to determine which form of airpower will best serve American power projection requirements as we approach the turn of the century. It examines three forms of airpower: carrier air, long-range combat air (B-2), and theater air (i.e., F-15, F-16, and EF-111). The author concludes that theater aircraft are the mainstay of US airpower. Theater airpower was the decisive form of airpower in our three major conflicts since World War II (Korea, Vietnam, and Iraq) and will be in the regional conflicts of the future. It is superior in the broadest sense of the word—economically, militarily, and politically.

This analysis starts by assuming an equal monetary investment in each military instrument and then compares each instrument's ability to project airpower. The cost-effectiveness analysis is based on spending $36.3 billion on each—to procure and operate (for 30 years) a carrier battle group, a package of 312 theater aircraft, and 38 B-2s. Power projection means that the instrument will enable American forces to defeat the military strategy of an adversary after crossing territory not owned or occupied by the United States. Relevant examples of US power projection are Korea, Vietnam, and Iraq.

Each instrument is evaluated for "power" (ordnance load, ordnance flexibility, and mission flexibility), and is then evaluated for its ability to "project" (speed and autonomy). Each receives a relative ranking on each criterion. The criteria themselves are of differing importance. Mission flexibility and the attributes that yield power are most important.

Theater aircraft are most powerful and least able to project. Long-range combat aircraft project best, are powerful, but have limited mission flexibility. Carrier aircraft project very well, have mission flexibility, but are least powerful. Historically, the projection liabilities of theater aircraft have been irrelevant. Given the nature of future conflicts—regional and tied to vital US interests—theater aircraft will continue to dominate power projection. Long-range bombers and carrier air have a subsidiary role to play. Defense spending should heavily favor theater air assets. Other recommendations follow:

- Theater air needs more and better defense-suppression ability. Historically, and in the future, the main threat to US airpower is ground based.
- Theater air is dependent on sea lift for deployment. Fast sea lift with roll-on/roll-off capability will enhance its strategic mobility.
- Theater air needs secure bases. In the future, base and port security will be challenged by ballistic missiles. The United States needs a deployable base, missile defense system.
- In terms of US airpower, a long-range attack aircraft for the Navy is a low priority. Certainly, the A-6 needs a replacement.

However, there is nothing a carrier-borne strike aircraft (A-X) can offer the United States that we cannot get from a more effective system. Since the niche of carrier air is cover for amphibious landings, the E/F version of the F/A-18 is a viable alternative.

Introduction

While the military shrinks by 25 to 50 percent, precious skills and weapon systems disappear. The instruments of American airpower which pounded Iraq into submission will be reshaped by new priorities. As the United States (US) confronts a different world, which instruments of airpower are most important? Exactly what does the United States get when it invests in carrier air or a B-2? This is an analysis of American airpower and its ability to project power into regional conflicts. In particular, I examine three military instruments of US airpower. Instrument one is carrier airpower. The carrier battle group (CVBG) and carrier air (CA) are the base force of my analysis. Instrument two is theater airpower (TAP).[1] This instrument includes fighters, fighter-bombers, and their associated aircraft. Instrument three is the B-2. I chose the B-2 because it represents a breakthrough in technology for long-range combat aircraft (LRCA).[2] Because of its stealthy characteristics, the B-2 is the only LRCA that could conceivably conduct a prolonged bombing campaign without escort. How we invest in these three instruments of airpower will have a large impact on our readiness for the next war.

My purpose is to determine which types of air forces are most essential to America's ability to project airpower in the coming decade and next century. Proportionally, how should the United States distribute its procurement and operations and support (O&S) dollars? The debate on this topic is dominated by simple dollar comparisons or by articles on one or two aspects of airpower.[3] This analysis takes a broader look at how these three kinds of airpower contribute to US power projection. I conclude that theater aircraft are far more powerful and versatile than either long-range combat aircraft or carrier aircraft. Theater aircraft are less able to project that power autonomously (i.e., without allied assistance). However, historical precedent and the current political outlook suggest that this disadvantage does not detract from the overwhelming advantage of theater airpower.

My findings are based on a new definition of power projection and the role airpower plays. Derived from this definition are five attributes of airpower projection forces: ordnance load, ordnance flexibility, mission flexibility, speed, and autonomy. These attributes become criteria—of differing importance—by which to evaluate the economic, military, and political efficacy of each instrument.

To compare the three instruments, I first fix the costs based on the cost to procure and operate a carrier battle group for 30 years (36.3 billion fiscal year [FY] 92 dollars).[4] The CVBG is the base force, because it represents the minimum unit size that naval air can employ. I then buy an appropriate package of theater air assets and a wing of B-2s. Each instrument is sized by the fixed cost ($36.3 billion) and in the way it would be employed.[5] This allows a cost-effectiveness comparison based on the military and political efficiency of each to project airpower. In the course of

the evaluation I specifically describe the unique contribution of each instrument to the power projection mission. I do not propose to eliminate any form of airpower. Instead, I hope to identify what each does and justify varying US investment accordingly. If I am right, and LRCA and CA have a relatively small niche in the power projection mission, defense spending should reflect that fact. My thesis is, of course, shaped by how I define power projection, the role of airpower in power projection, and the implication of the power projection mission on funding.

Funding, Airpower, and Power Projection

This analysis is based on two assumptions regarding funding. First, it presumes that procurement decisions are based primarily on a combination of the importance of the threat and its likelihood. For the last 45 years the vast majority of military procurement was based on the Soviet threat. That was our most serious threat, and though not most likely, it was likely enough to dominate our planning. Consequently, a strategic nuclear confrontation and/or a conventional confrontation in Europe drove most military planning and procurement. Now regional conflict is driving military planning and procurement.[6] Examples of such regional conflict include a coup in the Philippines, a coup in Panama, North Korea invading South Korea, Iraq invading Kuwait and Saudi Arabia, North Korea invading South Korea simultaneously with Iraq invading Saudi Arabia and Kuwait, Russia invading Lithuania, and a resurgent/emergent global threat.[7] Weapon systems that meet these threats are the ones we will, and should, buy.[8]

Second, this paper supposes that spending on TAP, CA, and LRCA will depend largely on their contribution to the power projection mission. Since the crumbling of the Soviet Union, arguments on behalf of the B-2 are in regard to its conventional capability. Its other capabilities are important but subsidiary to its ability to contribute to conventional conflict resolution. Similarly, the Navy's argument for Nimitz-class carriers, forward deployment, and an advanced attack aircraft hinge on power projection. Whether the Navy should be primarily concerned with power projection or sea control is a divisive issue.[9] Given the diminished likelihood of a Soviet naval threat, the Navy may have to restructure the fleet if its carriers are not crucial to the power projection mission. The structure and tempo of fleet operations is currently based on keeping large deck carriers forward deployed. If my thesis is correct, that is unnecessary. Likewise, Air Force acquisition of the F-22 is based on the claim that airpower projection requires air superiority. That claim is consistent with the most prominent instances of US power projection.

I define the term *power projection* along the lines of the major historical examples rather than according to general usage or the conservative "planning" usage. As used in general, power projection refers to any use of US military power for political ends. This usage occurs in broad strate-

gic documents.[10] In this broad sense, US aid to Israel in the 1973 Yom Kippur War was power projection. This case did not include US participation in the conflict and is more correctly called a security assistance surge.[11] Another example is the raid on Libya. The raid relied on US airpower to send a political message. Neither of these cases required the United States to defeat an adversary's military.

This general sense of the term power projection is ill suited to this paper for two reasons. First, it is too broad. It includes everything from gunboat diplomacy to nuclear war. Such an array of missions will not allow a focus on the direct (weapons delivery) aspect of airpower.[12] This paper is not examining the deployment of military force for contingencies which have no possibility of war.[13] Second, it fails to focus on the most serious threats upon which procurement of weapons systems is based. I assume that major acquisition decisions are based on power projection scenarios that involve high-risk, conventional war. We did not buy *Nimitz*-class carriers to perform Libya raids or to evacuate embassies, though we will certainly use them for that. Nor will we buy B-2s to perform Libya raids or to bomb a barracks in Panama—though we may use them for that. In contrast to this general use of the term, power projection also refers to specific military capabilities.

In the late 1970s, projection forces were tailored to a demanding scenario requiring two specific capabilities.[14] The scenario specified that the United States would have little support from allies. This led to two planning requirements. One, our forces had to be able to travel long distances and forcibly enter enemy-occupied territory against armed opposition. Two, they had to mobilize rapidly and be able to strike quickly without being prematurely committed to hostilities. Forcible entry without allied assistance requires a carrier battle group with Marines or airlifted airborne troops like the 82d Airborne Division.[15] This notion of power projection led to planning around two contingencies. The primary contingency was in the Persian Gulf and generated the rapid deployment force.[16] Another contingency involved the northern flank of the North Atlantic Treaty Organization (NATO).[17] This notion of power projection is much closer to the sense of the term I plan to employ. However, rather than define power projection so narrowly around two hypothetical scenarios, I use past scenarios and focus on the capabilities historically required.

In this paper, power projection involves two notions. First, it requires conventional military force at a scale sufficient to defeat an adversary's military. Second, that force is applied at a point that requires traversing territory which the United States does not own or occupy. This definition identifies cases where the military power employed is sized to defeat an adversary's military strategy or the adversary's possible military strategy. By this definition, the cases of power projection since World War I include Nicaragua (1926–31), World War II (1941–45), Korea (1950–53), the Dominican Republic (1965), Vietnam (1964–72), Grenada (1983), Panama (1989), and Iraq (1990–91). This definition focuses on the deployment of

enough lethal force to counter the adversary's military strength and thereby ensure the attainment of US objectives.[18] These historical examples can be pared down even more in order to focus on regional conflicts. World War II was clearly not a regional conflict. It was a global threat, involving resources that we do not plan to keep mobilized. Coup attempts are relevant but often do not present an air threat. Nicaragua, the Dominican Republic, Grenada, and Panama used air and sea power but mostly for air and sea lift. Since there was no battle for air control, and the adversary never mounted a significant conventional effort, there was only a small role for direct airpower. This paper treats power projection, specifically the projection of airpower as it was illustrated in Korea, Vietnam, and Iraq. Power projection, as I define it, requires moving sufficient military force to defeat the possible military force of the adversary. Additionally, I am only interested in those cases where there was a battle for air superiority and extensive use of lethal airpower. Given this definition of power projection, and having identified the subset of relevant cases, I see five important attributes of airpower projection forces.

Criteria

As the term implies, power is the first requirement, and the ability to project it is the second. Power, for air forces, involves how much ordnance can be delivered over time and whether it can be delivered in the right manner. In the face of an adversary in the air, counterair weapons are the most crucial. For most other missions, the target set determines the amount and kind of weapon that will be most effective. I measure these attributes, in order of importance, by mission flexibility, ordnance load, and ordnance flexibility.

Mission flexibility compares the ability of each instrument to perform the various missions of airpower. This is the most important criterion because it ensures that the airpower instrument can perform the tasks expected of it. Of particular concern are the force application missions of strategic attack, interdiction, close air support (CAS), and their usual prerequisite, counterair.[19] In Korea, Vietnam, and Iraq, all of the missions of airpower were required. In every case there was a battle for air superiority, and in every case US victory in that battle was crucial to future success. Only after air superiority was assured, could the United States pursue options in strategic attack, interdiction, and close air support. The instrument that performs all the missions of airpower well is the best power projection instrument.

Mission flexibility is based on the ability to do a mission effectively and survive. Since I measure ordnance load and ordnance flexibility elsewhere, by effective I mean characteristics such as range, all-weather capability, and basic aircraft design and function. Range is a necessity for getting the aircraft to the target set. Night and all-weather capability allow an aircraft to accomplish the mission in the greatest variety of meteorological

conditions. An aircraft that cannot perform at night/day or in the weather fails to project power under those conditions. Clearly B-2s are not effective air-to-air platforms nor are F-14s effective air-to-ground platforms.[20] Even if equipped for a particular mission, an aircraft may rarely if ever perform it for lack of survivability. For example, the F-16 may be judged a better CAS aircraft than the A-10. The F-16 has better night capability and is more survivable.[21] Each military instrument receives a relative rank based on the number of missions it can perform efficiently and survive. Another aspect of power is its lethality. Two criteria, of equal importance, measure this: ordnance load and ordnance flexibility.

Ordnance load measures the tonnage of explosives an instrument can deliver per day. An important part of lethal combat power is the sheer amount of firepower that can be brought to bear. Korea, Vietnam, and Iraq provide examples of the importance of large payloads. During the Korean War, jet aircraft from Japan simply did not carry enough ordnance to provide the firepower needed.[22] Bomber aircraft, despite their inaccuracy, were able to accomplish more in the early stages of the war.[23] In Vietnam, where the jungle canopy often hid the enemy, the large swath cut by B-52 raids was sometimes the most effective kind of airpower.[24] The Republican Guard and tank berms in Iraq provided another example of the utility of sheer firepower. Airfields, entrenched divisions, nuclear and chemical plants, and other industrial targets require large amounts of ordnance to destroy. Even smaller targets, if they must be attacked without precision weapons, may require many bombs to be destroyed. The ordnance capability of an instrument is a function of three factors.

Ordnance load varies by the number and type of strike aircraft available, the usable load of each, and the number of sorties each strike aircraft can fly. As I describe each instrument, it will be clear that the proportion of strike aircraft varies for each instrument. The aircraft that carry ordnance carry different loads. Finally, different aircraft generate a different number of sorties per day. All these factors must be considered to get an accurate appraisal of the aggregate ordnance load capability of each instrument. Ordnance load is about half the measure of lethality. Of equal importance is precision.

Ordnance flexibility is a simple comparison of the ability of each aircraft to deliver a variety of weapons. The most important capability is the ability to deliver precision-guided munitions (PGM). There are numerous historical cases that testify to the importance of PGMs. Korea's case of the "elastic bridge" is one of them.[25] It occurred during the crucial interdiction campaign waged as United Nations forces were holding the Pusan perimeter. One of the main arteries out of Seoul crossed a steel cantilever bridge. The bridge was attacked daily for nearly four weeks with as many as nine B-29s (carrying 54 tons of bombs) or 37 Corsairs and Skyraiders from Task Force 77. That job could be done on a single day by two F-117s with precision weapons. We had the same experience in Vietnam and Iraq;

bridges which resisted numerous attacks by aircraft with "dumb" bombs (unguided gravity bombs) were felled by one or two sorties carrying PGMs.

The ability to deliver the right weapon accurately is a crucial element of airpower.[26] Ordnance flexibility is measured based on three factors. First, can the air instrument deliver both dumb bombs and precision weapons? Second, can the aircraft deliver precision weapons autonomously? Some aircraft can carry and release a PGM but cannot provide guidance for it. Third, will the air instrument have a full complement of precision weapons at its disposal? A small part of ordnance flexibility is based on logistics. Logistics is a major player in the projection aspect of airpower.

The problem of projecting airpower boils down to two criteria: how quickly can it be done (speed), and do we need the assistance and or permission of other nations (autonomy)? The fastest way to deploy is by air. However, it is not practical to move weighty or bulky items by air. Airlift moves people efficiently. Tanks, munitions, and fuel usually must go by sea. Additionally, air deployment may require overflight permission and certainly requires secure facilities with fuel. Deployment by sea is more versatile. The CVBG travels in international waters and can replenish at sea. Sea deployment can be accelerated by being forward deployed. All the factors that affect the projection of airpower can be reduced to their impact on speed and autonomy.

Speed compares the time required for each instrument to bring its total force to bear on the adversary and sustain it. Korea and Iraq illustrate the importance of this criterion. In the Korean War theater aircraft had to be ferried over on carriers. The bases available for theater aircraft decreased drastically as the North Koreans pressed down to Pusan. Navy carriers, preoccupied with the Soviet and Chinese threat and with getting Marines to the theater, did not provide significant air support until over a month into the conflict.[27] Only because we had US forces in Japan, were we able to intervene before the whole peninsula fell to the Communist forces. Had the peninsula fallen, the military and possibly the political situation would have been different. The Iraqi invasion of Kuwait posed different problems. Despite bases and pre-positioned material, it took time to deploy theater aircraft 7,000 miles and match them up with the appropriate ordnance. If Iraq had moved immediately into Saudi Arabia, speed would have been of the essence to preserve that nation. Our inability to defend them might have made the Saudis negotiate with Saddam Hussein, locking the United States out of the whole situation.

Despite the problems lack of speed may cause, the relative speed of each instrument is not very significant. This is true because the force required to stop invasions (North Korea versus South Korea and Iraq versus Kuwait) is so great—usually requires heavy armor, artillery, and overwhelming airpower—that no rapid deployment force can do the job.[28] Probably, such a rapid response by carriers was rejected in the case of Iraq because "such attacks could not be sustained very long and probably would not accomplish much in terms of hurting the Iraqi military or

economy."[29] Although speed may not be the most important factor for power projection, again, it is an important constraint worth structuring forces to overcome when practical.

Speed of response will depend on starting point (deployment patterns), rate at which the instrument can travel, and the extent of pre-positioned supplies. In Korea theater aircraft were first on the scene because they were based in Japan (in the theater of operations). In Operation Desert Shield, carrier air was on the scene first because a carrier was deployed nearby in the Indian Ocean. Each instrument will receive a relative ranking based on how quickly it can bring its total force to bear. Speed will be evaluated apart from the possible political constraints which certainly affect it. Those are evaluated under autonomy.

Autonomy addresses the political constraints the United States faces when attempting to project military power. The United States has invested significantly in forces that operate autonomously despite the historical record that indicates autonomy is rarely important.[30] The rapid deployment force was originally constructed around a forced-entry ability. There were two reasons for that. First, assuming the worst is always a safe way to plan. From a military perspective, designing forces with a forced-entry capability is very demanding. Second, military planning was then based on resisting a Soviet threat which might prevent (by occupation or intimidation) local nations from assisting the United States. In the post-cold-war era the United States does not have many (if any) vital interests abroad which require a forced-entry capability. That is not to say we should not maintain some forced-entry ability, but it is to say that it is a lesser priority for power projection. In both Korea and Iraq, the United States was part of a coalition which permitted deployment without a forced entry. In Vietnam forced entry was again irrelevant because we had a "host" government. The United States has never been prevented from protecting vital interests because allies have refused to cooperate. As long as the United States plans to resist aggression by other states, there should be allies ready to provide the access and assistance we need. Though autonomy may not be the most important attribute of power projection forces, it is an attribute worth noting because of the limitations it places on projection forces.

An instrument's autonomy rating depends upon such features as forward basing and access to various geographic locations. An instrument gets a lower relative ranking to the extent it depends on foreign bases to deploy and employ. The ranking also varies if an instrument cannot access certain locations. Afghanistan has no coastal approaches. A relative placement regarding autonomy is the last criterion with which I will evaluate each instrument.

To this point, I have established a foundation upon which to compare the ability of three military instruments to project US airpower. I am examining power projection from the perspective of current US interest in regional conflicts. We are not going to structure our forces based on a

world conflict (like World War II or a NATO-Warsaw Pact confrontation). Furthermore, I claim that the procurement of aircraft is not based on their use in minor contingencies (the Libya raid, embassy evacuations) or even on their use in power projection scenarios like Grenada or Operation Just Cause. Instead, I claim that major weapon system procurement is based on conventional war scenarios (Korea and Iraq) and thus use Korea, Vietnam, and Iraq to derive attributes of airpower projection forces. With those, I evaluate the three military instruments based on a fixed cost for each.

Fixed-Cost Composition of Each Airpower Instrument

The following comparisons of fixed-cost composition of the three military instruments should generate an accurate cost-effectiveness evaluation.

Carrier Battle Group and Carrier Air Wing

The basic fighting unit of naval air is the carrier air wing. Carriers operate in a carrier battle group. The reason carrier air is so versatile (and so expensive) is that it is located on a mobile platform protected by an array of other vessels (see table1) [31] and includes the air assets shown in table 2.[32, 33]

Table 1

Vessels in Normal Carrier Battle Group

No.	Description of Vessel	Cost in FY 92 Dollars
1	Aircraft Carrier (nuclear powered)	3,770 million
2	Guided Missile Cruisers	2,151 million
2	Guided Missile Destroyers	1,680 million
2	Destroyers	1,549 million
2	Submarines (nuclear powered)	1,514 million
1	Oiler	480 million

Sources: Cost and composition figures adapted from Ronald O'Rourke, *The Cost of a U.S. Navy Aircraft Carrier Battlegroup* (Washington, D.C.: Congressional Research Service [CRS], 1987), 9; and Air Force Regulation (AFR) 173-13, *US Air Force Cost and Planning Factors,* 31 October 1989, as amended 14 February 1992.

Total procurement cost for the CVBG is 15.2 billion in FY 92 dollars, with annual operations and support costs of 705 million (21.1 billion FY 92 dollars over 30 years).[34] Using FY 92 dollars for procurement and 30 years of O&S, total investment in a CVBG comes to 36.3 billion dollars. Carrier air is charged with the whole cost of the CVBG because that is the cost of transporting and defending it in international waters. Since we cannot plan

on operating the carrier in a benign environment, the cost of carrier air includes the necessary escort vessels. Carrier air is expensive since all the costs for mobility are built into the carrier battle group. Theater air and long-range combat aircraft operate under different conditions.

Table 2

Air Assets in Carrier Battle Group

Aircraft on the Carrier	No.	Cost in FY 92 Dollars
F-14 Air-to-Air	20	1,196 million
F/A-18 Air-to-Air/Ground	20	685 million
A-6 Air-to-Ground	20	975 million
S-3 Antisubmarine	10	307 million
E-2C Airborne Early Warning	5	319 million
EA-6B Electronic Warfare	5	274 million
SH-60F Helicopter/Antisub	6	123 million
Helicopters on Other Vessels	**No.**	**Cost in FY 92 Dollars**
SH-60B Combat Support	6	117 million
CH-46 Antisubmarine	2	12 million

Sources: Adapted from Ronald O'Rourke, *The Cost of a U.S. Navy Aircraft Carrier Battlegroup* (Washington, D.C.: CRS, 1987, 27); and AFR 173-13, *US Air Force Cost and Planning Factors,* 31 October 1989, as amended 14 February 1992.

Theater Airpower

The basic fighting unit of the Air Force is the F-15 and F-16 wing. Unlike the deployed carrier wing, Air Force units have historically operated from a base with only one or two types of aircraft. This reduces O&S costs. The standard Air Force fighter wing contains three squadrons of 24 aircraft for a total of 72 aircraft. A notional strike force package might look something like table 3.[35]

Total procurement cost for this package of 312 aircraft is $12.3 billion (FY 92). O&S costs run $701 million a year for a 30-year sum of 21.0 billion dollars (FY 92).[36] To this I added the cost of deployment equipment. The Air Force invested about one billion dollars into Harvest Eagle, Harvest Bare, Harvest Falcon, and fuels mobility support equipment.[37] I tripled that amount to cover the expenditures in a 30-year period. This yields a total cost of $36.3 billion for the theater airpower strike package in FY 1992 dollars. The higher unit costs of LRCA will result in a much smaller wing of B-2s.

Table 3

Composition of Theater Airpower Strike Force

Type A/C	Description	No.	Cost in FY 92 Dollars
F-117A	Air-to-Ground	23	1,010 million
F-16C/D	Air-to-Air/Ground	72	1,260 million
F-15C	Air-to-Air	72	2,585 million
F-15E	Air-to-Air/Ground	32	1,555 million
F-4G	Defense Suppression	26	478 million
EF-111	Defense Suppression	13	1,126 million
E-3	Communication/Warning	6	902 million
KC-135R	Air Refueling	62	3,286 million
EC-13OE	Communication	3	77 million
RC-135	Electronic Intelligence	3	64 million

Sources: Composition is based on several sources: personal analysis of Desert Storm force composition; testimony from Maj Tom Griffith and Col Dennis Carpenter, Desert Storm veterans; congressional testimony on Desert Storm, House *Department of Defense Appropriations for 1992: Hearings before the Subcommittee of the Committee on Appropriations,* 102d Cong., 1st sess., 1991, pts. 1 and 5; *Selected Acquisition Report, F-15 (Eagle)* (Wright-Patterson AFB, Ohio: Air Force Systems Command, 31 December 1990); and AFR 173-13, *US Air Force Cost and Planning Factors,* 13 October 1989.

Long-Range Combat Aircraft (B-2)

A wing of LRCA usually consists of a squadron of bombers and a squadron of tankers (table 4). For this analysis, the ratio of bombers to tankers will be two-to-one because of the difference in sortie production of tankers to bombers.[38]

Table 4

Composition of Long-Range Combat Aircraft Wing

Type	Description	No.	Cost in FY 92 Dollars
B-2	Stealth Bomber	38	21.3 billion
KC-135R	Air Refueler	19	1.0 billion

Source: "Using B-2 Bombers for Conventional Naval Missions," staff memorandum (Washington, D.C.: Congressional Budget Office [CBO], September 1991), 17.

Operation and support costs for a wing of 57 aircraft is 14 billion dollars (FY 92).[39] This yields a total cost of 36.3 billion FY 92 dollars for the B-2 wing. The resulting airpower instruments are then compared (table 5).

Table 5

Cost Comparison of Airpower Instruments

	Carrier Air	Theater Air	B-2 Wing
Total No. Aircraft	**86**	**312**	**57**
Procurement Costs (Billions/FY 92 Dollars)	15.2	12.3	22.3
O&S Costs (Billions/FY 92 Dollars)	21.1	21.0	14.0
Total Cost of Instruments (Billions/FY 92 Dollars)	36.3	36.3*	36.3

*The costs do not add for TAP because the table does not reflect the investment in bare-base equipment.

Sources: "Using B-2 Bombers for Conventional Naval Missions," staff memorandum (Washington, D.C.: CBO, 1991); and AFR 173-13.

This table reveals some interesting things about the three instruments of airpower in question. It gives a better picture of what an investment in airpower buys and what proportion of it is in procurement versus O&S. Matching this chart with the earlier ones shows exactly how much equipment is purchased. Clearly, investment in TAP buys a much larger fleet of aircraft. The carrier air assets are much fewer because of the huge investment in procuring and operating all the associated vessels in the carrier battle group. The B-2 gives everyone sticker shock because most of its costs are up front in procurement, and its operating costs per plane are very high (although relative to the total O&S costs of the other instruments they are low). For both CA and TAP the bulk of their expenses are in operations and support. The efficiencies of having a small but potent force, as in the B-2, do not show until life cycle costs are figured.

The O&S costs for theater air power may be underestimated. They are based only on flying costs plus paying and training the crew members and those who support them. These costs do not reflect all the costs of running a base, and that number of aircraft requires many bases. O&S costs for the CVBG do not include home port costs or ports used for replenishment. Hopefully, these omissions balance out. If any instrument suffers from that, it is the B-2, because it would have a small increase in O&S costs for such a small force (two bases). Having evened the forces out by dollar investment, I now evaluate each as an airpower projection instrument.

In the balance of this paper each instrument is evaluated according to its ordnance load, ordnance flexibility, mission flexibility, speed, and autonomy. The first three will yield a power rating, and the last two establish a projection rating. It is impossible to weight each criterion or give more than a relative ranking within each criterion. The power ratings are treated first because I judge them to be most important. That judgment is

based on the conviction that those criterion measure the capabilities which determined the outcome in Korea and Iraq, and will determine the outcome in the future. These criteria did not determine the outcome in Vietnam only because the outcome of that war was determined by non-military factors.[40] Although I judge the projection rating as less important, there are clearly cases where it could be most important. Any Falklands-type scenario (forced entry) requires forces which are easily projected. If US vital interests abroad include several such scenarios, my prioritization of the criterion is incorrect. The comparison begins with ordnance load because that examination reveals the most about the operation of each instrument.

Ordnance Load

Tons per Day by Carrier Air

To calculate the tons per day of ordnance a carrier can deliver requires an estimate of how many sorties a carrier can generate and what load those sorties carry. Carriers generate sorties in two basic ways: cyclic operations or Alpha strikes.[41] Alpha strikes involve large waves with each launch. A carrier might launch two or three waves a day. The balance of the day is then devoted to maintenance and crew rest. Although cyclic operations are more grueling, they are more conducive to maximizing day and night flying hours. Cyclic operations also maximize the number and range of the sorties launched. A single carrier at maximum effort would launch aircraft according to the following schedule (table 6).

The schedule in table 6 illustrates several facts about carrier air operations.[42] The maximum amount of strike sorties is approximately 52.[43] The bulk of the strike sorties are A-6 sorties since defense suppression absorbs many of the F/A-18 sorties. The A-6 will fly at night because of its vulnerability and its ability to do so accurately. This schedule reflects the surge capability of a single carrier. Surge operations take a heavy toll on crews and machines. It is not clear how long the carrier could maintain this tempo. Surges usually require standing down every few days for maintenance and crew rest, and the carrier needs to replenish fuel and munitions. This means that over time the carrier will not average 52 sorties a day but something less. Operating several days and then standing down for a day approximates Desert Storm operations.

Operation Desert Storm illustrated both continuous and surge carrier operations. During the week surrounding the ground offensive, the six carriers averaged between 42 and 46 strike sorties a day.[44] When the ground offensive kicked off, strike sorties jumped up to between 50 and 60 sorties a day.[45] After that surge, they dropped to one-half that rate (also because the war was ending). The rate through the first five weeks of the war was 26 strike sorties a day.[46] Accordingly, I estimate a carrier could

Table 6

Cyclic Operations Schedule
(Carrier Air)

Schedule	Aircraft	No. A/C	Mission
Continuous			
(24-Hour)	F-14	4	Air Patrol
	E-2	1	Early Warning
Day Operations			
0800–0945	F/A-18	6	Bomber
	F/A-18	2	Defense Suppression (DSUP)
	F-14	4	Escort
	A-6	2	Surface/Coastal Strike
0945–1115	F/A-18	6	Bomber
	F/A-18	2	DSUP
	F-14	4	Escort
	A-6	2	Surface/Coastal Strike
1115–1300	F/A-18	6	Bomber
	F/A-18	2	DSUP
	F-14	4	Escort
	A-6	2	Surface/Coastal Strike
Night Operations			
1900–2045	A-6	8	Bomber
	F/A-18	2	DSUP
	EA-6	1	Electronic Warfare (EW)
	F-14	4	Escort
2045–2215	A-6	6	Bomber
	F/A-18	2	DSUP
	EA-6	1	EW
	F-14	4	Escort
2215–0015	A-6	8	Bomber
	F/A-18	2	DSUP
	EA-6	1	EW
	F-14	4	Escort
0015–0200	A-6	6	Bomber
	F/A-18	2	DSUP
	EA-6B	1	EW
	F-14	4	Escort

Source: This schedule is based on the experiences of and conversations with Lt Comdr Terry Kraft, an A-6 pilot who led one of the first naval strikes at an Iraqi airfield during Operation Desert Storm.

produce, on average, continuously, 45 sorties a day. I base that on the average sortie rate of the six carriers in Desert Storm in the heaviest week of flying.[47] The ordnance they delivered is based on the type of aircraft and mission flown.

In the carrier wing the A-6 and the F/A-18 are the bomb droppers. The A-6 is the main strike aircraft. Of the 45 total strike sorties, the A-6 may fly 30 of them. It can carry 18,000 pounds of weapons.[48] In combat, however, it usually carries a smaller load for maneuverability and survivability. In Desert Storm it normally carried four- to six-thousand pounds.[49] At 30 sorties a day, with a load of 6,000 pounds per sortie, A-6s will deliver 180,000 pounds, or 90 tons. Like the A-6, the F/A-18 can carry a large load—17,000 pounds.[50] The F/A-18 is limited by range and is very sensitive to the drag and weight of its load. In order to operate at even a modest range of 250 miles, it will carry about 3,000 pounds.[51] At 15 strike sorties a day, and 3,000 pounds per sortie, F/A-18s will deliver 45,000 pounds, or 22.5 tons a day. Based on those numbers, a carrier wing can sustain an air campaign delivering 112.5 tons of ordnance a day. Theater airpower operates in a totally different environment.

Tons per Day by Theater Airpower

Land-based air generates sorties and ordnance tailored more to the threat than to the constraints of the environment. Figuring out sortie rate and ordnance for theater air is more complex because it is more variable. Sortie rate is not constrained much by the runway or ramps, and maintenance can reconfigure modern aircraft very quickly. At one point during Desert Storm the 363d Tactical Fighter Wing (Provisional) was turning F-16s around in thirty-five minutes. Sortie rates are determined more by sortie duration and seriousness of the threat. Long sorties limit sortie rate due to crew duty day (fatigue). If there is danger of the field being overrun, then maintenance and fatigue are put off and jets fly. Israel may have had pilots fly as many as eight sorties a day in the most desperate part of the l967 Arab-Israeli war.[52]

The range of sortie rates for theater aircraft is considerable, but this analysis uses the rates flown in Desert Storm. F-16s can surge to between five and eight sorties a day. They cannot maintain that rate, but two to three sorties a day is maintainable. During Desert Storm the 363d Wing averaged 1.4 sorties a day and surged at one point to 1.7 sorties a day for a 12-day period. Tactical Air Command has been shooting for three sorties a day since the 1970s.[53] Even then, before the experience and improvements made in the 1980s, 1.5 sorties per day seemed reasonable for the F-l5C. The F-117A may have averaged a sortie per day during Desert Storm.[54] To align with Desert Storm experience, I will use 1.7 sorties per day for the F-16, 1.2 per day for the F-15E, and an estimate of .85 for the F-117A.[55] As a result, 72 F-16s will fly 122 sorties, 32 F-15Es will fly 38 sorties, and the 23 F-117As will fly 19 sorties per day.

Ordnance capabilities of the F-15E and the F-16 are similar to the Navy aircraft. The small, fighter-bomber F-16 can carry a large load but usually carries around 3,000 pounds.[56] The F-15E can carry a large load and matches the A-6 by carrying 6,000 pounds. Since the F-117A is limited to internal carriage, it carries consistently 4,000 pounds.[57] At 3,000 pounds

per sortie the F-16s will deliver 366,000 pounds, or 183 tons. The F-15Es will drop 228,000 pounds, or 114 tons. The F-117s will deliver 76,000 pounds, or 38 tons. Total theater air ordnance load amounts to 335 tons per day. To accomplish that, theater air needs a host of supporting aircraft: EF-111s, F-4Gs, and E-3As. The B-2 could conceivably operate alone.

Tons per Day by B-2s

The sortie rate of heavy bombers is subject to many variables. Large, and designed for intercontinental missions, they do not produce as many sorties as fighters. The length of the sortie has a big impact on sortie rate. In the Vietnam War many bomber missions originated in Guam, resulting in 12-to-16-hour missions.[58] The "short" sorties from Utapao were 3.5 hours long.[59] Desert Storm saw sorties from Diego Garcia which took over 15 hours.[60] Sorties do not have to be long; some B-52 sorties in Desert Storm were flown from Jeddah, lasting only 4.5 hours. Short sorties are an option when the bomber is based in-theater. Putting bombers in-theater, presumably at a base previously unprepared for them, requires a significant logistics effort. The maintenance, fuel, and munitions requirements of a heavy bomber squadron dwarf those of fighters. Three B-2s use approximately the same munitions load and one-to-one more fuel per day than an entire F-16 squadron.[61]

This analysis assumes the B-2 will operate only out of main operating bases (US bases, Guam, and Diego Garcia). This has several advantages. First, all logistics, fuel, and munitions can be pre-positioned. Second, deployments can be practiced and do not require allied cooperation. The disadvantage is that the B-2 will face very long sortie durations, 15 to 24 hours. Sortie durations of this length will halve the sortie rate.

B-52 availability in Vietnam suggests that a .65 to .75 sortie rate is the best to expect. In the fall of 1972 the 307th Strategic Wing at Utapao reported average sortie rates per airplane of 22.8 and 20.6 per month.[62] Those numbers lead to .76 and .69 sorties per plane per day. The 307th had a maintenance contract for 30 sorties a day in the fall of 1972 when there were 50 aircraft at the field.[63] That calculates to only a .6 sortie rate per day. During the fall of 1972, the 43d Strategic Wing, Andersen Air Base, Guam, had a maintenance contract of 66 aircraft per day. That wing had, at one time, up to 155 airplanes on the field. James Dunnigan, in *How to Make War*, assigns the B-52 a 70 percent availability rate and the B-1 an 80 percent availability rate.[64] Since modern aircraft are designed for higher sortie rates, the B-2 ought to do better than the B-52. However, it may not have the availability of the B-1 because it incorporates dramatically new technology. An availability of 75 percent is a compromise between the two positions. With a 38-aircraft wing, and a sortie rate of .75, the B-2 would fly 28 sorties a day. If the B-2 can only halve that due to long sortie durations, the wing could produce 14 sorties a day. Given its 40,000-pound

ordnance load, the B-2s can deliver 560,000 pounds per day, or 280 tons.[65] The previous data reveals the following comparison (see table 7).

Table 7

Comparison of Strike Sorties and Ordnance Loads

Type of Airpower	Strike Sorties per Day	Ordnance Load in Tons per Day
Theater (TAP)	179	335
B-2	14	80
Carrier (CA)	5	112.5

Source: Adapted from Barry D. Watts, "Conventional Options for the B-2" (unpublished article by the Northrop Analysis Center, Arlington, Virginia, 17 June 1991), 77.

Having looked at only ordnance load, a few observations seem pertinent. Theater airpower clearly delivers the biggest punch, three times the carrier load and 20 percent more than the B-2. Thirty-eight B-2s deliver a strong punch and an incredible amount per plane. The carrier delivers a relatively small amount of ordnance. But, despite the utility of a large payload, ordnance load is not the best measurement of power.

Heavy bombers delivered a disproportionately large share of the ordnance in Korea, Vietnam, and Iraq, yet it is not clear that they played the most important role in any of the conflicts. In Desert Storm B-52s flew one percent of the total sorties, yet dropped 29 percent of the ordnance.[66] Still, reports abound of attacks on a target by numerous aircraft with heavy ordnance loads who fail to destroy the target. They are followed by two to four F-117A sorties which get the job done.[67] The ability to match load with precision weapons is captured by the criterion, ordnance flexibility.

Ordnance Flexibility

The United States uses a variety of different weapons in the air-to-ground attack missions. They can be divided into three general categories: bombs, guided bombs, and missiles. Bombs include all weapons that rely on gravity and the trajectory imposed by the delivering aircraft for their guidance. Bombs include the Mk-82 (500 lbs), Mk-83 (l,000 lbs) and Mk-84 (2,000 lbs) bombs. There are also special-purpose bombs: the fuel air explosive (FAE), the penetrating bomb (I-2000), and the cluster bomb unit (CBU), among others. Guided bombs are those which are modified to be guided to the target. They are not self-propelled, as are missiles, but use movable fins to steer them through the air. Guided bombs are most often guided by electrooptical signal, infrared signal, or laser designation.

New guidance systems are being developed which use GPS (global positioning satellite) signals or are inertially guided. Missiles use many of the same guidance systems and some use terrain mapping (such as cruise missiles like Tomahawk) for navigation. Aircraft are limited in what they can carry either by lacking the appropriate internal equipment or because their logistic system does not supply that weapon. This was one of the important lessons learned in Desert Storm by the Navy.[68]

Naval aircraft faced two weapons-related problems during the war. First, the F/A-18, like the F-16, was not able to laser-designate targets for delivery of laser-guided bombs. The F/A-18 could carry laser-guided munitions but could not deliver them without an A-6 to designate the target. This was problematic for reasons I address under mission flexibility. Second, naval aircraft are limited to the stores aboard the carrier. Even had the Navy had the proper munitions in its inventory, there is only a particular subset of that aboard the carrier. As it was, the Navy did not have a penetrating weapon (like the I-2000 bomb) or as many laser-guided bomb kits as they could have used.[69] The Navy can solve the inventory and aircraft equipment problems. It cannot alter the fact that the carrier has limited storage space, or that its weapons load is usually determined before it knows the kinds of missions required. The aircraft equipment problem is exacerbated by the fact that the carrier only has two kinds of strike aircraft (A-6 and F/A-18) on board. The Air Force's problem with the F-16 was ameliorated by the fact that there were other strike aircraft that could substitute.

The TAP package has three strike aircraft with complementary capabilities. The F-16 is primarily a daytime, visual flight rules (VFR) fighter. It is rapidly becoming a night, all-weather precision platform, but it did not have that capability in Desert Storm. The F-117A is a night precision platform (its main weapon, the laser-guided bomb, requires VFR conditions for precision delivery). The F-15E is a day/night all-weather precision platform. In terms of ordnance delivery the F-15E and A-6 match up fairly equally. Each can deliver the full spectrum of weapons autonomously. The F-16 and the F/A-18 match up closely also. Each delivers primarily Hk-80 series weapons or CBUs. The advantage theater airpower has is the F-117A, although this role could also be filled by the F-111 in terms of precision ordnance delivery. Despite its small ordnance load, the F-117A hit 31 percent of the targets on the first night of Desert Storm and up to 40 percent thereafter.[70] Not only does TAP have the advantage of more precision-munition deliverers but also has the I-2000 bomb, which proved so valuable for attacking hardened targets like aircraft shelters and bunkers. In Desert Storm TAP also had a logistical advantage.

If bases are available and secure, TAP has a significant advantage over carrier air. A base usually has access to a larger amount and greater variety of ordnance. In Desert Storm the United States had six months to preposition supplies in-theater for the air campaign. Additionally, stores could move relatively quickly around the theater. Had the war been initi-

ated immediately, the munitions available would have been much more restricted. Given that bases are a precondition for the presence of theater airpower, it will normally operate at an advantage to carrier air. The B-2 will operate in a similar environment.

The B-2, like all Air Force aircraft, will be designed to carry the Mk-80 series weapons but will probably use specially designed precision weapons.[71] The Air Force is developing adverse-weather PGMs for use in long-range combat aircraft.[72] These weapons will not have the limitation of current PGMs, which cannot function in or above clouds. Such a capability is critical to a weapon system that may fly 8 to 12 hours to get to the target area. This may mean the B-2 will not have a capability for laser-, electrooptical- or infrared-guided munitions. Hopefully they would not be necessary because the all-weather munition would be roughly as accurate. However, the PGM ability comes with a penalty—this being the reduced load the B-2 can carry if it carries PGMs. The payload may drop as low as 24,000 pounds or 12 tons.[73] A 40 percent reduction in payload to go to PGMs is significant. The B-2's numbers would become 168 tons—still a very large and lethal ordnance load. Though the B-2 will have a bomb and PGM capability, that capability will not be as diverse as CA or TAP. However, it could have a more dependable logistic system.

Due to its range, the B-2 can pre-position stores at its main operating bases. Since its sortie count in this analysis is based on operating out of one of three bases, each can be well prepared for a sustained air campaign. By flying out of known bases, in a secure area, the B-2 can avoid the logistical constraints of both CA and TAP. Despite that advantage, I rate the B-2 third in ordnance flexibility. TAP is best because of its more robust PGM capability. The B-2 and the carrier are about equal, but I favor carrier air because the F/A-18 and A-6 can deliver a wider variety of ordnance despite the limited storage space on the carrier.

Mission Flexibility

Power projection requires the ability to perform all the missions of airpower under most environmental conditions. This is the most important criterion for an airpower projection force. It is critical because it is impossible to predict what the next war will be like. Who would have guessed the stir that Scuds caused in Desert Storm? They ended up absorbing many of our F-15E sorties.[74] This analysis will focus on counterair, strategic attack, interdiction, and close air support. These criteria clearly reveal that the B-2 can only capture a niche of the power projection mission. The B-2 will operate only at night, have no air-to-air capability and limited CAS capability. The B-2 will travel mostly without escort and rely on escaping detection to accomplish its mission. To do that it must attack at night and avoid electronic emissions. This means missions that require voice communication (often CAS does) or radar searching (interdiction might) will be more difficult for the B-2. The B-2 can make sizeable and

unique contributions to many of the missions. To the extent bombing airfields helps the counterair effort, the B-2 should be an unsurpassed weapon.[75] All stationary interdiction targets will be vulnerable to the B-2 as well as many mobile targets. To the extent that attacking stationary troops or armor concentrations is close air support (preplanned CAS), again the B-2 will excel. Effective antiarmor mines or a modern antiarmor sensor-fazed weapon may make the B-2 very capable against armor.[76] Even so, power projection is a joint effort. The B-2 cannot provide battlefield protection over Army or Marine operations. Nor can the B-2 provide effective (day or emergency) CAS for those operations. For these reasons the B-2 is the least mission-flexible power projection instrument. Despite that flaw, the B-2 has a unique strength.

The B-2's strength is not just precision ordnance in large quantities, but also at great range. Even in a theater as limited as Iraq, there were targets which taxed the range of theater airpower and were well beyond the reach of carrier air. For the F-117A to hit targets northeast of Baghdad required moving refueling operations (with all the associated escort and electronic defense) well into Iraq.[77] That means that the United States could hit that target only after the threat had diminished enough to take such a risk. The B-2 would have given us that capability from the first day. The range, stealth, and payload of the B-2 enable it to conduct strategic attacks absolutely impossible with other weapon systems. This is vital for preemptive strikes against nuclear, biological, and chemical (NBC) weapons. The B-2 offers the best means of neutralizing an adversary's NBC arsenal early in the war or even prior to US troops entering the theater. Nevertheless, this capability is night only and cannot control the air, night or day. The B-2's lack of survivability in the day hurts its mission flexibility. The Navy faces the same problem with the A-6.

Carrier air can perform all the missions airpower must accomplish to project power but it does have significant limitations. The main limitations of CA are the vulnerability of the A-6 and range constraints. The A-6, about the same age as the B-52, suffers from too large a radar cross section and a lack of speed and maneuverability. For those reasons it flew 80 percent of its missions at night and did not team well with the F/A-18 to provide laser identification.[78] This presents a significant problem for the Navy in terms of the strategic attack and interdiction missions. It detracts from their day options and limits the A-6 to the range of its escorts. If the escorts are F/A-18s, that becomes a significant range constraint. The Navy's ability to conduct combat operations beyond two hundred miles from the carrier is almost totally dependent on land-based air refueling.[79]

The Navy's range limitations stem from three areas: the unrefueled range of carrier aircraft, Navy air refueling assets, and the position of the carrier. The F/A-18 has a potential strike radius of 375 nautical miles with external fuel.[80] But by the time degradations for munitions, formation and operational tactics, and recovery procedures are factored in, it cannot strike significantly farther than two hundred miles. This can be extended by air

refueling. The Navy has modest air refueling capability in KA-6s. This capability cannot support large, long-range strikes.[81] Long ranges may be required because of the vulnerability of the carrier. Carriers are vulnerable to land-based air. At the beginning of Desert Storm, the Persian Gulf carriers were well over 150 miles from Kuwait and thus more than 500 miles from strategic targets in Iraq.[82] Defense of the carrier also reduces the F-14s available for escort or counterair operations. The end result is severe constraints on the carrier's ability to perform the missions of airpower. Theater airpower assets avoid many of these liabilities.

Theater airpower brings a larger variety of more capable aircraft to the battle. The TAP package includes aircraft assets that carriers simply cannot accommodate. These include a tandem of defense suppression aircraft—the EF-111 and F-4G—instead of just the EA-6B. It includes the EC-130H and RC-135 for communication, jamming, and signal intelligence. Most important, the TAP package includes 62 KC-135Rs. These associated aircraft give TAP force enhancement capability that neither the B-2 nor CA can compete with. To complement that, TAP has more modern aircraft. The F-15E takes all the A-6 bombing/all-weather/night capability and puts it into a more survivable aircraft. The F-117A puts precision and stealth (survivability) together in a way only the B-2 can compete with. TAP has the F-15C to do counterair (all-weather, night capable). It has the F-15E (all-weather, night capable) and F-117A (night VFR only) to carry out strategic attack and interdiction. It has the F-16 (day VFR, limited night/weather) to carry out interdiction and CAS. All these assets have enhanced range due to air refueling. Even so, strategic attack and interdiction are limited to approximately four hundred miles after the last air refueling. Although TAP has assets with greater range than that, range is limited by the accompanying airplane with the shortest range (this excludes the F-117A which needs no escort). Barring delivering a large payload at long range, theater airpower has unparalleled mission flexibility.

Power

Table 8 compares and rates the ordnance load, ordnance flexibility, and mission flexibility of the three types of airpower instruments. The major limitations of TAP appear in the projection arena.

Table 8

Comparison of Flexibility in Ordnance and Mission

	Theater Air	B-2	Carrier Air
Ordnance Load in Tons per Day	335	280	112.5
Ordnance Flexibility	Best	3d	2d
Mission Flexibility	Best	3d	2d

Speed

Strategic air offers the United States the quickest response to a crisis. By circumventing the need to deploy to the conflict, the B-2 can deliver ordnance anywhere within 48 hours.[83] Since the B-2 can travel unescorted and not be tracked, defenses and borders are not barriers. Unlike previous nonstealthy strategic bombers, the LRCA B-2's survivability makes it a credible threat against any fixed target on the globe. Previous to the B-2, the US ability to use long-range carrier air was limited. Strategic bombing over Germany was feasible in World War II only with fighter escort. In Japan the B-29 campaign was possible only because there was no air defense. Linebacker I and II, some of the more famous examples of use of long-range combat aircraft, were possible only with escort and significant defense suppression from theater assets. Even then losses were very nearly prohibitive. The stealth characteristics of the B-2 obviate those problems and permit an immediate and significant military response to a crisis. The B-2 could strike targets on its way to its deployment base and recover there for follow-on strikes. Korea offers an example of the importance of the range, and hence the speed of LRCA.

When the North Koreans charged across the 38th parallel, the United States had few military forces in the country. As US forces arrived, the South Korean and UN forces were being driven down to what became the Pusan perimeter. This retreat resulted in the loss of so many airfields that all the combat aircraft were withdrawn to Japan.[84] Although the shorter range theater aircraft could still reach Korea, they had little ordnance or loiter time. Medium and heavy bombers from Japan bore the bulk of the early air effort. Only a deployed carrier offers such a speedy response.

The carrier relies on its forward presence for speed of response. If the carrier is needed close to its deployed location, it will be first on the scene. As long as the carrier is within 2,000 miles, it can be on station ready to fly within three days.[85] Carriers were on station first for Desert Shield because they were relatively close (they did not start from the United States) and they could move prior to political coordination. Another benefit is that carriers arrive ready for employment. While the carrier moves, its crews can prepare and rest. Its logistics and maintenance are all on board, and as soon as it is within range it can launch missions. Even if theater air could beat the carrier to the theater, logistics support and infrastructure would not permit complete employment as quickly.

Theater air, augmented by air refueling, can deploy to any suitable runway on the globe very quickly. In Desert Storm, the 71st Tactical Fighter Squadron was taking off from Langley Air Force Base (AFB), Virginia, on 7 August—only 20 hours after President George W. Bush notified them of deployment. They were bedding down in Saudi Arabia on the eighth and flew the first mission (combat air patrol) on 10 August.[86] Due to the cargo and air refueling capacity of KC-10s, theater air can arrive quickly. The first two F-16 squadrons to deploy flew 16 and one-half hours directly to

the Gulf area. The first squadron arrived with all 24 aircraft, and the second arrived with 20 of 24 aircraft.[87] This speed depends not only on a base to land at, but permission to land there.

Theater air needs local infrastructure to support combat operations. In the case of a bare base, where theater air must provide all its own support, it may take five to ten days to be ready for combat.[88] This becomes problematic when we try to deploy many wings simultaneously (not to mention the Army). In 1971 the Air Force estimated it took 405 C-141 sorties to deploy an F-4E wing to a bare base and 41 sorties per day to sustain it.[89] Theater air is mobile, but is neither as easy or as cheap as it seems. It becomes more complicated when the nature of the host country is considered.

Autonomy

Autonomy is a measure of the constraints on bringing an element of airpower to bear in a theater. The B-2 would be the most autonomous form of airpower because it can strike without deploying and deploy without constraint. At a minimum, bases on Guam and Diego Garcia could receive long-range combat aircraft. Assuming these bases would have pre-positioned supplies and petroleum, oil, and lubricants (POL), B-2s could begin operations from there shortly after arrival. From just these bases the B-2 can strike virtually any area of the world. Had the United States owned B-2s then, they could have struck Iraq from the United States, deployed to Diego Garcia, and conducted a sustained campaign. The B-2s would not have been in the theater, and strikes would require six to seven hours of flying time to get to the theater. Yet, with its range, the B-2 could strike targets beyond the range of carrier air. No target in Iraq would have been safe from B-2 strikes. Carriers are almost as mobile but lack the range.

Carriers rank high on this criterion because they travel in international waters. A cursory look at a map will reveal that the majority of the earth's population and its major cities are within 50 miles of a seacoast. When President Bush decided on 6 August to send troops to the Middle East, the carrier battle groups *Independence* and *Eisenhower* were close by. On 7 August they were already in the Gulf of Oman and Red Sea respectively. They had been steaming to the area since 4 August. The freedom of the CVBG to move in international waters into the likely theater of operations is a powerful political and military advantage. Initially, carriers were our only military force in the region deterring Saddam Hussein's move into Saudi Arabia. In Korea (a peninsula), Vietnam, and Iraq, carrier air could bring significant forces to bear without requiring the cooperation of allies. Additionally, it could move those forces around in the theater, which provided a broader spectrum of air options to the United States. In Vietnam for instance, the carriers used Yankee station off North Vietnam and Dixie station off South Vietnam. Theater airpower is not nearly as autonomous.

Theater air forces are the least autonomous form of airpower. This problem is not because TAP has not devoted lots of energy to deploying. It is

based entirely on the physical or political availability of bases. Without a base near the conflict, they cannot respond. The limited range of theater air (even with air refueling and external tanks) constrains them to be near the conflict. The obvious question is, when would there not be a base? A Falklands-type scenario immediately comes to mind. In the Falklands case, England could not reach the islands with theater air; even long-range combat aircraft were out of range for lack of air refueling. The carrier was the weapon that made any effective operation conceivable. The nature of theater air also makes it dependent on local infrastructure. It not only needs a runway, but ramp space, fuel, and ordnance. Beyond the constraints of local infrastructure, theater air is limited by the political and economic price of access to that infrastructure.

Even when a nation has adequate infrastructure it may be reluctant to allow American access. Saudi Arabia is a clear example. When the United States was committed to action, we still needed the permission of our allies to deploy theater air. American TAP in the Middle East used 20 different bases in seven different countries.[90] Our efforts to maintain the coalition (aid to Israel and forgiving Egypt's loans) were not cheap. Those efforts were important to land and sea power as well, but our theater air options were completely dependent on allied consent. The question regarding autonomy is its importance. I address that in the analysis (also see table 9).

Table 9

Comparative Analysis of Airpower Instruments

Power	Theater Air	B-2	Carrier Air
Ordnance Load	Best	2d	Distant 3d
Ordnance Flexibility	Best	Close 3d	Close 2d
Mission Flexibility	Best	3d	2d
Projection Speed	3d	Best	2d*
Autonomy	Distant 3d	Best	Close 2d

*The carrier is a close second only if it is deployed. Of course, you cannot keep a carrier deployed. Depending on the area, the United States must have between four and seven carriers to keep one deployed.

Source: Ronald O'Rourke, *Aircraft Carrier Force Levels and Deployment Patterns: Issues and Options,* CRS report to Congress, 26 June 1991 (Washington, D.C.: CRS, 1991), 4.

Analysis

Theater airpower is not only the most powerful instrument but also the most cumbersome to project. TAP can deliver three times the ordnance of carrier air and 20 percent more than the B-2. Not only can it deliver more but it offers the most flexibility in targeting and precision. This implies

that regardless of the intensity of the conflict, or the nature of the target set, TAP will offer the most options. The disadvantages of TAP lay in the time required to deploy and its dependence on host-nation support. It is quite possible that Hussein thought that once Kuwait was occupied, no neighboring countries would permit Western troops on their soil. This would have made the rescue of Kuwait an entirely different proposition. Putting a naval armada in the Gulf for an amphibious invasion of Kuwait is not an attractive option, but it is better than no option. To the extent the United States has vital interests overseas, in countries vulnerable to quick defeat (Israel?), TAP cannot be our sole source of airpower. Autonomy becomes more essential the longer it takes to bring power to bear.

Theater airpower can arrive quickly but needs sea lift for sustainment. In Desert Shield TAP had no bomb droppers in the theater until 10 August, and when they could have begun continuous operations is hard to tell. Crew rest constraints make the 12th the earliest likely date. More important are the munition constraints. TAP depends on sea-lifted munitions unless there are stores in-theater. The Saudis may have stored munitions. If not, the Maritime Pre-positioned Squadron from Diego Garcia did not start unloading until the 15th.[91] It is conceivable that the air-to-ground squadrons could not have sustained operations until around 17 August. Eleven days from notification until sustained combat operations is probably a good estimate of what theater airpower can do under optimum conditions. That time is just for the initial squadrons. It would be considerably longer before a package of 312 combat aircraft of various kinds could be ready to fight as a team. Lack of speed and autonomy are TAP's greatest liabilities. How great those liabilities are depends on the nature of the United States's vital interests abroad and the nature of the threat to those interests.

Although the United States clearly has global interests, it is not clear that it has any interests overseas that are both vital and vulnerable to quick defeat.[92] The liabilities of TAP only become significant when our interests/allies abroad can be isolated from deploying theater airpower—a Falklands scenario. In addition to thinking that the United States has such vulnerable interests, CA or LRCA are viable alternatives only if they could bring to bear sufficient power to prevent such situations as the fall of South Korea (1950) or the fall of Kuwait (l990). It is very unlikely that a CVBG or an air campaign by B-2s could stop such invasions. It appears that for all scenarios, we will ultimately have to bring TAP to bear to protect vital interests. That does not mean that LRCA and CA have no important role to play.

The B-2 brings three unique qualities to the power projection mission. First, it offers the quickest response to a threat. Its speed and range allow US forces to put bombs on target anywhere within 48 hours. Second, its payload allows it to do more damage in a single strike than any other instrument. This may be a crucial attribute if the United States adopts a

preemptive strike strategy to deal with renegade nuclear and/or chemical threats. Third, the B-2's range allows it to strike strategic targets that are beyond the reach of carrier air or theater air. In most cases it would be the only weapon the United States could use to attack an adversary's nuclear, chemical, or biological arsenal before any US troops were in-theater. Range and payload are improvements on what TAP can do. Responding immediately (speed), without allied consent (autonomy), is an attribute of the B-2 which TAP does not have. The longevity of this attribute is not clear.

The stealth of the B-2 raises two questions. First, just how stealthy will it be? Testing on the B-2 continues and it is not clear yet what operational constraints will exist on the B-2. Second, when will stealth counters become technologically and fiscally feasible, so that stealth loses its effectiveness? The effectiveness of the B-2, as described in this analysis, is very sensitive to the answers to those two questions. If the B-2 can be tracked and engaged effectively in the next 10 to 20 years, it will lose its most valuable features. When stealth is defeated, the B-2 becomes just another LRCA. Long-range combat aircraft have their role but they do not offset the projection problems of TAP. Because LRCA are not survivable alone over the course of an air campaign, they become an adjunct of TAP. An LRCA that is not survivable must fly with the escorts only TAP or carrier air can give. The B-2 offers some attractive qualities but there is a technological risk, and that risk is a disadvantage in addition to the B-2's other limitations.

The B-2 can only address a portion of the missions of air forces. The B-2's lack of mission flexibility means it could only augment a more complete source of airpower. That was always obvious but it is important to notice that stealth air-to-ground platforms, B-2 or F-117, do not obviate the need for more conventional weapon systems. Stealth, and the B-2 in particular, have potential but have not proven that considerable investment in conventional platforms is unwarranted. It is not clear how stealth technology will be incorporated into carrier aircraft.

Carrier air delivers the full range of airpower missions and it does so quickly, without the political and basing constraints of TAP. The carriers' advantages were clearly demonstrated in Desert Storm. Iraq invaded Kuwait on 2 August 1991. On the fourth, when a move against Saudi Arabia becomes possible, the USS *Independence* starts moving towards the Gulf and the USS *Eisenhower* heads for the Suez Canal. Two days later (6 August) the US secretary of defense and the Saudis are still discussing plans as stateside forces mobilize. On 7 August the carriers are arriving on station and could have begun combat operations on the eighth if necessary. The eighth of August is the day initial US forces are arriving; the first F-15C will fly a combat air patrol sortie on the 10th. As stated earlier, air-to-ground operations probably could not have been sustained until around 17 August. If so, the carriers beat the initial squadrons by nine days and the remainder by perhaps as much as a month. The beauty

of carriers is they can do that, even if no other country wants to assist us. They permit the autonomous projection of US airpower. The downside is that they lack punch and availability.

Carriers lack punch simply in terms of their sortie count and ordnance load. Forty-five sorties, which deliver 112.5 tons, can demonstrate resolve, but I doubt they could have kept Iraq out of Kuwait or Saudi Arabia. The value of speed is not just in getting there, but getting there with combat power. The carrier ranks far below theater airpower in this category.

The other great drawback of the carrier is its availability. If a carrier is homeported in the United States (one carrier is ported in Yokosuka, Japan), it takes anywhere from four to eight carriers to keep one on station in the Mediterranean or Indian Ocean.[93] Comparisons of TAP or the B-2 to a deployed carrier are misleading in the sense that it usually takes four carriers to have one deployed. In that light, the cost of keeping one carrier in the Mediterranean is four times the cost of a CVBG. That is a huge investment to get the power available from a carrier. The United States has traditionally kept a carrier in the Mediterranean, the Indian Ocean, and the western Pacific. This deployment pattern gives US forces an independent and speedy response to a crisis. What that force can accomplish in terms of projecting US power is limited.

The CVBG cannot compete in terms of power or range with TAP or LRCA. Although some of these deficiencies are not inherent to carrier operations, it is not clear that the Navy can reverse many of them.[94] Given the funds, naval aircraft can be equipped to deliver PGMs, be replaced by more survivable platforms, and have more capable air refueling platforms. However, there will probably be only marginal improvements in the range of naval strike packages. Not all the aircraft can be replaced and the range improvement is likely to be incremental. Additionally, there is no foreseeable high-capacity air-refueling platform that can launch from carrier decks. Although CA ranks high in projection ability, its lack of power means it only plays a peripheral role in US airpower projection. Its main contribution is the ability to provide battlefield protection for surface forces beyond the range of TAP. For forced-entry scenarios (Falklands) or amphibious landings beyond the range of TAP (Inchon), carrier air is essential. However, for strategic attack or raids, the B-2 is a better alternative. The B-2 is just as autonomous, is faster, and delivers two and one-half times the ordnance.

Conclusions and Recommendations

For power projection, as defined in this analysis, theater airpower is the predominate player. Our next war will probably not be decided by the contributions of carrier air or long-range combat aircraft. Carrier air simply does not have the power. LRCA will play a decisive role only if our adversary's country is so large that most strategic targets are beyond the range of TAP. Theater air looks like the decisive element for the foreseeable

power projection scenarios. The B-2 and carrier air play a subsidiary role based on the need for their unique contributions. Carrier air is the sole source of battlefield protection for amphibious landings beyond the range of TAP. The B-2 may have enough power to be used preemptively against a nuclear, chemical, or biological threat. Given these attributes, the following recommendations are made.

Theater Air

The vast majority of defense dollars allocated to airpower should go to theater air assets. This paper does not indicate which TAP assets need immediate attention. The F-22 makes sense to the extent that control of the air is necessary for all other air missions (stealth being an exception). However, Vietnam and Iraq suggest that regional powers have a limited ability to mount an air-to-air threat. Korea, Vietnam, and Iraq were able to challenge US air superiority with Soviet fighters. They could neither attain enough aircraft nor train enough pilots to seriously challenge us. Future regional powers will probably not be able to count on acquiring sophisticated Soviet fighters. On the other hand, they may be able to do what Vietnam and Iraq did quite well. That is, mount a formidable surface threat with antiaircraft artillery and surface-to-air missiles. Given the age of our suppression of enemy air defense (SEAD) assets (F-4G at 30 years and EF-111 at 26 years), TAP may need to make an equally large investment in that area. This analysis indicates that force enhancement assets, like SEAD and tankers, are as crucial as the strikers.

Theater airpower must develop an air base missile defense capability. TAP is tethered to air bases and dependent on ports for sea lift. The most devastating Scud attack in Desert Storm occurred against a base. The next war may include an adversary with missiles which can attack our bases. Given the difficulty of stopping mobile launchers, TAP must have the ability to defend its bases from such attacks.

The Air Force must continue to work TAP's weaknesses in autonomy and speed. First, the Air Force must impress upon the State Department the importance of access to other countries. The Air Force should pursue access to various countries for joint exercises. Any place where the United States has vital interests we must ensure appropriate base structures and pre-positioned stores. This will require a hand on the pulse of US civilian leadership. We were surprised in Korea because the nature of "vital interest" was changing as the cold war escalated. Second, TAP can improve its speed. A near-term possibility is dedicated maritime pre-positioned ships that are fast sea lift with roll-on/roll-off capability. They carry twice the load, get to the scene faster, unload faster, and quickly begin the inevitable shuttle of equipment required for TAP operations. A future possibility is airships.[95] Modern technology may prove capable of building airships with enough capacity to move items previously moved by sea lift (POL, munitions, armor). Although the airships will not have the speed of modern jets they would travel four or five times faster than sea lift and go

directly to the final destination. These sorts of improvements would make TAP much more responsive to regional crises.

A look at the TAP package reveals that it comes in great numbers dispersed over many bases. Although the composite wing is great for getting the initial fighting package in-theater, it is not obvious that all wings should be organized this way. The drawback of TAP is deployment. Deploying a composite wing will be more difficult because of the greater diversity of spare parts, ground equipment, and munitions. If all wings are so organized and deploy that way the duplication of logistic effort will be incredible. There would be some pluses. Composite wings disperse our high-value assets. They would also make each base an independent fighting unit. That is a good tactic because then a couple of well-placed missiles cannot take out all our Airborne Warning and Control Systems or EF-111s. However, the Air Force excelled in Desert Storm because it had the computer and communication ability to create an air tasking order and execute it for forces dispersed across the theater. The benefits of centralized control come when dispersed forces are integrated. The benefits of O&S savings, mobility, and centralized control dictate a small number of composite wings.

Carrier Air

In terms of US airpower, a long-range attack aircraft for the Navy is a low priority. Certainly, the A-6 needs a replacement. However, there is nothing a carrier-borne strike aircraft can offer the United States that we cannot get from a more effective system. Since the niche of carrier air is cover for amphibious landings, the E/F version of the F/A-18 is a viable alternative.

The Navy would solve a host of problems if it had a carrier-launched refueling aircraft. Makeshift tankers like the KA-6 simply do not have the off-load capacity necessary. I do not know a solution to this problem but it is more pressing than the A-X.

Long-Range Combat Aircraft/B-2

Although the B-2 has only a subsidiary role in US airpower, a buy of 35 to 45 aircraft makes more sense than 20. For power projection, 16 operational B-2s will probably yield six sorties each night. That will be 120 tons of gravity bombs or 72 tons of smart weapons. That is formidable, but it cannot stand any attrition and is unlikely to deter, or preempt, an adversary with NBC weapons.

The B-1 needs major work. The Air Force cannot ask for an advanced attack aircraft and operate 100 B-1s that cannot deliver PGMs in all weather.

As US attention focuses on domestic concerns and budget problems, the military will be forced to make increasingly more difficult choices. The Defense Department must balance carefully its investment in air assets that are powerful, flexible, and autonomous. We need forces that can not only get there, but also get there and win.

Notes

1. I use the phrase *theater airpower* instead of tactical airpower. Historically, tactical referred to aircraft with limited range that performed tasks near the front; thus, tactical commonly referred to fighters and fighter-bombers. That was an unfortunate use of the word because tactical really identifies the use of an aircraft, not a type of aircraft. I prefer to use theater because it designates aircraft which, due to range limitations, are usually based in the theater of operations. Theater does not specify any particular role or mission an aircraft serves.

2. I use the term *long-range combat aircraft* (LRCA) instead of the more commonly used strategic aircraft. Like tactical, strategic refers to a mission and is inappropriately used to refer to a type of aircraft. Strategic commonly referred to B-52s, B-ls, C-5s, C-141s, and other aircraft which, because of their range, travel between theaters. By LRCA, I mean the B-2 or other long-range, heavy-payload bombers such as the B-52 or B-1.

3. Much of the popular information on the B-2, the F-22, or the now-canceled Navy A-12 from newspapers reflects sticker shock, with little understanding of military or cost-effectiveness. Magazines offer more information but usually fail to address cost-effectiveness or alternatives. The following sources offer some insight on one or two of the aspects of airpower, which I have tried to consolidate in this paper. See "Using B-2 Bombers for Conventional Naval Missions," staff memorandum (Washington, D.C.: Congressional Budget Office [CBO], September 1991); William W. Kaufmann, *A Thoroughly Efficient Navy* (Washington, D.C.: Brookings Institution, 1987); and Joshua M. Epstein, *Strategy and Force Planning: The Case of the Persian Gulf* (Washington, D.C.: Brookings Institution, 1987).

4. The number of years used in life-cycle costs varies. Ships and aircraft may have different life spans, with the ship's usually being longer. Although figures of 20 or 25 years are often used, I picked 30 years because replacement costs seem to be driving the life span of systems up. Consider the age of the following aircraft: B-52/33 years, A-6/31 years, A-10/30 years, F-4G/30 years, and EF-111/26 years.

5. The Navy would always prefer to employ carriers in groups of two or more since carriers are more efficient that way. This analysis uses an estimate of carrier performance based on the operations of six in Desert Storm. The cost reflects the cost of one carrier battle group but the performance of the carrier includes the increase in performance based on having it operate with others.

6. There is ample evidence of the change in US planning. *The National Military Strategy of the United States* (Washington, D.C.: Joint Chiefs of Staff, January 1992) is based on a reduced Soviet threat and the likelihood of regional conflicts. The seven scenarios used for planning and procurement in the Pentagon also reflect the emphasis on regional conflict. See related article in the *Washington Post,* 20 February 1992.

7. *Washington Post,* 20 February 1992.

8. Ballistic missile defense may be a higher priority than regional conflict. This is a separate issue, but the funding of each will affect the other. We will also buy systems for special operations and low intensity conflict, but they will not be of the same magnitude as conventional weapons procurement.

9. Kenneth J. Hagan's book, *This People's Navy: The Making of American Sea Power* (New York: Free Press, 1991), chronicles the development of naval strategic thought and the conflict regarding the primary role of American sea power.

10. Notice the use of power projection in the following documents: *National Military Strategy of the United States; Global Reach—Global Power* (Secretary of the Air Force, 1990); and *The Way Ahead* (Washington, D.C.: Secretary of the Navy, 1991).

11. The Army and Air Force define four types of low intensity conflict in Army Field Manual (AFM) 100-20, *Military Operations in Low Intensity Conflict,* and Air Force Pamphlet (AFP) 3-20, *Military Operation in Low Intensity Conflict,* 5 December 1990, 5-1. The four are (1) supporting insurgencies and counterinsurgencies, (2) combating terrorism, (3) peacekeeping operations, and (4) peacetime contingency operations. Peacetime contingency operations include shows of force and demonstrations, noncombatant evacuation operations, rescue and recovery operations, strikes and raids, peacemaking, unconventional warfare, disaster relief, security assistance surges, and support to US civil authorities.

12. This is not a suggestion that the direct (weapons delivery) aspect of airpower is the only important part. In fact, for air and sea power, the airlift and sea-lift elements are most frequently used and are essential to the other elements of air and sea power. Since Desert Storm, it may well be that the C-17 should be the Air Force's highest priority. Air and sea lift are the projection part of power projection and will be more critical in the years ahead.

13. The use of military power to threaten and persuade rather than compel is well documented. See Barry M. Blechman and Stephen S. Kaplan, *Force Without War: U.S. Armed Forces as a Political Instrument* (Washington, D.C.: Brookings Institution, 1978). For the political use of naval forces, see James Cable, *Gunboat Diplomacy 1919–1979: Political Application of Limited Naval Force* (New York: St. Martin's Press, 1981).

14. *U.S. Projection Forces: Requirements, Scenarios, and Options* (Washington, D.C.: CBO, 1978), xiii and 1.

15. Ibid.

16. Jeffrey Record, "The Rapid Deployment Force: U.S. Power Projection and the Persian Gulf," in *Projection of Power,* eds. Uri Ra'anan, Robert L. Pfaltzgraff Jr., and Geoffrey Kemp (Medford, Mass.: Archon Books, 1982), 107.

17. Kenneth A. Myers, "U.S. Power Projection in the Northern Flank," in *Projection of Power,* ed. Uri Ra'anan et al. (Medford, Mass.: Archon Books, 1982), 187.

18. Vietnam is an exception, because, although we deployed what we thought was enough military force to attain our objectives, we failed to do so.

19. Air Force Manual (AFM) 1-1, *Basic Aerospace Doctrine of the United States Air Force,* vol. 1, March 1992, 7; and AFM 1-1, *Basic Aerospace Doctrine of the United States Air Force,* vol. 2, March 1992, 104–5. According to Air Force doctrine, there are four roles of aerospace power—*aerospace control, force application, force enhancement,* and *force support.* This paper focuses on aerospace control and force application. In the context of this paper, aerospace control demands the mission of counterair. Counterair includes the ability to neutralize or destroy enemy air forces in the air or on the ground, suppress enemy air defenses, and protect our forces from enemy air attack. Force application includes the missions of strategic attack, interdiction, and close air support. Strategic attack means to destroy or neutralize the enemy's ability to produce or sustain military forces or his will to use those forces. Interdiction is an attack on an enemy's forces en route to the battle that does not require coordination with friendly surface forces. Close air support is an attack on enemy forces whose proximity to friendly forces demands detailed coordination with those friendly forces.

20. The B-2 is not designed for air-to-air engagements and will not carry an air-to-air weapon. Similarly, the F-14 is designed only for air-to-air engagements and carries no air-to-ground ordnance.

21. Many might argue this point. Indeed, A-10 advantages include its ability to loiter over the battlefield, operate from more austere runways, and its gun, which gives it more firepower. Nevertheless, the Air Force judges it less effective because of its vulnerability in a high-threat environment.

22. Ibid., 40.

23. Ibid.

24. Truong Nhu Tang, *A Viet Cong Memoir* (New York: Vintage Books, l985), 167.

25. Robert Frank Futrell, *The United States Air Force in Korea, 1950–1953* (Washington, D.C.: Office of Air Force History, 1983), 130.

26. A more accurate comparison of weapon systems is measuring their effectiveness against particular target sets and specific defenses. Such a comparison requires a specific scenario and classified data about defenses, countermeasures, and weapon/weapon system accuracies. In an attempt to approximate such a comparison, this analysis is limited to unclassified information regarding aircraft and weapon capabilities.

27. Richard P. Hallion, *The Naval Air War in Korea* (Baltimore, Md.: Nautical & Aviation Publishing Company of America, 1986), 37–41.

28. This is not to imply that the rapid deployment force could not do its job. But the fact of the matter is that the RDF required a 30-day notice to get in-theater and included most of the elements of US military power (infantry, heavy armor, Marines, theater aircraft, and naval air). See Jeffrey Record, *The Rapid Deployment Force and U.S. Military Intervention in the Persian Gulf* (Cambridge, Mass.: Institute for Foreign Policy Analysis, Inc., 1981), 52–61. It was not practical to create a credible force of only the most mobile/rapid military instruments.

29. Bob Woodward, *The Commanders* (New York: Simon & Schuster, 1991), 228.

30. The Marines and all our amphibious craft are designed for the forced-entry mission. That mission is important and was used extensively in World War II. However, forced entry has played a very limited role in regional conflict scenarios, Inchon being the only significant exception.

31. Cost and composition figures are taken from Ronald O'Rourke, *The Cost of an U.S. Navy Aircraft Carrier Battlegroup* (Washington, D.C.: Congressional Research Service [CRS], 1987), 9. O'Rourke's figures were in FY 88 dollars. I converted them to FY 92 dollars by using an inflation index (1.161) from Air Force Regulation (AFR) 173-13, *Air Force Cost and Planning Factors*, 31 October 1989, as amended 14 February 1992. See SABLE Model Reports: Version 92-1, 27 November 1991.

32. Ibid., 27.

33. Ibid.

34. Ibid., 9–10. My total procurement costs differ slightly from O'Rourke's because I excluded the costs of training and pipeline aircraft. I did not use O'Rourke's 30-year life-cycle costs. Instead, for all three instruments I simply multiplied the annual O&S costs by 30. The disadvantage in simply multiplying by 30 is that it fails to account for the different value of a FY 92 dollar and an out-year dollar. I used simple multiplication to avoid including some of the costs that O'Rourke used which were not relevant to my comparison. Additionally, discounting out-year dollars is speculative, given the changing costs of fuel, labor, and personnel.

35. Composition is based on several sources: personal analysis of the composition of forces in Desert Storm; testimony from Desert Storm veterans, Maj Tom Griffith (F-15E) and Col Dennis Carpenter (commander of an EC-135 wing); and congressional testimony on Desert Storm. See House, *Department of Defense Appropriations for 1992: Hearings before the Subcommittee of the Committee on Appropriations*, 102d Cong., 1st sess., 1991, pts. 1 and 5. Note the chart on the value of stealth found on page 639 in pt. 1. Omitted from the composition are C-130 communication-jamming aircraft, scheduled theater airlift routes (STAR), and reconnaissance aircraft. These assets may be substituted for all or part of the EC-130E and RC-135 aircraft or these functions may go to space systems. Costs are taken from four sources. The F-16C/D, F-15C, and F-15E procurement costs are based on average procurement costs taken from the *Selected Acquisition Report*. F-15C and F-15E costs come from the report dated 31 December 1990, 14. See Aeronautical Systems Division, *Selected Acquisition Report, F-15 (Eagle)* (Wright-Patterson AFB, Ohio: Air Force Systems Command, 31 December 1990). The F-16 cost is the FY 91 cost from the *F-16 System Program Office Aircraft Cost Analysis Report*, 29 January 1992. The F-117A procurement cost is on page 409, part 5 of the hearings cited above. All other costs are unit flyaway costs taken from AFR 173-13, *US Air Force Cost and Planning Factors*, 13 October 1989, Table A10-1 (updated16 January 1992). The same regulation gives inflation indices.

36. AFR 173-13 references a SABLE model for calculating O&S costs. My costs are based on the most current SABLE information available from the Secretary of the Air Force's Cost Accounting and Analysis Office, Headquarters USAF. These costs include fuel, depot maintenance, consumable supplies, depot-level repairables, replacement ground support equipment, military pay, civilian pay, training munitions, upgrade kits, and installation costs. These figures reflect the cost of the flying unit, its equipment, and operating and support costs. It excludes much of the base costs. This is to match up with the costs of the carrier battle group whose costs don't include port costs.

37. Headquarters USAF/LEXP, "Point Paper on Bare Base Systems" (Washington, D.C.: Headquarters USAF, 28 January 1991).

38. Costs for the B-2 vary greatly based on how the cost is calculated and the number purchased. One CBO memorandum cited costs from 380 million to 1.95 billion dollars, depending on the number bought and whether or not sunk costs were included. I used a unit price of 560 million dollars for two reasons. First, the costs for carrier aircraft and theater airpower aircraft were not total program costs and thus did not reflect sunk costs such as research and development. Second, for the carrier and TAP aircraft the costs were those of a production airplane, where production reflected a large buy according to DOD plans. The B-2 price I chose excludes sunk costs and reflects the administration's planned rate of production. Although that price does not reflect actual conditions, it is the fairest measure of the potential of the B-2 if it were procured instead of canceled. See staff mem-

orandum, "Using B-2 Bombers for Conventional Naval Missions" (Washington, D.C.: CBO, 1991), 17.

39. The CBO staff memorandum gave an estimate of O&S costs. Their estimate was based on the assumption that the B-2 would cost 30 percent more than the B-1 to operate. I used that estimate to figure cost per airplane and then multiplied by 38 for the annual costs. That number times 30 gave 30-year O&S costs. Operations and support costs for the EC-135R are based on the same USAF Regulation 173-13 figures used earlier.

40. Certainly the United States lost the Vietnam War in the sense that we failed to achieve our objectives. The military was part of that failure since it failed to apply military power in an appropriate way. However, the US military was not defeated on the battlefield. The United States withdrew its military for political reasons. I believe that the United States had sufficient conventional military power in Vietnam but that such power could not be decisive given the nature of the conflict.

41. Comdr John B. Nichols, USN, Retired, *On Yankee Station: The Naval Air War over Vietnam* (Annapolis, Md.: Naval Institute Press, 1987), 99.

42. This schedule is based on conversations with Lt Comdr Terry Kraft, an A-6 pilot who led one of the first naval strikes at an airfield in Iraq during Desert Storm. He described the above operations based on his experience and the type of operations he saw during the war.

43. The number of strike sorties will vary with the threat to the carrier, the air defense environment, and the range of the target. If there is a surface threat to the carrier, A-6s and F/A-18s will fly sea-strike sorties. A strong air defense network will require more EA-6B sorties and more F/A-18s dedicated to SEAD. If the target is far away, the strike packages will be limited to what the KA-6s (air refueling aircraft) can support.

44. These figures are based on statistics provided by the Navy in the pamphlet, *The United States Navy in "Desert Shield" and "Desert Storm"* (Washington, D.C.: Office of the Chief of Naval Operations, 15 May 1991), D-6 and D-9. The peak week of operations was 21–27 February. Strike sorties were calculated by adding offensive counterair (OCA), interdiction, and close air support (CAS) sorties from table 1 or OCA, theater strike, and maritime strike from table 2. I assumed all six carriers participated. I also assumed they surged on 25 to 27 February, based on the dramatic increase of sorties on those days and the subsequent decrease on 28 February. Most of the time only five carriers operated per day. However, as the ground invasion approached, it is likely that all carriers were operating.

45. Ibid.

46. Ibid. Calculated from table 2 by adding OCA, theater strike, and maritime strike sorties to get strike sorties per day. I divided by six for the carriers on station. On average, there were only five carriers operating on any given day. What each carrier was flying was closer to 31 strike sorties each day. However, once you factor in down-days, the numbers I use reflect what a carrier accomplishes over time.

47. Ibid. The average of 45 strike sorties a day is based on the Navy's statistics. Each table shows total sorties. In table 1, OCA and interdiction are added to yield total strikers, which is then divided by six. In table 2, OCA, theater strike, and maritime strike are added and divided by six. In actuality, only four or five carriers flew on a given day. Averaging this out over a week gives an estimate of what a single carrier might maintain continuously without a stand-down. The week I used was 21 to 27 February.

48. Mark Lambert, ed., *Jane's All the World's Aircraft 1990–1991* (Surrey, UK: Jane's Information Group, Ltd., 1990), 416. All the ordnance loads are based on the aircraft's typical load of Mk-82s. The Mk-82 is a 500-pound bomb used by virtually all US combat aircraft. The "typical" load refers to ordnance loads often used in Desert Storm, which was obtained from interviews with veterans.

49. Lt Comdr Terry Kraft, interviewed by author at the Air University Library, Maxwell AFB, Ala., November 1991.

50. Ibid.

51. Ibid.

52. Neville Brown, *The Future of Airpower* (New York: Holmes & Mier Pub., Inc., 1986), 24.

53. Joshua M. Epstein, *Measuring Military Power: The Soviet Air Threat to Europe* (Princeton, N.J.: Princeton University Press, 1984), 33.

54. Michael A. Dornheim, "F-117A Pilots Conduct Precision Bombing in High Threat Environment," *Aviation Week & Space Technology,* 22 April 1991, 51. According to this article, the 37th Tactical Fighter Wing flew 1,270 sorties. They started with one squadron in-theater and then built up to approximately 40–45 aircraft. Their sortie rate was somewhere between .65 and 1.2. Given the length of their sorties and the fact that they only flew at night, I estimate a sortie rate of .85.

55. The 363d Fighter Wing maintained 1.7 sorties per day from a forward operating location. A rate of 1.2 sorties per day was generated by the 335th Tactical Fighter Squadron as part of the 4th TFW in Desert Storm. Data in both cases was extracted from press releases from the respective units.

56. Lambert, 414. Typical ordnance loads were obtained from interviews with veterans of Desert Storm and from official records of the Tactical Air Command's Office of History.

57. Bert Kinzey, *The Fury of Desert Storm: The Air Campaign* (Blue Ridge, Pa.: Tab Books, 1991), 73.

58. Brig Gen James R. McCarthy, *Linebacker II: A View from the Rock* (Maxwell AFB, Ala.: Airpower Research Institute, 1979), 12.

59. Ibid.

60. This is the author's estimate.

61. Author's approximation is based on the payload difference of the two aircraft and an "average" fuel load of an F-16 and a B-52.

62. Headquarters 307th Strategic Wing, *History of 307th Strategic Wing, October–December 1972,* Air Force Historical Research Center, Maxwell AFB, Ala., file no. K-WG-307-HI, 1, 12 July 1973.

63. Ibid.

64. James F. Dunnigan, *How to Make War: A Comprehensive Guide to Modern Warfare* (New York: William Morrow and Co., 1988), 164.

65. Barry D. Watts, "Conventional Options for the B-2" (unpublished article by the Northrop Analysis Center, Arlington, Va., 17 June 1991), 77.

66. Benjamin F. Schemmer, "Six Navy Carriers Launch Only 17% of Attack Missions in Desert Storm,"*Armed Forces Journal International,* January 1992, 13.

67. Dornheim, 53. For another example in the same issue of *Aviation Week & Space Technology* (22 April 1991), see the article titled "Flexibility of Attack Aircraft Crucial To Crushing Iraq's Military Machine," 46.

68. Rear Adm Riley D. Mixson, "Where We Must Do Better," U.S. Naval Institute *Proceedings,* August 1991, 38–39. Also see Strike Fighter Squadron 87, "Aircraft—Yes, Tactics—Yes, WEAPONS—NO," U.S. Naval Institute *Proceedings,* September 1991, 55.

69. Mixson, 38.

70. Dornheim, 52.

71. David A. Fulghum, "USAF Rests Precision Guidance Bombs for Large-Payload Strategic Aircraft," *Aviation Week & Space Technology,* 4 November l99l, 71.

72. Ibid.

73. Watts, 81.

74. Jeffrey M. Lenorovitz, "Air Crew Training, Avionics Credited for F-l5E's High Target Hit Rates," *Aviation Week & Space Technology,* 22 April 1992, 60–61.

75. Ibid. This article assumes an all-weather precision weapon is developed for the B-2.

76. David Hughes, "Air Force Expects Go-Ahead for Sensor Fuzed Weapon Production," *Aviation Week & Space Technology,* 20 January 1992, 52.

77. House, *Department of Defense Appropriations for 1992: Hearings,* pt. 5, 473.

78. Breck W. Henderson, "Aging A-6 Intruder Proves Value with Accurate Desert Storm Bombing," *Aviation Week & Space Technology,* 15 July 1991, 46. Also see Mixson, 39.

79. Mixson, 38.

80. Rear Adm Riley D. Mixson, "Navy's Version of Carrier Contribution to Desert Shield/Storm," *Armed Forces Journal International,* February 1992, 44.

81. Mixson, "Where We Must Do Better," 39.

82. Mixson, , "Navy's Version," 44.

83. This is the author's own estimate. I allowed 24 hours to get the crews into crew rest, coordinate air refueling, and prepare the aircraft and weapons. The second 24 hours is preflight mission preparation and flight time. Targets halfway around the world require 16 to 19 hours of flying time, depending on how directly the plane can proceed.

84. Hallion, 40.

85. Norman Friedman, *Desert Victory: The War for Kuwait* (Annapolis, Md.: Naval Institute Press, 199l), 82.

86. Information was taken from a press release by the 1st Tactical Fighter Wing, Langley AFB, Va.

87. Information was taken from the 363d Tactical Fighter Wing's application for a Presidential Unit Citation.

88. Center for Studies and Analyses, *A Comparison of Bare-Basing, Dual-Basing, and Permanent-Basing Deployment Concepts for a Tactical Fighter Wing* (Washington, D.C.: Department of the Air Force, December 1971), 37. In 1971 the Air Force estimated it would take 9.5 days to get a wing of F-4Es fully operational at a bare base. The first C-141s didn't arrive until day two and it took three days for the F-4Es to deploy. I am assuming 10 days is now the worst case and five days is closer to what an F-16 unit can do.

89. Ibid., 27–28. Going to a bare base is the worst case, and more modern aircraft may be less airlift intensive. The problem remains that it is airlift intensive and there are likely to be many demands for airlift.

90. Eric Micheletti, *Air War over the Gulf* (London: Windrow & Greene, 1991), 7; supplemented by information from an unclassified message from USCINCCENT CCJ3, DTG1905Z June 91.

91. Office of the Chief of Naval Operations, *The United States Navy in "Desert Shield" and "Desert Storm,"* A-3.

92. For support of the view that the United States has no vulnerable vital interests overseas, see Stephen Van Evera, "Why Europe Matters, Why the Third World Doesn't: American Grand Strategy After the Cold War," *Journal of Strategic Studies* 13, June l990. For support of the view that the United States has many vital interests overseas, see *International Security,* Summer 1989, for articles by Steven R. David, "Why the Third World Matters,"and Michael C. Desch, "Keys that Lock Up the World."

93. Ronald O'Rourke, *Aircraft Carrier Force Levels and Deployment Patterns: Issues and Options,* CRS report for Congress, 26 June 1991 (Washington, D.C.: CRS, June 1991), 6.

94. William B. Scott, "Funding Issues to Dictate Future of Navy's Forces and Purchases," *Aviation Week & Space Technology,* 22 September 1991, 54.

95. Lt Col Donald E. Ryan Jr., "The Airship's Potential for Intertheater and Intratheater Airlift" (unpublished master's thesis, School of Advanced Airpower Studies, Maxwell AFB, Ala., May 1992).