

COUNTERING STRATEGIC PRECLUSION: THE REQUIREMENT
FOR TRULY GLOBAL REACH IN THE 21st CENTURY

BY

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APPROVAL

The undersigned certify that this thesis meets master's-level standards of research, argumentation, and expression.

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DISCLAIMER

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.



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ABSTRACT

The shift in focus of US strategic vision to the Pacific region also brings with it a shift in focus to adversaries with the capability to complicate or even deny US power projection. Much of the current emphasis on such capabilities is in the area of anti-access/area denial (A2/AD) technologies and tactics. However, A2/AD technologies are only one part of a larger concept for power projection denial, Strategic Preclusion, where an adversary attempts to fully deny access to an area at all levels and not just operationally or tactically. This thesis is an analysis and evaluation of the recommendations presented by documents suggesting a strategic vision for the Air Force for the ability they provide to counter an adversary who executes Strategic Preclusion. The thesis first provides a new definition of Strategic Preclusion, a term first used in the early 1990s as part of a debate over how best to rapidly project power in overseas contingency operations. The study then examines US power projection experiences in Operations DESERT SHIELD, DESERT STORM, and IRAQI FREEDOM, focusing on airpower operations. Following that is an examination of the British power projection experience in the Falkland Islands in 1982. The comparison between the two experiences shows how US airpower operations have essentially been local operations that followed a long-range deployment, while the British difficulties in using airpower to its maximum extent were primarily the result of having to conduct both deployment and employment operations over great distances. Following those historical examinations is a brief overview of a strategy document published by two Colonels in China's People's Liberation Army Air Force, indicating a belief in the ability to deny the US the opportunity to conduct such localized airpower operations and describing the methods by which China could accomplish that denial. The thesis then analyzes and evaluates the recommendations put forth in two documents, *An Air Force Strategy for the Long Haul* and *Air Force Strategy Study 2020-2030*, for their ability to counter the difficulties imposed on the projection of airpower by Strategic Preclusion. Finally, the conclusion identifies some issues not discussed in those documents that have implications for the Air Force in the future, and highlights those areas of the strategic visions analyzed that provide the necessary level of strategic flexibility for the Air Force. The future of power projection in the face of Strategic Preclusion dictates an Air Force capable of truly global reach on a large scale, not a force that requires significant deployment effort to then support and conduct localized operations.

CONTENTS

Chapter	Page
DISCLAIMER	ii
ABOUT THE AUTHOR	iii
ACKNOWLEDGMENTS	iv
ABSTRACT	v
INTRODUCTION	1
1 STRATEGIC PRECLUSION: THEN AND NOW.	4
2 DEVELOPING A FRAMEWORK FOR ANALYSIS	9
3 VISIONS FOR THE FUTURE OF THE AIR FORCE	29
4 VISIONS VERSUS REALITY	37
5 CONCLUSION	53
BIBLIOGRAPHY	66

Illustrations

Figure

1 Falklands Map with Distances	20
2 Major U.S. Air and Naval Facilities in the Western Pacific	38

Introduction

*U.S. economic and security interests are inextricably linked to developments in the arc extending from the Western Pacific and East Asia into the Indian Ocean region and South Asia, creating a mix of evolving challenges and opportunities. Accordingly, while the U.S. military will continue to contribute to security globally, **we will of necessity rebalance toward the Asia-Pacific region.***

President Barack Obama

The rebalancing of military focus to the Asia-Pacific region as directed above by the President indicates the continuing necessity for a strong and responsive power projection capability for the 21st century Air Force. For most of the last decade, the American military has necessarily focused on two primary challenges. First among them is conducting simultaneous counterinsurgency operations in Iraq and Afghanistan, and second is combating the violent extremist movements linked to the issue of international terrorism.

The shift in major strategic focus to the Asia-Pacific region brings with it new challenges. According to the document directing the shift, the primary military challenge in that region is the growth of Chinese military power.¹ As part of the answer to that challenge, the document emphasizes the requirement to account for and plan to counter adversary capabilities designed to complicate or prevent U.S. power projection operations. Currently, the military includes most of those capabilities under the umbrella term anti-access/area denial (A2/AD).²

¹ Department of Defense, *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense* (Washington, D.C.: Office of the Secretary of Defense, January 2012), 2.

² Department of Defense, *Sustaining U.S. Global Leadership*, 4-5. For specifics on the various challenges presented by A2/AD in multiple areas of the world, see the following documents: Andrew Krepinevich, Barry Watts & Robert Work, *Meeting the Anti-Access and Area-Denial Challenge* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2003); Jan van Tol, *AirSea Battle: A Point-of-Departure Operational Concept* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2010); and Mark Gunzinger, *Outside-In: Operating from Range to Defeat Iran's Anti-Access and*

A2/AD capabilities and systems, however, are only one method by which an adversary could attempt to degrade or prevent U.S. power projection.

This thesis presents Strategic Preclusion as an overarching concept for preventing effective power projection, one for which A2/AD should be considered a subset of operations or tactics. The intent is to determine whether the Air Force, in terms of potential strategies, is preparing itself to deal with the variety of challenges posed by a Preclusion strategy, and not just the operations challenges of A2/AD. To do so, this paper first demonstrates the challenges for airpower that a Preclusion strategy could impose on an attacker. Following that is a critical analysis of recent strategy documents suggesting a path forward for the United States Air Force against the capability those paths provide to deal with the challenges of Strategic Preclusion. Chapter 1 provides the history behind the term Strategic Preclusion, and offers a new definition for use in discussing the issues for power projection in the future.

Chapter 2 briefly examines U.S. power projection operations against Iraq from 1990-2003 to highlight that our most recent major combat operations (MCO) have been relatively free of adversary attempts to impede our ability to project power. Following that examination, Chapter 2 looks at the British experience during the Falkland Islands campaign of 1982 to emphasize the difficulties the British faced in effectively employing airpower to conduct those missions expected of it during MCO. These difficulties for the British indicate the key airpower capabilities and requirements that a strategy of preclusion could target, and provides the framework for analysis of the strategic documents chosen for study.

The next two chapters combine to provide the analytical case studies in order to analyze two strategy documents offering suggestions

for future U.S. Air Force capabilities. This examination will determine the degree to which these documents provide answers to the problems posed by an adversary attempting a strategy of preclusion. The two documents examined are *An Air Force Strategy for the Long Haul*, by Thomas P. Ehrhard of the Center for Strategic and Budgetary Assessments; and *Air Force Strategy Study 2020-2030*, by General (Ret.) John A. Shaud, Director of the Air Force Research Institute.³

Finally, Chapter 5 will conclude this study, providing conclusions, recommendations, and implications from these two strategic visions for the U.S. Air Force and its ability to meet the challenges of a Strategic Preclusion concept. These chapters provide a framework for understanding required capabilities and planning strategies necessary to overcome the challenges presented by a regional power focused not only on using its power for local influence or control, but also on preventing interference from an outside entity such as the United States.

The next chapter will briefly discuss the history behind the term Strategic Preclusion, provide a new definition of the term to frame the rest of the analysis presented in this paper, and explain why the US strategic situation presents opportunities to an adversary with a mind toward preclusion.

³ While there are several documents available providing recommendations for future capabilities, this thesis focuses on these two documents for three reasons. First is that the space available only allows for a proper examination and analysis of two such documents. Second, the comprehensive nature of these two documents, both in the way they describe the futures they envision and how the recommendations they provide account for those future challenges, make possible a thorough analysis and evaluation. Finally, the chief authors of each of the two documents are respected members of the Air Force and defense communities whose opinions carry tremendous weight. Dr. Ehrhard was a career Air Force officer, and was hired as the Special Assistant to the Chief of Staff of the Air Force after writing *An Air Force Strategy for the Long Haul*. General Shaud had a distinguished Air Force career, was selected as the head of the Air Force Research Institute, and produced *Air Force Strategy Study 2020-2030* at the behest of the Chief of Staff of the Air Force.

Chapter 1

Strategic Preclusion: Then and Now

Introduction

In his *Chairman's Strategic Direction to the Joint Force*, General Dempsey highlights several challenges that face the United States military in the near-terms. Most troubling are the combination of an “increasingly competitive security environment” characterized by “persistent conflict” with the transition from “abundant to constrained resources.”⁴ The resource constraints are driven by the current fiscal reality in the United States, a reality that also shapes the Chairman's strategic vision to at all times consider the “relevance of cost and the reality of financial risk” in any force employment situation.⁵ This “new valuation of risk,” as the Chairman calls it, indicates that an adversary wishing to challenge the United States militarily can now add a new variable to its strategic calculus. One method of exploiting this variable is the concept of Strategic Preclusion. This chapter will briefly examine the history of the term Strategic Preclusion, initially postulated as a methodology for offensive power projection, in United States military circles. The chapter then establishes a new definition of Strategic Preclusion as an adversary strategy aimed at United States power projection capability.

The Concept of Strategic Preclusion in the Past

The concept of Strategic Preclusion is not new, and has been the subject of controversy in the past. In the mid-1990s, the Air Force put forth a power projection concept known as the “Halt Phase,” which called for the rapid application of air power as the key element in stopping a large-scale armored force before it could seize its objectives. While Air Force leadership acknowledged that large-scale armored conflict was

⁴ General Martin Dempsey, *Chairman's Strategic Direction to the Joint Force*, 6 February 2012, 3.

⁵ General Dempsey, *Chairman's Strategic Direction*, 6.

unlikely as the prevalent form of future warfare for the US, they also realized this type of warfare would be the primary choice for countries such as North Korea and Iran and therefore represented one of the greatest challenges for US power projection overseas. In addition, adoption of the “Halt Phase” concept as the philosophic basis for future power projection had significant budget implications, requiring a massive focus on airpower technology development and procurement. As such, the concept quickly became “anathema to the Army.”⁶

At approximately the same time that the Air Force was developing the “Halt Phase” concept, the Army was building an idea known as “Strategic Preclusion,” which contended:

Contingency response operations will require joint maneuver and interdiction forces capable of moving with such speed...and with such overmatching lethality that a potential enemy cannot “set” his forces and operate at an advantage against our power projection forces. The ultimate objective of these operations is Strategic Preclusion, where the adversary realizes he cannot achieve his objectives and ceases further escalation.⁷

The focus on maneuver forces in the “Strategic Preclusion” concept made it an Army-centric idea and, like the “Halt Phase” for the Air Force, its adoption as an overarching philosophy of power projection would mean Army dominance in the financial arena of future force development.

As envisioned over a decade ago, the pitting of the concepts of “Halt Phase” and “Strategic Preclusion” against each other resulted in an “acrimonious interservice dispute.”⁸ As a consequence, these two terms have almost disappeared from the lexicon of military thought. However, as the United States attempts to plan for a future in which nations

⁶ James Riggins and David E. Snodgrass, “Halt Phase Plus Strategic Preclusion: Joint Solution for a Joint Problem,” *Parameters* 29, no. 3 (Autumn 1999): 70-85. The individual page numbers were not visible on the copy of this article used for this paper.

⁷ Riggins and Snodgrass, “Halt Phase.” This definition of Strategic Preclusion is narrower and more offensive in focus than the one presented in this paper.

⁸ Riggins and Snodgrass, “Halt Phase.”

attempt to challenge its hegemony at a regional level, the concept of Strategic Preclusion is once again relevant, except that it is now a strategy adversaries might employ against the United States in order to prevent effective American power projection and intervention in regional conflicts.

Strategic Preclusion in the Future

Before going any further, framing the rest of the analysis presented in this paper requires a new definition of Strategic Preclusion. That new definition of Strategic Preclusion is the use of any or all forms of national power by a state to deny effective power projection by its adversary. This definition removes any of the service- or asset-specific connotations from the previous debate, allowing a focus on the concept itself.

The primary goal of such a strategy aimed at the United States would be to deny our military forces the ability to leverage their tactical superiority on the battlefield. The method for doing so would include some combination of measures designed to generate sufficient fear of strategic failure, with ultimate success being the United States electing not to contest the issue at hand with military force. In this respect, the final sentence of the previous Army definition of Strategic Preclusion is applicable. However, the goal is not necessarily to create a situation in which the United States is unable to achieve its objectives. More likely is an adversary attempting to create a situation in which the United States would be unwilling to pay the costs in manpower and material required to achieve its objectives.

It is imperative to view Strategic Preclusion as a concept guiding a defensive strategy against power projection rather than a tactic, and viewing it as such shows that it can take many forms. The employment of a robust Anti-Access/Area Denial (A2/AD) capability is certainly one

such form, as is the use of power to fracture alliances or coalitions.⁹ In any case, the focus of Strategic Preclusion is not on the use of forces on the battlefield. Rather the focus is on the requirements, be they political, military, or economic in nature, for getting those forces to the battlefield.

Conclusion

The “new valuation of risk” as explained by General Dempsey underscores the reality that future United States power projection operations will be viewed more closely with respect to potential costs of the operation, not just in terms of loss of life or destruction of equipment, but also with respect to the pure dollar cost of munitions, fuel, and all other sustainment requirements. The fiscal situation in the United States is such that a tactical victory with too high a price tag may equal a strategic failure. Of course, the idea of victory at too high a cost is not new; else the phrase “Pyrrhic victory” would not exist. However, the stated interest in cost present in recent strategic documents puts low expenditures almost on par with success as far as importance of objectives.¹⁰ An adversary looking to blunt United States power projection capability in order to expand its own regional power would be foolish not to take this new risk calculus into account, and Strategic Preclusion provides an opportunity to do just that.

Chapter 2 will provide a brief comparison of United States power projection experience in major combat operations (MCO) in Iraq from 1990 through 2003 with the British experience in the Falklands War of 1982. This comparison, combined with an examination of a strategy

⁹ For example, the Iraqi use of SCUD missiles against Israel during Operation DESERT STORM

¹⁰ In addition to General Dempsey’s document, Secretary Donley and General Schwartz released a white paper on 1 February 2012, titled “Air Force Priorities for a New Strategy with Constrained Budgets.” This document presents five service priorities, one of which is “Disciplined Use of Defense Dollars.” This priority is presented ahead of “Taking Care of People.” Additionally, the stated goal for the Air Force to meet its requirements is “agile, flexible, and cost effective forces.”

document written by two Chinese military officers, establish the framework through which the case study analysis will take place.



Chapter 2

Developing an Framework for Analysis

Introduction

As a global power with global interests, the United States is certainly not a newcomer to power projection. As such, the United States has much experience in dealing with the primary difficulty involved in deploying forces to conduct worldwide operations, that of the time/cost penalty imposed by distance. With respect to airpower employment, especially of offensive combat capabilities, the primary method of overcoming that penalty has been the establishment of robust forward bases. This serves to reduce the most significant effects of distance to those imposed on sustainment and logistics by turning the employment of offensive combat power into an essentially local operation.

This chapter begins with an examination of airpower projection in Operations DESERT STORM and IRAQI FREEDOM to underscore the point that these were mainly long-range deployment operations that became local employment operations once the fighting began, and not truly long-range power projection missions. The chapter then turns to the British campaign in the Falklands in 1982 to demonstrate the problems involved for effective airpower employment in a true long-range projection operation. Finally, the chapter examines a conceptual document for future warfare, written by military officers from a potential adversary nation, which indicates the variety of ways that an adversary could execute a Strategic Preclusion concept. The intent in examining that document is to show the ways Strategic Preclusion could affect airpower employment beyond those encompassed under the umbrella term A2/AD.

Recent American MCO Power Projection Experience

The two primary examples of US military power projection in major combat operations (MCO) in recent history are Operations DESERT SHIELD/DESERT STORM and Operation IRAQI FREEDOM. As part of

the discussion on Strategic Preclusion, both are presented as examples of what not to expect in future power projection scenarios, due to their long force build-up periods and extensive shaping activities.

Operation DESERT SHIELD¹¹ began almost immediately after the Iraqi invasion of Kuwait on 2 August, 1990. Problems plagued the deployment process from the start, some due to command decisions and some due to inefficiencies in the deployment process. In total, the defensive force deployed to Saudi Arabia numbered approximately 265,000 personnel.¹² The final force size for Operation DESERT STORM would number more than 500,000 personnel.¹³

The first US airpower assets arrived in theater on 8 August, in the form of two aircraft carriers, twenty-four F-15C air superiority fighters, and an E-3 AWACS.¹⁴ Within a month, Coalition aircraft in theater totaled 1,220.¹⁵ By the time Operation DESERT STORM began in February, Coalition air strength was 2,614 aircraft. Of that total, 1,990 were American, and 1,540 were land based.¹⁶ The Coalition conducted

¹¹ Operation DESERT SHIELD officially began on 12 August 1990, with a focus on the defense of Saudi Arabia and eventually the buildup of offensive combat power. Operation DESERT STORM began on 17 January 1991, and was the actual combat operation to expel Iraqi forces from Kuwait.

¹² Michael R. Gordon and General Bernard E. Trainor, *The General's War* (Boston, MA: Little, Brown and Company, 1995), 57-63. Gordon and Trainor document that, even though ground combat forces began arriving in Saudi Arabia in mid-August, General Schwarzkopf was not confident that he could repel an Iraqi invasion of Saudi Arabia until approximately 24 September. Many units felt that their deterrence capabilities were essentially a "bluff," since priority for lift assets was given to combat units without appropriate consideration for their sustainment requirements, e.g. fuel and munitions. Essentially, the deterrent capabilities of the force were based more on mass than on actual combat effectiveness of the deployed units. The deployment itself was further complicated by problems with the readiness of sea lift assets and crews, loading and unloading capability at ports, and the fact that many of the Maritime Prepositioning Ships delivered equipment that was not ready for employment on arrival (e.g., vehicles with no oil or the wrong type of oil for the environment, dead batteries, etc.).

¹³ Gordon and Trainor, *The General's War*, ix

¹⁴ Richard G. Davis, *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq* (Washington, D.C.: Air Force History and Museums Program, 2002), 40.

¹⁵ Richard Hallion, *Storm Over Iraq* (Washington, D.C.: Smithsonian Institution, 1997), 135-7.

¹⁶ Hallion, *Storm Over Iraq*, 157. For comprehensive information on the deployment of air forces for the operations, see Eliot A. Cohen and Thomas A. Keaney, *Gulf War Air Power Survey Summary Report* (Washington, D.C.: Department of the Air Force, 1993),

offensive operations from twenty-four separate bases in theater, and the furthest distance from any base to Baghdad, Iraq was 1,252 miles.¹⁷ US aircraft, particularly B-52s, also operated from multiple bases outside the theater, including Barksdale AFB in the United States and bases in England and Diego Garcia.¹⁸

The logistics involved in deploying and sustaining a force this large were impressive. During DESERT SHIELD, Air Force airlift aircraft averaged one landing every twenty-two minutes in theater, moving over 200,000 personnel and 210,000 tons of cargo.¹⁹ Once combat operations began in DESERT STORM, that time went to one landing every eleven minutes. The Air Force moved seventy-five percent of air cargo and thirty-three percent of personnel into theater, employing eighty percent of its C-141 fleet and ninety percent of its C-5 fleet (the only two strategic airlifters in the Air Force inventory at the time) to do so. Civilian aircraft, operating under the Civil Reserve Air Fleet (CRAF) program, carried the remainder of cargo and personnel.²⁰ Once personnel and cargo arrived in theater, US Air Force tactical airlift assets, primarily C-130s, provided movement to final location. The Air Force deployed thirty-two percent of its C-130 fleet in the Persian Gulf region during DESERT SHIELD/DESERT STORM.²¹

and Department of the Air Force, *Gulf War Air Power Survey, Volume III, Logistics and Support*, (Washington, D.C.: Department of the Air Force, 1993).

¹⁷ Hallion, *Storm Over Iraq*, 157. The distance from Masirah, Oman to Baghdad. *Gulf War Air Power Survey, Volume III, Logistics and Support*, provides extensive detail on the beddown plan and locations, as well as the support required to implement and maintain that plan.

¹⁸ Hallion, *Storm Over Iraq*, 164. For details on the processes and difficulties involved in planning an air campaign using that many aircraft and bases, see Diane T. Putney, *Airpower Advantage: Planning the Gulf War Air Campaign, 1989-1991* (Washington, D.C.: Air Force History and Museums Program, 2004).

¹⁹ Hallion, *Storm Over Iraq*, 138.

²⁰ Hallion, *Storm Over Iraq*, 137. According to the *Gulf War Air Power Survey Summary Report*, this was the first-ever implementation of the CRAF.

²¹ Hallion, *Storm Over Iraq*, 137. *Gulf War Air Power Survey, Volume III, Logistics and Support*, provides full data on inter- and intra-theater airlift operations during both DESERT SHIELD and DESERT STORM, to include sortie counts, total cargo offloads, and number of aircraft deployed and employed

The refueling effort necessary to support both offensive operations and the airlift missions was no less impressive. The Air Force had two primary tanker aircraft, the KC-135 and KC-10, and committed forty-four percent of the KC-135 inventory and seventy-five percent of the KC-10 inventory to the two operations.²² Just during DESERT SHIELD alone these aircraft flew more than 20,000 hours and off-loaded 68.2 million gallons of fuel.²³ Despite the impressive results of the US airlift effort during these operations, it is important to note that sealift played a much larger role in moving cargo than airlift. For example, during the first four months of DESERT SHIELD, sealift delivered ten times more cargo than airlift (over 2,000,000 tons versus 210,000).²⁴ This disparity between the requirements for sealift versus airlift is a crucial factor when discussing future power projection operations.

Just over a decade later, in September 2001, the US began planning in earnest for Operation IRAQI FREEDOM, the invasion of Iraq to remove Saddam Hussein from power.²⁵ There were several iterations of the plan, as military and civilian leadership jockeyed back and forth over the force ratios necessary to accomplish the mission. Some variations of the plan were Generated Start, which called for an invasion force of 145,000 that would be reinforced to 275,000; Running Start, which called for starting the operation with as few as 18,000 troops; and the Hybrid plan, a larger variation of Running Start.²⁶ In the end, a plan known as Cobra II was finalized, that began the operation with an

²² Hallion, *Storm Over Iraq*, 139

²³ Hallion, *Storm Over Iraq*, 138.

²⁴ Hallion, *Storm Over Iraq*, 139. *Gulf War Air Power Survey, Volume III, Logistics and Support*, provides full data on air refueling operations during both DESERT SHIELD and DESERT STORM, to include sortie counts, total fuel offloads, and number of aircraft deployed and employed.

²⁵ Michael R. Gordon and General Bernard E. Trainor, *Cobra II: The Inside Story of the Invasion and Occupation of Iraq* (New York, NY: Pantheon Books, 2006), 17.

²⁶ Gordon and Trainor, *Cobra II*, 88-89.

invasion force of roughly 145,000 troops, including 20,000 personnel from the British 1st Armored Division.²⁷

The deployment timeline was significantly shorter than that of DESERT SHIELD/DESERT STORM, with the bulk of the effort beginning in January 2003 and the invasion beginning on 19 March 2003. However, one key difference between the 1991 and 2003 Iraq campaigns was the decade of shaping operations that had been conducted since the end of DESERT STORM.

Operations PROVIDE COMFORT (7 April 1991 – 31 December 1996), SOUTHERN WATCH (27 August 1992 – 19 March 2003), DESERT STRIKE (3-4 September, 1996), NORTHERN WATCH (1 Jan 1997-March 17 2003), and DESERT FOX (17-20 Dec 1998) had all contributed significantly to both intelligence preparations for the eventual invasion in 2003 as well as the existing deployment of US command and control, force protection, combat power and sustainment capabilities to the CENTCOM AOR. This was starkly different from the 1991 campaign, when CENTCOM had to start almost from scratch in generating an effective combat force.

While both of these operations were successful power projection operations to achieve national objectives in major combat operations, they are not representative of challenges in power projection that the US can expect to face in the future. Five key factors in the Gulf scenarios enabled the spectacular success airpower enjoyed in the two conflicts examined here.

Strategic Access to the Region

In both scenarios, the US enjoyed considerable access for airpower assets. For DESERT STORM, the direct threat to Saudi Arabia by Iraqi forces in Kuwait undoubtedly meant that little diplomatic effort was

²⁷ Stephen T. Hosmer, *Why the Iraqi Resistance to the Coalition Invasion Was So Weak* (Santa Monica, CA: RAND Corporation, 2007), 134.

required to gain this access.²⁸ Iraqi attempts to dissuade Saudi from allowing US participation would likely have fallen on deaf ears with Republican Guard forces sitting across the border. For IRAQI FREEDOM, the relationship between the US and Kuwait resulting from the liberation and the allowance from Saudi Arabia to base non-combat forces again allowed the US to base sufficient airpower assets in the region.²⁹

Preposition of Ammunition and Fuel for Aircraft in Theater

The US had an existing supply of prepositioned bombs and missiles for aircraft in the Gulf theater of operations that combat aircraft were able to fall in upon. This decreased the amount of logistical support necessary to supply the operation in the initial stages, freeing up air- and sealift assets for more critical missions.³⁰

The Robust US Logistics Sustainment Network

Between the combination of US military airlift assets and the CRAF, the US was able to meet its supply needs. The strategic access to the region, especially airbases, already mentioned enabled this ability. One indicator of the ability of the US to meet its strategic logistic needs is that the CRAF equivalent for sealift, the Voluntary Intermodal Sealift Agreement (VISA), did not activate for either DESERT SHIELD/STORM or IRAQI FREEDOM.

Forward Located C² Structure

In both DESERT SHIELD/STORM and IRAQI FREEDOM, the US based its C² facility and personnel in the theater of operations.³¹ Such forward locations certainly reduced many of the inefficiencies in communication and decision-making processes that would have occurred

²⁸ Evidenced by the speed with which US combat airpower assets received clearance to base in Saudi Arabia.

²⁹ OIF Planner (briefing, School of Advanced Air and Space Studies, Air and Space Operations Senior Staff Course, Maxwell AFB, AL, 18 April 2012).

³⁰ Department of the Air Force, *Gulf War Air Power Survey, Volume III*, 2.

³¹ For DESERT SHIELD/STORM, the location was Prince Sultan Air Base in Saudi Arabia. For IRAQI FREEDOM, the location was Al Udeid Air Base, Qatar.

had the C² facilities, and more importantly the air component commander and staff, been based a much greater distance away.

Unchallenged Ability to Use Airborne ISR Assets

Though many frustrations existed with the availability and integration of ISR assets in both conflicts, the US overmatch of Iraqi air defense capabilities provided a level of air superiority that enabled the deployment of any ISR capabilities in the inventory.³² The existence of these five factors in future power projection scenarios is not something upon which the US should depend, especially against a sophisticated and powerful adversary. This is especially true if that adversary has the capability and desire to attempt a campaign based on Strategic Preclusion.

Specifically, the long deployment timelines of DESERT SHIELD/DESERT STORM, the ability to conduct that deployment with no interference, and continued free access to a network of bases built up over a decade of combat operations are exactly what a Preclusion strategy would aim to deny. In order to demonstrate the challenges such denial would present, the next section of this chapter describes a power projection campaign conducted without the five factors discussed here.

British Experience in the Falklands

On 2 April 1982, Argentinian forces invaded the Falkland Islands, forcing the surrender of the British Governor of the islands. The next day, British forces on the island of South Georgia also surrendered to an Argentinian invasion force.³³ This escalation to force was the result of more than a century and a half of contention between Argentina and the

³² For a list of assets employed during DESERT STORM, see Department of the Air Force, *Gulf War Air Power Survey Volume II, Operations and Effects and Effectiveness* (Washington, D.C.: Department of the Air Force, 1993), 347-350. No such open source list currently exists for OIF, however a briefing from an OIF planner given at SAASS indicates that intelligence and assessment problems for airpower were not due to preclusion of any particular capability by the situation.

³³ Royal Air Force, "The Falkland Islands Campaign," Royal Air Force, <http://www.raf.mod.uk/history/1982Overview.cfm> (accessed 21 May 2012).

United Kingdom over the question of sovereignty rights to the Falkland Islands.³⁴ Over the next seventy-four days, the struggle for control of the islands progressed from a primarily naval battle supported by airpower, to a British counter invasion on 21 May, and ended with the recapture of Port Stanley, the capital of the Falklands.³⁵

In the end, British casualties numbered 1023 (256 killed and 777 wounded), while the Argentinians suffered 2082 casualties (746 killed and 1336 wounded) along with 11,400 personnel captured.³⁶ The British reestablished sovereign control of the Falklands, and while Argentina has not relinquished its claim to the islands, it has not since challenged the British militarily. From that standpoint, the operation was a success for Great Britain.

Three key difficulties the British faced while achieving that success bear examination here with respect to the future of United States power projection operations, especially where airpower is concerned. Additionally, there were two key potential weaknesses in the Falklands situation that the Argentinians were unable to exploit that will undoubtedly challenge American power projection operations against an advanced adversary utilizing a preclusion strategy.

British Difficulty #1 – Lack of Forward Basing

First and foremost among these difficulties was a lack of forward ground basing for airpower in theatre. As a result, the only fixed-wing

³⁴ BBC News, "Regions and Territories: Falklands Islands," BBC News, http://news.bbc.co.uk/2/hi/americas/country_profiles/4087743.stm (accessed 21 May 2012).

³⁵ Royal Air Force, "The Falkland Islands Campaign, 1982 Overview" <http://www.raf.mod.uk/history/1982Overview.cfm> (accessed 21 May 2012).

³⁶ Anthony H. Cordesman and Abraham R. Wagner, *The Lessons of Modern War, Volume III: The Afghan and Falklands Conflicts* (Boulder, CO: Westview Press, 1990), 267. For more information, the Royal Air Force has an extensive history posted at <http://www.raf.mod.uk/history/TheFalklandIslandsCampaign.cfm>. Lawrence Freedman, "Air Power and the Falklands, 1982," in *A History of Air Warfare*, ed. John Andreas Olsen (Washington, D.C.: Potomac Books, Inc., 2010), 157-174, also provides significant historical data on events involving air power. The Royal United Services Institute online journal, located at www.rusi.org, contains a great deal of historical information on the conflict, from both military and policy perspectives.

aircraft available to the British task force were the twenty-eight Royal Navy Sea Harriers organic to the fleet and an additional ten GR-3 Harriers from the Royal Air Force (RAF).³⁷ The Sea Harriers represented eighty-two percent of the entire Royal Navy inventory.³⁸ This low number of aircraft meant that the flexibility generally considered a strength of airpower was absent in this conflict. The Sea Harriers were dedicated almost solely to defensive counter-air (DCA) operations in protection of the fleet; the RAF Harriers only arrived in theater on 18 May, three days prior to British ground assault, and were dedicated entirely to close air support of British ground forces and not as part of the air defense mission.³⁹

The lack of forward basing significantly hampered DCA operations because it denied the British the use of any airborne early warning (AEW) or aerial refueling assets. Without AEW, the Sea Harriers were limited to their on-board radar, which had extreme difficulty detecting attacking aircraft flying low-altitude profiles, the preferred tactic of the Argentinians.⁴⁰ The lack of aerial refueling limited the Sea Harriers to an average of twenty minutes of station time during combat air patrol. Fortunately, the Argentinians possessed no night attack capability, thus limiting the number of hours the British had to keep DCA screens airborne.⁴¹

The low numbers of DCA aircraft available because of the lack of basing severely limited their overall effectiveness. The Sea Harriers did account for almost twenty-five percent of Argentinian aircraft losses (twenty-eight out of one hundred and two, with twenty-five coming in air-to-air combat), but the Argentinians were still able to mount successful attacks against British shipping on almost one out of every three days of

³⁷ Freedman, *Air Power and the Falklands*, 160.

³⁸ Cordesman and Wagner, *The Lessons of Modern War*, 300.

³⁹ Cordesman and Wagner, *The Lessons of Modern War*, 251 and 309.

⁴⁰ Cordesman and Wagner, *The Lessons of Modern War*, 324.

⁴¹ Cordesman and Wagner, *The Lessons of Modern War*, 323-4.

the fighting where flying was possible.⁴² These attacks resulted in the loss of six British ships. Seven more British ships were hit by bombs or missiles that failed to explode; in fact, almost eighty percent of Argentinian munitions that struck British ships failed to detonate.⁴³ It is particularly important to note that every ship hit by weapons that detonated was lost. The outcome of the campaign could very easily have been in doubt had the British lost the seven vessels luckily hit by dud weapons.

Of the thirteen ships damaged or sunk by air attack, the Argentinians only attacked three from beyond visual range. They targeted the rest with aircraft dropping iron bombs using visual delivery methods. The ability of the Argentinians to so readily close on the British fleet and conduct daylight bombing attacks indicates that the British never possessed anything like air superiority during the conflict, and only escaped catastrophic losses to their fleet due to the fortunate circumstances of the failure of Argentinian munitions.

Finally, the lack of forward basing meant that assets from outside the task force conducted other missions traditionally provided by airpower. The British made five attempts at offensive-counter air (OCA) missions targeted at the Port Stanley airfield, and two attempts at destroying an Argentinian radar facility on the Falklands. The British conducted these missions as part of Operation Black Buck.

The British attempted seven missions as part of Black Buck, only one of which they considered successful. On 1 May, the first day of fighting in the Falklands, a single British bomber managed to put one crater in the runway at Port Stanley. However, the Port Stanley airfield was only 4,000 feet long, too short for any of the Argentinian aircraft used to attack the British fleet throughout the campaign, and the crater

⁴² There were thirteen days during the conflict where weather prevented Argentinian aircraft from conducting operations

⁴³ Cordesman and Wagner, *The Lessons of Modern War*, 254 and 337-8.

location did not prevent the Argentinians from using the runway for aircraft with short take-off and landing distances.⁴⁴ The other six missions resulted in two attacks on the airfield with no damage to the runway, two missions against radar sites that resulted in minor damage, one mission canceled because the headwinds for the attacking force were too great over the distance involved, and one mission canceled because of maintenance problems in the aerial refueling tanker fleet necessary to get a bomber to the target.⁴⁵

British Difficulty #2 – Distance to the Falklands from British Base

The British Task Force based out of Ascension Island, approximately three thousand seven hundred and fifty miles from the Falklands. This distance presented several challenges to British airpower during the Falklands conflict.

As mentioned before, British attempts at long-range strike were almost completely unsuccessful. Inappropriate munitions for runway attacks played a significant part in this failure, but most important was that the British could only launch and support one bomber at a time to and from the Falklands.

The airfield on Ascension Island had only enough parking space for sixteen tanker aircraft. Each Black Buck mission required fourteen tankers, thirteen operational and one reserve, to support a single bomber, because the distances involved were so great that the tanker aircraft also required aerial refueling in order to accomplish the mission.⁴⁶ The extreme range from Ascension to the Falklands also greatly affected the role fixed-wing airpower could play in the realm of

⁴⁴ Royal Air Force, "The Falklands Islands Campaign, Operation Black Buck" Royal Air Force, <http://www.raf.mod.uk/history/OperationBlackBuck.cfm> (accessed 21 May 2012).

⁴⁵ Royal Air Force, "The Falklands Islands Campaign, Operation Black Buck" Royal Air Force, <http://www.raf.mod.uk/history/OperationBlackBuck.cfm> (accessed 21 May 2012).

⁴⁶ Royal Air Force, "The Falklands Islands Campaign, Operation Black Buck" Royal Air Force, <http://www.raf.mod.uk/history/OperationBlackBuck.cfm> (accessed 21 May 2012).

logistics. The British flew five times as many transport and supply sorties as they did combat sorties.⁴⁷



Figure 1 - Falklands Map with Distances

Source: United States Military Academy Department of History, "Falklands Map with Distances," United States Military Academy Department of History, [http://www.usma.edu/history/SiteAssets/SitePages/Western Conflicts Since 1958/falklands-map-a.gif](http://www.usma.edu/history/SiteAssets/SitePages/Western%20Conflicts%20Since%201958/falklands-map-a.gif) (accessed 30 May 2012)

However, of these approximately ten thousand sorties, only thirty five delivered troops or supplies directly to the theatre of operations, and these only by airdrop.⁴⁸ The same refueling limitations that hampered

⁴⁷ Cordesman and Wagner, *The Lessons of Modern War* 300-03. British reports for Harrier combat sorties range from 1650 to 2526. This number, combined with the seven Black Buck sorties, puts transport and supply sortie numbers at approximately 10,000.

⁴⁸ Cordesman and Wagner, *The Lessons of Modern War*, 303.

the Black Buck missions also precluded any concentrated employment of airdrop missions.

The other airlift missions delivered troops and cargo only as far as Ascension Island, from which there was an approximate ten day cruise time to reach the Falklands.⁴⁹ The British intended to use rotary-wing assets for battlefield logistics, but the Argentinians sank the British ship *Atlantic Conveyor*, and with it all but one of the British heavy helicopters, on 25 May.⁵⁰ This forced the British to conduct ship-to-shore logistics using landing craft, necessitating bringing the two container ships in the task force close to shore. The lack of British air superiority provided the Argentinians opportunity to attack and destroy one of the British container ships and damage the other, fortunately after all British ground forces had disembarked, but before their supplies made it ashore.

British Difficulty #3 – Intelligence, Surveillance, Reconnaissance

Throughout the Falklands conflict, the British suffered from a lack of real-time or even near real-time information on Argentinian force locations or activities. This shortage of quality ISR⁵¹ was the result of three factors: limitations on satellite image intelligence (IMINT) capabilities, a lack of aircraft equipped for and dedicated to ISR, and the unreliable nature of signals intelligence (SIGINT) and communications intelligence (COMINT) collected from the Argentinians.

The British had no organic IMINT satellite capability of their own providing coverage over the Falklands, and relied on United States satellites to provide IMINT data.⁵² However, only those Argentinian positions that were fixed, such as coastal defenses and the airport at Port

⁴⁹ Cordesman and Wagner, *The Lessons of Modern War*, 303.

⁵⁰ United Kingdom Ministry of Defence, "RAF's Bravo November returns from Afghanistan," United Kingdom Ministry of Defence, <http://www.mod.uk/DefenceInternet/DefenceNews/EquipmentAndLogistics/RafsBravoNovemberReturnsFromAfghanistan.htm> (accessed 21 May 2012).

⁵¹ Intelligence, Surveillance, and Reconnaissance

⁵² Cordesman and Wagner, *The Lessons of Modern War*, 269-70.

Stanley, were especially viable IMINT targets once the fighting on the ground started.⁵³ The time needed for United States intelligence agencies to collect, transmit, process, and then retransmit IMINT data to British forces meant that any images of Argentinian ground forces on the move was out of date by the time it was in the hands of the British. In addition, the same weather that prevented air attacks for a significant portion of the fighting also precluded effective satellite IMINT coverage during the British counter invasion.⁵⁴

The British had no organic airborne ISR capability in the task force, and the long range ISR aircraft that it could employ in the theatre were modified Nimrod aircraft that possessed only electronic intelligence (ELINT) capability.⁵⁵ These British employed these aircraft for maritime surveillance, and they provided no help in the area of providing up to date information on Argentine ground forces and their locations or movements.

Additionally, at no time did the British have any capability to monitor in real- or near real-time the actions of forces based in Argentina. Since the Argentinians never used Port Stanley airfield to launch any of the air attacks on the British fleet, this meant that the only warning the British had of impending air attack was when the ISR systems of the fleet picked up the inbound attackers.⁵⁶

Finally, the SIGINT and COMINT collection of information transmitted by Argentinian leaders on the ground in the Falklands was unreliable due to the highly politicized nature of the Argentinian high command and government structure. Argentinian ground commanders often transmitted false data and information on the status of the

⁵³ Cordesman and Wagner, *The Lessons of Modern War*, 274.

⁵⁴ Cordesman and Wagner, *The Lessons of Modern War*, 270.

⁵⁵ Cordesman and Wagner, *The Lessons of Modern War*, 277-78.

⁵⁶ Cordesman and Wagner, *The Lessons of Modern War*, 277-78.

campaign, meaning that British commanders could not utilize this data to make any meaningful decisions.⁵⁷

Unexploited Power Projection Weakness #1 – C³I

Throughout the campaign, the British were able to utilize secure and uninterrupted long-range satellite communications for command, control, communications, and information (C³I) operations. The Argentinians had no capability to monitor these communications, much less attempt to disrupt them. The only real problem the British faced with their long-distance communications was periodic inability of the satellites to handle the amount of traffic flowing between the Falklands and Great Britain.⁵⁸

Unexploited Power Projection Weakness #2 – Maritime Logistics

At no point in the conflict did the Argentinians make any attempt to attack or disrupt the maritime logistics chain extending from Ascension Island to the Falklands. While the Argentinians did possess four submarines, it is unclear whether they possessed the range, doctrine, or training necessary to attempt any such attacks.⁵⁹ Further, the Argentine Air Force did not possess the range to carry out such attacks, since the distance from Argentina to the Falklands was already at the extreme end of their attack capability.⁶⁰ Considering the difficulty the British had in defending the naval task force once fully employed in the theatre, an adversary capability to attack those naval forces during the long transit across the Atlantic, especially the sixteen civilian cargo and passenger transport vessels pressed into service for the operation, would have been extremely problematic for the British.

Strategic Preclusion in the Future Security Environment

The three primary difficulties the British faced in the Falklands campaign, as well as those opportunities for disruption that the

⁵⁷ Cordesman and Wagner, *The Lessons of Modern War*, 272 and 281.

⁵⁸ Cordesman and Wagner, *The Lessons of Modern War*, 280.

⁵⁹ Cordesman and Wagner, *The Lessons of Modern War*, 261.

⁶⁰ Cordesman and Wagner, *The Lessons of Modern War*, 312-13.

adversary was unable to exploit, are factors that remain problematic for long range power projection today. The difference for the United States looking forward is that the progress of time has given potential adversaries the capability to impose those difficulties on the United States as part of their strategy, rather than simply attempt to benefit from their existence.

Currently, much of the discussion on what such a strategy might look like revolves around purely military aspects like A2/AD capabilities and the challenges involved in operating against them. Unlike A2/AD, Strategic Preclusion, while aimed at preventing effective projection of military power, is not purely a military concept. To help underscore this point, a brief examination of a conceptual document for future warfare from one possible adversary is in order.

In 1999, two Chinese military officers published a work titled *Unrestricted Warfare*. Based on the preface to their work, it appears that the authors began their study and concept development in response to DESERT STORM, which they call “[the war that] changed the world.”⁶¹ The authors contend that DESERT STORM demonstrated the end of the era of “might makes right” in international relations, in that as long as one power, in this case the US, remained dominant in the field of military might then the outcome of any direct challenge to that might was inevitable failure. As a result, future warriors would have to conduct their operations not just in the military arena, but in multiple arenas and multiple locations simultaneously in order to prevail.

At its core, the document presents an argument for the expansion of what the authors perceive as the traditional limits of war, what they call “modified combined war that goes beyond limits.”⁶² They further describe this concept of “beyond limits” as “surpassing all boundaries

⁶¹ Qiao Liang and Wang Xiangsui, *Unrestricted Warfare* (Beijing, China: PLA Literature and Arts Publishing House, 1999), 4.

⁶² Liang and Xiangsui, *Unrestricted Warfare*, 181.

and conforming with the laws of victory when conducting warfare with combinations.”⁶³ The laws of victory they reference are not applicable to the discussion here. Rather, the idea of “warfare with combinations,” as well as another idea the authors discuss, that of addition, are what underlie the concept of Strategic Preclusion.

Looking first at the idea of addition, the two Colonels quickly point out that the concept of addition in warfare is not something new. They point out that military leaders “from Alexander to Napoleon and even up to Schwartzkopf [sic]” have understood the greater efficacy in military strength gained by “the addition of technology with technology, tactics with tactics, weapons with weapons, and measures with measures.”⁶⁴ These concepts underlie the principles joint and combined arms warfare. What Liang and Xiangsui focus on is a higher level of addition or combination in war. They write of “combining the battlefield and non-battlefield, warfare and non-warfare, military and non-military” in order to “jump outside of the ruts made by the war spirit that has persisted for several thousand years.”⁶⁵

The authors’ goal in this discussion of addition is to lay the foundation for their idea of warfare with combinations, a concept that they feel must go “beyond all fetters of politics, history, culture and ethics” in order to achieve success in modern conflict. They then move into their discussion of warfare with combinations. They cover several ideas in that discussion, but there are three that are most relevant to the concept of Strategic Preclusion. They are supra-national combinations, supra-domain combinations, and supra-tier combinations.⁶⁶

⁶³ Liang and Xiangsui, *Unrestricted Warfare*, 181.

⁶⁴ Liang and Xiangsui, *Unrestricted Warfare*, 142.

⁶⁵ Liang and Xiangsui, *Unrestricted Warfare*, 142-43.

⁶⁶ Liang and Xiangsui, *Unrestricted Warfare*, 188. The authors carefully point out that the names of each of these versions of combination is a “shortened form,” and they all should be followed with “of actions in warfare” to understand their true meaning, e.g. “supra-national combinations of actions in warfare.”

The authors' idea of supra-national combinations is essentially the mixing of national, international, and non-state organizations and their relative strengths to achieve supra-national means of influence, and the use of those supra-national means to accomplish security objectives and secure national interests. The underlying idea of their belief in the rise in importance of supra-national means is the breaking down of traditional state barriers in many aspects of politics, economics and culture brought about by advances in information technology that allow individuals to "easily [bypass] territorial boundary markers."⁶⁷ They point out that the United States, as a mature power and the only world superpower, is "the best at using supra-national combinations."⁶⁸ The authors also contend that the rise in relative importance of these supra-national combinations indicates their essential nature in future conflict resolution.

The concept of supra-domain combinations, or combinations beyond the domain of the battlefield, builds on the idea of supra-national means. The authors contend that the expansion of the domain of warfare is "a necessary consequence of the ever-expanding scope of human activity," activity that is driving political, economic, military and cultural domains to overlap with each other.⁶⁹ Accepting this necessary consequence, the authors advocate no boundary on the domains of warfare, calling for "information warfare, financial warfare, trade warfare, and other entirely new forms of warfare" made possible by removing traditional domain limits.⁷⁰

The supra-tier combination, or the combination of all levels of conflict into each campaign, is nothing more than the combination of what the US military refers to as the three levels of war (strategic, operational, and tactical) with national policy, or Grand Strategy.

⁶⁷ Liang and Xiangsui, *Unrestricted Warfare*, 183.

⁶⁸ Liang and Xiangsui, *Unrestricted Warfare*, 181-86.

⁶⁹ Liang and Xiangsui, *Unrestricted Warfare*, 189.

⁷⁰ Liang and Xiangsui, *Unrestricted Warfare*, 189.

However, what the authors point out is that twenty-first century military leaders must not only understand how to operate at these various levels. They must also study how to disrupt an adversary at these various levels.⁷¹ For the purposes of our discussion here, that leads to a corollary position that twenty-first century military leaders must also understand what it means to defend against disruption at these various levels, or whether such defense is even possible from a purely military standpoint when supra-tier means are combined with supra-national ones.

Much of what Liang and Xiangsui described as supra-national, supra-domain, and supra-tier combinations provides the impetus for the idea of Strategic Preclusion. Clearly, these combinations intend to deny the five factors for success enjoyed by the US in its Gulf power projection scenarios, with strategic access as their primary target. Such a denial would inflict upon the US the constraints faced by the British during the Falklands campaign. How should the Air Force prepare itself to meet the challenges posed by an adversary that bases a Preclusion strategy on the combination of sophisticated military measures to achieve A2/AD capability with unrestricted diplomatic, financial, trade and cultural warfare measures? To further complicate matters, how can the Air Force expect to reasonably defend against an adversary that applies those measures at all levels of policy and war in the nations which the Air Force currently depends on for basing and support to conduct its operations?

The answer is that the Air Force needs to focus its future development on developing or enhancing its truly global capabilities, and decrease its requirement to relocate power into a particular region to conduct local operations. The next two chapters will examine two documents advocating strategies for the Air Force over the next twenty

⁷¹ Liang and Xiangsui, *Unrestricted Warfare*, 197-98.

years to determine the extent to which they address this requirement for truly global reach and power. The five factors identified in the Falklands campaign are the criteria the examination will focus on.



Chapter 3

Visions for the Future of the Air Force

Introduction

The previous chapter established the factors that any future Air Force strategy must account for in order to maintain offensive capability against an adversary employing an effective Preclusion strategy. Those factors are:

1. Requirement for forward basing
2. Ability to conduct sufficient long-range attack and sustainment if forward basing is not available
3. Ability to conduct effective and persistent ISR
4. Ability to conduct effective command and control

These factors are the criteria used in the comparative analysis in the next chapter. This chapter presents an overview of each of the documents used for that analysis. Each overview will outline the future security environment towards which each document is oriented, and then describe the challenges each document identifies for Air Force power projection.

An Air Force Strategy for the Long Haul

An Air Force Strategy for the Long Haul,¹ published in 2009, is a monograph presentation of a study conducted by the Center for Strategic and Budgetary Assessments (CSBA) and authored by Thomas P. Ehrhard.² The Executive Summary of the document describes it as a discussion of the current state of the Air Force and how it can best posture itself to meet future security challenges.³ That discussion is broken down into three main chapters: the first covered the state of the Air Force today; the second highlighted implications of the future

¹ The paper uses a shortened title, *Long Haul*, to refer to this document for the rest of this case study

² Dr. Ehrhard served as Senior Fellow at CSBA from 2006 to 2009 before becoming Special Assistant to the Chief of Staff of the Air Force.

³ Thomas P. Ehrhard, *An Air Force Strategy for the Long Haul* (Washington, D.C.: Center for Strategic and Budgetary Assessments, 2009), xi.

security environment for the Air Force; and the third provided recommendations for the Air Force based on the ability of the current force structure to meet the future security challenges discussed.

With respect to the second chapter on the future security environment, *Long Haul* identified three challenges against which it would examine the Air Force's long-range plans: opposing violent Islamic radicals, hedging against the rise of China as a possible military competitor, and counterproliferation of nuclear weapons. For the purposes of this paper, the only issues and recommendations examined are those surrounding the second challenge, the rise of China.⁴

Challenges of the Future Security Environment

The central theme of *Long Haul* with respect to the rise of China is that the extensive and ongoing modernization of the People's Liberation Army (PLA) is a direct challenge to US power projection capability into the Asia-Pacific region. Further, the current methods and capabilities of the US Air Force do not provide it the ability to serve as a hedge against growing Chinese capability.⁵ The *Long Haul* study focuses on PLA A2/AD capabilities as well as those means used to deny free use of global commons, identifying space and cyberspace as particularly critical to Air Force operations.

With respect to A2/AD, *Long Haul* points out that the expansion of these capabilities has the potential to cause problems for the US beyond just the operational problem of countering them. It also has the potential to cause diplomatic problems for the US, as allies may decide to deny basing to US forces to avoid having their territory targeted by an adversary concerned with US power projection.⁶ In order for the Air Force to cope with the capabilities identified, *Long Haul* declares

⁴ The guidance mentioned in the Introduction to this paper that directed the shift in strategic focus to the Asia-Pacific region is the reasoning behind the narrower focus on the CSBA document here.

⁵ Ehrhard, *Long Haul*, 35.

⁶ Ehrhard, *Long Haul*, 38-9.

survivability, strategic reach, persistence (both from strike platforms and ISR platforms), and the capability to maintain and operate networks in the face of dedicated opposition as the necessary characteristics for the future force.⁷

Survivability

Long Haul focuses on the ability of current Air Force assets, both aircraft and munitions, to survive against the most modern integrated air defense systems (IADS). Accordingly, the document puts a premium on stealth and low-observable (LO) characteristics, and points out that only two aircraft, comprising less than six percent of the current Air Force inventory, are LO designs.⁸ Additionally, the document highlights the retirement of the Advanced Cruise Missile (ACM), an LO penetrating munition, leaving the Joint Air-to-Surface Standoff Missile (JASSM) as the only LO penetrating munition in the Air Force inventory.⁹

Long Haul also points out more general survivability concerns linked to increasing age of the airplane inventory, specifically the high-performance fighter and attack aircraft. According to the document, the last two decades have seen these aircraft flying at twice their designed rate, and increasing age and fatigue have begun to affect the reliability of the force.¹⁰

Strategic Reach

Long Haul states that of the 1,475 operational fighters and bombers in the Air Force, only six percent are long-range aircraft. Of that number, some percentage is dedicated to the nuclear strike mission

⁷ Ehrhard, *Long Haul*, 40-1.

⁸ Ehrhard, *Long Haul*, 15. The F-22 and B-2.

⁹ Ehrhard, *Long Haul*, 15-6.

¹⁰ Ehrhard, *Long Haul*, 17-8. The document specifically references the 2008 incident in which an F-15 came apart in flight, resulting in a fleet-wide grounding, and the fleet-wide grounding of A-10s the same year when cracks were discovered that could have resulted in wings breaking off during flight.

and unavailable for conventional operations.¹¹ With short-range aircraft making up the bulk of combat forces, strategic reach depends on a network of forward bases and a robust aerial refueling capability.

Long Haul points out that the increasing sophistication of A2/AD measures puts the basing network at risk, both in terms of survivability from attack and denial of usage by other nations based on fear of attack.¹² The aerial refueling requirement is also a point of concern, due to the increasing age of the USAF tanker fleet.¹³

Persistence

Long Haul makes no explicit argument about persistence in its discussion on the current state of the Air Force. However, the focus on stealth and LO as the key to survival in a modern IADS combined with the emphasis on range imply that the same shortfalls that affect survivability and strategic reach will have an equal impact on persistence.

Ability to Operate in a Contested Network Environment

Like Persistence, *Long Haul* makes no explicit references to network capabilities in the section concerning the state of the Air Force. However, in its discussion on the challenges posed by China, the document directly addresses the need for an ability to operate its command, control and communications networks in the face of attack on those networks.¹⁴

In addition, *Long Haul* accuses the Air Force of accepting vulnerability to jamming, disruption, and destruction of its space assets.¹⁵ These assets are critical to all of the Air Force's missions in the security environment envisioned by *Long Haul*. Aside from vulnerability

¹¹ Ehrhard, *Long Haul*, 15. The document later, on page 67, lists an unrefueled operating range of more than 3,000 miles as its criteria for long-range.

¹² Ehrhard, *Long Haul*, 20-1.

¹³ Ehrhard, *Long Haul*, 17.

¹⁴ Ehrhard, *Long Haul*, 42.

¹⁵ Ehrhard, *Long Haul*, 42.

to attack, the document also points out that the Air Force satellite fleet suffers from the same longevity problem that affects the aircraft fleet.¹⁶

Summing Up the State of the Air Force

The state of the Air Force, as CSBA presents it in *Long Haul*, combined with the unique challenges of aerial warfare against a modern and sophisticated adversary, leads *Long Haul* to what it calls a fundamental conclusion:

[T]he Air Force is building a “middle-weight” force structure that is much too sophisticated and expensive for low-end or irregular conflicts, while also lacking needed capabilities to address challenges at the high end of the military competition.¹⁷

The recommendations that *Long Haul* provides intend to minimize “middle-weight” capabilities and maximize what it calls a “high-low mix.”¹⁸ As the focus of this thesis is on the ability to counter the adversaries that represent the high end of conflict, the analysis in the next chapter will focus on how the recommendations provided in that arena prepare the Air Force to counter Strategic Preclusion. This paper now turns to the overview of the second case study document.

Air Force Strategy Study 2020-2030

Air Force Strategy Study 2020-2030,¹⁹ published in 2011, is the presentation of the results of a project conducted by the Air Force Research Institute (AFRI) at the direction of the Air Force Chief of Staff. The tasking letter for the document directed AFRI to “recommend options on how the USAF might adjust its forces, capabilities, organizations, operating concepts and doctrine” to meet the challenges of 2030. The tasking letter also directed AFRI to conduct the study without concern

¹⁶ Ehrhard, *Long Haul*, 18. *Long Haul* states that the average age of Air Force satellites exceeds their design life by more than a year, and that over half of the GPS satellites on orbit have exceeded their design life.

¹⁷ Ehrhard, *Long Haul*, 44.

¹⁸ Ehrhard, *Long Haul*, 45.

¹⁹ The paper uses a shortened title, *Strategy Study*, to refer to this document for the rest of this case study

for current programmatic realities.²⁰ As a result, *Strategy Study* is much less specific in its discussion on what *Long Haul* called the state of the Air Force, and instead focuses more on broad implications and recommendations.

The Executive Summary of *Strategy Study* described the approach the AFRI team took in conducting their review as a multi-phased one. First, the team identified what they considered to be the vital national interests that would drive US strategic posture in 2030.²¹ Next, the team analyzed four possible future scenarios in relation to their potential effects on the identified national interests and the Air Force's twelve core functions related to countering the adversaries in those scenarios.²² Like *Long Haul*, *Strategy Study* used China as the baseline adversary in its analysis of the challenges of a peer competitor.

Challenges of the Future Security Environment

Strategy Study breaks the concerns presented by the rise of China into two categories: political/economic and military. For the Air Force, the political/economic challenges relate directly to strains on the existing security situation in the Pacific. Specifically, *Strategy Study* is concerned with the potential effects of China's increasing political and economic strength on US alliances in the region, as those alliances are critical for US power projection capability.²³

²⁰ Gen (Ret.) John A. Shaud, *Air Force Strategy Study 2020-2030* (Maxwell AFB, AL: Air University Press, 2011), Chief of Staff's Tasking Letter.

²¹ Shaud, *Strategy Study*, ix. The vital interests identified were commerce; secure energy supplies; freedom of action at sea and in space, cyberspace and the skies; nuclear deterrence; and regional stability.

²² Shaud, *Strategy Study*, ix. The four scenarios analyzed were a peer competitor, a resurgent power, a failed state, and a jihadist insurgency. Per Air Force Doctrine Document 1, 14 October 2011, page 43, the twelve Air Force core functions are Nuclear Deterrence Operations, Air Superiority, Space Superiority, Cyberspace Superiority, Command and Control, Global Integrated ISR, Global Precision Attack, Special Operations, Rapid Global Mobility, Personnel Recovery, Agile Combat Support, and Building Partnerships.

²³ Shaud, *Strategy Study*, 95.

Militarily, the Chinese capabilities most pressing for the AFRI team are A2/AD, space, and cyberspace.²⁴ Ballistic and cruise missiles, as well as ballistic missile defense, are the key A2/AD capabilities identified in *Strategy Study*, particularly the increasing range of China's ballistic missiles.²⁵ In the space domain, *Strategy Study* is primarily concerned with China's antisatellite capabilities, both earth- and space-based abilities,²⁶ and Chinese security writings concerning surprise attack and preemption in space.²⁷ The discussion on cyberspace in *Strategy Study* focuses on the ability of China to conduct attacks that could complicate US deployment of forces in case of hostilities.²⁸

Of the twelve Air Force core functions, *Strategy Study* designates seven of them as critical to US goals regarding China,²⁹ or any possible peer competitor. These functions include: space superiority, cyber superiority, nuclear deterrence, global precision attack, rapid global mobility, global integrated ISR, and partnership building.³⁰

The analysis conducted on China's security challenges led the *Strategy Study* team to synthesize the identified Air Force core functions into four critical capabilities necessary for the Air Force to meet the power projection challenges of 2030: power projection; freedom of action

²⁴ Shaud, *Strategy Study*, 95.

²⁵ Shaud, *Strategy Study*, 100. *Strategy Study* focuses on the current estimated range of Chinese ballistic missiles (1,500 miles), and efforts to extend the range of ballistic and cruise missiles to between 2,500 and 5,000 miles by 2020.

²⁶ The earth-based capability discussed is the 2006 used by China of a ground-based laser to blind a US reconnaissance satellite. In space, *Strategy Study* is concerned with Chinese research into small launch vehicles and small satellites that could be used for anti-satellite missions.

²⁷ Shaud, *Strategy Study*, 100.

²⁸ Shaud, *Strategy Study*, 101. Other than denial-of-service, *Strategy Study* makes no reference to any specific capability or targeting methodology.

²⁹ The identified goals are maintaining regional security, protecting lines of communication and energy, and ensuring commerce. These goals tie directly to one or more of the vital interests identified earlier.

³⁰ Shaud, *Strategy Study*, 104.

in air, space, and cyberspace; global situational awareness; and air diplomacy.³¹

Conclusion

An Air Force Strategy for the Long Haul and *Air Force Strategy Study 2020-2030* both paint roughly the same picture of future Air Force concerns with respect to power projection against a peer competitor. That picture is one in which advances in technology provide adversaries with sophisticated A2/AD measures, measures that challenge the Air Force's traditional superiority in air and space and call into question the outcome of the battle to come for dominance in cyberspace.

Most pressing for the Air Force is the effect this will have on the network of forward bases that underpin current security strategy in the Pacific. In the diplomatic realm, allies will have to question whether allowing US basing rights presents a greater risk or reward in the face of a rising regional power. In the military realm, the US will have to question what balance to strike between investments in capability and infrastructure required to defend and attack from bases inside an A2/AD umbrella and those required to project power from outside that umbrella. The next chapter will analyze the recommendations that both *Long Haul* and *Strategy Study* provide for the Air Force to achieve that balance against the factors identified for maintaining power projection in the face of Strategic Preclusion.

³¹ Shaud, *Strategy Study*, ix. A fifth capability, Military Support to Civil Authorities, was not discussed relative to conflict with a peer competitor.

Chapter 4

Visions versus Reality

Introduction

The previous chapter examined the future requirements envisioned by *An Air Force Strategy for the Long Haul* and *Air Force Strategy Study 2020-2030*. Both documents see the future challenges posed by range limitations and adversary threat capabilities in the Pacific as issues requiring significant adjustment to current Air Force power projection capabilities. Both documents also see roughly the same solutions to these challenges: a highly technologically advanced Air Force, capable of projecting power from both short and long distance, and capable of operating from inside and outside adversary threat envelopes. This chapter provides an analysis of those solutions against their ability to satisfy the factors required to counter Strategic Preclusion.¹

Requirement for forward basing

Both *Long Haul* and *Strategy Study* recognize the diplomatic and technological limitations that drive the requirement for forward basing, as well as the diplomatic and technological challenges to forward basing presented by sophisticated adversaries.² They attempt to solve this paradoxical challenge with a combination of infrastructure investments designed to provide a more strategically flexible network of forward bases while simultaneously reducing the need for them with technological advancements in long-range strike and ISR capability.

The primary technological limitation driving a need for forward basing is the range limitation of Air Force fighter aircraft. Both

¹ Requirement for forward basing, ability to conduct sufficient long-range attack and sustainment, ability to conduct effective and persistent ISR, and ability to conduct effective C²

² Ehrhard, *Long Haul*, 39, and Shaud, *Strategy Study*, x-xi. The discussion on diplomatic necessity involves the deterrent value of US forward basing in demonstrating resolve to both the Chinese and American allies that the US will not abandon those allies in the face of China's rise.

documents are specifically concerned about the range of the Air Force's fifth-generation fighter aircraft, the F-22 and F-35A.³ In the Pacific theater, especially with China perceived as the most dangerous threat, this concern is particularly valid considering the Air Force only has one base within 500NM of the Taiwan Strait.⁴



Figure 2 - Major U.S. Air and Naval Facilities in the Western Pacific

Source: Roger Cliff et al., *Entering the Dragon's Lair* (Santa Monica, CA: RAND Corporation, 2007), 84.

The range limitations of the F-22 and F-35A dictate forward basing in order to achieve optimum employment. The two documents have slightly different concerns over that dictate, however. Both documents are concerned with ensuring that the capability of the forward-based aircraft is sufficient to justify the effort involved in maintaining the

³ In fact, the F-22 and F-35A are the only specific programs mentioned in the recommendations for power projection and air superiority in *Strategy Study*. The F-22's unrefueled combat radius is 540NM, and the F-35As is 600NM. Air Force Association, "F-22 versus F-35 Comparison," Air Force Association, http://www.afa.org/professionaldevelopment/issuebriefs/F-22_v_F-35_Comparison.pdf (accessed 23 May 2012).

⁴ Kadena AB, Japan is approximately 460NM from the Taiwan Strait. The Chinese have multiple variants of ballistic missile capable of traveling that distance, including the DF-21, with a range of 935NM, and the DF-21C, with a range of 1375 NM. Sean O'Connor, "PLA Ballistic Missiles," Air Power Australia, <http://www.ausairpower.net/APA-PLA-Ballistic-Missiles.html#mozTocId779953> (accessed 23 May 2012).

required network of bases, and *Long Haul* has additional concerns with survivability and flexibility within that network.

Regarding capability, both documents are concerned with the gap in performance between the F-35A and the F-22. *Long Haul* is the most blunt, declaring the F-35A unsuitable for use in a high-threat environment because of deficiencies in speed, maneuverability, operational ceiling, and relative degree of LO capability.⁵ These are the capabilities most necessary for an air superiority airplane to survive in the future threat environment, and *Long Haul* is not the only document concerned with F-35A capabilities in this area.⁶ Additionally, *Long Haul* highlights the difference in missile carriage capacity of an F-35A versus the F-22, making the F-35A less lethal in the air-to-air role in addition to being more vulnerable.⁷ The F-35A has a larger air-to-ground capacity than the F-22, but only if it can use external stores.⁸ Due to LO concerns, this is not possible in a high threat environment. *Long Haul* recommends reducing the planned F-35A purchase numbers in order to add more F-22s to the force.⁹ *Strategy Study* expects fiscal restraints to result in a reduced F-35A force regardless, and suggests investment in additional air-to-air capability for both aircraft such as onboard systems for conducting air-to-air cyber attacks on enemy aircraft systems.¹⁰

⁵ Ehrhard, *Long Haul*, 84.

⁶ Committee on Future Air Force Needs for Survivability, *Future Air Force Needs for Survivability* (Washington, D.C.: National Academies Press, 2006), 33. Also, Scott Perdue and John Stillion, "Air Combat: Past, Present, and Future," RAND presentation, August 2008.

⁷ Ehrhard, *Long Haul*, 84. The F-35A can carry a maximum of four air-to-air missiles, compared to eight on the F-22.

⁸ When forced to use internal weapons storage only, the F-35 can carry two air-to-air missiles plus two 2,000 pound class weapons or eight small diameter bombs. The F-22 can carry four air-to-air missiles plus two 1,000 pound class weapons or eight small diameter bombs.

⁹ Ehrhard, *Long Haul*, 85-88.

¹⁰ Shaud, *Strategy Study*, 27. While such capability is not currently operational, the potential was demonstrated by the Israeli attack on Syria in 2007. See Maj Richard A. Martino, "Leveraging Traditional Battle Damage Assessment Procedures to Measure

With respect to survivability, the capabilities most pressing to the *Long Haul* team are Chinese ballistic missiles (BM) and cruise missiles (CM). *Long Haul* recommends a comprehensive effort in the Pacific to harden existing bases and improve capacity to conduct rapid repairs after an attack to keep the force functioning.¹¹ The discussion of hardening bases focuses on adding shelters at existing bases for large aircraft,¹² hardening runways to blunt effects of attack,¹³ and improving rapid runway repair capability to restore operation after attack.¹⁴ Finally, *Long Haul* recognizes that any airfield expected to operate within an A2/AD environment will require active defense against both BM and CM threats. Such active defense is an extremely complicated problem, if for no other reason than the sheer number of BM China possesses.¹⁵

In order to reduce the burden on the active defenses of any single location, *Long Haul* recommends constructing additional bases in the Pacific to serve as dispersal bases. Such bases would serve to increase US agility and complicate A2/AD options for an adversary. The two areas specifically mentioned as prime candidates for new bases are the Northern Marianas islands and Palau.¹⁶ Unfortunately, such bases

Effects From a Computer Network Attack,” Graduate Research Project (Wright-Patterson AFB, OH: Air Force Institute of Technology, 2011), 4.

¹¹ Ehrhard, *Long Haul*, 94-5.

¹² Ehrhard, *Long Haul*, 94-5. For detailed discussion on large aircraft shelters, see Roger Cliff et al., *Entering the Dragon’s Lair* (Santa Monica, CA: RAND Corporation, 2007), 82. As of the publication of that document, the USAF had neither developed nor constructed shelters for large aircraft such as AWACS or tankers (excepting the B-2). The lack of such shelters makes such aircraft especially vulnerable to cluster submunitions, which the Chinese can deploy on their ballistic missiles.

¹³ Ehrhard, *Long Haul*, 94-5. For detailed discussion on Chinese airfield attack capabilities, see Roger Cliff et al., *Shaking the Heavens and Splitting the Earth* (Santa Monica, CA: RAND Corporation, 2011), 185. Open source reporting from China states that the PLAAF is developing a runway-penetrating submunition. This means that ballistic missiles with even relatively low accuracy could be used to render runways unusable unless they were constructed from material sufficient to withstand attack.

¹⁴ Ehrhard, *Long Haul*, 94-5.

¹⁵ Cliff et al., *Shaking the Heavens*, 234. Best-case scenario (for US defense) is that China can only put 50 missiles over Kadena simultaneously. This best-case number, however, would overwhelm the three PAC-3 batteries stationed there (only 48 interceptors).

¹⁶ Ehrhard, *Long Haul*, 94.

would do nothing to help alleviate the range penalties of the Pacific. The Northern Marianas are 1,722 miles, and Palau is 1,572 miles, from the Taiwan Strait; both distances are more than two and a half times the combat radius of the F-35A.

Recognizing the diplomatic impossibilities of abandoning our forward bases in the Pacific, *Long Haul* attempts to strike a balance between hardening and dispersal that allows for minimum possible risk for forward-based assets. However, that balance imposes severe operational constraints on the fifth-generation aircraft that are the future of the Air Force fighter structure, requiring those short-range aircraft to conduct long-range operations in time of conflict. Additionally, neither the F-22 nor F-35A can conduct the level of air-to-ground attack necessary for the Air Force to meet its requirements in a high-intensity conflict.¹⁷

The recommendation in both *Long Haul* and *Strategy Study* to deal with this contradiction is the development of new capabilities in long-range strike, which leads to the discussion of the second factor necessary to overcome Strategic Preclusion.

Ability to conduct sufficient long-range attack and sustainment

Both *Strategy Study* and *Long Haul* recommend investment in new long-range capability for the Air Force. *Strategy Study*, because of its intentional lack of specificity with respect to platforms or programs, simply states that power projection in the future security environment will require integration of air, space, and cyber capabilities into single platforms; and long-range capability for air-breathing platforms.¹⁸ In contrast, *Long Haul* recommends moving forward immediately with acquisition of a new penetrating/LO bomber, which it refers to as the Next Generation Bomber (NGB); a modernization program for the B-52

¹⁷ Neither aircraft can carry more than two surface attack munitions internally. The F-35A can carry more munitions externally, but that would further increase its signature and decrease its survivability in a high threat environment.

¹⁸ Shaud, *Strategy Study*, 26.

that allows for greater carriage of standoff, penetrating LO munitions; and the development of new standoff munitions with greater range.¹⁹

Long Haul suggests an immediate need in the short-term for an initial version of the NGB, referred to as Block 10, to supplement the B-2 fleet.²⁰ In order to field the Block 10 NGB more rapidly, *Long Haul* recommends using mature capabilities in weaponry, sensors, propulsion and countermeasures.²¹ After Block 10, the Block 20 version would begin to add more advanced capabilities, most specifically in the area of propulsion, to increase range and loiter capability.²² Significantly, *Long Haul* suggests designing the Block 20 NGB, as well as all subsequent versions of the NGB, as an unmanned aircraft.²³ For the Block 30 NGB, *Long Haul* suggests the need for aeroservoelastic wing technology.²⁴ This technology would allow for wings that are able to change their shape or sweep without the need for exposed hinges or seals, such as the F-14 and F-111 had, thereby preserving the low-observable nature of the aircraft.²⁵ The final version of the NGB suggested by *Long Haul* is a version optimized for ISR, which this chapter discusses later.

¹⁹ Ehrhard, *Long Haul*, 69-72

²⁰ The B-2 is the only bomber in the USAF inventory with a low-observable capability to penetrate an advanced IADS.

²¹ Ehrhard, *Long Haul*, 70.

²² Ehrhard, *Long Haul*, 71. Specifically, *Long Haul* suggests using Advanced Variable Engine Technology (ADVENT). This program was announced by the Air Force in 2007, and is proceeding in development (see Larine Barr, "Air Force Plans to Develop Revolutionary Engine," Air Force Official Website, <http://www.af.mil/news/story.asp?id=123046410> [accessed 24 May 2012]). Committee on Air Force Needs, *Future Air Force Needs for Survivability*, declares variable cycle engine technology such as ADVENT both feasible and valuable in future threat environments. Recently, a research team at the Air Force Academy filed for a patent on a hybrid cycle engine design that balances capabilities for both speed and loiter efficiency (Amber Baillee, "Cadets, Professors Submit Patents for Next-gen Aircraft Engines," US Air Force Academy Official Website, <http://www.usafa.af.mil/news/story.asp?id=123297082> [accessed 24 May 2012]).

²³ Ehrhard, *Long Haul*, 71-72.

²⁴ Ehrhard, *Long Haul*, 72.

²⁵ Committee on Air Force Needs, *Future Air Force Needs for Survivability*, refers to such technology as morphing technology, citing its advantages in allowing an aircraft to optimize itself for speed or loiter while maintaining its low-observable characteristics. However, the document declares that the concept needs further research and investigation into its feasibility. Ehrhard, *Long Haul*, 50, cites a 2005 Texas A&M

The previously mentioned modernization program for the B-52 and the development of longer-range standoff munitions are the second main argument in *Long Haul* for ensuring the Air Force has sufficient long-range attack capability in the future. With respect to modernization, the B-52 has no internal capacity to carry the Air Force's most modern LO standoff weapon, the Joint Air-to-Surface Standoff Missile (JASSM).²⁶ The issue is one of software compatibility, and resolving that issue has the potential to increase the B-52's JASSM carriage from twelve missiles up to twenty-eight missiles.²⁷ Currently, the B-52 can carry the AGM-86 conventional cruise missile internally, but this missile does not have the LO characteristics necessary to penetrate a modern air defense system.²⁸ As such, increasing the capability of the B-52 to carry LO standoff weapons will increase the offensive capability the Air Force against sophisticated air defense systems.²⁹

In addition to increasing capability to employ current weapons, *Long Haul* recommends developing standoff munitions with greater range than that of JASSM, the Extended Range version of which has a range of only 600 nautical miles.³⁰ There is little open source data to suggest such development is underway. However, the concept is certainly

University study that declares the concept mathematically feasible. However, that document has no physical testing data available. The Air Force and NASA began flight-testing a concept aircraft in 2003 (NASA, "Active Aeroelastic Wing," NASA Official Website, <http://www.nasa.gov/centers/dryden/news/ResearchUpdate/AAW/> [accessed 24 May 2012]). No information is available in open sources to suggest that the technology is nearing operational status.

²⁶ Ehrhard, *Long Haul*, 69.

²⁷ Description of proposed B-52 upgrades in Presidential Budget 2012. Defense Technical Information Center, "Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Air Force, R-1 ITEM NOMENCLATURE PE 0101113F: *B-52 SQUADRONS*," Defense Technical Information Center Official Website, http://www.dtic.mil/descriptivesum/Y2012/AirForce/0101113F_7_PB_2012.pdf (accessed 24 May 2012).

²⁸ US Air Force, "AGM-129A Advanced Cruise Missile, US Air Force Official Website, <http://www.af.mil/information/factsheets/factsheet.asp?id=3548> (accessed 24 May 2012).

²⁹ The B-1 and B-2, the other long-range bombers in the Air Force, are fully compatible with JASSM at this time.

³⁰ Ehrhard, *Long Haul*, 69. *Long Haul* recommends stand-off munitions with a range from 1,500 to 3,000 nautical miles.

feasible. The Air Force recently retired a nuclear-armed, LO, long-range cruise missile, the AGM-129. This missile had an unclassified range of more than 2,000 miles, providing exceptional standoff capability and survivability for both the crew and weapon.³¹

Moving from long-range attack to sustainment, *Long Haul* makes only one significant reference to long-range, or inter-theater, airlift, declaring this area one of the few in which the Air Force is currently healthy.³² Air Force leadership currently agrees with this assessment, testifying in January 2012, that the current C-17 and C-5 fleet size and modernization programs are sufficient to meet current and future needs.³³ The current world situation supports this stance, as evidenced by the ability of Air Mobility Command (AMC) in March 2011 to provide long-range supply simultaneously to combat operations in Iraq, Afghanistan, Libya, and the humanitarian relief in Japan.³⁴ With respect to high-end conflict in the Pacific, *Strategy Study* only mentions inter-theater airlift in the context of ensuring that the Air Force possesses sufficient freedom of action in the air domain to protect the assets.³⁵

The final piece of sustainment for both strike and mobility assets is the issue of aerial refueling. However, the lack of specificity in the

³¹ US Air Force, AGM-129A Factsheet.

³² Ehrhard, *Long Haul*, 65.

³³ Gen Norton A. Schwartz, Chief of Staff, US Air Force (Air Force Strategic Choices and Budget Priorities Brief at the Pentagon, Washington, D.C., 27 January 2012).

³⁴ 618 Tactical Airlift Control Center, "618 TACC Contributions to the Fight, January-March 2011," 618th Tactical Airlift Control Center Official Website, <http://www.618tacc.amc.af.mil/shared/media/document/AFD-110602-022.pdf> (accessed 24 May 2012).

The inter-theater airlift support to Operation Tomodachi in Japan only required the dedicated use of two USAF C-17s, less than one percent of the fleet (Pacific Air Forces, "USAF Support to Japan Crisis," Pacific Air Forces Official Website, <http://www.pacaf.af.mil/shared/media/document/AFD-110330-077.pdf> [accessed 24 May 2012]).

Additionally, two US allies in the Pacific, Australia and India, are both contracted with Boeing to purchase C-17s (The Boeing Company, "Boeing: C-17 Globemaster III – C-17 Around the World," Boeing Official Website, <http://www.boeing.com/defense-space/military/c17/c17world.html> [accessed 24 May 2012] and The Economic Times, "India to Buy More than 16 C-17 Airlifters, The Economic Times Website, <http://economictimes.indiatimes.com/news/economy/policy/india-to-buy-more-than-16-c-17-airlifters/articleshow/8850290.cms> [accessed 24 May 2012]), potentially providing extra support to military airlift in times of crisis in the Pacific.

³⁵ Shaud, *Strategy Study*, 104.

recommendations provided in *Strategy Study* leaves little room for analysis here.³⁶ Conversely, the high level of detail and specific program recommendations provided in *Long Haul* have been overcome by events since the document was published in 2009.³⁷ As a result, the next chapter discusses air-refueling concerns for the Air Force in the future.

By advocating for both a new penetrating aircraft and new penetrating munitions, *Strategy Study* and *Long Haul* present an effective balance of capability intended to operate in the most difficult threat environment. Such a capability would provide maximum flexibility to decision makers in situations spanning all threat levels. However, in order to maximize that capability, the Air Force also needs the ability to locate and identify targets, and assess the effects of its attacks. That is the next issue addressed in this analysis.

Ability to conduct effective and persistent ISR

The recommendations in *Long Haul* and *Strategy Study* combine to form a picture of future ISR requirements that is very similar to that of future strike: high-end conflict will require the ability to conduct both stand-off and local ISR. Unlike strike operations, ISR operations can also occur in space, providing an additional standoff capability. Between the two documents, the primary recommendations for the future of ISR are better integration between the USAF and other ISR agencies, improved data processing capability, and the development of ISR aircraft that can penetrate and loiter in high-threat environments.

On the integration front, *Strategy Study* has a very simple recommendation: the Air Force should ensure that it has the necessary level of awareness and ability to influence development decisions on

³⁶ Shaud, *Strategy Study*, 9. With respect to operations in the Pacific, the document simply states that it “may be possible to develop small, stealthy, high-speed, autonomous tankers” to operate in high-threat areas.

³⁷ Ehrhard, *Long Haul*, 63-65. The conversation revolves mostly around suggestions for how to restructure the request for proposal for the Air Force KC-X contract. The US has since awarded that contract to Boeing and the program is proceeding as the KC-46A.

space-based ISR assets in other intelligence agencies.³⁸ The Air Force has traditionally relied on very high-altitude aircraft that can avoid threat envelopes while providing ISR, such as the U-2 and RQ-4 Global Hawk. However, the most modern surface-to-air missile (SAM) systems have the ability to target both of these aircraft in their operational envelopes, making space-based ISR the only capability that does not incur risk when penetrating areas with modern defensive systems.³⁹ As a result, the Air Force does in fact need to integrate effectively with the agencies that provide the space-based ISR capability the Air Force needs in the future. This is the only way to ensure that future development and programming decisions for space provide the necessary backfill for the loss of organic airborne capability.

The second key recommendation for future ISR is the development of improved capability to conduct processing, exploitation, and dissemination (PED) of the information gathered. *Strategy Study* specifically points to developing automated processes that conduct much of the processing, leaving humans free to conduct high-order tasks such as analysis and decision-making.⁴⁰ The amount of manpower required to conduct PED currently lends credence to the concern about the ability to conduct PED in more sophisticated conflicts in the future. Currently,

³⁸ Shaud, *Strategy Study*, 30. *Strategy Study* specifically mentions the National Reconnaissance Office (NRO), which lists as one of its key functions providing targeting and BDA support to military operations. These are obviously two critical functions for the Air Force in any conflict (NRO, "NRO – What We Do," NRO Official Website, <http://www.nro.gov/about/nro/what.html> [accessed 24 May 2012]).

³⁹ US Air Force, "U-2S/TU-2S," US Air Force Official Website, <http://www.af.mil/information/factsheets/factsheet.asp?id=129> (accessed 24 May 2012). The maximum altitude of the U-2 is listed as 70,000+ feet. Per US Air Force, "RQ-4 Global Hawk," US Air Force Official Website, <http://www.af.mil/information/factsheets/factsheet.asp?id=13225> (accessed 24 May 2012), the maximum altitude of the RQ-4 is 60,000 feet. Per Dr Carlo Kopp, "Almaz-Antey S-300PMU2 Favorit Self Propelled Air Defence System / SA-20 Gargoyle," Airpower Australia Official Website, <http://www.ausairpower.net/APA-S-300PMU2-Favorit.html#mozTocId894981> (accessed 24 May 2012), the maximum altitude of an out-of-production model of the SA-20 SAM system is 82,000 feet. Newer models of the SA-20 have almost double the horizontal range, which very likely means an increase in altitude capability as well.

⁴⁰ Shaud, *Strategy Study*, 30.

one MQ-1 Predator or MQ-9 Reaper orbit requires 53 analysts to conduct PED on the data collected through full motion video (FMV) and signals intelligence (SIGINT) sensors.⁴¹

Advances in sensor technology have allowed the production and installation of wide-area sensor pods that can capture and transmit data on up to ten points simultaneously.⁴² The increase in manpower required to conduct PED once all ISR drones are equipped with such wide-area sensors is unknown. However, even complicated mathematical solutions that attempt to mitigate manpower requirements while simultaneously increasing risk of ineffective PED still result in unsustainable numbers for the Air Force in the future.⁴³

The projected manpower shortfall is the primary driver behind the push for some level of automation in the PED process. With respect to FMV, the one area most critical is a full-time, automated “eyes-on” capability that then provides cueing for the human in the loop.⁴⁴ The potential exists to create this capability either in the sensor itself, such that only information that meets the cueing threshold is transmitted, or in the ground-based processing equipment.⁴⁵

Outside of FMV, other types of intelligence also require significant PED effort, such as the SIGINT mentioned previously. However, unlike

⁴¹ Lance Menthe et al., *The Future of Air Force Motion Imagery Exploitation: Lessons from the Commercial World* (Santa Monica, CA: RAND Corporation, 2012), 5. This is for a drone equipped with a single video sensor.

⁴² Craig Whitlock, “Gorgon Stare surveillance system gazes over Afghan war zone,” The Washington Post Official Website, http://www.washingtonpost.com/national/gorgon-stare-gazes-over-war-zone/2011/04/29/AF2xliGF_story.html (accessed 24 May 2012).

⁴³ Menthe et al., *Future of Motion Imagery*, 8.

⁴⁴ For example, if the goal of a particular ISR platform is simply to notice if and when something in the area changes, then an automated system could monitor for that change and then alert a human operator. Currently, a human must sit and monitor the FMV feed constantly to notice such changes.

⁴⁵ For discussion of potential for on-board processing in ISR sensors, see Werner Dahm, *Report on Technology Horizons: A Vision for Air Force Science & Technology During 2010-2030* (Washington, D.C.: Office of the Chief Scientist of the Air Force, 2010) 63-64. For discussion on potential of ground-based automation capabilities, see Menthe et al., *Future of Motion Imagery*, 8. *Future of Motion Imagery* also references a companion report that discusses and provides recommendations for such automation in detail, but that report was not yet available at the time of writing.

FMV, which requires an individual to actually watch the feed full-time, the limitations on PED of other types of intelligence often result from computing limitations.⁴⁶ *Strategy Study* rightly recommends that to account for this, the Air Force must remain abreast of advances in computing power and speed and ensure that it acquires the necessary capability.

With respect to PED, what neither document discusses is the necessity for increased capability to conduct rapid fusion of multiple intelligence and sensor sources and the transmission of that data directly to the warfighter. The next chapter will discuss issues and recommendations in that area. The final ISR issue discussed here is the need for airborne ISR assets able to penetrate and loiter in high-threat environments.

Strategy Study has little to say about the requirement for penetrating ISR, focusing instead on the two issues already discussed. Regarding ISR, *Long Haul* recommends a three-tiered structure of upgrades, focusing solely on remotely piloted aircraft (RPAs). These three tiers all focus on designing, building, and fielding stealthy aircraft. The first tier is a replacement for the MQ-9 to serve in the theater ISR role. The second tier is a stealthy RPA to serve what *Long Haul* refers to as a regional role, such as the RQ-4 and U-2 currently do.⁴⁷ The vision for the third tier is actually a Block upgrade to the NGB mentioned earlier, creating a remotely piloted RNGB.⁴⁸

The same threat capabilities and required countermeasures identified earlier in the discussion on long-range strike drive the

⁴⁶ Shaud, *Strategy Study*, 30.

⁴⁷ Since the publishing of *Long Haul*, the Air Force cancelled procurement of the Block 30 RQ-4, which conducts SIGINT and IMINT (Dave Majumdar, "Air Force seeks to nix Block 30 Global Hawks," The Air Force Times Official Website, <http://www.airforcetimes.com/news/2012/01/defense-air-force-block-30-global-hawks-nix-012612w/>, [accessed 24 May 2012]). This leaves the U-2 as the only long-range airborne ISR platform in the inventory capable of conducting those missions.

⁴⁸ Ehrhard, *Long Haul*, 71-5. Reconnaissance Next Generation Bomber.

requirement for stealth capability in ISR, especially if persistence in a threat envelope is required by an operation. The Air Force will require such persistence in future conflict, if for no other reason than to directly assess the effectiveness of penetrating stand-off munitions.⁴⁹

Additionally, as threat systems become more mobile, or at least capable of rapid relocation, penetrating and persistent ISR may provide the only solution to locating, fixing, and providing targeting information on those systems.

An ISR fleet based on the recommendations in *Long Haul* would provide the ability to both operate against A2/AD capabilities as well as avoid the penalties that other methods of preclusion could impose. Such a fleet would certainly serve the Air Force well in the future. However, one key aspect of such a fleet, especially with unmanned capability considered essential by strategists, is the ability to maintain effective and secure communication with the aircraft. This leads to the final category of analysis in this section.

Ability to conduct effective command and control (C²)

Two primary concerns with C² arise from reading *Long Haul* and *Strategy Study*. The first is the technological challenge associated with conducting C² of airborne forces against an adversary with the capability to directly attack, through cyber or more traditional EW means, the Air Force's C² infrastructure. *Long Haul* offers specific recommendations to mitigate that threat.

The second issue is the question of C² of automated and unmanned strike aircraft. Both documents recommend characteristics for future aircraft, and both studies address the technical issues associated with their development. However, neither document speaks to the potential doctrinal nor ethical challenges such aircraft will present.

⁴⁹ One of the primary limitations of stand-off munitions is that the crew employing them has no capability to assess their effectiveness.

This chapter discusses the first issue, mitigation of adversary network attack, while the next chapter focuses on the second issue.

Because of the extreme range penalty imposed on operations in the Pacific region, *Long Haul* focuses on improved beyond line of sight (BLOS) communications capability as the single factor requiring immediate attention. Two such BLOS improvements are Extra-High Frequency (EHF) and laser satellite communications. According to *Long Haul*, the Air Force planned to field these capabilities in two stages. The first was Advanced EHF (AEHF) satellites. The second was the transitional satellite (TSAT) program that would combine EHF and laser communication on one platform.⁵⁰

The security and bandwidth provided by laser communications are extremely important to future Air Force operations. Because these communications do not occur in the radio frequency (RF) spectrum, they are not susceptible to traditional jamming techniques. In addition, because of laser characteristics, such communication has an extremely low probability detection or intercept.⁵¹ Finally, laser communications have the potential to transmit nearly four hundred times the amount of data per second as traditional RF systems.⁵² Such secure and rapid communication is sure to be an almost vital necessity in the most defended areas of the future, but the path is unclear in order to operationalize such a capability.

In 2009, the Department of Defense (DoD) cancelled the TSAT program, due to cost overruns and issues with the maturity of its

⁵⁰ Ehrhard, *Long Haul*, 77-8.

⁵¹ V. Nikulin, J. Sofka, and R. Khandekar, "Performance of Free-Space Laser Communication Systems as a Function of the Sampling Rate in the Tracking Loop", Research Study (Binghamton, NY: Center for Advanced Information Technologies, 2005). Such low probability of detection is important when discussing the ability of aircraft to loiter stealthily in a high-threat environment.

⁵² Laboratory of Directed Research and Development, "SATRN: ADVANCED TECHNOLOGY FOR LONG-RANGE LASER COMMUNICATIONS," Laboratory of Directed Research and Development Official Website, <https://ldrd.llnl.gov/pdfs/SATRN.pdf> (accessed 24 May 2012).

technology.⁵³ One primary concern was the inability of laser communications from space-based assets reaching airborne assets in conditions of atmospheric attenuation caused by clouds or dust. In order to compensate, the TSAT program would have required airborne assets to serve as "gateways" between the TSAT and other aircraft.⁵⁴ Such gateway aircraft would have to orbit in a location where the TSAT laser had an unobstructed view, then re-transmit information to aircraft in obstructed areas. When DoD cancelled the TSAT program, such a capability did not exist.

Currently, the Air Force is fielding just such a gateway system in the form of the Battlefield Airborne Communications Node (BACN). This system, fielded both manned and unmanned aircraft,⁵⁵ is the first step in providing the gateway capability necessary to enable the extremely long range, protected communication envisioned in the TSAT program.⁵⁶ In order to meet the challenges of Strategic Preclusion, the Air Force must invest in reliable, secure, and powerful BLOS C² capability. *Long Haul* correctly states that TSAT-type capability is an urgent need in the future security environment.⁵⁷

Conclusion

An Air Force Strategy for the Long Haul and *Air Force Strategy Study 2020-2030* both focus on the challenges in the Pacific created by range and exacerbated by adversary A2/AD technology. Though neither document addresses the potential for other forms of Strategic Preclusion,

⁵³ Space News International, "Pentagon Cancels T-Sat Program, Trims Missile Defense," Space News International Official Website, <http://www.spacenews.com/military/pentagon-cancels-t-sat-program-trims-missile-defense.html> (accessed 24 May 2012).

⁵⁴ Lt Gen Michael Peterson, "Objective Gateway: Information to the Battlefield's Edge," RUSI Defence Systems 10, no.1 (June 2007): 96-97.

⁵⁵ Ultra long-range Bombardier BD-700 business jets, or Block 20 Global Hawks rebranded as EQ-4s.

⁵⁶ Defense Industry Daily, "Bringing Home the BACN to Front Line Forces, Defense Industry Daily Official Website, <http://www.defenseindustrydaily.com/Bringing-Home-the-BACN-to-Front-Line-Forces-05618/> (accessed 24 May 2012).

⁵⁷ Ehrhard, *Long Haul*, 78-9.

the recommendations put forth in the documents are robust and directly address the four factors identified in this paper as critical to overcoming such a strategy. In the next chapter, the evaluation of the documents turns to whether the recommendations serve US strategic necessities fully, and do not just solve an operational access problem.

Additionally, as the focus of the documents is almost entirely technological, some doctrinal and ethical issues are left alone. The next chapter will discuss these issues and their implications for the strategic vision analyzed here, and then provide an overall synopsis and conclusion for this thesis.



Chapter 5

Conclusion

Introduction

The two previous chapters identified and analyzed the approaches that *An Air Force Strategy for the Long Haul* and *Air Force Strategy Study 2020-2030* recommended to deal with the scenario of employing airpower against a sophisticated and powerful adversary possessing a robust air defense capability built around the concept of A2/AD at the operational and tactical level. In both cases, the recommendations centered on technological solutions to base defense in forward areas, increased survivability through full spectrum stealth, and increases in range for both aircraft and munitions to allow maximum standoff capability. Both documents advocated for unmanned aircraft with significant increases in autonomy. Additionally, both documents identified a requirement for advances in communication technology to enable effective C2 of operations in such a scenario.

Here, the discussion turns to whether the recommendations of the two documents fully serve the strategic interests of the US, and do not just solve an operational access problem for airpower. The framework for that discussion will again align along the four criteria already established.

Requirement for Forward Basing

The most significant issue of strategic importance with respect to forward basing is the requirement to harden those bases against attack, since those bases exist in other nations with their own strategic visions. Using the example of Kadena AB, Japan, the question is whether hardening the base against Chinese attack enhances the US security position in the region or makes it more untenable.¹

¹ While the example given focuses on Japanese bases and China as an adversary, the issue of base defense is one that the US must consider regardless of base location. For

From the US perspective, permanent forward basing is a method to deter potential adversaries while simultaneously reassuring partners of American commitment to their combined security.² However, a potential counter to that perspective is that such forward basing turns allies into potential targets. With respect to Japan, the Air Force itself can do little to influence the feelings of that nation, especially since it is a democracy. Currently, it appears that the Japanese government shares both the US concern over the expanding reach of China's ballistic and cruise missile forces and the idea that hardening of facilities and installation of active defenses are the only military options to deal with those specific threats.³

In addition, the US military presence on Okinawa, where the Air Force has its closest base relative to China, is already unpopular.⁴ It is not unreasonable to think that the population might reject initiatives to increase the defensive capacity of bases there, especially since such initiatives all but guarantee those bases as targets should deterrence ever fail.

The hardening of Andersen AFB, Guam, and the potential for developing other bases in the Pacific may serve to ameliorate this potential diplomatic issue by giving the Air Force more options in the region. However, as previously mentioned, the distances from these bases to China do little to solve any military problems. On one hand, they remain within range of Chinese ballistic missile systems currently fielded and potential cruise missile systems in development. On the

example, should the US reach some agreement with India to base US forces there, the requirement to harden that base against attack from adversaries, hostile either to the US or India, would still exist.

² Department of Defense, *Joint Operational Access Concept, Version 1.0* (Washington, D.C.: Office of the Chairman of the Joint Chiefs of Staff, January 2012), 7.

³ Sugio Takahashi, "Counter A2/AD in Japan-U.S. Defense Cooperation: Toward 'Allied Air-Sea Battle'," *Futuregram* 12-003 (Arlington, VA: Project2049 Institute, 2012), 16-17, and Yoichi Kato, "Japan's response to new U.S. defense strategy: 'Welcome, but ...'," *The Asahi Shimbun Official Website*, http://ajw.asahi.com/article/behind_news/politics/AJ201203090025 (accessed 24 May 2012).

⁴ Emily Cadei, "Shrinking a Base to Bolster an Alliance in Japan," *CQ Roll Call Official Website*, <http://public.cq.com/docs/weeklyreport/weeklyreport-000004027341.html> (accessed 24 May 2012).

other hand, they impose a severe enough range penalty on the Air Force fighter force that they almost no longer count as "forward" bases.

While the US has a responsibility to defend the forward bases it intends to operate from in time of conflict, it must never lose sight of the potential loss of those bases. For the Air Force, this means a requirement for the capability to conduct truly global attack and ISR. However, there are potential strategic implications for these capabilities as well.

Ability to conduct sufficient long-range attack

Given the nature of the air defense threats of the future, it is undeniable that any aircraft or munition expected to penetrate those defenses will require sufficient stealth capability, speed, and potentially maneuverability in order to survive.⁵ Therefore, the focus in both documents examined here on the development of new, long-range attack capability for the Air Force is a sound one. However, there are two significant sources of friction for such a concept within the current US strategic environment.

The first is the question of whether such a capability is too high end to make it cost-effective for employment in less demanding threat environments. The last decade of warfare in Iraq, Afghanistan, and the Horn of Africa (HOA), among other places, have caused significant debate over which capabilities the US should focus on for its military forces. On one side of the debate are those who claim that the frequency with which

⁵ Cliff et al., *Shaking the Heavens*, details the efforts of the Chinese in particular to create an IADS that provides overlapping system coverage and frequency diversity designed to prevent entry by any but the stealthiest or most survivable aircraft or munition. Committee on Air Force Needs, *Future Air Force Needs for Survivability*, details the process of the IADS kill chain, in order to demonstrate the various places along that chain that aircraft capability can serve to break it. Dr Carlo Kopp, "Surviving the Modern Integrated Air Defense System," Air Power Australia Official Website, <http://www.ausairpower.net/APA-2009-02.html#mozTocId498100> (accessed 24 May 2012), provides details about measures incorporated into specific modern defense systems to counter low-observable technology and traditional countermeasures such as jamming and chaff, as well as efforts to increase the capability of modern SAM systems to provide point defense against smaller targets such as cruise missiles, JDAM, and small diameter bombs (SDB).

irregular conflicts, such as the insurgencies in Iraq and Afghanistan, occur means that the US military ought to focus on the equipment and capabilities necessary there.

The other side of the debate does not reject the reality that irregular conflicts make up the vast majority of warfare in history, but do reject the idea that the US should optimize to defeat them. Instead, they find the twenty percent of conflicts that are state versus state warfare the most dangerous, and believe the US should optimize first against that threat before looking elsewhere.⁶ Another way of referring to this debate is as one of the “Most Likely” versus “Most Dangerous” version of future conflict.

In this debate, the NGB has been a high-visibility project for the Air Force. In 2009, the program was cancelled by the Secretary of Defense because it was a capability perceived as unnecessary to maintain the existing US dominance in the conventional realm.⁷ The program was revived less than a year later, because of concerns among Air Force leadership over the capability of the B-2 to maintain that dominance in the near term.⁸ Considering that the projected cost of the NGB is \$550 million per unit, those on the “Most Likely” side of the debate do not accept the need for such an aircraft when the B-52 and B-1 have employed effectively over the last decade.⁹

The aforementioned cost is the second source of strategic friction for the NGB. Considering the large cost overruns of recent Air Force acquisition programs like the F-22 and F-35A, it is reasonable to expect

⁶ Regarding percentages of various types of conflict, see David Gayvert, “Words Matter: Re-imagining Irregular Warfare,” Small Wars Journal Official Website, <http://smallwarsjournal.com/blog/journal/docs-temp/825-gayvert.pdf> (accessed 24 May 2012).

⁷ Jeremiah Gertler, “Air Force Next-Generation Bomber: Background and Issues for Congress,” CRS Report for Congress (Washington, D.C.: Congressional Research Service, December 2009), 1.

⁸ Jeff Schogol, “Schwartz Defends Cost of Next-Gen Bomber,” Air Force Times Official Website, <http://www.airforcetimes.com/news/2012/02/airforce-schwartz-defends-cost-of-next-gen-bomber-022912w/> (accessed 24 May 2012).

⁹ Schogol, “Schwartz Defends Cost.”

that the \$550 million price tag will only grow as the NGB project proceeds.¹⁰ Considering the fiscal restraints facing the future force, any high-priced item will likely face intense scrutiny.

Between these two sources of friction, the Air Force may have a tough road ahead in trying to acquire the NGB. However, in order to maintain strategic flexibility, the Air Force must possess the capability to conduct truly global strike. Even if irregular conflict continues to make up the majority of warfare scenarios around the world, there is no guarantee such conflict will occur in areas that provide the same level of strategic access enjoyed by the US in Iraq and Afghanistan. While these areas may not require the same level of threat penetration capability envisioned for the NGB, they may require the same range and/or loiter capability. It seems extremely unlikely that the Air Force will find the money to develop new and separate long-range strike capabilities for both high-tech and low-tech conflict. As such, prudence dictates pursuing the capability most readily operated across all spectrums.

Ability to conduct effective and persistent ISR

There are no significant sources of friction in the recommendations proposed for ISR in the two documents.¹¹ Considering the public acknowledgement of the RQ-170 Sentinel drone, and the later and very public loss of one of the drones in Iran, the Air Force has obviously

¹⁰ United States Government Accountability Office, *GAO Assessments of Selected Weapons Programs* (Washington, D.C.: United States Government Accountability Office, March 2011), 10.

¹¹ In fact, nearly any document that deals with the future needs of the Air Force, regardless of where it sits on the “Most Likely” vs. “Most Dangerous” debate scale, focuses heavily on the need for persistent ISR. John P. Geis, et al., *Blue Horizons II: Future Capabilities and Technologies for the Air Force in 2030 Executive Summary* (Maxwell AFB, AL: Air University Press, 2009) has persistent ISR as one of its top four areas for focused improvement in every future scenario that it studied. Lt Gen Dave Deptula, “Air Force Unmanned Aerial System (UAS) Flight Plan 2009-2047” (briefing presented in 2009) shows the increasing demand for ISR and the impacts of that demand as time moves forward and the complexity of conflict increases. Combined with the increasing lethality of air defenses already mentioned, the need for persistent and survivable ISR delineated in the documents studies here is clear.

already pursued one of the key recommendations regarding stealthy, theater-level ISR aircraft.

The key issue that neither document addressed sufficiently is that of rapid fusion of multiple ISR sources into data usable in the air. This is especially critical against the backdrop of a requirement for full spectrum stealth in future strike and ISR platforms. One current example of this shortcoming can be found in the F-22. The F-22's onboard sensors allow it to collect vast amounts of information and provide considerable situational awareness (SA) to the pilot. F-22s can share this information with each other using an Intra-Flight Data Link (IFDL) that allows for stealthy communication.¹² However, the IFDL does not transmit directly to other aircraft, to include other LO aircraft expected to play a part in a high-tech fight.¹³

The current solution to this problem is to use the airborne BACN system mentioned in the previous chapter, which can receive the IFDL signal and rebroadcast it in a format receivable by other aircraft.¹⁴ However, the survivability of BACN-enabled platforms is questionable in advanced threat-environments. Additionally, the risk of information loss, corruption, or interception only increases with the number of pathways required for transmission. Moving forward with its vision for ISR, the Air Force must take an integrated approach to requirements and acquisition to ensure that collection platforms can communicate information directly to strike and C² platforms in a secure manner.

Ability to conduct effective command and control (C²)

As stated in both *Long Haul* and *Strategy Study*, the Air Force will require robust and secure BLOS communication capability for effective employment and C² of forces in the future. As the ultimate high ground,

¹² John Reed, "F-22s Won't Get F-35 Datalinks, Yet," DOD Buzz Official Website, <http://www.dodbuzz.com/2011/03/31/f-22s-wont-get-f-35-datalinksyet/> (accessed 24 May 2012).

¹³ Reed, "F-22s Won't Get F-35 Datalinks, Yet."

¹⁴ Reed, "F-22s Won't Get F-35 Datalinks, Yet."

space provides significant potential for enhancing existing BLOS capability. The AEHF program that the DoD chose in 2009 to expand, vice proceeding with the TSAT program, is proceeding. The first satellite reached its orbit in late 2011.¹⁵ The second satellite is scheduled for launch on May 3, 2012.¹⁶ However, as stated previously, the bandwidth capabilities provided by laser communications are so much greater than those of RF communication systems like AEHF.

Considering the issues identified previously in this thesis with the amount of data collected by ISR, the requirements for PED of that data, and the need to ensure rapid and efficient fusion of data into information for the warfighter, the bandwidth and security provided by lasers is a capability that the Air Force should not put off for very long.

The discussion will now turn to one issue that was not discussed sufficiently in either document, and that is close air support (CAS). Following that is a brief discussion of an ethical question that arises from the premium put in *Strategy Study* on autonomous aircraft for future conflict. Finally, the chapter concludes with a summary of this thesis, briefly explaining the concept of Strategic Preclusion, the penalties that its use imposes on the use of airpower, and how the recommendations from the two documents studied here will serve the Air Force in the future to overcome those penalties.

Close Air Support

The subject of CAS receives almost no coverage in either of the two documents examined here. *Strategy Study* makes no reference whatsoever to the topic. CAS is only mentioned twice in *Long Haul*, and in neither case is it part of a discussion on how the Air Force needs to

¹⁵ United States Government Accountability Office, *GAO Assessments of Selected Weapons Programs* (Washington, D.C.: United States Government Accountability Office, March 2012), 137.

¹⁶ Marcus Weisgerber, "U.S. Air Force AEHF Launch Set for May 3," Defense News Official Website, <http://www.defensenews.com/article/20120418/DEFREG02/304180011/U-S-Air-Force-AEHF-Launch-Set-May-3> (accessed 24 May 2012).

prepare itself for this mission on a future battlefield.¹⁷ Neither document states it directly, but there appears to be an underlying belief on the part of the authoring groups that there will be no place for ground forces on a modern Pacific battlefield.¹⁸ As a result of this belief, it appears they also feel CAS is not a necessary topic for conversation.

Given the threat envisioned by both documents, the truth of the matter is that the capabilities required to conduct penetrating attacks with either aircraft or standoff weapons are the same requirements any CAS platform would need. However, it is the stark absence of any discussion of CAS that is certain to give members of the other services pause if they read such documents to see the future envisioned by senior airpower strategists. As the Air Force moves forward with future acquisition programs, especially those designed to function against in a high-threat air defense environment, it must be careful to fully explain how those capabilities enable and support the joint force and not just the Air Force.

For example, if the air defense threat environment only allows the use of standoff weapons with ranges of 1500-3000 miles, the Air Force must be able to explain how those weapons can effectively meet the detailed integration standard required for CAS missions.¹⁹ If those weapons cannot meet those standards, the Air Force must be honest about that as well. While neither document discussed here openly examined CAS in any significant way, the Air Force must do so as part of its strategy for the future. And, it must do so for all potential theaters and levels of conflict.

Autonomy

Unlike CAS, the subject of autonomy received significant attention in the recommendations put forth in the documents examined,

¹⁷ Ehrhard, *Long Haul*, 65 and 89.

¹⁸ *Long Haul* makes no reference to the Korean peninsula, and *Strategy Study* briefly discusses it as one possible source of tension between the US and China.

¹⁹ Joint Publication 3.09-3, *Close Air Support*, 8 July 2009, ix.

particularly those in the *Strategy Study*. Like CAS, there was little to no discussion of the potential implications of those recommendations. In the case of autonomy, those implications primarily lie in the legal and ethical realms.

Turning first to legality, significant concerns exist regarding the ability of autonomous systems to meet the requirements for target identification and discrimination required by the various treaties and protocols collectively known as the laws of war.²⁰ The technology to allow such discrimination may someday exist, but it is highly unlikely within the timeframe envisioned by *Strategy Study*.²¹ As such, it seems reckless for the Air Force to invest significantly in a capability whose use may not conform to international law.

Compounding the legal issue are more general ethical concerns about the ease with which decision makers may decide to initiate conflict when they no longer have to risk the lives of their own forces to do so. The reduction of such risk is indeed one of the primary drivers behind the call for remotely piloted and autonomous systems, though not the only one. The high threat environment envisioned in the future is one in which the human mind will likely be the slowest processor on the battlefield, and one where autonomous machine minds can provide vast increases in efficiency and lethality.²²

²⁰ Professor Noel Sharkey, "Challenges of Autonomous Weapons," RUSI Defence Systems 11, no.2 (October 2008): 86-89, and Maj Erin A. McDaniel, "Robot Wars: Legal and Ethical Dilemmas of Using Unmanned Robotic Systems in 21st Century Warfare and Beyond," Master's Thesis (Fort Leavenworth, KS: US Army Command and General Staff College, 2008). The concern is not whether one could program an autonomous machine to apply discrimination in targeting, but whether there is sufficient technology to provide the necessary sensor input to allow the machine to discriminate.

²¹ Sharkey, "Challenges of Autonomous Weapons."

²² Patrick Lin, George Bekey, and Keith Abney, "Autonomous Military Robotics: Risk, Ethics, and Design," Report for the Office of Naval Research (San Luis Obispo, CA: California Polytechnic State University, December 2008) and Fernando Camutari, "Robot Ethics: A Scientific Autonomous Military Robot Systems Survey," Academia.edu Official Website, http://sheffield.academia.edu/FernandoCamutari/Papers/889097/Robot_Ethics_A_Scientific_Autonomous_Military_Robot_Systems_Survey (accessed 24 May 2012). The primary issues at hand in this area are machine-speed increases in

The requirement to conform not just to international law, but also to American norms, is sacrosanct. Therefore the Air Force must deal openly and thoroughly with these legal and ethical issues as it pursues autonomy of systems in future requirements. Should it fail to do so, it may find itself with capabilities that it cannot use; considering the cost involved in developing such capabilities, it seems unlikely that robust alternatives would exist. In such a case, the Air Force would find itself in the unacceptable position of being unable to satisfy the strategic requirements placed on it.²³

Conclusion

There is a great deal of discussion currently about the challenge to operational access for airpower posed by A2/AD technologies. However, there is little discussion about potential challenges to strategic access. This thesis attempted to determine if visions for the strategic future of the Air Force accounted for these strategic access problems. To do so, this thesis first introduced a new definition of an old term, Strategic Preclusion, designed to encompass this idea of denying strategic access through the uses of all instruments of state power.

battlefield processing and the ability to conduct battlefield operations without the inefficiencies of human frailty, e.g. exposure to elements, hazardous materials, emotional response, etc. Of strategic concern is whether the “human in the loop” at the operational or strategic level of execution can keep track of the machine-speed pace of tactical operations.

²³ The point in bringing up the lack of discussion regarding CAS and the possible ethics of autonomy was to point out possible criticisms of these documents as a whole regarding what they imply about the Air Force as an institution. Considering the amount of time and effort the Air Force has invested in enhancing its ability to provide precision air-to-ground support over the last ten years of operations, it is strange to see no mention of that capability as important to maintain in the coming decades. Considering the amount of discussion that exists regarding the ethics of autonomy and military technology, it is also strange that no document makes any mention of those issues when advocating so strongly for the adoption of such technology. It would appear from these two documents that Air Force leaders continue to propagate at least two of the five faces ascribed to the Air Force by Carl Builder in *The Masks of War*: worship at the altar of technology and sensitivity to the legitimacy of service independence (Carl Builder, *The Masks of War: American Military Styles in Strategy and Analysis* (Baltimore, MD: The Johns Hopkins University Press, 1989). Whether or not this is inappropriate is not the issue here. The issue is how the Air Force, should it elect to adopt either or both of these documents as a blueprint for action, can explain the absence of consideration of these two topics.

Then, this thesis examined US power projection in Operations DESERT SHIELD/DESERT STORM and IRAQI FREEDOM, and compared those actions to the British experience with power projection during the Falkland Islands campaign. The purpose of that comparison was to demonstrate the challenges posed to the British by a lack of strategic access, and highlight that the American experience with power projection is really one where strategic access has allowed the long-range deployment of forces to conduct short-range, local operations. This examination led to the establishment of four criteria against which to judge any future Air Force strategy for its ability to counter Strategic Preclusion.

These criteria are the requirement for forward basing, the ability to conduct long-range strike and sustainment, the ability to conduct effective and persistent ISR, and the ability to conduct effective command and control. With respect to forward basing, the requirement of any given strategic vision should be low, as effective Strategic Preclusion will deny that basing outright. Following the establishment of criteria, this thesis examined a document published by two Colonels from the Chinese PLA. This document spelled out the many ways to employ the various instruments of state power to deny strategic access, highlighting that strategic access is indeed a target set of potential adversaries.

Next, this thesis examined two documents published by senior figures within Air Force strategy circles. The first was *An Air Force Strategy for the Long Haul*, by Colonel (Ret.) Thomas Ehrhard, PhD, of the Center for Strategic and Budgetary Assessments. The second was *Air Force Strategy Study 2020-2030*, by General (Ret.) John Shaud, PhD, director of the Air Force Research Institute. Both of these documents examined the capabilities the Air Force would require to counter the high-tech threat posed by a rising peer competitor, then offered recommendations on how to acquire those capabilities.

The Air Force envisioned by the two documents is one that still requires a robust network of forward basing, due to the range limitations of the F-22 and F-35 as well as diplomatic commitments of the US to allies around the world. However, both documents recognize the threat posed to that network, and make recommendations both on how to defend it as well as acquire capabilities that render the bases unnecessary. Those capabilities include advances in full spectrum stealth, increases in range and loiter capability for both aircraft and munitions, and advanced communications capability to ensure the ability to operate in environments where networks are contested.

As previously mentioned, both documents also place a premium on future aircraft being remotely piloted. In the case of *Strategy Study*, autonomy is also a heavy emphasis item. While all of these recommendations are intended to allow the Air Force to overcome operational access challenges, they do in fact simultaneously provide the Air Force the capability to overcome access challenges presented by Strategic Preclusion as well. Each of the four criteria established in this thesis are adequately addressed by the strategic visions of *Long Haul* and *Strategy Study*. The recommendations strike an appropriate balance between utilizing the strategic access the US currently enjoys to conduct regional or local power projection and developing the capability to conduct truly global attack, ISR, and C2 against a high level threat.

The Air Force should proceed with the development of those global capabilities, but must ensure that it does so while maintaining a frank and open dialogue about how these capabilities will also serve to perform the enabling functions upon which the Air Force's joint partners have come to rely. Additionally, the legal and ethical issues that surround any discussion of unmanned forces, and especially autonomous unmanned forces, have the potential to negatively affect the use of these capabilities in the future. As such, the Air Force must also conduct the proper

assessments of the appropriateness of these technologies with respect to international law as well as international and American cultural norms.

A great strength of airpower has always been the flexibility it provides by leveraging speed and three-dimensional maneuver to overcome challenges imposed by range, geography, and defense. As the US shifts its strategic focus to the Pacific, those traditional challenges only become more severe. Ranges increase, the geography provides little in the way of basing options, and the sophistication and lethality of the defenses becomes much greater. While much of the current concern over Air Force capability focuses on the defenses, it is important not to forget that adversaries have options at their disposal to actively aggravate the other challenges as well. Through the use of combinations of national power, adversaries may deny strategic access to US forces, not just complicate operational access. That is what Strategic Preclusion is, and, while the Air Force can do little to defend against it, it must be prepared to operate in the face of it.

BIBLIOGRAPHY

- Air Force Association. "F-22 versus F-35 Comparison." Air Force Association. http://www.afa.org/professionaldevelopment/issuebriefs/F-22_v_F-35_Comparison.pdf (accessed 23 May 2012).
- Baillie, Amber. "Cadets, Professors Submit Patents for Next-gen Aircraft Engines." US Air Force Academy Official Website. <http://www.usafa.af.mil/news/story.asp?id=123297082> (accessed 24 May 2012).
- Barr, Larine. "Air Force Plans to Develop Revolutionary Engine." US Air Force Official Website. <http://www.af.mil/news/story.asp?id=123046410> (accessed 24 May 2012).
- The Boeing Company. "Boeing: C-17 Globemaster III – C-17 Around the World." Boeing Official Website, <http://www.boeing.com/defense-space/military/c17/c17world.html> (accessed 24 May 2012).
- British Broadcasting Corporation (BBC) News. "Regions and Territories: Falklands Islands." BBC News. http://news.bbc.co.uk/2/hi/americas/country_profiles/4087743.stm (accessed 21 May 2012).
- Builder, Carl. *The Masks of War: American Military Styles in Strategy and Analysis*. Baltimore, MD: The Johns Hopkins University Press, 1989.
- Cadei, Emily. "Shrinking a Base to Bolster an Alliance in Japan." CQ Roll Call Official Website. <http://public.cq.com/docs/weeklyreport/weeklyreport-000004027341.html> (accessed 24 May 2012).
- Camutari, Fernando. "Robot Ethics: A Scientific Autonomous Military Robot Systems Survey." Academia.edu Official Website. http://sheffield.academia.edu/FernandoCamutari/Papers/889097/Robot_Ethics_A_Scientific_Autonomous_Military_Robot_Systems_Survey (accessed 24 May 2012).
- Cliff, Roger, Mark Burles, Michael S. Chase, Derek Eaton, and Kevin L. Pollpeter. *Entering the Dragon's Lair*. Santa Monica, CA: RAND Corporation, 2007.
- Cliff, Roger, John Fei, Jeff Hagen, Elizabeth Hague, Eric Heginbotham, and John Stillion. *Shaking the Heavens and Splitting the Earth*. Santa Monica, CA: RAND Corporation, 2011.
- Cohen, Eliot A., and Thomas A. Keaney. *Gulf War Air Power Survey Summary Report*. Washington, D.C.: Department of the Air Force, 1993.
- Committee on Future Air Force Needs for Survivability. *Future Air Force Needs for Survivability*. Washington, D.C.: National Academies Press, 2006.
- Cordesman, Anthony H., and Abraham R. Wagner. *The Lessons of Modern War, Volume III: The Afghan and Falklands Conflicts*. Boulder, CO: Westview Press, 1990.

- Dahm, Werner. *Report on Technology Horizons: A Vision for Air Force Science & Technology During 2010-2030*. Washington, D.C.: Office of the Chief Scientist of the Air Force, 2010.
- Davis, Richard G. *On Target: Organizing and Executing the Strategic Air Campaign Against Iraq*. Washington, D.C.: Air Force History and Museums Program, 2002.
- Defense Industry Daily. "Bringing Home the BACN to Front Line Forces." Defense Industry Daily Official Website. <http://www.defenseindustrydaily.com/Bringing-Home-the-BACN-to-Front-Line-Forces-05618/> (accessed 24 May 2012).
- Defense Technical Information Center. "Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Air Force, R-1 ITEM NOMENCLATURE PE 0101113F: B-52 SQUADRONS." Defense Technical Information Center Official Website. http://www.dtic.mil/descriptivesum/Y2012/AirForce/0101113F_7_PB_2012.pdf (accessed 24 May 2012).
- Dempsey, Gen Martin. *Chairman's Strategic Direction to the Joint Force*. 6 February 2012.
- Department of the Air Force. *Gulf War Air Power Survey Volume II, Operations and Effects and Effectiveness*. Washington, D.C.: Department of the Air Force, 1993.
- Department of the Air Force. *Gulf War Air Power Survey, Volume III, Logistics and Support*. Washington, D.C.: Department of the Air Force, 1993.
- Department of Defense. *Joint Operational Access Concept, Version 1.0*. Washington, D.C.: Office of the Chairman of the Joint Chiefs of Staff, January 2012.
- Department of Defense. *Sustaining U.S. Global Leadership: Priorities for 21st Century Defense*. Washington, D.C.: Office of the Secretary of Defense, January 2012.
- Deptula, Lt Gen David. "Air Force Unmanned Aerial System (UAS) Flight Plan 2009-2047." Briefing. Air Command and Staff College, Maxwell AFB, AL, AY 2011.
- Donley, Michael B., and Gen Norton Schwartz. "Air Force Priorities for a New Strategy with Constrained Budgets." White Paper, 1 February 2012.
- The Economic Times. "India to Buy More than 16 C-17 Airlifters." The Economic Times Website. <http://economictimes.indiatimes.com/news/economy/policy/india-to-buy-more-than-16-c-17-airlifters/articleshow/8850290.cms> (accessed 24 May 2012).
- Ehrhard, Thomas P. *An Air Force Strategy for the Long Haul*. Washington, D.C.: Center for Strategic and Budgetary Assessments, 2009.

- Freedman, Lawrence. "Air Power and the Falklands, 1982." In *A History of Air Warfare*, edited by John Andreas Olsen. Washington, D.C.: Potomac Books, Inc., 2010.
- Gayvert, David. "Words Matter: Re-imagining Irregular Warfare." Small Wars Journal Official Website. <http://smallwarsjournal.com/blog/journal/docs-temp/825-gayvert.pdf> (accessed 24 May 2012).
- Geis, John P., Christopher J. Kinnan, Ted Hailes, Harry A. Foster, and David Blanks. *Blue Horizons II: Future Capabilities and Technologies for the Air Force in 2030, Executive Summary*. Maxwell AFB, AL: Air University Press, 2009.
- Gertler, Jeremiah. "Air Force Next-Generation Bomber: Background and Issues for Congress." Congressional Research Service Report for Congress. Washington, D.C.: Congressional Research Service, December 2009.
- Gordon, Michael R., and General Bernard E. Trainor. *The General's War*. Boston, MA: Little, Brown and Company, 1995.
- Gordon, Michael R., and General Bernard E. Trainor. *Cobra II: The Inside Story of the Invasion and Occupation of Iraq*. New York, NY: Pantheon Books, 2006.
- Gunzinger, Mark, and Chris Dougherty. *Outside-In: Operating from Range to Defeat Iran's Anti-Access and Area-Denial Threats*. Washington, D.C.: Center for Strategic and Budgetary Assessments, 2011.
- Hallion, Richard. *Storm Over Iraq*. Washington, D.C.: Smithsonian Institution, 1997.
- Hosmer, Stephen T. *Why the Iraqi Resistance to the Coalition Invasion Was So Weak*. Santa Monica, CA: RAND Corporation, 2007.
- Joint Publication 3.09-3. *Close Air Support*, 8 July 2009.
- Kato, Yoichi. "Japan's response to new U.S. defense strategy: 'Welcome, but...'," The Asahi Shimbun Official Website. http://ajw.asahi.com/article/behind_news/politics/AJ201203090025 (accessed 24 May 2012).
- Kopp, Dr Carlo. "Almaz-Antey S-300PMU2 Favorit Self Propelled Air Defence System/SA-20 Gargoyle." Airpower Australia Official Website. <http://www.ausairpower.net/APA-S-300PMU2-Favorit.html#mozTocId894981> (accessed 24 May 2012).
- Kopp, Dr Carlo. "Surviving the Modern Integrated Air Defense System." Air Power Australia Official Website. <http://www.ausairpower.net/APA-2009-02.html#mozTocId498100> (accessed 24 May 2012).
- Krepinevich, Andrew, Barry Watts, and Robert Work. *Meeting the Anti-Access and Area-Denial Challenge*. Washington, D.C.: Center for Strategic and Budgetary Assessments, 2003.

- Laboratory of Directed Research and Development. "SATRN: ADVANCED TECHNOLOGY FOR LONG-RANGE LASER COMMUNICATIONS." Laboratory of Directed Research and Development Official Website. <https://ldrd.llnl.gov/pdfs/SATRN.pdf> (accessed 24 May 2012).
- Liang, Qiao, and Wang Xiangsui. *Unrestricted Warfare*. Beijing, China: PLA Literature and Arts Publishing House, 1999.
- Lin, Patrick, George Bekey, and Keith Abney. "Autonomous Military Robotics: Risk, Ethics, and Design." Report for the Office of Naval Research. San Luis Obispo, CA: California Polytechnic State University, December 2008.
- Majumdar, Dave. "Air Force seeks to nix Block 30 Global Hawks." The Air Force Times Official Website. <http://www.airforcetimes.com/news/2012/01/defense-air-force-block-30-global-hawks-nix-012612w/> (accessed 24 May 2012).
- Martino, Maj Richard A. "Leveraging Traditional Battle Damage Assessment Procedures to Measure Effects From a Computer Network Attack." Graduate Research Project. Wright-Patterson AFB, OH: Air Force Institute of Technology, 2011.
- McDaniel, Maj Erin A. "Robot Wars: Legal and Ethical Dilemmas of Using Unmanned Robotic Systems in 21st Century Warfare and Beyond." Master's Thesis. Fort Leavenworth, KS: US Army Command and General Staff College, 2008.
- Menthe, Lance, Amado Cordova, Carl Rhodes, Rachel Costello, and Jeffrey Sullivan. *The Future of Air Force Motion Imagery Exploitation: Lessons from the Commercial World*. Santa Monica, CA: RAND Corporation, 2012.
- National Aeronautics and Space Administration (NASA). "Active Aeroelastic Wing." NASA Official Website. <http://www.nasa.gov/centers/dryden/news/ResearchUpdate/AAW/> (accessed 24 May 2012).
- National Reconnaissance Office (NRO). "NRO – What We Do." NRO Official Website. <http://www.nro.gov/about/nro/what.html> (accessed 24 May 2012).
- Nikulin, V., J. Sofka, and R. Khandekar. "Performance of Free-Space Laser Communication Systems as a Function of the Sampling Rate in the Tracking Loop." Research Study. Binghamton, NY: Center for Advanced Information Technologies, 2005.
- O'Connor, Sean. "PLA Ballistic Missiles." Air Power Australia. <http://www.ausairpower.net/APA-PLA-BallisticMissiles.html#mozTocId779953> (accessed 23 May 2012).
- OIF Planner. Briefing. School of Advanced Air and Space Studies/Air and Space Operations Senior Staff Course, Maxwell AFB, AL, 18 April 2012.
- Pacific Air Forces. "USAF Support to Japan Crisis." Pacific Air Forces Official Website. <http://www.pacaf.af.mil/shared/media/document/AFD-110330-077.pdf> (accessed 24 May 2012).

- Perdue, Scott and John Stillion. "Air Combat: Past, Present, and Future." RAND presentation, August 2008.
- Peterson, Lt Gen Michael. "Objective Gateway: Information to the Battlefield's Edge." RUSI Defence Systems 10, no.1 (June 2007): 96-97.
- Putney, Diane T. *Airpower Advantage: Planning the Gulf War Air Campaign, 1989-1991*. Washington, D.C.: Air Force History and Museums Program, 2004.
- Reed, John. "F-22s Won't Get F-35 Datalinks, Yet." DOD Buzz Official Website, <http://www.dodbuzz.com/2011/03/31/f-22s-wont-get-f-35-datalinksyet/> (accessed 24 May 2012).
- Riggins, James, and David E. Snodgrass. "Halt Phase Plus Strategic Preclusion: Joint Solution for a Joint Problem." *Parameters* 29, no. 3 (Autumn 1999): 70-85.
- Royal Air Force. "The Falkland Islands Campaign, 1982 Overview." Royal Air Force. <http://www.raf.mod.uk/history/1982Overview.cfm> (accessed 21 May 2012).
- Royal Air Force. "The Falklands Islands Campaign, Operation Black Buck." Royal Air Force. <http://www.raf.mod.uk/history/OperationBlackBuck.cfm> (accessed 21 May 2012).
- Schogol, Jeff. "Schwartz Defends Cost of Next-Gen Bomber," Air Force Times Official Website. <http://www.airforcetimes.com/news/2012/02/airforce-schwartz-defends-cost-of-next-gen-bomber-022912w/> (accessed 24 May 2012).
- Schwartz, Gen Norton A. Chief of Staff, US Air Force. Air Force Strategic Choices and Budget Priorities Brief at the Pentagon, Washington, D.C., 27 January 2012.
- Sharkey, Professor Noel. "Challenges of Autonomous Weapons." RUSI Defence Systems 11, no.2 (October 2008): 86-89.
- Shaud, Gen (Ret.) John A. *Air Force Strategy Study 2020-2030*. Maxwell AFB, AL: Air University Press, 2011.
- Space News International. "Pentagon Cancels T-Sat Program, Trims Missile Defense." Space News International Official Website. <http://www.spacenews.com/military/pentagon-cancels-t-sat-program-trims-missile-defense.html> (accessed 24 May 2012).
- Takahashi, Sugio. "Counter A2/AD in Japan-U.S. Defense Cooperation: Toward 'Allied Air-Sea Battle'." Futuregram 12-003. Arlington, VA: Project2049 Institute, 2012.
- Tol, Jan van, Mark Gunzinger, Andrew Krepinevich, and Jim Thomas. *AirSea Battle: A Point-of-Departure Operational Concept*. Washington, D.C.: Center for Strategic and Budgetary Assessments, 2010.

- United Kingdom Ministry of Defence. "RAF's Bravo November returns from Afghanistan." United Kingdom Ministry of Defence. <http://www.mod.uk/DefenceInternet/DefenceNews/EquipmentAndLogistics/RafsBravoNovemberReturnsFromAfghanistan.htm> (accessed 21 May 2012).
- United States Air Force (USAF). "AGM-129A Advanced Cruise Missile." USAF Official Website. <http://www.af.mil/information/factsheets/factsheet.Asp?id=3548> (accessed 24 May 2012).
- United States Air Force (USAF). "RQ-4 Global Hawk." USAF Official Website. <http://www.af.mil/information/factsheets/factsheet.asp?id=13225> (accessed 24 May 2012).
- United States Air Force (USAF). "U-2S/TU-2S." USAF Official Website. <http://www.af.mil/information/factsheets/factsheet.asp?id=129> (accessed 24 May 2012).
- United States Government Accountability Office (GAO). *GAO Assessments of Selected Weapons Programs*. Washington, D.C.: United States Government Accountability Office, March 2011.
- United States Government Accountability Office (GAO). *GAO Assessments of Selected Weapons Programs*. Washington, D.C.: United States Government Accountability Office, March 2012.
- Weisgerber, Marcus. "U.S. Air Force AEHF Launch Set for May 3," Defense News Official Website. <http://www.defensenews.com/article/20120418/DEFREG02/304180011/U-S-Air-Force-AEHF-Launch-Set-May-3> (accessed 24 May 2012).
- Whitlock, Craig. "Gorgon Stare surveillance system gazes over Afghan war zone." The Washington Post Official Website. http://www.washingtonpost.com/national/gorgon-stare-gazes-over-war-zone/2011/04/29/AF2xLiGF_story.html (accessed 24 May 2012).
- 618th Tactical Airlift Control Center. "618 TACC Contributions to the Fight, January-March 2011." 618th Tactical Airlift Control Center Official Website. <http://www.618tacc.amc.af.mil/shared/media/document/AFD-110602-022.pdf> (accessed 24 May 2012).