Army Air and Missile Defense: Preparing for the Future Requires a Joint Force Solution

A Monograph

by

MAJ Colleen M. Shepherd
US Army

School of Advanced Military Studies
US Army Command and General Staff College
Fort Leavenworth, KS

2020

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
21-05-2020	Master's Thesis	June 2019 - May 2020

4. TITLE AND SUBTITLE
Army Air and Missile Defense: Preparing for the Future Requires a Joint Force Solution

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
MAJ Colleen M. Shepherd

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Command and General Staff College
ATTN: ATZL-SWD-GD
Fort Leavenworth, KS 66027-2301

8. PERFORMING ORG REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Advanced Military Studies Program

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release; Distribution is Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
According to the US National Security Strategy, the Joint Force spent the last decade in a "procurement holiday" negatively affecting the evolution of critical capabilities in every operating domain – air, ground, sea, space, and cyberspace. In contrast, US adversaries are enhancing existing offensive missile capabilities while developing new and unprecedented types of sea- and air-launch systems and hypersonic capabilities. As a result, US adversaries have created non-permissive, contested environments which challenge the normal model of US force projection and operational strategies by denying immediate air superiority. This monograph examines the need for a Joint Force solution to address future air and missile defense threats. After establishing a better understanding of the current problem for accessing operational areas, this monograph reviews the current US military approach to air and missile defense. Subsequently, an assessment of the anticipated operating environment provides the foundation for analysis against the effectiveness in future conflicts and whether there is a need to develop a new approach against emerging threats.

15. SUBJECT TERMS
Air and Missile Defense (AMD), Air Defense (AD), Anti-Access/Area Denial (A2/AD), Integrated Air and Missile Defense Battle Command System (IBCS), Multi-Domain Operations (MDO)

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**	(U)	53	**19b. PHONE NUMBER** *(include area code)*
(U)	(U)	(U)			913 758-3300

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

Monograph Approval Page

Name of Candidate: MAJ Colleen M. Shepherd

Monograph Title: Army Air and Missile Defense: Preparing for the Future Requires a Joint Force Solution

Approved by:

_____, Monograph Director
G. Scott Gorman, PhD

_____, Seminar Leader
Jürgen Prandtner, COL (GS) German Army

_____, Director, School of Advanced Military Studies
Brian A. Payne, COL

Accepted this 21st day of May 2020 by:

_____, Acting Director, Office of Degree Programs
Prisco R. Hernandez, PhD

Abstract

Army Air and Missile Defense: Preparing for the Future Requires a Joint Force Solution, by MAJ Colleen M. Shepherd, 53 pages.

According to the US National Security Strategy, the Joint Force spent the last decade in a "procurement holiday" negatively affecting the evolution of critical capabilities in every operating domain – air, ground, sea, space, and cyberspace. In contrast, US adversaries are enhancing existing offensive missile capabilities while developing new and unprecedented types of sea- and air-launch systems and hypersonic capabilities. As a result, US adversaries have created non-permissive, contested environments which challenge the normal model of US force projection and operational strategies by denying immediate air superiority. Since the post-Cold War era, the United States has shifted from ready forces in overseas garrisons to an expeditionary force. Additionally, the proliferation of precision strike systems and medium-high-altitude air defense systems have furthered eroded the strategic advantages once held by the United States. Consequently, the United States must prepare to gain access into contested environments where air superiority is not a guarantee.

Will the current US Army air and missile defense approach work in the anticipated operational environment? This monograph proposes that the US Army's current approach to air and missile defense will not work in the future because of independent service-specific systems and solutions that are unable to communicate data horizontally or vertically across the Joint Force. This monograph examines the strategic environment and the affect from the proliferation of air and missile threats. After establishing a better understanding of the current problem for accessing operational areas, this monograph reviews the current approach to air and missile defense from a pre-conflict and conflict perspective. Subsequently, an assessment of the anticipated operating environment provides the foundation for analysis against the current approach's effectiveness in future conflicts. The author concludes that while the current approach could work, in future conflicts the character of warfare will require a more robust Joint Force solution in lieu of service-specific systems and strategies.

Contents

Acknowledgements

I would like to thank the following people for their encouragement, support, and assistance with this paper: Dr Gorman, my monograph director first for selecting me and second for believing in my ideas and abilities throughout this process. Without it, I would have never believed I could accomplish such an enormous academic task. CPT Mary Jocelyn for pushing the creative limits of my mind, helping to refine my argument and logic, and your sometimes brutal but always welcomed proofreading assistance. Last but not least, to my family for your endless encouragement and support throughout the past year.

Abbreviations

A2/AD	Anti-Access/Area Denial
AAMDC	Army Air and Missile Defense Command
AMD	Air and Missile Defense
AWACS	Airborne Warning and Control System
CARL	Combined Arms Research Library
CGSC	Command and General Staff College
CJCS	Chairman of the Joint Chiefs of Staff
CM	Cruise Missile
C-RAM	Counter-Rocket, Artillery, and Mortar
FW	Fixed-Wing
IADS	Integrated Air Defense System
IBCS	Integrated Air and Missile Defense Battle Command System
ICC	Information and Coordination Central
JOE	Joint Operating Environment
JTIDS	Joint Tactical Information Distribution System
MANDPADS	Man-Portable Air Defense System
MDA	Missile Defense Agency
MDO	Multi-Domain Operations
NATO	North Atlantic Treaty Organization
OE	Operational Environment
RAND	Research and Development Corporation
RW	Rotary Wing
SHORAD	Short-Range Air Defense
THAAD	Terminal High Altitude Air Defense
UAS	Unmanned Aircraft Systems

Figures

Introduction

According to the US *National Security Strategy*, the Joint Force spent the last decade in a "procurement holiday" negatively affecting the evolution of critical capabilities in every operating domain – air, ground, sea, space, and cyberspace.[1] In contrast, US adversaries pursued technological and operational capabilities threatening our dominance across all operating domains. Many of the threats focus on strategic factors and seek to deny the United States access into theaters of operations, freedom of movement, and freedom of action.[2] US adversaries have created non-permissive, contested environments which challenge the normal model of US force projection and operational strategies by denying immediate air superiority.

Air superiority forms the backbone to any US military strategy, force projection model, or campaign plan. US Joint Publication (JP) 3-01, *Countering Air and Missile Defense*, defines air superiority as "that degree of control of the air by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats."[3] Since the Korean War, the United States has achieved and maintained air superiority in every major US conflict to include the Vietnam War, Operation Desert Storm, and Operation Iraqi Freedom. However, as stated in the summary of the 2018 US *National Defense Strategy*, "every domain is contested" and the underlying assumptions of owning the advantages in soldier quality, technology, and automatic air superiority are no more.[4]

---

[1] US President Donald J. Trump, *National Security Strategy of the United States of America* (Washington, DC: The White House, 2017), 27, accessed September 3, 2018, https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf.

[2] Steven Biddle and Ivan Oelrich, "Future Warfare in the Western Pacific: Chinese Antiaccess/Area Denial, U.S. AirSea Battle, and Command of the Commons in East Asia," *International Security* 41, no. 1 (July 2016): 7.

[3] US Department of Defense, Joint Staff, Joint Publication (JP) 3-01, *Countering Air and Missile Threats* (Washington, DC: Government Printing Office, 2018), I-4.

[4] Secretary of Defense James N. Mattis, *Summary of the National Defense Strategy of the United States of America 2018* (Washington, DC: Government Printing Office, 2018), 3, accessed September 3, 2018, https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf.

According to Everett Dolman, the United States has had command of the air for so long that it has become an underlying assumption, almost factual, to any plan or theory of action.[5] Yet, the emergence and proliferation of offensive missile threats and drones; as well as, a resurgence of potential air-to-air combat are challenging this assumption. Today, nearly thirty countries possess ballistic missiles and numerous countries are developing various ground-, sea-, and air-launched cruise missile systems.[6] Similarly, more than thirty countries have or are developing armed drones and more than ninety countries have unarmed drones.[7]

In addition, as the Joint Force shifts training and preparation activities from counterinsurgency operations to large-scale combat operations, a more traditional adversary with conventional force structures is becoming the focus. Future conflict is likely to involve adversaries with fixed and rotary wing threats which introduces elements unfamiliar in the current operational environments within Iraq and Afghanistan. In 2017 Brigadier General Randall McIntire, then the US Army Air Defense Artillery School Commandant, wrote that attack helicopters are the greatest threat to ground forces due to standoff distances, electronic warfare capabilities, and a small radar signature.[8] General McIntire's comments reinforce the US Department of Defense's concern about maneuver forces being ill-equipped to handle the range of aerial threats present in today's environment.

---

[5] Everett C. Dolman, *Pure Strategy: Power and Principle in the Space and Information Age* (London: Frank Cass, 2005), 38.

[6] Lieutenant General James H. Dickinson, *Statement Before the Subcommittee on Strategic Forces Committee on Armed Services United States Senate: Fiscal Year 2020 Authorization Request for Missile Defense* (Washington, DC: Government Printing Office, 2019), 3, accessed September 22, 2019, https://www.armed-services.senate.gov/imo/media/doc/Dickinson_04-03-19.pdf.

[7] Elisa C. Ewers et al., *Drone Proliferation: Policy Choices for the Trump Administration* (Washington, DC: Center for a New American Security, 2017), 4, accessed December 31, 2019, http://drones.cnas.org/reports/drone-proliferation/.

[8] Brigadier General Randall McIntire, "The Return of Army Short-Range Air Defense in a Changing Environment," *Fires* (November-December 2017): 5, accessed October 30, 2019, https://sill-www.army.mil/firesbulletin/archives/2017/nov-dec/nov-dec.pdf.

Each threat presents problems to the Joint Force in terms of gaining access to an area of operations and establishing air superiority for freedom of maneuver and freedom of action. A changing threat landscape with new methods of employment for offensive means, as well as longer distances of employment are disrupting the traditional model of service-based solutions. As the operational environment continues to evolve and traditional and emergent aerial threats continue to challenge the assumption of air superiority, what is the impact on the US Army's current approach to air and missile defense as part of the Joint Force? The US Army will have to create new solutions as part of the Joint Force approach to address air and missile defense problems within the anticipated operational environment.

To test this hypothesis, this monograph examines the strategic environment and the effect from the proliferation of air and missile threats. After establishing a better understanding of the current problem for accessing operational areas, this monograph reviews the current approach to air and missile defense. Subsequently, an assessment of the anticipated operating environment provides the foundation for analyzing the current approach's effectiveness in future conflicts. The first section defines the current operational environment's problem, addressing the threats and how threats are challenging US air superiority in any given theater of operation. The second section analyzes the US Army's current approach to air and missile defense against the established threat and operational environment from the first section. The third section describes the anticipated operational environment and discusses if the current approach will suffice to mitigate threats in future conflicts. Finally, the last section analyzes if the Joint Force, specifically the US Army, requires a new approach to remain relevant against emerging threats or if the current approach is sufficient. Examples and case studies provide support in each section.

Section I: Challenges in the Current Operational Environment

> Current global trends indicate ballistic and cruise missiles are becoming more capable, due in part to the proliferation of advanced technologies, resulting in systems with global reach, increasing speed, and greater accuracy.
>
> —Lieutenant General James H. Dickinson, April 2019

US adversaries have created non-permissive, contested environments which challenge the post-Cold War normal model of US force projection and operational strategies by denying immediate air superiority. Prior to the end of the Cold War, US Army Corps were stationed across a wide range of locations to include Europe and Japan. These forces were meant to serve as the contact, blunt, and surge forces before the arrival of reinforcements. Yet, today there are no Corps overseas and active duty end strength has fallen from nearly 800,000 to 420,000 soldiers since the collapse of the Soviet Union.[9]

Prior to 1991, any US concept of anti-access or area denial strategies were likely to only affect reinforcement operations as significant combat power and combat enablers were already in theater prior to a conflict starting.[10] In spite of that, over the last eighteen years while the United States has reduced forces stationed overseas, adversaries have developed alternative methods to deny the United States access to regions and disrupt freedom of maneuver and action within contested spaces. Additionally, access to information and the transfer of advanced missile system capabilities continue to thwart US nonproliferation goals.[11] Further, the rise of long-range

---

[9] Vincent H. Demma, *Department of the Army Historical Summary, Fiscal Year 1989*, ed. Susan Carroll (Washington, DC: Army Center of Military History, 1989), 109, accessed January 5, 2020, https://history.army.mil/books/DAHSUM/1989/Index.htm.

[10] Timothy M. Bonds et al., *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defending Aggression?* (Santa Monica, CA: RAND Corporation, 2017), 1, accessed September 22, 2019, www.rand.org/t/RR1820.

[11] US Department of Defense, Missile Defense Agency, *2019 Missile Defense Review* (Washington, DC: Government Printing Office, 2019), VIII.

precision strike systems coupled with multi-tier air defense systems have enhanced the layered anti-access and area denial threats.

As previously noted, the United States has achieved and maintained air superiority in every major US conflict since the Korean War. Furthermore, recent US adversaries have been less than capable with regards to air and missile threats to US operations. During Operations Desert Shield and Desert Storm, US and allied forces were able to build combat power overseas in relatively uncontested areas.[12] Approximately twenty years later the United States would follow a similar method in preparation for Operations Enduring Freedom and Iraqi Freedom into Afghanistan and Iraq, respectively. There was little to no need for a robust air defense approach to protect the build-up of combat power.

For each conflict, air superiority was achieved as a consequence of effective air power and air defense. Air power consists primarily of offensive operations using manned and unmanned aircraft to control or dominate the air domain. Manned aircraft include bombers, fighters, and helicopters; while unmanned aircraft are either high-flying, large, and fast or low, slow and small unmanned aerial systems.[13] On the other hand, air defense consists primarily of defensive operations using ground-based sensor and firing units to contest air threats. Together, air power and air defense aim to create conditions where the Joint Force can gain access into areas of operations with the freedom of movement and action necessary to obtain the military objective. While this approach sounds integrated and interoperable, each service executes their strategy often independent of the other services. To further expand on the current problem, this section addresses the effects of maintaining an expeditionary force, the proliferation and emergence of air and missile threats, and the impact to the underlying assumption of air superiority for any conflict.

[12] Bonds et al., *Land-based, Multi-Domain*, x.

[13] US Joint Staff, JP 3-01 (2018), I-2.

Expeditionary Force Versus Overseas Garrison

The United States uses overseas military bases and ally or partner nation locations, where no US installation is present, to set conditions for unopposed deployment operations. Overseas basing postures US military forces to support the execution of the US defense strategy. Benefits include quicker operational responsiveness from crisis response to large-scale combat operations, deterrence of adversaries and assurance to allies, and additional forces to participate in security cooperation activities. On the flip side, overseas basing also poses risks to include vulnerability to attack from state and non-state actors, political risk since overseas basing in peacetime conditions could appear as an occupation or US imperialism, and diplomatic risk as the selection of any given location over another messages a preference between US allies and partners.

Since the end of the Cold War, overseas garrisons for US forces have shrunk in terms of the number of locations, the size of remaining installations, and the number of personnel occupying each installation. This analysis does not include contingency bases and focuses on enduring bases. Contingency bases are generally meant for temporary use and last less than five years; whereas, enduring bases are those locations such as a main operating base, forward operating site, or cooperative security location which provide strategic access and use to support US security interests for the foreseeable future.[14] Examples of enduring locations include Ramstein Air Force Base in Germany, Camp Humphreys in South Korea, and Camp Butler in Japan. In 1991, there were approximately 1,600 US bases abroad compared to approximately 500

[14] US Department of Defense, Joint Staff, Joint Publication (JP) 4-04, *Contingency Basing* (Washington, DC: Government Printing Office, 2019), GL-4.

bases in 2016.[15] Subsequently, active duty US military personnel in garrison bases overseas went from almost 600,000 to approximately 200,000 military personnel from 1991 to 2016.[16]

In reducing overseas garrisons, the United States has also reduced the type of capabilities pre-positioned for deterrence or response. For example, since 1990 the US Army removed over 5,000 tanks from Germany until there were none left in country by 2014.[17] Equally, the fall of the Soviet Union meant that the explicit air threat to US forces in Europe also fell. As a result, US air defense assets were completely removed from Germany with the inactivation of the 32nd Army Air Defense Command in 1995.[18] To address the need for air defense overseas, the US Army activated the 32nd Army Air and Missile Defense Command (AAMDC) in 1998 at Fort Bliss. This organization would serve as the deployable air defense unit with any joint expeditionary force.[19] Yet, by removing air defense from overseas locations such as Europe, the United States effectively removed the ability to protect from within the limits of an adversary's anti-access strategy.

Recognizing the gap in air defense, at least in Germany, the United States activated the 10th AAMDC in 2011. Today, there is one Patriot battalion, one air defense brigade, two missile defense batteries, and one short-range air defense battalion stationed in Germany. While these units provide the first level of force protection to critical assets in the European theater from

---

[15] David Vine, "The United States Probably Has More Foreign Military Bases Than Any Other People, Nation, or Empire in History," *The Nation*, September 14, 2015, accessed January 11, 2020, https://www.thenation.com/article/the-united-states-probably-has-more-foreign-military-bases-than-any-other-people-nation-or-empire-in-history/; and US Department of Defense, *Base Structure Report – Fiscal Year 2017 Baseline* (Washington, DC: Government Printing Office, 2017), 7, accessed January 11, 2020, https://www.acq.osd.mil/eie/Downloads/BSI/Base%20Structure%20Report%20FY17.pdf.

[16] Michael J. Lostumbo et al., *Overseas Basing of U.S. Military Forces: An Assessment of Relative Costs and Strategic Benefits* (Santa Monica, CA: RAND Corporation, 2013), 8, accessed January 11, 2020, https://www.rand.org/pubs/research_reports/RR201.html.

[17] Scott Boston et al., *Assessing the Conventional Force Imbalance in Europe: Implications for Countering Russian Local Superiority* (Santa Monica, CA: RAND Corporation, 2018), 6, accessed January 18, 2020, https://www.rand.org/pubs/research_reports/RR2402.html.

[18] John A. Hamilton, *Blazing Skies: Air Defense Artillery on Fort Bliss, Texas, 1949-2009* (Washington, DC: Government Printing Office, 2009), 314.

[19] Hamilton, *Blazing Skies*, 315.

within, there are still too few resources to completely defeat an anti-access strategy within the region. While maintaining an expeditionary force can provide cost savings, the question remains at what cost will this ultimately impact the ability of US forces to support national defense strategies abroad and quell conflict prior to escalating to an all-out war?

Meanwhile, other regional actors such as Russia and China continue to expand their spheres of influence, resulting in an increasing trend of decreasing support for US bases overseas. Moreover, even where international support exists, domestic politics are unlikely to be supportive for additional force deployment whether for conflict response or pre-emptive posturing. In a study conducted last year, Pew Research Center found that sixty-two percent of US Americans say the wars in Iraq and Afghanistan are not worth it.[20] Additionally, Charles Koch Institute recently updated results from a survey asking if the US military should be more or less involved globally, finding that forty-three percent believe the United States should be less involved while only twelve percent believe the United States should be more involved.[21] As the evidence suggests, the US public does not favor an increase in global involvement and therefore supports a continuation of an expeditionary force model. As such, US military forces must prepare to deploy into contested environments where air defense capabilities are not present or are present in limited quantities. Deploying units compounds the issue of air defense planners attempting to employ limited assets against competing requirements between personnel and critical assets. Thus, the air defense capabilities will be unable to protect all US forces projecting into a theater of operations and all critical assets in a given operational environment.

[20] Ruth Igielnik and Kim Parker, "Majorities of U.S. veterans, public say the wars in Iraq and Afghanistan were not worth fighting," *Pew Research Center*, July 10, 2019, accessed February 14, 2020, https://www.pewresearch.org/fact-tank/2019/07/10/majorities-of-u-s-veterans-public-say-the-wars-in-iraq-and-afghanistan-were-not-worth-fighting/.

[21] Charles Koch Institute, "Seventeen Years On, Americans–Including Veterans–Want Out of Afghanistan," January 23, 2020, accessed February 14, 2020, https://www.charleskochinstitute.org/news/afghanistan-17-anniversary-poll/.

Anti-Access and Area Denial Threats

The military defines anti-access as the action, activity, or capability designed to prevent an advancing enemy force from entering usually by way of long-range systems; complementary to anti-access, area denial is designed to limit an enemy force's freedom of action using short-range systems.[22] Although anti-access and area denial are not new concepts, the proliferation of air and missile threats directly impacts the ability of future US forces to project into operational areas.[23] Missile threats have become far more advanced than the missile threats of the 1990s. Advancements in technologies have resulted in ballistic and cruise missile systems with global reach, greater accuracy, and advanced countermeasures.[24] Additionally, with the shift in the military operating model from overseas garrisons to expeditionary forces, the United States has created the challenge of defeating an anti-access strategy from the outside rather than from within. Growing inventories of ballistic missiles, cruise missiles, and drones create anti-access problems for which the Joint Force is currently unable to fully address. Furthermore, fixed and rotary wing assets coupled with missile and drone threats expand the adversaries' area denial capabilities.

JP 3-01 defines a ballistic missile as "any missile that does not rely upon aerodynamic surfaces to produce lift and follows a ballistic trajectory when thrust is terminated."[25] In other words, once the fuel that propels the missile burns up, the missile will keep moving in the same direction and can't be altered via additional guidance systems. Alternatively, JP 3-01 defines a guided missile as "an unmanned vehicle moving above the surface of the Earth whose trajectory

---

[22] US Department of Defense, *DOD Dictionary of Military and Associated Terms* (Washington, DC: Government Printing Office, 2019), 18, accessed January 18, 2020, https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf.

[23] US Department of Defense, *Joint Operational Access Concept, Version 1* (Washington, DC: Government Printing Office, 2012), ii.

[24] Dickinson, *Authorization Request for Missile Defense*, 3.

[25] US Joint Staff, JP 3-01 (2018), ix.

or flight path is capable of being altered by an external or internal mechanism."[26] While the missile threat to the continental United States is low and improbable, US forces abroad are more vulnerable to attacks. The United States has invested heavily in homeland missile defense at the expense of regional, deployable, and highly mobile defense systems. The limited air defense resources available to expeditionary forces is insufficient to cover the demand presented globally by state and non-state actors. As demonstrated by the Iranian missile attack on January 10, 2020, US forces were unable to conduct defensive counterair operations to destroy or reduce the effectiveness of the ballistic missile threats because there were no ground-based air defense platforms present.

Ballistic missiles continue to pose significant threats to US forces abroad, especially given the ability to carry nuclear warheads and advancements in decoy and jamming operations. Regional actors such as Russia, China, Iran, and North Korea all possess ballistic missiles that continue to threaten US forces, allies, and partners. The concern is no longer regionally contained. Adversaries can strike long-range targets external to their borders with greater accuracy than historically demonstrated through previous conflict. As well, with global trends of increasing capability and affordability, many unknown state and non-state actors have acquired ballistic and cruise missile systems. Figure 1 illustrates the major state and non-state actors who possess offensive missile capabilities around the world as of 2018.

[26] US Joint Staff, JP 3-01 (2018), GL-11.

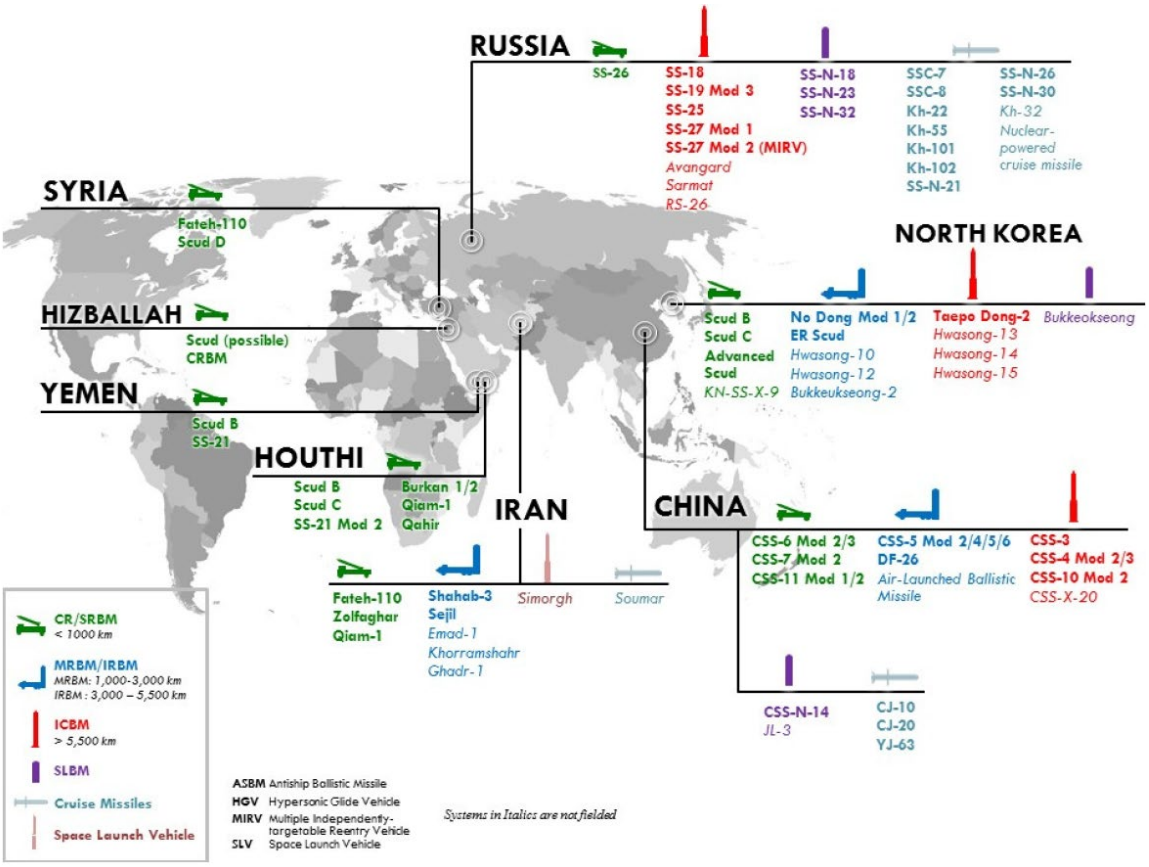

Figure 1. Offensive Missile Capabilities. Data from US Department of Defense, Missile Defense Agency, *2019 Missile Defense Review* (Washington, DC: Government Printing Office, 2019), 7.

While ballistic missiles continue to present an aerial threat to forces abroad, evidence suggests that cruise missiles pose a greater threat due to their high speed, low altitude, terrain following flight paths and difficulty in detection.[27] Unlike ballistic missiles, cruise missiles generally fly a flat trajectory and are guided by radar or satellite systems to the intended target. Additionally, the United States has primarily focused on ballistic missile defense vice cruise missile defense, inherently creating an opportunity for adversary exploitation both to the homeland and abroad.[28]

[27] Michael J. Predny, "The US Army and the Emergence of Unmanned Threats" (Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2016), 1, accessed October 28, 2019, https://apps.dtic.mil/docs/citations/AD1022201.

[28] Thomas G. Mahnken, *The Cruise Missile Challenge* (Washington, DC: Center for Budgetary Assessments, 2005), 5.

The United States used cruise missiles during the 1991 Persian Gulf War demonstrating their destructive power precision. The results were illuminating with destruction taking place in a short period of time. A traditional air campaign would have taken hundreds of sorties to accomplish what the precision strike campaign accomplished: forty-one of fifty-four key Iraqi bridges and thirty-one hasty pontoon bridges destroyed in less than four weeks.[29] Subsequently, during the early months of the US-led invasion into Iraq, the Iraqi military fired cruise missiles towards Camp Commando, the US Marine Corps headquarters in Kuwait.[30] This marked the first time cruise missiles were used against US ground forces and demonstrated a lack of US countering capability. For this reason, missile defense planners assume adversaries will use cruise missiles as a "poor man's air force" to maximize the probability of penetrating US missile defense capabilities.[31] Cruise missiles are relatively cheap alternatives, that are harder to detect, track, and intercept in comparison to fixed and rotary wing aircraft.

Since World War I, aircraft have been used in conflict to deny ground forces freedom of maneuver and freedom of action. Since the Korean War, the US Air Force has dominated command of the air, thus affording ground forces the ability to operate free from fear of an aerial attack via fixed or rotary wing aircraft.[32] Yet, the reemergence of great power competition is bringing the idea of a conventional air threat back to the forefront of military problems. Fixed-wing and rotary wing aircraft provide offensive capabilities from extended ranges and a wide variety of platforms. Fixed-wing aircraft covers systems commonly classified as fighter, strike, ground-attack, bombers, and transport aircraft. Similarly, rotary wing aircraft covers systems that

---

[29] US Department of Defense, *Conduct of the Persian Gulf War: Final Report to Congress* (Washington, DC: Government Printing Office, 1992), 189, 211.

[30] Dennis M. Gormley, "Missile Defence Myopia: Lessons from the Iraq War," *Survival* 45, no. 4 (Winter, 2003): 62, accessed January 14, 2020, ProQuest Ebrary.

[31] Michael R. Gordon, "A Poor Man's Air Force," *New York Times*, June 19, 2013, accessed January 4, 2020, https://www.nytimes.com/2003/06/19/international/middleeast/a-poor-mans-air-force.html.

[32] Dolman, *Pure Strategy*, 38.

are classified as light, attack, transport, and reconnaissance. Most fixed-wing strike aircraft have a range of 2,000 to 3,000 kilometers and attack helicopters have a range of 500 to 900 kilometers; as well, both systems can carry a variety of armament to include bombs, rockets, and missiles.[33] To this end, maneuver forces are at risk any time the air domain is ceded to the enemy due in part to the lack of maneuver short-range air defense assets available to the force.

The Challenge of Air Superiority

> If we lose the war in the air, we lose the war and we lose it quickly.
>
> —Field Marshal the Viscount Bernard Montgomery

Air superiority in conflict remains one of the most critical factors to success and often determines the victor from the defeated. As airpower theorist retired US Air Force Colonel John A. Warden III once explained, "no country has won a war in the face of enemy air superiority."[34] Put differently, without air superiority an offense cannot succeed nor can a defense sustain itself against an adversary with air superiority. The US military has enjoyed air superiority for decades. The last time a US soldier was killed from an enemy air attack occurred during the Korean War in 1953.[35] Air superiority is achieved in concert between air attack operations and air defense operations to destroy the adversary's aircraft. Air superiority underpins the US way of war as demonstrated in doctrine, exercises, and real-world application in every major conflict since the development of AirLand Battle. As a result, many countries have enhanced air defense architectures creating an integrated air defense system (IADS). Countries are now purchasing longer-range missile systems with more capability to deny access, enhancing radar and

[33] US Army, Training and Doctrine Command (TRADOC), *Worldwide Equipment Guide, Volume 2: Air and Air Defense Systems* (Fort Leavenworth, KS: G-2 ACE, Threats Integration, 2016), 1, 15.

[34] John A. Warden III, *The Air Campaign: Planning for Combat* (Washington, DC: National Defense University Press, 1988), 13.

[35] Peter Grier, "April 15, 1953," *Air Force Magazine* 94, no. 6 (June 2011), accessed January 18, 2020, https://www.airforcemag.com/article/0611april/.

communications equipment, and acquiring more tactical air defense systems to contest US dominance in the air domain.

In spite of this, the United States remains dominant in air-to-air capabilities at this time; however, adversaries such as Russia and China have upgraded capabilities, actively demonstrating them for the world to see. In 2019, Russia and China conducted a joint air exercise of long-range aerial patrols in the Indo-Pacific region.[36] Additionally, the *National Interest* recently published an article ranking Russia and China as the second and third most deadly air forces in the world, with the United States ranked first.[37] Nevertheless, according to Air Force Chief of Staff General Goldfein, the US Air Force faces a crisis in maintaining the ability to dominate the air domain.[38] Challenges to achieving air superiority stem from shortages in manpower, aging equipment, budgetary constraints, and active air campaigns in Syria, Iraq, and Afghanistan and deterrence missions in North Korea and China.[39]

Summary

Overseas bases have long served to present a posture for contingency response, deterrence of potential adversaries, assurance to allies and partner nations, and security cooperation efforts. Likewise, overseas forces provide strategic benefits to combatant commanders with forces able to respond quickly to a range of conflicts from crisis action to large-scale combat operations. During the Cold War, overseas basing in Europe served to prevent initial

---

[36] Franz-Stefan Gady, "China, Russia Conduct First Ever Joint Strategic Bomber Patrol Flights in Indo-Pacific Region," *Diplomat*, July 23, 2019, accessed January 9, 2020, https://thediplomat.com/2019/07/china-russia-conduct-first-ever-joint-strategic-bomber-patrol-flights-in-indo-pacific-region/.

[37] Kyle Mizokami, "These are the Deadliest Air Forces Across the Entire Globe," *National Interest*, September 5, 2019, accessed January 17, 2020, https://nationalinterest.org/blog/buzz/these-are-deadliest-air-forces-across-entire-globe-78166.

[38] US Department of Defense, *Transcript of Press Briefing by Secretary James and Gen. Goldfein on the State of the Air Force in the Pentagon Briefing Room*, August 10, 2016, accessed January 17, 2020, https://www.defense.gov/Newsroom/Transcripts/Transcript/Article/911083/department-of-defense-press-briefing-by-secretary-james-and-gen-goldfein-on-the/.

[39] Alex Locke, "Air Superiority is Not an American Birthright," *Business Insider*, August 11, 2016, accessed October 30, 2019, https://www.businessinsider.com/us-air-superiority-in-crisis-2016-8.

setbacks or defeat by major threats until reinforcements could arrive to help achieve military objectives. Still, the United States transitioned to an expeditionary force capable of deploying anywhere in the world. Aerial threats have always been present in conflict; the shift to an expeditionary force has created opportunities for adversaries to expand their anti-access and area denial strategies. Furthermore, the proliferation of technologies associated with aerial threats continues to shrink the characteristic advantages of US weapon systems over developing adversaries. Accordingly, air superiority is no longer certain and without it, all military operations will be at increased risk. Consequently, the aerial challenges present in today's operational environment limit the United States' pursuit of strategic objectives and ability to uphold global security commitments.

Section II: Meeting the Challenges of the Current Operational Environment

As demonstrated in the previous section, air superiority throughout a campaign can never be wholly guaranteed. The spread of missiles, drones, aircraft and other aerial threats throughout the strategic environment paired against limited resources creates a continual disparity between measures and countermeasures. Nevertheless, military planners establish operational approaches to achieve desired results through the creation of combined arms effects to exploit the resultant advantage. As part of this, the current air and missile defense approach focuses on developing and fielding capabilities for protection of critical assets and maneuver forces abroad in coordination with allies and partners to strengthen deterrence architectures from regional missile threats.[40]

Countering regional missile threats is predicated on a strategic environment where the United States can build combat power in uncontested space and requires cooperation with allies and partners. Additionally, air and missile defense is based on a multi-layered defense concept using a diverse arrangement of platforms to protect against a variety of aerial threats. That is,

[40] US Department of Defense, Missile Defense Agency, *2010 Ballistic Missile Defense Review Report* (Washington, DC: Government Printing Office, 2010), iv-v.

most air defense platforms are built to protect against a specific type of threat and are unable to protect against aerial threats outside of the specifications for that particular system.

Defending Against the Aerial Threat

The US military uses a variety of ground-, air-, and sea-launched interceptors, aircraft, radars, satellites, and command, control, and communications equipment to defend against aerial threats. Currently, US forces protect critical assets by employing air defense systems, procedures, and tactics from the US Army, US Navy, US Marine Corps, and US Air Force. While each service provides some capability to the overall system, the US Army is the primary service responsible for protecting the maneuver force using ground-based interceptors and radar systems in static and mobile configurations.

The importance of both static and maneuver air defense was demonstrated during the Arab-Israeli Wars in 1967 and 1973.[41] In 1967, often referred to as the Six Days War, Israeli forces overwhelmed the Egyptians, taking control of the Golan Heights and destroying much of the Egyptian air force through successive air raids.[42] Egypt had air defense assets and Jordanian radar operators attempted to notify the Egyptians of incoming aircraft; but, on the day of the attack, Egyptian military leaders were conducting inspections and had instructed all antiaircraft guns not to fire at any aircraft.[43] While the Six Day War was a huge victory for Israel, it also served to provide Egypt with a vast array of lessons to be learned for which they rectified in 1973. In October 1973, in what was known as the Yom Kippur War, Egypt launched a massive attack across the Suez Canal. Using combined arms maneuver in coordination with mobile air defense assets, Egyptian forces were able to thwart Israeli air threats, continue the ground attack,

[41] Hamilton, *Blazing Skies*, 240.

[42] Williamson A. Murray and Geoffrey Parker, "The Post-War World," in *The Cambridge History of Warfare*, ed. Geoffrey Parker (Cambridge: Cambridge University Press, 2005), 386.

[43] Michael Peck, "How Israel's Air Force Won the Six-Day War in Six Hours," *National Interest*, June 2, 2017, accessed January 14, 2020, https://nationalinterest.org/blog/the-buzz/how-israels-air-force-won-the-six-day-war-six-hours-20980.

and ultimately achieve the political objective of retaking the Sinai, and garnering more US political support.[44]

As a result of international events in the 1960s and 1970s, such as the Six Day War and the Yom Kippur War, the United States re-evaluated the military approach to operations, creating AirLand Battle. AirLand Battle concept emphasized the complementary efforts of maneuver forces in concert with air forces to achieve operational and strategic objectives.[45] For air defense specifically, this meant developing doctrine and platforms to enable the maneuver force while protecting them from air threats and maintaining close coordination of air-ground operations. Consequently, Patriot and Avenger ground-based air defense systems were developed as anti-aircraft systems to protect the maneuver force. However, after the 1991 Persian Gulf War the aircraft threat towards US forces diminished while the missile threat increased, as is supported through present day with operational experience in the Middle East. Subsequently, for the last twenty-five years the US Army invested in missile defense focusing on Patriot system upgrades and developing Terminal High Altitude Area Defense (THAAD) for future operating environments. As well, the US Army continued to address current operational environment threats such as rockets, artillery, and mortars creating the Counter-Rocket, Artillery, and Mortar (C-RAM) system from a joint urgent operational needs statement.

Within the US Army today, there are four main ground-based air defense interceptor systems in operation to address the variety of aerial threats: THAAD, Patriot, Avenger, and C-RAM. THAAD serves to protect against ballistic missile threats providing upper-tier, layered defense against short-, medium-, and intercontinental-range ballistic missiles.[46] Traditionally,

---

[44] George W. Gawrych, *The 1973 Arab-Israeli War: The Albatross Of Decisive Victory*, illustrated ed. (Auckland, New Zealand: Pickle Partners Publishing, 2015), 79.

[45] John L. Romjue, *From Active Defense to AirLand Battle: The Development of Army Doctrine, 1973-1982* (Fort Monroe, VA: Historical Office, US Army Training and Doctrine Command, 1984), 55-57.

[46] US Army, 32d Army Air and Missile Defense Command, *AMD Systems Smart Book* (Fort Bliss, TX, 32d AAMDC Headquarters, 2007), 10.

THAAD protects theater and corps commander's assets using a static, area defense tactic. Patriot serves to protect against short- and medium-range ballistic missiles, cruise missiles, larger unmanned aerial systems, and fixed-wing and rotary wing aircraft.[47] Much like THAAD, Patriot systems defend theater and corps critical assets using a static, area defense tactic; however, Patriot systems can move throughout the battlefield more easily than a THAAD system. Avenger and C-RAM are commonly referred to as Short Range Air Defense (SHORAD) weapon systems and are employed specifically in support of the maneuver force. Avenger fire units are highly mobile and provide low altitude air defense protection against cruise missiles, unmanned aircraft systems (UAS), and fixed-wing and rotary wing aircraft.[48] Additionally, the Stinger missile fired from the Avenger can be dismounted and used in a shoulder-fired configuration called Man-Portable Air Defense System (MANPADS). Both Avengers and MANPADS weapons can be used in a point or area defense method. C-RAM provides a point defense of critical assets and personnel located on forward operating bases from indirect fire associated with rockets, artillery, and mortars.[49] While C-RAM is considered to be a SHORAD system and can move into a position, it cannot provide air defense on the move and requires stationary emplacement to be effective. As such, this leaves only the Avenger weapon system, or MANPADS configuration with the Stinger missile, as the single air defense platform capable of shoot-on-the-move against an aerial target and to maneuver with ground forces throughout an area of operations.

THAAD, Patriot, Avenger, and C-RAM air defense systems each provide independent protection against a specific threat type. In other words, each system in and of itself is only capable of defending against a specific aerial threat at a specific altitude, or tier of space, within the parameters of the given software and interceptor capabilities. As well, each system relies on independent command and control structures, sensor feeds, and unique data-language between

[47] 32d AAMDC, *AMD Systems Smart Book*, 4.

[48] Ibid., 8.

[49] Ibid., 14.

sensor, command and control elements, and the ground-based air defense platform. Essentially, each air defense platform and the associated equipment is a stand-alone package with minimal interoperability and integration across US Army systems. That being said, there is some integration built into the Patriot Information Coordination Central (ICC), a data processing and communications center that assists with engagement decisions. Through the ICC it is possible to incorporate THAAD and Avenger weapons systems under a single command and control center. However, the technical expertise and institutional knowledge to achieve the required communications network architecture at the tactical level has been lost over the last two decades. Additionally, the integration and subsequent engagement decisions are still accomplished through system specific radar feeds and platforms. That is, US Army air defense platforms lack horizontal integration to leverage current capabilities and increase lethality through technical solutions using any sensor, any shooter.

Undoubtedly, much of this problem is a result of defense contractors and manufacturers protecting intellectual property. According to a study by the Institute for Defense Analyses, intellectual property encompasses patents, copyrights, trademarks, and trade secrets.[50] Defense contractors and manufacturers seek to protect their intellectual property because it is what gives them a competitive advantage over the competition. For example, Raytheon holds the majority of requirements for Patriot to include the development and production of the weapon system, while Lockheed Martin is the prime contractor responsible for the production of the fire control system and the Patriot Advance Capability (PAC)-3/Missile Segment Enhancement (MSE) upgrades. Competing government contractors use different technical language, algorithms, and programming which creates an interoperability issue both internal to an air defense platform and with other platforms. Therefore, to achieve complete protection from the array of aerial threats

[50] Richard Atta et al., *Department of Defense Access to Intellectual Property for Weapons Systems Sustainment* (Alexandria, VA: Institute for Defense Analyses, 2017), iii, accessed March 1, 2020, https://apps.dtic.mil/dtic/tr/fulltext/u2/1038450.pdf.

present in any given operational environment, all four major ground-based air defense assets and their associated equipment must be employed in the same area of operations. Yet, there are not enough systems for all four ground-based air defense asset types to be present in the same area of operations, with sufficient quantity to create a layered defense design, and ultimately provide complete protection from all aerial threats. Therefore, the US Navy and US Air Force both provide assets to help counter aerial threats and provide additional capability to protect forces.

The US Navy primarily supports theater air defense using the AEGIS weapons system from a littoral approach extending offensive naval air defenses overland. There are currently eighty-seven multi-mission cruisers and destroyers with the AEGIS combat system.[51] The AEGIS combat system makes the ships capable of conducting anti-air, anti-surface, and anti-submarine operations against air and missile threats.[52] The primary purpose of the AEGIS combat system is for fleet protection. A ship operating in anti-air mode requires a second ship to operate in ballistic missile defense, as anti-air only targets fixed- and rotary-wing threats. Also, to extend air defense to forces other than the ship itself requires the ship to operate within a specified area to achieve an ability to intercept a missile threat.[53] Additionally, the naval air defense sensors extend situational awareness and early warning capability through tactical data link architectures.[54] Thus, naval air defense provides a mobile sea-based option to protect forces projecting into theater until ground-based air defense assets arrive that can move inland with maneuver units. Similarly, the US Air Force provides an air-based option to protect ground forces from air and missile threats.

---

[51] "AEGIS WEAPON SYSTEM," United States Navy Fact File, last updated January 10, 2019, accessed February 14, 2020, https://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=200&ct=2.

[52] Ibid.

[53] David B. Larter, "The US Navy is fed up with ballistic missile defense patrols," *Defense News*, June 16, 2018, accessed February 14, 2020, https://www.defensenews.com/naval/2018/06/16/the-us-navy-is-fed-up-with-ballistic-missile-defense-patrols/.

[54] "Multifunctional Information Distribution System (MIDS)," Products and Services, Collins Aerospace, accessed February 14, 2020, https://www.rockwellcollins.com/Products-and-Services/Defense/Communications/Tactical-Data-Links/Multifunctional-Information-Distribution-System.aspx.

The US Air Force contributes to air and missile defense through sense and warn, offensive counterair operations, preemptive strikes against adversarial missile systems on the ground, and close air support of maneuver units in action.[55] Of note, the US Navy can also provide aircraft to support offensive and defensive counterair operations; however, counterair is the primary function of the US Air Force during joint operations.[56] The US Air Force also serves as the lead service for integrating and disseminating an air picture which provides situational awareness and early warning to the Joint Force in a theater of operations. Also, assets such as the Airborne Warning and Control System (AWACS) and Theater Air Control System (TACS) further increase the operational reach of radios, sensors, and command and control systems used to conduct air battle management in a theater of operations.[57] There are currently thirty-one AWACS aircraft in the US Air Force's inventory, all of which integrate into the tactical data link architectures.[58] In addition, attack operations that seek to destroy adversarial air threats and missile capabilities while still on the ground requires a level of local air superiority which as stated before cannot always be guaranteed. Therefore, commanders are unlikely to conduct deep attack operations using manned aircraft without air superiority as a result of the associated risk to the pilot, the aircraft, and successful mission accomplishment.

While each service provides assets that can integrate into an air and missile defense plan for sense and warn operations, the assets are unable to communicate for inter-service intercept operations. Once again, service-specific systems and solutions lack vertical integration and are unable to communicate with sister-service platforms to leverage current capabilities and increase

[55] US Department of Defense, Air Land Sea Application Center, Multi-Service Tactics, Techniques, and Procedures (MTTP) Publication, *SCAR* (Washington, DC: Government Printing Office, 2018), 12, 28, accessed February 16, 2020, https://www.alsa.mil/mttps/scar/.

[56] JP 3-01, *Countering Air and Missile Threats,* xii.

[57] Ibid., II-5-6.

[58] "E-3 Sentry AWACS," U.S. Air Force Fact Sheet, last modified September 22, 2015, accessed February 16, 2020, https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104504/e-3-sentry-awacs/.

lethality through technical solutions. As before, the lack of vertical integration is one consequence of defense contractors protecting intellectual property to remain competitive within the defense industry. Additionally, assets capable of providing air and missile defense from the US' Army, Navy, and Air Force are considered low-density, high-demand assets. That is to say there are too few US assets to provide complete air defense coverage for every overseas location of importance to the US military. For that reason, leveraging ally and partner assets become critical in the current approach to defending against aerial threats.

Leveraging Ally and Partner Nations

The 2017 *National Security Strategy* states that "[a]llies and partners are a great strength of the United States[,]" adding to our military and intelligence capabilities, and that "[n]one of our adversaries have comparable coalitions."[59] The *NSS* also promotes a US forward military presence throughout the world to achieve influence over other actors in the strategic environment.[60] Rather than stationing units in overseas garrisons where they operate in isolation, US forces temporarily engage with ally and partner nations on a regular basis to achieve enduring effects. Hence, the United States participates in a number of training events, exercises, and initiatives globally, with various partners and allies, and with various international organizations such as the United Nations and the North Atlantic Treaty Organization (NATO). For example, US forces participate in NATO's enhanced forward presence operations leveraging US rotational forces with forces from Canada, Germany, Norway, Poland, and Slovenia among others to strengthen the deterrence and defense posture towards Russian aggression in the Baltic region.[61] In doing so, the United States is not only building relationships with partnering countries, they are

[59] Trump, *National Security Strategy*, 37.

[60] Ibid., 47.

[61] "Boosting NATO's presence in the east and southeast," North Atlantic Treaty Organization, last updated January 21, 2019, accessed January 23, 2020, https://www.nato.int/cps/en/natohq/topics_136388.htm.

posturing US forces within the Russian anti-access system. In this sense, the United States can project power in non-hostile ways and use power as a means of influence.

Eliot Cohen defines power as "the ability to get people to do things that they would not otherwise do."[62] The United States maintains a dominant position in the world order through power projection beyond just the military, incorporating diplomatic, informational, and economic efforts as well. Regardless, the 2017 *NSS* explicitly states that a forward military presence throughout the world is one way the United States achieves influence over other actors in the strategic environment.[63] For instance, in 2019 the United States deployed a THAAD air defense system to Israel as part of an exercise to demonstrate US-Israeli military ties and resolve against near and distant threats in the Middle East.[64] Utilizing exercises, training events, and operations such as NATO's enhanced forward presence allows the United States to penetrate adversarial anti-access strategies pre-conflict. In any case, it is unrealistic to assume the United States can and will deploy air defense assets into an area of operations pre-conflict or that cooperation is guaranteed. Therefore, it is important to ensure allies and partners already have the internal capacity and capability to defend against regional air and missile threats.

One way to build ally and partner capacity and capability is through foreign military sales. Foreign military sales allow for the United States to leverage ally and partner nations in combating anti-access strategies by selling air and missile defense equipment. According to the US State Department, the US government sells approximately forty-three billion dollars in defense equipment annually.[65] Specifically, the Defense Security Cooperation Agency,

---

[62] Eliot Cohen, *The Big Stick* (New York: Basic Books, 2016), 16.

[63] Trump, *National Security Strategy*, 47.

[64] Isabel Debre, "In first, US deploys THAAD anti-missile system in Israel," *Defense News*, March 4, 2019, accessed September 19, 2019, https://www.defensenews.com/land/2019/03/04/in-first-us-deploys-thaad-anti-missile-system-in-israel/.

[65] "U.S. Arms Sales and Defense Trade," Bureau of Political-Military Affairs, US State Department, last updated May 21, 2019, accessed February 16, 2020, https://www.state.gov/u-s-arms-sales-and-defense-trade/.

responsible for supervising the implementation and execution of sales, lists six countries including Germany, Japan, the Kingdom of Saudi Arabia, and the Republic of Korea who sought major arms sales in 2019 for missiles or air defense systems to complement existing infrastructure.[66] Moreover, selling US defense equipment not only signals US support for the recipient country, it can create an enduring relationship through training opportunities and upgrade requirements. Additionally, sales increase the ability of US forces to seamlessly integrate with recipient country military forces and equipment as familiarity and interoperability already exist. For instance, US air defense command and control systems can use cross-domain software solutions to expand protection by providing basic track data to allies and partners.

Summary

While the US Army focuses on ground-based air defense for both homeland defense and protection of maneuver forces in conflict, the US Navy and US Air Force also contribute to air and missile defense. However, each service has created service-based solutions to address air and missile defense. Even though sensor feeds and communications equipment allow for inter-Service sharing of an air picture, intercept platforms are unable to operate without the platform specific radar to track and transmit target data. The Joint Force has become stove-piped, lacking the integration and interoperability necessary across the force to achieve *Joint Combined Arms* as directed in the 2018 US *National Military Strategy*.[67] Additionally, services developed air defense platforms for specific threat types creating the need for a multi-layered defense design. As such, US Army air defense planners must ensure a mix of assets are incorporated in defense design planning. Furthermore, the low-density of air defense assets requires planners to determine

[66] "Major Arms Sales," Defense Security Cooperation Agency, accessed February 16, 2020, https://www.dsca.mil/major-arms-sales.

[67] US Department of Defense, Chairman Joint Chiefs of Staff, *Description of the National Military Strategy 2018* (Washington, DC: Government Printing Office, 2018), 2, accessed September 3, 2018, https://www.jcs.mil/Portals/36/Documents/Publications/UNCLASS_2018_National_Military_Strategy_Description.pdf.

early where to deploy air defense assets using threat assessments and prioritization frameworks. Generally speaking, from the US Army perspective, only Patriot and THAAD assets are pre-positioned in an operational status globally under a pre-conflict environment. Once the environment shifts from pre-conflict to conflict, then all Joint Force assets in a theater are deployed to the area of operations. Ideally, assets will already be within the area covered by an adversary's anti-access strategy. One way to ensure assets are present whether US owned or not is through foreign military sales. Foreign military sales support the advancement of US national security interests abroad by helping to build ally and partner capacity and capability. For this reason, the United States must leverage ally and partner capabilities through equipment sales, training and exercises, and alliances. Even still, as previously mentioned, air defense assets are too few to be everywhere and are unlikely to provide the necessary level of air defense required initially. Hence, a description of the evolving operational environment and identification of future threats will help guide modernization efforts for the air and missile defense community.

Section III: Anticipating the Future

> The future operating environment is characterized by increasingly complex threats, sustained operational tempo, limited resources, and the ability of great power competitors to contest US forces in all domains.
>
> —*Air and Missile Defense Vision 2028*

Uncertainty in the future operational environment is a given in that the operational environment is an open system with emergent properties.[68] There is no way to accurately predict the future; however, planners and strategists alike can anticipate the future by understanding emerging trends and applying models to help interpret information. For example, the model from Peter Schwartz, a leading futurist, uses multisource-information gathering to identify driving

[68] Robert Jervis, *System Effects: Complexity in Political and Social Life* (Princeton: Princeton University Press, 1998), 28.

forces and predetermined elements to create scenarios to perceive futures in the present.[69] While approaches such as the Schwartz model have strengths for forecasting, there is always the chance of being wrong. As German Army Colonel Jürgen Prandtner notes, analysts could be wrong when predicting the future which could have grave implications in creating a balanced force.[70] With that in mind, the Joint Force attempts to look ahead using creative, rigorous, and credible ways to describe the future security environment thereby driving change across the force to better prepare for future conflict.[71]

For the Joint Force, many organizations and documents provide insight into the strategic context shaping the future to include studies from the Asymmetric Warfare Group, the Research and Development Corporation, and the US National Intelligence Council's *Global Trends* project. Consequently, the Joint Force developed and published the *Joint Operating Environment 2035* "to support and accelerate our future strategy and force planning activities across the Joint Force."[72] Consistent across these organizations and publications is the opinion that Russia will continue to be the United States' pacing threat with improvements to their air force, precision targeting capabilities, and air defense systems. However, China and North Korea increasingly escalate in threat as they also modernize their armed forces creating offensive capabilities under the guise of defensive posturing. Additionally, rising competitors will acquire capabilities quickly by exploiting the globally connected information environment through cyber espionage and

---

[69] Peter Schwartz, *The Art of the Long View: Planning for the Future in an Uncertain World* (New York: Crown Business, 1996), 36, 105, 111-112.

[70] Jürgen Prandtner, "Uncertainty: The Forgotten Factor in Joint Planning" (Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2019), 17 and 36, accessed November 19, 2019, Combined Arms Research Library Digital Library.

[71] US Department of Defense, Joint Staff, *Joint Operating Environment (JOE) 2035: The Joint Force in a Contested and Disordered World* (Washington, DC: Government Printing Office, 2016), 52.

[72] Ibid., 1.

intellectual property theft. Thus, the next fifteen to twenty years will see the emergence of a multi-polar world with regards to military power as a result of power transitions and diffusions.[73]

What Tomorrow Looks Like Today

A general trend analysis of the last one hundred years demonstrates how political, economic, informational and cultural systems have become more complex and interconnected.[74] Since 1920 the world experienced the Second World War, the creation of the United Nations and NATO, the emergence of global markets, the spread of cultures through immigration, and the birth of the Information Age. Change will continue to create challenges and opportunities for all actors in the global strategic environment. Moreover, warfare in the future will increase in scale, domains, and classes of actors while decision cycles and reaction times will compress.[75] Major trends anticipated to affect the future operational environment include changes in world order, shifting demographics, and advancements in science, technology, and engineering.[76]

As John Ikenberry, a theorist of international relations, posits: "if the past is a guide, American primacy should produce resistance and counterbalancing."[77] After nearly seventy-five years of leading the world order, the United States is facing challenges from rising powers, shifting strategic relationships, and the evolving roles of international organizations.[78] Rising powers will continue to challenge the global world order as competitors seek to assert themselves both regionally and globally. For example, Russia continues to display the capability to intervene

---

[73] Joseph Nye, *The Future of Power* (New York: Public Affairs, 2011), xv.

[74] US Army, TRADOC Pamphlet 525-3-1, *The U.S. Army in Multi-domain Operations 2028* (Washington, DC: Government Printing Office, 2018), 7.

[75] US Army, *2019 Army Modernization Strategy: Investing in the Future* (Washington, DC: Government Printing Office, n.d), 2.

[76] US Joint Staff, *JOE 2035* (2016), 3-4.

[77] G. John Ikenberry, *After Victory: Institutions, Strategic Restraint, and the Rebuilding of Order After Major Wars* (Princeton: Princeton University Press, 2001), 270.

[78] Francis J. Gavin, "Re-Imagining the World: Reflections on the Future of World Order," *War on the Rocks*, January 9, 2018, accessed February 17, 2020, https://warontherocks.com/2018/01/reimagining-world-reflections-future-world-order/.

in foreign conflicts such as the Syrian civil war.[79] In 2015, Russia deployed fixed-wing and aviation assets to Syria in support of Syrian President Bashar al-Assad's regime. As well, Russia continues to provide advisors and sell intelligence information, ammunition, and artillery to the Syrian regime's military.[80] As competition increases across the air and maritime domains, actors will seek to project power beyond borders and regional areas, with potential to reach the United States. In turn, this will lead to the United States rebalancing defense spending and diverting equipment to increase homeland defense capabilities, specifically air and missile defenses.

Moreover, it is anticipated that the broad network of alliances and partnerships the United States has developed will erode because of challengers such as Russia and China expanding influence around the world. Also, emerging economies able to compete with Western economies coupled with competition for scarce resources and energy reserves will create conditions for the formation of new alliances and the rebalancing of others. In turn, threatening the aptitude of the United States to leverage allies and partners to achieve US national security interests. There will likely also be a decrease in foreign military sales which will result in a decrease of interoperability and integration should conflict arise. Additionally, an increase in globally-present states will cause existing institutions and frameworks to fracture or evolve as fundamental differences contest previously accepted ways of governance.[81]

For example, while NATO continues to pursue its core mission of deterring aggressive rivals, its evolution in concept from preventing war to maintaining peace ensures the continuation of shared values and mutually beneficial relationships.[82] In spite of this, rising powers such as

---

[79] US Defense Intelligence Agency, *Russia Military Power: Building A Military to Support Great Power Aspirations* (Washington, DC: Government Printing Office, 2017), 43, 67.

[80] Ibid., 13.

[81] US Joint Staff, *JOE 2035* (2016), 8.

[82] Lindsay Lloyd and Bradford M. Freeman, "NATO: Still Relevant *in a* Dangerous World," *Catalyst*, no. 15 (Summer 2019), accessed February 17, 2020, https://www.bushcenter.org/catalyst/global-challenges/lloyd-nato-still-relevant-in-a-dangerous-world.html.

China, India, and Brazil will contest the current international rules-based order established under organizations such as NATO.[83] This tension will lead to less support for these organizations and the emergence of new rules and agreements among rising powers that will counterbalance the current order. For instance, the United States' formal withdrawal from the Intermediate-Range Nuclear Forces (INF) treaty in 2019 will stress the tipping point of a nuclear arms race. As recently stated in *Bulletin of the Atomic Scientists*, the United States' pursuit of missile defense without any limitation or constraint could produce a dynamic wherein adversaries develop offensive systems to counter US defensive systems.[84] Meanwhile, other agreements and treaties such as the Treaty on the Non-Proliferation of Nuclear Weapons could also dissolve fostering an environment for a nuclear arms race. Consequently, nuclear proliferation will magnify lethality while advances in science, technology, and engineering will continue to impact the precision and reach of future air and missile threats.

The pace of technological and scientific change is increasing and will continue to accelerate through 2050. For example, in the last twenty-five years the internet has become a global common, artificial intelligence is shortening decision cycles, and nanotechnology is making it possible for future threats to increase power and lethality while decreasing size and detectability. According to then Deputy Secretary of Defense Robert Work, the Joint Force faces "the very real possibility of arriving in a future combat theater and finding themselves facing an arsenal of advanced, disruptive technologies that could turn our previous technological advantage on its head…"[85] While the US Department of Defense budget is consistently more than the next five countries combined, research and development spending over the last thirty years continually

[83] US Joint Staff, *JOE 2035* (2016), 8.

[84] Matt Korda and Hans M. Kristensen, "US ballistic missile defenses," *Bulletin of the Atomic Scientists*, 75, no. 6 (2019): 295, https://doi.org/10.1080/00963402.2019.1680055.

[85] Deputy Secretary of Defense Robert Work, "Deputy Secretary of Defense Speech: National Defense University Convocation" (as prepared for delivery by Deputy Secretary of Defense Deputy Secretary of Defense Bob Work, Washington, DC, August 5, 2014), accessed February 17, 2020, https://www.defense.gov/Newsroom/Speeches/Speech/Article/605598/.

declined until 2015 when investments began to rise.[86] Meanwhile, competitors such as Russia and China have been developing and testing sophisticated systems that appear to be designed specifically to counter US military and technological advantages.[87] For Russia, advances in artificial intelligence center around urban combat to protect soldiers and make the force more precise and lethal.[88] As well, in 2019 artificial intelligence engineers in Moscow published a paper introducing a new technology that can "create realistic animations of a person's face from a single photo."[89] It is not far off to imagine the possibilities of using this technology to create a disinformation campaign to control and shape the narrative. On the other hand, while Russia invests approximately $12 million US dollars into artificial intelligence, the United States invests about $927 million US dollars with over six-hundred active projects.[90] While the United States remains intent to keep pace and create an enduring advantage, the democratization of artificial intelligence development will complicate matters as most advances will come from the commercial sector.[91] As the pace of technological and scientific change accelerates through 2050, US air and missile defense capabilities require modernization, integration with emphasis on protection from cyber and electronic attacks.

---

[86] Tom Temin, "Does DoD's research and development spending reflect strategic priorities?" *Federal News Network*, February 20, 2020, accessed March 7, 2020, https://federalnewsnetwork.com/defense-main/2020/02/does-dods-rdte-spending-data-reflect-strategy-tech-priorities/.

[87] Phil Stewart et al., "Russia, China aim to close military technology gap with U.S.: Hagel," *Reuters*, September 3, 2014, accessed March 7, 2020, https://www.reuters.com/article/us-usa-military-spending/russia-china-aim-to-close-military-technology-gap-with-u-s-hagel-idUSKBN0GY2CC20140903.

[88] Margarita Konaev and Samuel Bendett, "Russian AI-Enabled Combat: Coming to a City Near You?" *War on the Rocks*, July 31, 2019, accessed March 16, 2020, https://warontherocks.com/2019/07/russian-ai-enabled-combat-coming-to-a-city-near-you/.

[89] Ibid.

[90] US Library of Congress, Congressional Research Service (CRS), *Artificial Intelligence and National Security*, by Kelley M. Sayler, CRS Report R45178 (Washington, DC: Office of Congressional Information and Publishing, November 21, 2019), 2, 24.

[91] Ibid., 36.

The Impact of Emerging Trends on Air Defense

As stated in the *Army Air and Missile Defense 2028,* future operating environments will be "characterized by increasingly complex threats, sustained operational tempos, limited resources, and the ability of great power competitors to contest U.S. forces in all domains."[92] For the US air defense community, current and potential threats entail increased missile threats, the emergence of hypersonic weapons, and refinement of sophisticated anti-access and area denial capabilities. Forecasting through 2050 foresees new weapons taking advantage of advances in artificial intelligence and quantum computing, increasing the accuracy, lethality, and speed of delivery at ranges beyond the current capability of a US response.[93] The emerging trends contrasted against the current state of US air and missile defense reveals the US military is not ready to address the full range of threats today, nor prepared to address the potential threats of the future operating environment. The evidence supports that the current approach to air and missile defense will not work in the future because independent service-specific systems and solutions have minimal integration ability across the Joint Force.

In May 2018 the Fires Center of Excellence published the final version of a report on the concept and organization of short-range air defense. The document is consistent with literature regarding the complexity of future operating environments and the resurgence of aerial threats to the maneuver force. Most significantly, the document stated: "[t]he Army can no longer defend and dominate tactical airspace; a great deal of capability in both materiel and institutional knowledge has been lost in recent years."[94] As stated before, the technical expertise and institutional knowledge to create integrated communication network architectures and fight

---

[92] US Army, Space and Missile Defense Command, *Army Air and Missile Defense 2028* (Washington, DC: Government Printing Office, 2019), 2.

[93] US Army, TRADOC Pamphlet 525-92, *The Operational Environment and the Changing Character of Warfare* (Washington, DC: Government Printing Office, 2019), 13-16.

[94] US Army, Fires Center of Excellence, Capabilities and Development Integration Directorate, *United States Maneuver Short Range Air Defense Battalion Organizational and Operational Concept* (Fort Sill, OK: Fires Center of Excellence, 2018), 3.

SHORAD systems in support of the maneuver force at the tactical-level have been lost over the last two decades. What is more, service-specific intercept platforms require service-specific acquisition and tracking systems to conduct intercept operations. Additionally, most air defense systems are built to protect against a specific type of threat using target discrimination algorithms that are not compatible across different platforms. That being said, testing between THAAD, Patriot, and the US Navy's AEGIS Combat System demonstrates a limited integration capability. From 2013 to 2014 the Missile Defense Agency conducted a series of integrated flight tests to demonstrate the integrated missile defense operational effectiveness against various aerial threats.[95] While the test was considered successful, all systems stressed and missiles employed were developed, produced, and managed by the prime contractor, Lockheed Martin. At present, the majority of interoperability rests at the strategic level for early warning and not intercepting.[96] To be fair, since 2004 the US Army has been developing the Integrated Air and Missile Defense Battle Command System (IBCS). IBCS intends to create interoperability and integration at a level where any sensor and any shooter could work together to defeat aerial threats (see Figure 2).[97] The concept boasts an ability to integrate weapon and radar systems from across the Joint Force using an open architecture, employing multi-domain operations via rapid and continuous integration, and security through cyber resilience.[98] While the idea of IBCS provides an answer for a Joint Force solution to air and missile defense, the desired end state may be a bridge too far.

---

[95] US Department of Defense, Missile Defense Agency, *Integrated Flight Tests at U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site (USAKA/RTS) Environmental Assessment* (Redstone Arsenal, AL, 2012), 1.

[96] Adam Stone, "How the DoD is synchronizing missile defense systems," *C4ISRNet*, June 16, 2018, accessed January 25, 2020, https://www.c4isrnet.com/c2-comms/2018/06/26/how-the-dod-is-synchronizing-missile-defense-systems/.

[97] Dan Goure, "Is IBCS Another 'Too Big to Succeed' Army Program?" *Real Clear Defense*, December 6, 2018, accessed October 27, 2019, https://www.realcleardefense.com/articles/2018/12/06/is_ibcs_another_too_big_to_succeed_army_program_114004.html.

[98] "IBCS Functions and Features," Northrop Grumman, October 9, 2019, accessed January 25, 2020, https://www.northropgrumman.com/wp-content/uploads/L-0770-Integrated-Air-and-Missile-Defense-Battle-Command-System-Infographic.pdf.

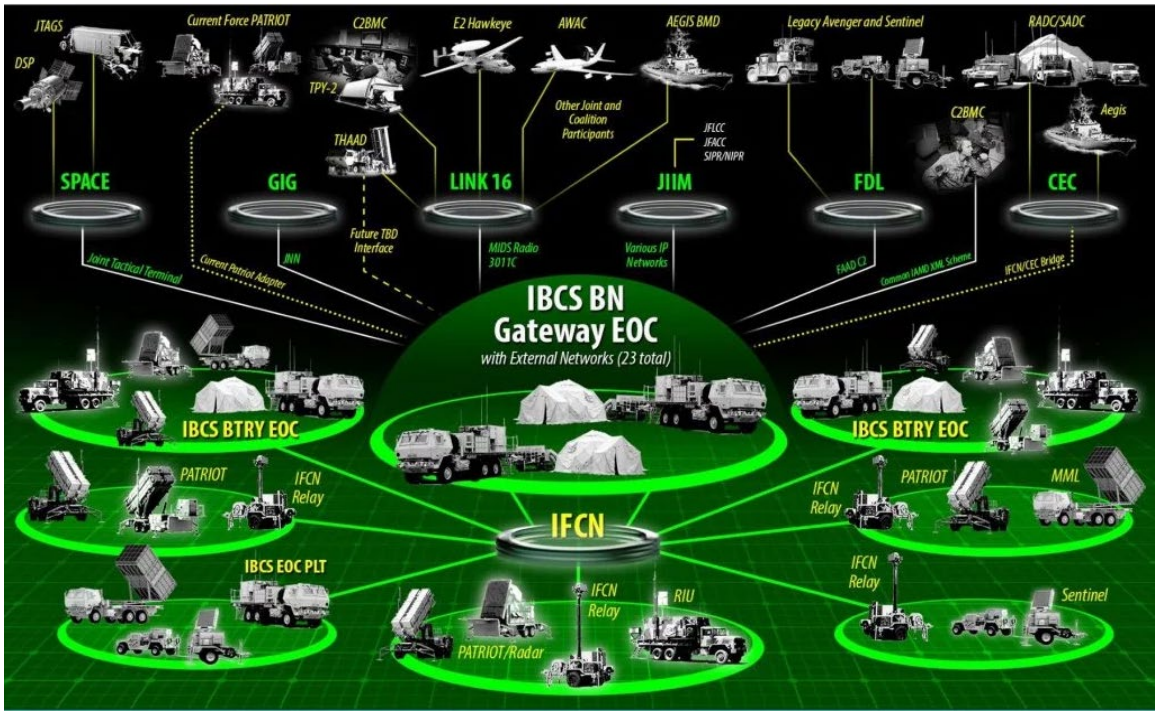

Figure 2. Simplified overview of Army IBCS command and control network, a system of systems. Image from Sydney J. Freedberg, Jr., "IBCS: Northrop Delivers New Army Missile Defense Command Post," *Breaking Defense*, May 1, 2019, accessed January 25, 2020, https://breakingdefense.com/2019/05/ibcs-northrop-delivers-new-missile-defense-command-post-to-army/.

Northrop Grumman's IBCS program has routinely struggled to achieve milestones and suffered from software issues, delaying the initial operational capability from fiscal year 2019 to the end of fiscal year 2022.[99] IBCS requires complex software development to replace at least seven separate command and control systems across the US Army air defense community.[100] For some systems it is as simple as a new card in the computer rack; however, for other systems an enormous software engineering challenge must be overcome to address target discrimination and scoring algorithms per platform. To complicate the matter, there are at least three prime

[99] Jen Judson, "After complex test, is the US Army's major missile defense command system ready for prime time?" *Defense News*, December 12, 2019, accessed March 7, 2020, https://www.defensenews.com/land/2019/12/12/after-complex-test-is-the-armys-major-missile-defense-command-system-ready-for-primetime/.

[100] Sydney J. Freedberg, Jr., "Crunch Time For Army Missile Defense Network," *Breaking Defense*, April 10, 2017, accessed January 25, 2020, https://breakingdefense.com/2017/04/crunch-time-for-army-missile-defense-network-ibcs/.

contractors responsible for the various air defense sensors and shooters to include Raytheon, Lockheed Martin, and Northrop Grumman. As the prime contractor for IBCS, Northrop Grumman was awarded $289 million US dollars at the beginning of fiscal year 2019 to develop the next build of software along with a new mobile command and control shelter and new integrated fire control network.[101] Despite progress towards an any sensor, any shooter concept, concerns over the ability to overcome the differences in data and data infrastructure continue to resonate with senior leaders. As General John Murray, commanding general of US Army Futures Command, recently states that while nobody is arguing the concept, "…it's how we get to, for a joint force, to enable that fight in that data architecture."[102] At the present time, only one IBCS engagement operations center has been delivered and is expected to conduct initial operational testing and evaluation late in 2020.[103] If the system works as intended, the complete Joint Force system of systems currently employed in isolation to one another would work in concert together.

Summary

The global environment is complex and characterized by a variety of actors, all with varying political and economic will, and military power. However, the future operating environment anticipates trends in technology, shifting demographics, changing strategic relationships, resource competition, etc. that "will likely lead to greater parity among a range of international actors thus allowing potential adversaries to more effectively challenge U.S. global

[101] Sydney J. Freedberg, Jr., "Army Awards Northrop $289M For IBCS Missile Defense Network," *Breaking Defense*, October 01, 2018, accessed January 25, 2020, https://breakingdefense.com/2018/10/army-gives-northrop-289m-for-ibcs-missile-defense-network/.

[102] Lauren C. Williams, "Services grapple with 'any sensor, any shooter' network concept," *Federal Computer Week*, March 6, 2020, accessed March 19, 2020, https://fcw.com/articles/2020/03/06/jadc2-shooter-sensor-williams.aspx.

[103] "Northrop Grumman Delivers First Command Center for US Army Integrated Air and Missile Defense," Northrop Grumman, May 1, 2019, accessed January 25, 2020, https://news.northropgrumman.com/news/releases/northrop-grumman-delivers-first-command-center-for-us-army-integrated-air-and-missile-defense.

interests."[104] Russia will continue to be the United States' pacing threat. China and North Korea will also continue to modernize their armed forces while rising competitors will acquire military and power projecting capabilities. These adversaries are increasing their presence across the space domain as they continue to "pursue a full range of anti- satellite weapons as a means to reduce U.S. military effectiveness and overall security."[105] Thus, the next fifteen to twenty years will see the emergence of a multi-polar world with regards to military power. While the Joint Force spent the last two decades focusing on the current fight, US adversaries pursued technological and operational capabilities that threaten US military dominance. For the air defense community, this means a proliferation of missile threats, the emergence of hypersonic weapons, and refinement of sophisticated anti-access and area denial capabilities.

To date, most US military services have created service-based solutions to implement strategies towards the end goal of *Joint Combined Arms* as directed in the 2018 US *National Military Strategy*.[106] Equally, the Joint Force has become stove-piped, with minimal integration and interoperability across the force necessary to achieve *Joint Combined Arms*. In spite of this, programs such as IBCS seek to create the next-generation system of systems environment across the Joint Force. Regardless of IBCS program's success or failure, the concept is moving US military forces towards a solution to address the future operating environment. Although changes in world order and shifting alliances will affect US dominance in the global security environment, the inability to defend against and defeat adversaries poses the greatest risk to US power projection and legitimacy. To succeed in the future operational environment requires the US military to address risk and mitigate gaps in cyber and space domains, developing networked systems and architectures that allow for the free flow of information critical to decision-making.

---

[104] US Joint Staff, *JOE 2035* (2016), 20.

[105] Office of the Director of National Intelligence, *The National Intelligence Strategy of the United States of America* (Washington, DC: Government Printing Office, 2019), 4, accessed March 7, 2020, https://www.dni.gov/files/ODNI/documents/National_Intelligence_Strategy_2019.pdf.

[106] Chairman Joint Chiefs of Staff, *National Military Strategy 2018*, 2.

In doing so, services will support the Joint All Domain Command and Control concept which supports multi-domain operations. Undoubtedly, the future operating environment will require weapon and sensor systems to be flexible, interoperable, networked, open, secure, and survivable across the Joint Force to reduce decision time and exploit windows of opportunity. Until the IBCS is in full production, however, the US Army will require a layered approach using air defense assets in theater to provide protection from air and missile threats. This means protecting US forces and critical assets abroad with only air defense systems approved for that area of operations by the Secretary of Defense.[107] If the previously mentioned trends continue towards an array of affordable technologies that create unexpected and lethal aerial threats, then the future operating environment will quickly overwhelm the current US capability. To address this change in the operational environment, the Joint Force is shifting from service-based to problem-based solutions requiring innovation, cooperation, and modernization amongst the services to reestablish dominance over an adversary.[108]

Section IV: Conclusion

> There are basically two ways to fight the US military: asymmetrically and stupid.
>
> —Lieutenant General H. R. McMaster, February 2017

Challenges in the current operational environment involve non-permissive, contested environments where the adversary creates anti-access or area denial strategies using a variety of air and missile threats. As has been since the Korean War, the United States can no longer assume that air superiority can and will be achieved or maintained throughout a conflict. The proliferation of advanced technologies, offensive missile threats, drones, and resurgence of air-to-air combat

[107] US Department of Defense, Joint Staff, Joint Publication 1, *Doctrine for the Armed Forces of the United States* (Washington, DC: Government Printing Office, 2017), II-5.

[108] Jonathan W. Bott, "What's After Joint? Multi-Domain Operations as the Next Evolution in Warfare" (Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2017), 34, accessed September 12, 2019, https://apps.dtic.mil/dtic/tr/fulltext/u2/1038879.pdf.

all threaten US military dominance across every operating domain – air, ground, sea, space, and cyberspace. Additionally, threats are no longer regionally contained and adversaries can strike long-range targets with greater accuracy than previously demonstrated. Namely, the shift from an overseas garrison operating model to an expeditionary model has created opportunities for adversaries to expand their anti-access and area denial strategies.

To meet the challenges of the current operational environment, military planners seek to establish operational approaches to achieve the desired results through joint combined arms effects. The current approach to defending against aerial threats incorporates service-specific air defense systems, procedures, and tactics to protect critical assets. While each Service provides some capability to overall air and missile defense, the US Army is primarily responsible for maneuver force protection. For US Army air defense planners, this requires a mix of assets built into the defense design to ensure critical assets are protected. Assets include THAAD, Patriot, Avenger, MANPADS, and C-RAM. Each system provides protection from specific threats such as fixed-wing and rotary-wing aircraft, ballistic and cruise missiles, and UAS to include drones. As well, most systems lack vertical and horizontal integration to expand on current capabilities to increase effectiveness through a system of systems approach. Furthermore, the low-density of current US Army air defense assets requires planners to pre-position assets based on threat assessments. Therefore, anticipating the future and understanding the evolving operational environment is critical to forecasting for a balanced force.

The future operating environment will be complex, characterized by changes in world order via shifting alliances, proliferation of advanced weapon technologies and long-range precision strike capabilities, competition across all domains coupled with rivalries for scarce resources. An increase in globally-present states will cause friction and possible fracture of fundamental institutions to the global security environment such as NATO and the UN. Russia and China will continue to expand their spheres of influence, develop hypersonic weapons, and refine sophisticated anti-access and area denial capabilities. Consistent with leading authorities,

Russia will continue to be the United States' pacing threat with improvements to precision targeting, air defense systems, and their air force. What is more, Syria provides Russia an opportunity to test and refine newly developed weapons and gain operational combat experience.[109] The future will require combatant commanders to make near-instant decision-making from relevant and reliable information. As the Joint Force shifts towards *Joint Combined Arms*, where convergence requires the ability to rapidly integrate, the US Army continues to pursue the IBCS concept where any sensor and any shooter can work together. In doing so, the US Army seeks to leverage current capabilities to increase lethality through software engineering, technical solutions, and common command and controls platforms. Then again, there have been significant delays and continuing concerns over the ability of the Joint Force to overcome differences in data architectures. So, while IBCS is an answer that provides a Joint Force solution to future air and missile defense operations, achieving the desired results in time may be a bridge too far.

Therefore, this monograph proposes that the US Army's current approach to air defense integration as part of the Joint Force will not work in the anticipated operational environment. The US Army's current approach relies on independent service-based platforms and solutions that require unique systems for employment. As well, the vertical rather than horizontal communication capabilities prevent intercept data sharing between systems within the US Army and across the Joint Force. For this reason, in 2017 General Mark Milley, then the US Army Chief of Staff, established a modernization strategy to create "air and missile defense capabilities that ensure our future combat formations are protected" from aerial threats.[110] The US Army

[109] Umer Khan, "The Syrian Conflict – A Training Ground, a Test Bed and a Showroom," (Paper, University of Buckingham, 2020), 1, accessed March 18, 2020, https://www.researchgate.net/publication/338416993_The_Syrian_Conflict_-A_Training_Ground_a_Test_Bed_and_a_Showroom.

[110] General Mark A. Milley and Ryan D. McCarthy, memorandum, October 3, 2017, "Modernization Priorities for the United States Army," 2, accessed September 5, 2019, https://admin.govexec.com/media/untitled.pdf.

must continue to look for ways to integrate weapon and sensor systems while ensuring interoperability, security, and survivability are maintained in an operational environment where the United States does not dominate the cyber and space domains. Additionally, while the modernization strategy is specifically focused on US Army modernization, the efforts to improve force protection must include modernizing all Joint Force assets capable of aerial threat intercept operations. The Joint Force must continue to search for problem-based solutions where all services contribute to convergence, mitigating weaknesses, and enhancing strengths. In essence, the US Army and Marine Corps' multi-domain operations concept can provide guidance to the Joint Force for what to work towards. The future requires innovation and cooperation among the services to regain and maintain dominance over an adversary in all operating domains.

Bibliography

Atta, Richard, Royce Kneece, Michael Lippitz, and Christina Patterson. *Department of Defense Access to Intellectual Property for Weapons Systems Sustainment*. Alexandria, VA: Institute for Defense Analyses, 2017. Accessed March 1, 2020. https://apps.dtic.mil/dtic/tr/fulltext/u2/1038450.pdf.

Biddle, Stephen and Ivan Oelrich. "Future Warfare in the Western Pacific: Chinese Antiaccess/Area Denial, U.S. AirSea Battle, and Command of the Commons in East Asia." *International Security* 41, no. 1 (July 2016): 7-48.

Bonds, Timothy M., Joel B. Predd, Timothy R. Heath, Michael S. Chase, Michael Johnson, Michael J. Lostumbo, James Bonomo, Muharrem Mane, and Paul S. Steinberg. *What Role Can Land-Based, Multi-Domain Anti-Access/Area Denial Forces Play in Deterring or Defending Aggression?* Santa Monica, CA: RAND Corporation, 2017. Accessed September 22, 2019. www.rand.org/t/RR1820.

Boston, Scott, Michael Johnson, Nathan Beauchamp-Mustafaga, and Yvonne K. Crane. *Assessing the Conventional Force Imbalance in Europe: Implications for Countering Russian Local Superiority*. Santa Monica, CA: RAND Corporation, 2018. Accessed January 18, 2020. https://www.rand.org/pubs/research_reports/RR2402.html.

Bott, Jonathan W. "What's After Joint? Multi-Domain Operations as the Next Evolution in Warfare." Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2017. Accessed September 12, 2019. https://apps.dtic.mil/dtic/tr/fulltext/u2/1038879.pdf.

Charles Koch Institute. "Seventeen Years On, Americans–Including Veterans–Want Out of Afghanistan." January 23, 2020. Accessed February 14, 2020. https://www.charleskochinstitute.org/news/afghanistan-17-anniversary-poll/.

Cohen, Eliot. *The Big Stick*. New York: Basic Books, 2016.

Collins Aerospace. "Multifunctional Information Distribution System (MIDS)." Products and Services. Accessed February 14, 2020. https://www.rockwellcollins.com/Products-and-Services/Defense/Communications/Tactical-Data-Links/Multifunctional-Information-Distribution-System.aspx.

Debre, Isabel. "In first, US deploys THAAD anti-missile system in Israel." *Defense News*, March 4, 2019. Accessed September 19, 2019. https://www.defensenews.com/land/2019/03/04/in-first-us-deploys-thaad-anti-missile-system-in-israel/.

Defense Security Cooperation Agency. "Major Arms Sales." Accessed February 16, 2020. https://www.dsca.mil/major-arms-sales.

Demma, Vincent H. *Department of the Army Historical Summary, Fiscal Year 1989*. Edited by Susan Carroll. Washington, DC: Army Center of Military History, 1989. Accessed January 5, 2020. https://history.army.mil/books/DAHSUM/1989/Index.htm.

Dolman, Everett C. *Pure Strategy: Power and Principle in the Space and Information Age*. London: Frank Cass, 2005.

Ewers, Elisa C., Lauren Fish, Michael C. Horowitz, Alexandra Sander, and Paul Scharre. *Drone Proliferation: Policy Choices for the Trump Administration*. Washington, DC: Center for a New American Security, 2017. Accessed December 31, 2019. http://drones.cnas.org/reports/drone-proliferation/.

Freedberg, Sydney J. Jr. "Crunch Time For Army Missile Defense Network," *Breaking Defense*, April 10, 2017. Accessed January 25, 2020. https://breakingdefense.com/2017/04/crunch-time-for-army-missile-defense-network-ibcs/.

———. "Army Awards Northrop $289M For IBCS Missile Defense Network," *Breaking Defense*, October 01, 2018. Accessed January 25, 2020. https://breakingdefense.com/2018/10/army-gives-northrop-289m-for-ibcs-missile-defense-network/.

Gady, Franz-Stefan. "China, Russia Conduct First Ever Joint Strategic Bomber Patrol Flights in Indo-Pacific Region." *Diplomat*, July 23, 2019. Accessed January 9, 2020. https://thediplomat.com/2019/07/china-russia-conduct-first-ever-joint-strategic-bomber-patrol-flights-in-indo-pacific-region/.

Gavin, Francis J. "Re-Imagining the World: Reflections on the Future of World Order." *War on the Rocks*, January 9, 2018. Accessed February 17, 2020. https://warontherocks.com/2018/01/reimagining-world-reflections-future-world-order/.

Gawrych, George W. *The 1973 Arab-Israeli War: The Albatross Of Decisive Victory*. Illustrated Edition. Auckland, New Zealand: Pickle Partners Publishing, 2015.

Gordon, Michael R. "A Poor Man's Air Force." *New York Times*, June 19, 2013. Accessed January 4, 2020. https://www.nytimes.com/2003/06/19/international/middleeast/a-poor-mans-air-force.html.

Gormley, Dennis M. "Missile Defence Myopia: Lessons from the Iraq War." *Survival* 45, no. 4 (Winter, 2003): 61-86. Accessed January 14, 2020. ProQuest Ebrary.

Goure, Dan. "Is IBCS Another 'Too Big to Succeed' Army Program?" *Real Clear Defense*, December 6, 2018. Accessed October 27, 2019. https://www.realcleardefense.com/articles/2018/12/06/is_ibcs_another_too_big_to_succeed_army_program_114004.html.

Grier, Peter. "April 15, 1953." *Air Force Magazine* 94, no. 6 (June 2011). Accessed January 18, 2020. https://www.airforcemag.com/article/0611april/.

Hamilton, John A. *Blazing Skies: Air Defense Artillery on Fort Bliss, Texas, 1949-2009*. Washington, DC: Government Printing Office, 2009.

Harper, Jon. "Army Working to Fill Air and Missile Defense Gaps." *National Defense Magazine*, October 2, 2018. Accessed January 18, 2020. https://www.nationaldefensemagazine.org/articles/2018/10/2/army-working-to-fill-air-and-missile-defense-gaps.

Igielnik, Ruth and Kim Parker. “Majorities of U.S. veterans, public say the wars in Iraq and Afghanistan were not worth fighting.” *Pew Research Center*, July 10, 2019. Accessed February 14, 2020. https://www.pewresearch.org/fact-tank/2019/07/10/majorities-of-u-s-veterans-public-say-the-wars-in-iraq-and-afghanistan-were-not-worth-fighting/.

Ikenberry, G. John. *After Victory: Institutions, Strategic Restraint, and the Rebuilding of Order After Major Wars*. Princeton: Princeton University Press, 2001.

Jervis, Robert. *System Effects: Complexity in Political and Social Life*. Princeton: Princeton University Press, 1998.

Judson, Jen. “After complex test, is the US Army’s major missile defense command system ready for prime time?” *Defense News*, December 12, 2019. Accessed March 7, 2020. https://www.defensenews.com/land/2019/12/12/after-complex-test-is-the-armys-major-missile-defense-command-system-ready-for-primetime/.

Khan, Umer. “The Syrian Conflict – A Training Ground, a Test Bed and a Showroom.” Paper, University of Buckingham, 2020. Accessed March 18, 2020. https://www.researchgate.net/publication/338416993_The_Syrian_Conflict_-A_Training_Ground_a_Test_Bed_and_a_Showroom.

Konaev, Margarita and Samuel Bendett, “Russian AI-Enabled Combat: Coming to a City Near You?” *War on the Rocks*, July 31, 2019. Accessed March 16, 2020. https://warontherocks.com/2019/07/russian-ai-enabled-combat-coming-to-a-city-near-you/.

Korda, Matt and Hans M. Kristensen. “US ballistic missile defenses.” *Bulletin of the Atomic Scientists*, 75, no. 6 (2019): 295-306. https://doi.org/10.1080/00963402.2019.1680055.

Kreuzer, Michael P. *Drones and the Future of Air Warfare: The Evolution of Remotely Piloted Aircraft*. London: Routledge, 2016.

Larter, David B. “The US Navy is fed up with ballistic missile defense patrols.” *Defense News*, June 16, 2018. Accessed February 14, 2020. https://www.defensenews.com/naval/2018/06/16/the-us-navy-is-fed-up-with-ballistic-missile-defense-patrols/.

Lloyd, Lindsay and Bradford M. Freeman. “NATO: Still Relevant in a Dangerous World.” *Catalyst*, no. 15 (Summer 2019): np. Accessed February 17, 2020. https://www.bushcenter.org/catalyst/global-challenges/lloyd-nato-still-relevant-in-a-dangerous-world.html.

Locke, Alex. “Air Superiority is Not an American Birthright.” *Business Insider*, August 11, 2016. Accessed October 30, 2019. https://www.businessinsider.com/us-air-superiority-in-crisis-2016-8.

Lostumbo, Michael J., Michael J. McNerney, Eric Peltz, Derek Eaton, David R. Frelinger, Victoria A. Greenfield, John Halliday, Patrick Mills, Bruce R. Nardulli, Stacie L. Pettyjohn, Jerry M. Sollinger, and Stephen M. Worman. *Overseas Basing of U.S. Military Forces: An Assessment of Relative Costs and Strategic Benefits*. Santa Monica, CA: RAND Corporation, 2013. Accessed January 11, 2020. https://www.rand.org/pubs/research_reports/RR201.html.

Mahnken, Thomas G. *The Cruise Missile Challenge*. Washington, DC: Center for Budgetary Assessments, 2005.

Mattis, James N. *Summary of the 2018 National Defense Strategy of the United States of America*. Washington, DC: Government Printing Office, 2018.

McIntire, Randall. "The Return of Army Short-Range Air Defense in a Changing Environment." *Fires* (November-December 2017): 5-8. Accessed October 30, 2019. https://sill-www.army.mil/firesbulletin/archives/2017/nov-dec/nov-dec.pdf.

Milley, Mark A and Ryan D. McCarthy. Memorandum, October 3, 2017. "Modernization Priorities for the United States Army." Accessed September 5, 2019. https://admin.govexec.com/media/untitled.pdf.

Mizokami, Kyle. "These are the Deadliest Air Forces Across the Entire Globe." *National Interest*, September 5, 2019. Accessed January 17, 2020. https://nationalinterest.org/blog/buzz/these-are-deadliest-air-forces-across-entire-globe-78166.

Murray, Williamson A. and Geoffrey Parker. "The Post-War World." In *The Cambridge History of Warfare*, edited by Geoffrey Parker, 362-422. Cambridge: Cambridge University Press, 2005.

North Atlantic Treaty Organization. "Boosting NATO's presence in the east and southeast." Last updated January 21, 2019. Accessed January 23, 2020. https://www.nato.int/cps/en/natohq/topics_136388.htm.

Northrop Grumman. "Integrated Air and Missile Defense Battle Command System (IBCS)." Accessed January 25, 2020. https://www.northropgrumman.com/land/integrated-air-and-missile-defense-battle-command-system-ibcs/.

———. "IBCS Functions and Features." October 9, 2019. Accessed January 25, 2020, https://www.northropgrumman.com/wp-content/uploads/L-0770-Integrated-Air-and-Missile-Defense-Battle-Command-System-Infographic.pdf.

Nye, Joseph. *The Future of Power*. New York: Public Affairs, 2011.

Odom, William, and Christopher D. Hayes. "Cross-Domain Synergy: Advancing Jointness." *Joint Force Quarterly* 73 (April 2014).

Office of the Director of National Intelligence. *The National Intelligence Strategy of the United States of America*. Washington, DC: Government Printing Office, 2019. Accessed March 7, 2020. https://www.dni.gov/files/ODNI/documents/National_Intelligence_Strategy_2019.pdf.

Peck, Michael. "How Israel's Air Force Won the Six-Day War in Six Hours." *National Interest*, June 2, 2017. Accessed January 14, 2020. https://nationalinterest.org/blog/the-buzz/how-israels-air-force-won-the-six-day-war-six-hours-20980.

Prandtner, Jürgen. “Uncertainty: The Forgotten Factor in Joint Planning.” Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2019. Accessed November 19, 2019. Combined Arms Research Library Digital Library.

Predny, Michael J. “The US Army and the Emergence of Unmanned Threats.” Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2016. Accessed October 28, 2019. https://apps.dtic.mil/docs/citations/AD1022201.

Romjue, John L. *From Active Defense to AirLand Battle: The Development of Army Doctrine, 1973-1982*. Fort Monroe, VA: Historical Office, US Army Training and Doctrine Command, 1984.

Schwartz, Peter. *The Art of the Long View: Planning for the Future in an Uncertain World*. New York: Crown Business, 1996.

Stewart, Phil, Andrea Shalal-Esa and David Alexander. “Russia, China aim to close military technology gap with U.S.: Hagel.” *Reuters*. September 3, 2014. Accessed March 7, 2020. https://www.reuters.com/article/us-usa-military-spending/russia-china-aim-to-close-military-technology-gap-with-u-s-hagel-idUSKBN0GY2CC20140903.

Stone, Adam. “How the DoD is synchronizing missile defense systems.” *C4ISRNet*, June 16, 2018. Accessed January 25, 2020. https://www.c4isrnet.com/c2-comms/2018/06/26/how-the-dod-is-synchronizing-missile-defense-systems/.

Tangredi, Sam J. *Anti-Access Warfare: Countering A2/AD Strategies*. Annapolis, MD: Naval Institute Press, 2013.

Temin, Tom. “Does DoD’s research and development spending reflect strategic priorities?” *Federal News Network*. February 20, 2020. Accessed March 7, 2020. https://federalnewsnetwork.com/defense-main/2020/02/does-dods-rdte-spending-data-reflect-strategy-tech-priorities/.

Trump, Donald J. *National Security Strategy (NSS) of the United States of America*. Washington, DC: White House, 2017.

US Department of the Air Force. “E-3 Sentry AWACS.” U.S. Air Force Fact Sheet. Last modified September 22, 2015. Accessed February 16, 2020. https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104504/e-3-sentry-awacs/.

US Department of the Army. *2019 Army Modernization Strategy: Investing in the Future*. Washington, DC: Government Printing Office, 2019.

———. 32d Army Air and Missile Defense Command (AAMDC), *AMD Systems Smart Book*. Fort Bliss, TX: 32d AAMDC Headquarters, 2007.

———. Fires Center of Excellence, Capabilities and Development Integration Directorate. *United States Maneuver Short Range Air Defense Battalion Organizational and Operational Concept*. Fort Sill, OK: Fires Center of Excellence, 2018.

———. Space and Missile Defense Command, *Army Air and Missile Defense 2028*. Washington, DC: Government Printing Office, 2019.

———. Space and Missile Defense Command, *Statement of Lieutenant General James H. Dickinson Commanding General, U.S. Army Space and Missile Defense Command/Army Forces Strategic Command and Commander, Joint Functional Component Command for Integrated Missile Defense Before the Subcommittee on Strategic Forces Committee on Armed Services United States Senate: Fiscal Year 2020 Authorization Request for Missile Defense*. Washington, DC: Government Printing Office, 2019. Accessed September 22, 2019. https://www.armed-services.senate.gov/imo/media/doc/Dickinson_04-03-19.pdf.

———. Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, *The U.S. Army in Multi-domain Operations 2028.* Washington, DC: Government Printing Office, 2018.

———. TRADOC Pamphlet 525-92, *The Operational Environment and the Changing Character of Warfare.* Washington, DC: Government Printing Office, 2019.

———. TRADOC, *Worldwide Equipment Guide, Volume 2: Air and Air Defense Systems.* Fort Leavenworth, KS: G-2 ACE, Threats Integration, 2016.

US Defense Intelligence Agency. *Russia Military Power: Building A Military to Support Great Power Aspirations*. Washington, DC: Government Printing Office, 2017.

US Department of Defense. *Base Structure Report – Fiscal Year 2017 Baseline*. Washington, DC: Government Printing Office, 2017. Accessed January 11, 2020. https://www.acq.osd.mil/eie/Downloads/BSI/Base%20Structure%20Report%20FY17.pdf.

———. *Conduct of the Persian Gulf War: Final Report to Congress*. Washington, DC: Government Printing Office, 1992.

———. *DOD Dictionary of Military and Associated Terms*. Washington, DC: Government Printing Office, 2019. Accessed January 18, 2020. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/dictionary.pdf.

———. *Joint Operational Access Concept, Version 1*. Washington, DC: Government Printing Office, 2012.

———. *Transcript of Press Briefing by Secretary James and Gen. Goldfein on the State of the Air Force in the Pentagon Briefing Room*. August 10, 1996. Accessed January 17, 2020. https://www.defense.gov/Newsroom/Transcripts/Transcript/Article/911083/department-of-defense-press-briefing-by-secretary-james-and-gen-goldfein-on-the/.

———. Air Land Sea Application Center. Multi-Service Tactics, Techniques, and Procedures (MTTP) Publication, *SCAR*. Washington, DC: Government Printing Office, 2018. Accessed February 16, 2020. https://www.alsa.mil/mttps/scar/.

———. Chairman Joint Chiefs of Staff. *Description of the National Military Strategy 2018*. Washington, DC: Government Printing Office, 2018. Accessed September 3, 2018. https://www.jcs.mil/Portals/36/Documents/Publications/UNCLASS_2018_National_Military_Strategy_Description.pdf.

———. Missile Defense Agency (MDA). *2010 Ballistic Missile Defense Review Report*. Washington, DC: Government Printing Office, 2010.

———. MDA. *2019 Missile Defense Review*. Washington, DC: Government Printing Office, 2019.

———. MDA. *Integrated Flight Tests at U.S. Army Kwajalein Atoll/Ronald Reagan Ballistic Missile Defense Test Site (USAKA/RTS) Environmental Assessment*. Redstone Arsenal, AL, 2012.

US Library of Congress. Congressional Research Service (CRS). *Artificial Intelligence and National Security*, by Kelley M. Sayler CRS Report R45178. Washington, DC: Office of Congressional Information and Publishing, 2019.

US Department of the Navy. "AEGIS WEAPON SYSTEM." United States Navy Fact File. Last updated January 10, 2019. Accessed February 14, 2020. https://www.navy.mil/navydata/fact_display.asp?cid=2100&tid=200&ct=2.

US Department of State. "U.S. Arms Sales and Defense Trade." Bureau of Political-Military Affairs. Last updated May 21, 2019. Accessed February 16, 2020. https://www.state.gov/u-s-arms-sales-and-defense-trade/., https://www.state.gov/u-s-arms-sales-and-defense-trade/.

Vine, David. "The United States Probably Has More Foreign Military Bases Than Any Other People, Nation, or Empire in History." *The Nation*, September 14, 2015. Accessed January 11, 2020. https://www.thenation.com/article/the-united-states-probably-has-more-foreign-military-bases-than-any-other-people-nation-or-empire-in-history/.

Warden III, John A. *The Air Campaign: Planning for Combat*. Washington, DC: National Defense University Press, 1988.

Weiss, Geoffrey. "Seeing 2020, America's New Vision for IAMD" JFQ 76, 1Q15, 109.

Williams, Lauren C. "Services grapple with 'any sensor, any shooter' network concept." *Federal Computer Week*, March 6, 2020. Accessed March 19, 2020. https://fcw.com/articles/2020/03/06/jadc2-shooter-sensor-williams.aspx.

Work, Robert. "Deputy Secretary of Defense Speech: National Defense University Convocation." As prepared for delivery by Deputy Secretary of Defense Deputy Secretary of Defense Bob Work, Washington, DC, August 5, 2014. Accessed February 17, 2020. https://www.defense.gov/Newsroom/Speeches/Speech/Article/605598/.