Future Roles of Army Aviation in Large Scale Combat Operations

A Monograph

by

MAJ Kenneth R. Dougher II
US Army

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

2019

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
23-05-2019	Master's Thesis	JUNE 18-MAY 19

4. TITLE AND SUBTITLE
Future Roles of Army Aviation in Large Scale Combat Operations

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
MAJ Kenneth R. Dougher II

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
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15. SUBJECT TERMS
Large Scale Combat Operations, Army Aviation, AirLand Battle

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. PHONE NUMBER** *(include area code)*
(U)	(U)	(U)	(U)	47	913-758-3300

Monograph Approval Page

Name of Candidate: MAJ Kenneth R. Dougher II

Monograph Title: Future Roles of Army Aviation in Large Scale Combat Operations

Approved by:

_____, Monograph Director
Mark T. Calhoun, PhD

_____, Seminar Leader
Geoffrey A. Whittenberg, COL

_____, Director, School of Advanced Military Studies
Kirk C. Dorr, COL

Accepted this 23rd day of May 2019 by:

_____, Director, Graduate Degree Programs
Robert F. Baumann, PhD

Abstract

Future Roles of Army Aviation in Large Scale Combat Operations, by MAJ Kenneth R. Dougher II, US Army, 47 pages.

The US Army is experiencing a cultural shift away from years of low intensity, counter-insurgency operations toward large scale combat operations with a near-peer or peer threat. The shift includes a major change from brigade-centric operations to divisions and corps serving as the primary warfighting headquarters. Headquarters must now not only provide resources, but simultaneously direct the conflict in multiple domains, including space and cyber-space. US Army Aviation can be a significant force multiplier, but only when used effectively. Army Aviation continues to gain ground through lessons learned from the readiness training centers on how best to reach deep in multi-domain operations. Army Aviation faces many obstacles to continue to be a force multiplier. The 2015 *Field Manual 3-04, Army Aviation*, set new expectations for large scale combat operations, but improvements in training, equipment, and doctrine are necessary to achieve what *FM 3-04* demands conceptually. The complex battlefield set by near-peer and peer threats restricts Army Aviation's freedom of maneuver with anti-access and area-denial systems. To respond to such threats, Army Aviation currently fields upgrades to its legacy fleet of helicopters, but this approach consumes resources that could go towards the future vertical lift fleet. For Army Aviation to be ready to fight today, they must continue to improve the legacy fleet. However, the more Army Aviation spends on updating the legacy fleet, the less it is investing in the future airframes. Additionally, the current fleet has limited potential for further modifications. The key question is whether such modifications to the legacy fleet will be enough to combat the challenges faced in the complex and lethal battlefield of large scale combat operations against a near-peer or peer threat. This monograph addresses those questions surrounding the shift from counter-insurgency to large scale combat operations for Army Aviation.

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Acknowledgments

I would like to thank my monograph director, Mark T. Calhoun, Ph.D., and my seminar leader, Colonel Geoffrey A. Whittenberg for their patience and consistent support throughout this research and analysis project. Thank you to my seminar classmates that really made SAMS such a great experience. A special thank you to MAJ Philip Neri for suffering through countless drafts of this piece, MAJ David Jones for providing invaluable feedback, and a thank you to my editor, Ms. Venita Krueger. Last, but not least, I am blessed and grateful to have the love, support, and patience of my family and friends, especially my better half, Tina, and our two amazing children, Kenneth, and Caitlin.

Acronyms

A2/AD	Anti-Access/Area Denial
AGO	Air Ground Operations
AH	Attack Helicopter
AMCOM	Army Aviation and Missile Command
AMSO	Army Aviation Mission Survivability Officer
CAB	Combat Aviation Brigade
CH	Cargo Helicopter
COIN	Counter-Insurgency
CSAR	Combat Search and Rescue
EAB	Echelons Above Brigade
FM	Field Manual
FOB	Forward Operating Base
FVL	Future Vertical Lift
HA	Holding Area
HMMWV	High Mobility Multipurpose Wheeled Vehicle
JRTC	Joint Readiness Training Center
LCMC	Life Cycle Management Command
LSCO	Large Scale Combat Operations
MANPAD	Man Portable Air Defense System
MCTP	Mission Command Training Program
MDO	Multi-Domain Operations
MUM-T	Manned Unmanned Team
NTC	National Training Center
OH	Observation Helicopter
PIR	Priority Intelligence Requirement
PMO ASE	Project Management Office for Aircraft Survivability Equipment

SERE	Survival, Evasion, Resistance, and Escape
SOAR	Special Operations Aviation Regiment (Airborne)
SOCCENT	Special Operations Command-Central
SOF	Special Operations Forces
TF	Task Force
UA	Unmanned Aircraft
UAS	Unmanned Aerial Systems
UH	Utility Helicopter

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Introduction

> Large-scale ground combat is more likely today than at any point since the end of the Cold War. And the risk of great power conflict will likely persist into the distant future. While the last 17 years of limited contingency and counterinsurgency operations were necessarily brigade-centric, conflict with a peer and near-peer threats requires a continued culture shift as well as the optimization of EABs (echelons above brigade) into highly capable divisions, corps, field armies, and theater armies.
>
> — Lieutenant General Michael D. Lundy, Commanding General, US Army Combined Arms Center

Background

Since the American Civil War, Army Aviation has played a role in US warfare. Army Aviation has continually adapted and strived to provide the ground force commander additional options, from deep attacks to reconnaissance, air assaults, medical evacuations, and more. In the most recent war on terrorism, Army Aviation provided these capabilities to the ground force commander which enabled numerous options, saving thousands of lives. While Army Aviation has proven itself as a combat multiplier in the current fight, past results may not be indicative of future success.

Former combat aviation brigade (CAB) commander Colonel Jimmy Blackmon observed that "pilots are the products of their experiences." Currently, there is a pressing challenge to create realistic training opportunities to prepare leadership for the rising threat of conflict with a peer or near-peer adversary. Army Aviation's primary focus over the past decade focused on meeting the requirement for training and completing missions during specific rotational deployments to stable theaters, with a focus on environmental conditions. In the Gulf War, close air support was not the primary goal for the air component. However, in the mountains of the Regional Command East, Afghanistan, it was essential to the mission. The primary objective for the limited contingency was close air support, but as the US Army gravitates back to the pressing challenge of Large Scale Combat Operations (LSCO), Army Aviation must be prepared to increase their deep attack and interdiction capabilities. LSCO, unlike counter-insurgency (COIN),

will challenge the Army in all domains. In recent history, the Army has assumed air superiority and not contended with electronic warfare, but, within LSCO, these challenges will present themselves.[1]

The concept of AirLand Battle has evolved since its inception in US Army doctrine in the 1970s, and first significant test in the Gulf War. As defined in the 1986 *Field Manual (FM) 100-5, Operations*, AirLand Battle involves "securing or retaining the initiative to accomplish the mission by throwing the enemy off balance with a powerful blow from an unexpected direction and following up rapidly and continuously to achieve the higher commander's goals." The two main Army Aviation elements of AirLand Battle: close air support and deep attack, have not changed significantly since the Gulf War, but evolution in technology changed the manner in which aviation executes these roles. Improved technology has brought in different weapon systems for attack helicopters (AH), surveillance, reconnaissance, and interdiction technology for unmanned aerial systems (UAS), utility helicopter (UH) 60M and cargo helicopter (CH) 47F models with digital readouts, and hovering features for lift helicopters to assist with air assault operations.[2]

Despite advances in technology, aviation brigades still face numerous challenges. According to two battalion commanders of the 101st Airborne Division, deployed aviation commanders had similar numbers of attack helicopters (AH 64s) and observation helicopters (OH 58Ds), but did not have enough CH-47Fs, the US Army's only cargo helicopter, to get all of their missions and tasks done. As such, CABs had to remain flexible in their formations. Additional

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[1] Jimmy Blackmon, *Pale Horse: Hunting Terrorists and Commanding Heroes with the 101st Airborne Division* (New York: Saint Martin's Press, 2016), 58; Michael D. Lundy, *"*Meeting the Challenge of Large-Scale Combat Operations Today and Tomorrow*," Military Review* (September-October 2018): 112-113, accessed January 17, 2019, https://www.armyupress. army.mil/Journals/Military-Review/English-Edition-Archives/September-October-2018/.

[2] US Department of the Army, *Field Manual (FM) 100-5, Operations* (Washington, DC: Government Printing Office, 1986), 14; Blackmon, *Pale Horse*, 162; Diane T. Putney, *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991* (Washington, DC: Library of Congress, 2004), 37.

challenges range from meteorological risks to a counterinsurgency-focused culture. However, Army Aviation will continue to play a vital role in future operations. As such, CABs must educate division and corps-sized headquarters on how best to utilize Army Aviation to shape the fight.[3]

Methodology

This monograph consists of three main sections. The initial section summarizes the relevant background of Army Aviation, the requirements involved with the move towards LSCO, and the current capability of the force to apply emerging doctrine. In the second section, a historical example of Army Aviation's transformation in the 1980s accounts for the significant change of Army operations doctrine to the AirLand Battle construct. This section includes analysis of Army Aviation roles in Operations Desert Storm and Desert Shield, evaluated using three key elements of operational art: operational reach, tempo, and risk. The third section provides analysis of the current gaps that exist between doctrinal requirements of Army Aviation and its current capability. This section also highlights the outlook for the next ten to fifteen years for Army Aviation, and the associated gaps that those advances could create or close. Lastly, this section provides proposed methods to meet any remaining gaps between requirements and capability within the branch.

Application of Operational Art in Army Aviation Doctrine

Operational Art has evolved alongside changes in technology and the incorporation of new battlefield domains into US Army doctrine. As described in *Army Doctrine Reference Publication (ADRP) 3-0*, *Operations*, operational art "requires creative vision, broad experience, and knowledge of capabilities, tactics, and techniques across multiple domains." Today's domains of cyber, space, electronic, and information present a significant challenge for officers maintaining the broad and creative vision as they are not as tangible as the traditional land, air,

[3] Blackmon, *Pale Horse*, 162.

and maritime domains. The publication of *FM 3-0*, according to Lieutenant General Michael D. Lundy, provides the Army with "an expanded physical, virtual, cognitive, and temporal perspective for accounting for the multi-domain extended capabilities of friendly and threat forces." The Army strives to meet the challenges presented by the multi-domain concept and LSCO threats with new manuals appearing in 2017 alongside the current body of aviation doctrine. LSCO has become the measuring standard of future conflict on lethality and large-scale demands of Army training and capabilities. Army officers can apply operational art as they plan, prepare, execute, and assess current and future operations including LSCO. Three of the ten elements of operational art—tempo, operational reach, and risk—enable an assessment of aviation doctrine as applied by commanders and staffs.[4]

ADRP 3-0, Operations, defines tempo as "the relative speed and rhythm of military operations over time with respect to the enemy." In both cases, Army Aviation must control tempo when reacting to and assessing the urgent requests for support from ground forces and air components. The ability to keep the tempo at the optimal level requires both audacity and patience. High tempo only remains effective for so long before increasing the risk to the endurance of the mission. The increase in congested airspace due to the proliferation of UAS and lower operational ceiling will also increase tempo while pushing the limits of its optimal level. A commander must assess and apply operational art in the planning of missions while maintaining the tempo when necessary to avoid sacrificing the other elements of operational art such as operational reach and decisive points.[5]

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[4] First quote from US Department of the Army, *Army Doctrine Reference Publication (ADRP) 3-0, Unified Land Operations* (Washington, DC: Government Printing Office, 1986), 2-4; second quote Michael D. Lundy, *"*Meeting the Challenge of Large-Scale Combat Operations Today and Tomorrow*,"* 113; US Department of the Army, *Army Doctrine Publication (ADP) 3-0, Operations* (Washington, DC: Government Printing Office, 2017), 13.

[5] US Army, *ADRP 3-0*, 2-37, 2-38, 2-39.

Army Aviation enhances speed, flexibility, and lethality during US Army operations. Army Aviation helps maintain the tempo of the combat arms team through deep attacks, reconnaissance, close and security support, and air movements. Per *FM 3-04*, a successful attack contains "audacity, speed, concentration of combat power at the right time and place, violence of execution, simultaneity of joint fires with ground and air maneuver, and maximizing the element of surprise." The optimal tempo maximizes the element of surprise while patience creates the window for the concentration of combat power and the seamless rhythm of coordinated air-ground operations (AGO) for a successful mission. An operation in a deep area that is aligned with the Army's prior AirLand Battle construct and remains in accordance with the current *FM 3-04*, influences the tempo for the accompanying unified land operations.[6]

> Aviation operations in deep areas may include—
>
> Attacks to destroy, defeat, disrupt, divert or delay enemy forces or high-value capabilities that are out of friendly contact using manned-unmanned teaming (MUM-T) or independent UAS attack-reconnaissance operations.
>
> Reconnaissance operations by manned and/or unmanned aircraft (UA) to obtain combat information to answer priority intelligence requirements (PIR) on the terrain, enemy or civilian populations.
>
> Air assaults of conventional or special operations forces to seize an objective, destroy an enemy force, or capture or kill a high-value target.
>
> Infiltrations of conventional and special operations forces to recover isolated personnel, emplace sensors, conduct raids, establish special reconnaissance positions, or to conduct partisan linkup.
>
> Air movements of supplies and personnel to ground maneuver units operating decentralized in deep areas.[7]

These operational examples from *FM 3-04*, all involve setting a desired tempo by striking quickly and violently, thereby supporting the rhythm for the AGO to either follow or attack simultaneously. As US Army leaders shift their focus from COIN to LSCO, their need increases

[6] US Department of the Army, *Field Manual (FM) 3-04, Army Aviation* (Washington, DC: Government Printing Office, 2015), 3-14, 1-1.

[7] US Army, *FM 3-04,* 1-39.

to incorporate coordinated attacks across multiple domains to present the enemy with multiple dilemmas simultaneously. *ADP 3-0* describes the goal of these coordinated attacks: "degrade enemy freedom of action, reduce enemy flexibility and endurance, and upset enemy plans and coordination." This remains a challenge for commanders shifting focus to LSCO, as many have rarely attempted or trained for this type of coordinated attack. If the coordinated attack is successful it will enhance the US Army's tempo.[8]

Tempo is not only essential in attack missions but also crucial in reconnaissance missions. A commander's ability to make sound and accurate decisions rest on the timely and accurate flow of reconnaissance. Army Aviation has a responsibility to perform at the optimal tempo to meet the needs of intelligence and respond when the situation develops. Aviation meets this need through employment of MUM-T. The MUM-T ensures longer reconnaissance windows of up to forty hours and decreased gaps in intelligence coverage caused by crew changes. The longer reconnaissance windows and increased depth of reconnaissance and maneuver of UAS systems increase endurance and increased reconnaissance abilities require commanders to initiate and sustain the most advantageous tempo with AGOs. MUM-T hinders tempo in the management of UAS communication as they descend below coordinating altitude from restricted operations zones as depicted in Figure 1. MUM-T requires extra time and communication, but the advantages of the higher commander's situational awareness due to intelligence surveillance and reconnaissance outweigh the extra airspace control authority, planning, and coordination.[9]

[8] US Army, *ADP 3-0*, 38.

[9] US Army, *FM 3-04*, 1-7, 2-95, 3-74.

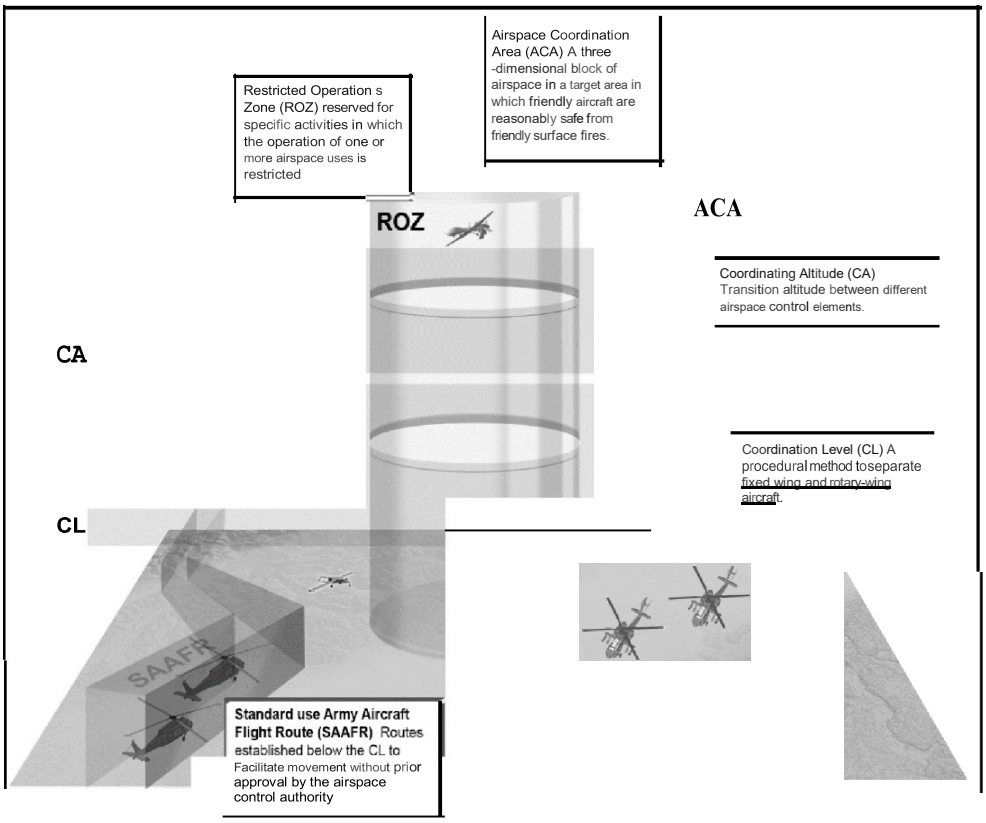

Figure 1. Common Army Airspace Coordinating Measures. *Field Manual (FM) 3-04, Army Aviation* 2015, 2-22.

Colonel Jimmy Blackmon has argued that recent COIN operations in Afghanistan and Iraq demonstrated that "the most underutilized collection assets were the rotary-wing aviation aircrews. Helicopters traverse and observe more of the brigade's battlespace daily than any other sensor on the battlefield." To keep the reconnaissance moving, all parties to include, UAS, pilots, and crews, whether lift or attack, need to be a part of the reconnaissance gathering as weather can prevent or limit employment of UAS and mission space does not always overlap. The US Army teaches soldiers to be critical thinkers. As one way to hone that skill, all aircrews should adopt a reconnaissance mindset.[10]

The tempo of the flow of reconnaissance is susceptible to disruption by many factors including natural and manmade, weather being the most prominent. Due to disruptions in

[10] Blackmon, *Pale Horse*, 58.

reconnaissance "the commander must balance the time available versus the advantage of executing with tempo and surprise with the minimum mission essential information required to understand the friendly forces, terrain, weather and enemy forces to achieve success." Terrain can also limit the flow of reconnaissance because of visibility and poor communication. Additionally, the enemy will limit reconnaissance in LSCO through electronic warfare and their air defense systems. The last seventeen years of limited contingency operations have demonstrated that the experience gained while working in varied terrain, including mountains which limit line of sight, may reduce UAS range and data relay capability. Difficult weather patterns degrade communications between UAS and ground maneuver units, as do urban and desert terrain, as seen in Iraq and Afghanistan.[11]

The rhythm of the tempo created by the relationship between the air and ground forces is crucial to the success of the mission. The relationship takes time and practice to develop but, when the rhythm of AGOs is seamless, the mission success increases due to inherent flexibility and reaction time. Ideally, during COIN, CABs assigned specific task forces (TFs) to support a ground commander. This required pre-deployment training with the ground commander to establish habitual relationships with the CAB so that it could achieve its full potential. In this case, time permitted pre-deployment planning, but units might not have this luxury when a peer threat escalates quickly into LSCO. Integration of the CAB in air mission coordination meetings and air mission briefs increases awareness of effective ways to use Army Aviation. However, this remains difficult at the brigade level and proves even more of a challenge at the division and higher levels of command. The lack of rhythm of AGOs could also detract from the CAB's

[11] US Army, *FM 3-04*, 3-33; Charles K. Bartles and Lester W. Grau, *Mountain Warfare and Other Lofty Problems: Foreign Perspectives on High Altitude Combat* (West Midlands, England: Helion, 2016), 23; US Army, *FM 3-04*, 3-154; US Army, *ADP 3-0*, 15; Joshua Durham, "Testing the Army's Extended Range Gray Eagle UAS," *Army Aviation* (November 2018): 52-53.

operational reach and increase risk until sound relationships develop and integration at the division level becomes routine.[12]

The second operational element routinely applied to Army Aviation is operational reach. *Joint Publication 3-0, Joint Operations,* defines operational reach as the "distance and duration across which a joint force can successfully employ military capabilities." The many changes in technology, new digital models of aircraft and MUM-T, have increased Army Aviation's length of optimal reach. Reach will play a pivotal role in Army Aviation's ability to shape the complex battlefield of LSCO. Army Aviation will need the ability to reach the centers of gravity to make the most impact on the conflict at hand. Difficulty could arise if a division, or above, does not understand how to effectively use Army Aviation's strengths, such as the potential reach of rotary wing operations or UAS, and therefore fails to integrate aviation effectively into their operations. The successful integration of MUM-T into a CAB can give commanders extended reach through continuous reconnaissance, current battle damage assessment, and contact with the enemy due to longer flight times of the Gray Eagle. The coordination of the UAS and AH-64 also extends reach for greater lethality by utilizing precision team targeting to give swift blows to high-payoff targets or against centers of gravity.[13]

Operational reach can be very critical to shaping operations as aviation's reach facilitates deep attacks. Aviation operational reach shapes the battlefield not only through deep attacks but also air assaults, and air movements. Placing critical supplies and soldiers where they will have the most impact on the battlefield extends the operational reach of the ground force to gain a position of relative advantage against threats that may outnumber US troops. Operational reach will be a critical element of any LSCO in order to keep the element of surprise, present multiple dilemmas simultaneously, disrupt troop reinforcements, and communications. The challenge is

[12] Blackmon, *Pale Horse*, 61; US Army, *FM 3-04*, 1-3.

[13] US Department of Defense, Joint Staff, *Joint Publication (JP) 3-0*, *Joint Operations* (Washington, DC: Government Printing Office, 2011), I-13; US Army, *FM 3-04*, 1-18.

Army Aviation's ability to meet the demands within the new doctrine, especially in LSCO against a peer threat.[14]

Army Aviation has seven core competencies, as seen below in Figure 2, and most apply to the operational reach of combat arms teams. Air assaults, in coordination with special operations forces (SOF) or other combined arms teams, can extend operational reach by quickly assembling battalions of troops for covert operations to cut off reinforcements or destroy centers of gravity that terrain would otherwise make impossible to reach. Air movements performed by cargo and utility aircraft also support operational reach of combined arms teams, especially when overcoming effects of terrain or enemy forces in isolated locations only accessible by rotary wing aircraft. Air movements can be inefficient compared to transporting heavy supplies and equipment by plane and therefore US forces utilize air movements when terrain or emergency necessitates the use. CABs arrange air movements by priority because of the smaller number of CH-47s assigned to CABs as seen below in Figure 3.[15]

The seven core competencies of Army Aviation are:

- Provide accurate and timely information collection on the enemy, terrain, local populations and friendly forces.
- Provide reaction time and maneuver space.
- Destroy, defeat, disrupt, divert, or delay enemy forces.
- Air assault ground maneuver forces.
- Air move personnel, equipment, and supplies.
- Evacuate wounded or recover isolated personnel.
- Enable mission command over extended ranges and complex terrain.

Figure 2. Core Competencies of Army Aviation. *Field Manual (FM) 3-04, Army Aviation* 2015, 2-96.

[14] US Army, *FM 3-04*, 1-18, 4-46.

[15] US Army, *FM 3-04,* 1-23, 4-69.

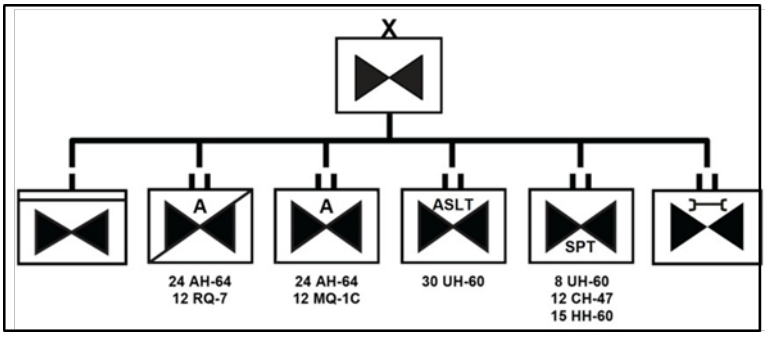

Figure 3. Combat Aviation Brigade. *Field Manual (FM) 3-04, Army Aviation* 2015, 2-2.

The third element of operational art that enables an assessment of Army Aviation doctrine is risk. LSCO presents a new demand on Army Aviation and will likely increase the risk of every mission. One of the demands of LSCO is the requirement of a CAB to retain flexibility within their formations. Formations may require tailored packages for different aircraft to facilitate different missions. The CAB contains finite resources and depending how LSCO unfolds it will be necessary to adjust formations to meet the demand of the ground force commander. This is like current COIN operations. However, it is likely the CAB must gain proficiency at adjusting frequently, where currently, they generally remain task organized for the duration of a deployment. Risk is inherent to all military operations. Commanders that are willing to incur a reasonable level of risk typically find it is "the key to exposing enemy weakness that the enemy considers beyond friendly reach."[16]

To mitigate risk, aviation commanders should—

Use the minimal security force required to gain contact while accomplishing the mission within the allotted time.

Maximize the use of UAS forward to provide reaction time and maneuver space.

Provide subordinates with control measures for not only their own areas of operations but also adjacent areas of operations to control and deconflict maneuver and fires.

Develop and coordinate air coordination measures to enable freedom of action of manned and unmanned systems.

[16] US Army, *ADRP 3-0*, 2-61; US Army, *FM 3-04*, 3-127-128; Blackmon, *Pale Horse,* 128.

Plan and employ joint fires through the depth of the zone.

Employ communications relay packages, Army Airborne Command and Control System or Airborne Battle Command Console aircraft to maintain communications over extended distances.

Position FARPs, UAS launch locations, and holding areas (HAs) forward to enable rapid turns of combat power once enemy contact is gained.

And most importantly, use speed and audacity to develop the situation upon gaining contact.[17]

While it is important to find ways to mitigate risks like those listed above when applying operational art of the ends, ways, and means, it is also crucial to account for the level of risk and risk limits of a potential enemy. When attacking from multiple domains it can increase the risk taken by the CAB, as well as increase the threat to the enemy and their level of risk. Risk is unavoidable, but navigating aviation operations and AGOs, a commander must strike a balance between acceptable risk and expected gains. Ways to mitigate such risks are maintaining flexibility within plans, planning thoroughly for missions, and establishing a good relationship between air and ground forces.[18]

Commanders need to be flexible in their planning of AGOs. Flexibility comes from retaining options, a position influenced by training and experience. Aviators can pull from their experiences as well as the experiences of others to create a flexible plan to account for different variables. The challenge with LSCO is the unfamiliarity of current aviation crews with such operations and the finite resources of a CAB to manage the demands of LSCO. Units need to have adaptable plans to react to the evolving circumstances in LSCO. Training, especially in coordination with the ground forces and integration at division level and above, can give the force an edge and foster flexibility by providing additional repetitions in exercises. Another technique to gain flexibility is to strive for habitual relationships between air and ground units.

[17] US Army, *FM 3-04*, 3-10.

[18] US Army, *ADP 3-0*, 23, 38; US Army, *FM 3-04*, 3-20.

Habitual relationships between air and ground units are ideal, but are often unattainable for varied reasons. It takes time and repetitions to cultivate such relationships. Given current demands, it is difficult to find the time to foster such relationships, and in a future LSCO it is doubtful there will be training time to build a relationship that does not exist. *FM 3-04*, operation doctrine refers to "hasty attacks in support of all friendly ground units regardless of their training level or habitual relationship, but with greater risk" as undesired, but this may become more common in future LSCO. Aviation doctrine teaches standardized procedures to reduce the risk of non-habitual relationships. Aviators must remain flexible and adaptive as Army Aviation moves forward into LSCO, to learn and mitigate risks to missions.[19]

One way to counterbalance the risks presented by a limited relationship with ground forces and experience is with reliable intelligence from reconnaissance. Reconnaissance mitigates risk by filling in the missing pieces of critical information, allowing commanders to make more informed decisions without jeopardizing the tempo of the mission set by waiting for the minimum critical mission information. Commanders require quick and reliable intelligence to be able to make bold decisions without large unnecessary risks, especially when having to coordinate and consider multiple domains in LSCO. The incorporation of MUM-T enables detection, consistent contact of enemy forces, and identification of high-payoff targets in a dynamic operating environment. MUM-T therefore provides flexibility as well as essential information which enables commanders to adjust their plans accordingly, while more accurately assessing risk. There is a potential risk in reliance on UAS, as other factors such as weather, or terrain, or the enemy's abilities may limit reconnaissance.[20]

Risk will always be a factor in operations, but it is the way aviators account and react to risk which ensures a successful mission. Aviators must strive to use and create a diverse

[19] US Army, *ADP 3-0*, 44; US Army, *FM 3-04*, 1-3.

[20] US Army, *FM 3-04*, 3-33, 3-40, 3-71, 3-154.

knowledge base through training and experience to remain flexible in a complex mission environment such as LSCO. Combined arms teams must use the time they have together to train and create a quality learning environment, to standardize training objectives and mutual goals of the combined arms team.

Operational art "requires creative vision, broad experience, and knowledge of capabilities, tactics, and techniques across multiple domains." A future LSCO with a peer threat will stretch the US Army's current knowledge and capabilities. LSCO will require Army Aviation to provide the commander options to maneuver and position forces in a manner to best achieve their concept of operations. Army Aviation will meet the commander's need by leveraging their current doctrine to balance operational reach, tempo, and risk.[21]

Historical Case Study: Gulf War

The Gulf War, Desert Shield, and Desert Storm, illustrated the incorporation of operational art into AirLand Battle doctrine. According to author Robert Scales, AirLand Battle's "four tenets, initiative, agility, depth, and synchronization, are timeless, immutable precepts for present and future wars" as seen in unified land operations today. This historical case study will analyze how AirLand Battle and other Army doctrine applies to a near-peer threat in a short LSCO (in comparison to other LSCO like World War II). The three sections of operational art discussed in the doctrine portions: operational reach, tempo, and risk, are the basis for analysis of the historical case study.[22]

Background

In 1990, many evaluated the Iraqi Army as a near-peer threat to the US Army as Iraq had the fourth largest standing Army in the world. The livelihood of the Middle Eastern countries in

[21] US Army, *ADP 3-0*, 26.

[22] Robert H. Scales, *Certain Victory: The US Army in the Gulf War* (Fort Leavenworth, KS: US Army Command and Staff College Press, 1994), 107.

1990 was oil production and Kuwait, even though small, was an oil-rich country. During the 1980s many countries, such as Saudi Arabia and Iraq, had negative returns from their oil industry. In contrast, Kuwait maintained a positive income from oil. During this time the organization of the petroleum exporting countries made agreements to reduce oil production to increase the cost of oil. Kuwait, along with Saudi Arabia, increased their production. The price per barrel reached a low of fourteen dollars in June of 1990. Saddam Hussein, Iraqi President, was concerned about increased oil output in Kuwait and Saudi Arabia. President Hussein also feared Kuwait's western leaning intentions. The size of Iraq's army increased due to the war with Iran from 1980 to 1988 but left their treasury depleted, and Hussein looked toward Kuwait as a "quick fix" for their financial troubles.[23]

Hussein took drastic measures in August of 1990 and invaded Kuwait to seize Kuwaiti oil platforms to bolster Iraq's own oil production. After the invasion, Hussein claimed that western foreigners had annexed Kuwait from Iraq after World War II and claimed Kuwait as the nineteenth province of Iraq. The United States and its allies responded with diplomatic solutions with the United Nations. While diplomatic channels were working, the United States with Saudi Arabia, set up a "line in the sand" near the border of Saudi Arabia and Kuwait. This was the start of Operation Desert Shield, which also afforded the train up prior to Desert Storm. Near the border, the United States and Saudi Arabia built up forces while training troops, and conducting exercises with aircraft and live fire munitions. Army Aviation conducted screening along the border to provide reconnaissance on Iraqi troop movements as an early warning system, and set

[23] Eliyahu Kanovsky, *The Economic Consequences of the Persian Gulf War: Accelerating OPEC's Demise* (Washington, DC: Washington Institute for Near East Policy, 1992), xvii; Lincoln R. Ward, "The Division Artillery: Linking Strategy to Tactics in Operations Desert Shield/Storm," in *Lethal and Non-Lethal Fires: Historical Case Studies of Converging Cross-Domain Fires in Large Scale Combat Operations,* ed. Thomas G. Bradbeer (Fort Leavenworth, KS: Army University Press, 2018), 94; Kanovsky, *The Economic Consequences of the Persian Gulf War*, xiii, xv; Dilip Hiro, *Desert Shield to Desert Storm: The Second Gulf War* (New York: Routledge, 1992), 85; US Army Aviation Warfighting Center, *United States Army Aviation in the Gulf War* (Fort Rucker, AL*:* US Army Aviation Warfighting Center, 1991), 10.

up forward operating bases (FOBs) near the Saudi Arabian and Kuwaiti border. The buildup of troops in Saudi Arabia was enough to deter Saddam Hussein from invading the country; a fear held by King Fahd of Saudi Arabia.[24]

Desert Shield Analysis

Desert Storm's high-speed air and ground offense often overshadows Desert Shield's contribution to the Gulf War. Desert Shield was a necessary step that paved the way for the success of Desert Storm. The planning, training, and rehearsal time for Desert Storm was unprecedented. In past conflicts, the escalation to war with little intelligence "meant that first battles proved to be bloody schools in which green staffs and units were obliged to refine their skills on the battlefield." The training time afforded during Desert Shield gave not only US Army Aviation time to train the desert terrain, but also afforded time to develop joint relationships with sister services to "avoid another instance of learning in combat what the services could have practiced in pre-war training."[25]

Lieutenant Colonel Dell Dailey's 3-160th conducted a joint exercise that mitigated risk and cultivated relationships between the services by incorporating Navy, Marine, and Air Force pilots practicing combat search and rescue (CSAR). Colonel Jesse Johnson of Special Operations Command-Central (SOCCENT), oversaw all CSAR operations in Kuwait, Iraq, and twelve miles out into the gulf as SOF had the most experienced crews and best equipped aircraft for deep insertions. If available, Lieutenant Colonel Dailey fielded most of the calls as he had taken

[24] US Army Aviation Warfighting Center, *United States Army Aviation in the Gulf War,* 4; Herbert H. Blumberg and Christopher C. French, eds., *The Persian Gulf War: Views from the Social and Behavioral Sciences* (Lanham, MD: University Press of America, 1994), 29; James Williams, *A History of Army Aviation: From Its Beginnings to the War on Terror* (Lincoln, NE: iUniverse, 2005), 236-37; Scales, *Certain Victory*, 151; Thomas Houlahan, *Gulf War: The Complete History* (New London, NH: Schrenker Military Pub., 1999), 12-13.

[25] First quote from Scales, *Certain Victory,*153-154; second quote from Mark T. Calhoun, "Close Air Support and Bombardment Theory: Operation Cobra," in *Lethal and Non-Lethal Fires: Historical Case Studies of Converging Cross-Domain Fires in Large Scale Combat Operations,* ed. Thomas G. Bradbeer (Fort Leavenworth, KS: Army University Press. 2018), 179.

measures to prepare his crews and build confidence in CSAR operations with sister services by creating CSAR scenarios in the deserts of Saudi Arabia during Desert Shield. Lieutenant Colonel Dailey dropped the Navy, Air Force, and Marine pilots in the desert at night, and then recovered them through extraction. This training was beneficial for those dropped off as it enhanced their survival, evasion, resistance, and escape (SERE) training for the pilots, then have his crews come in low and fast for a night extraction. By using the time of Desert Shield for training CSAR operations, Lieutenant Colonel Dailey was able to minimize risk, maximize tempo as crews were familiar with conducting night CSAR operations. Therefore, his pilots needed minimal planning as they were well trained. The incorporation of the other services' pilots fostered relationships across the services which facilitated the tempo of Desert Storm as the crews conducted close air support and deep attacks in concert.[26]

The risk was still present even for the more experienced SOF pilots and crews. SOCCENT had to determine, with every call, if it was an acceptable risk to expose aircraft and crews to danger to conduct CSAR operations. The SOF pilots had trained for CSAR operations and were better prepared for the risky situation of a hot landing zone. The 229th Attack Helicopter Battalion from Fort Rucker, Alabama, did not undergo the same training as the SOF pilots. A UH-60 from 2-229th attempted a CSAR operation, for a downed Air Force F-16 pilot, when SOF was not available and the enemy shot the UH-60 down. Only three of the seven CSAR missions throughout Desert Storm were successful. The SOF crews, who had received the extra training, flew all the successful CSARs. The specialized training of the SOF pilots and crews mitigated risk and allowed the crews to reach deep into enemy territory.[27]

Forces maintained operational tempo during Desert Storm because of the training performed during Desert Shield. The XVIII Airborne Commander, General Gary Luck, described

[26] Scales, *Certain Victory,* 195-198.

[27] Scales, *Certain Victory*, 195.

it as “actually the best training we’ve probably ever had in this Army because of the resources and space put at our disposal.” General Luck set up training areas and firing ranges to sharpen combat skills and to adjust to the desert climate and challenges. The AirLand Battle defines agility as “the ability of friendly forces to act faster than the enemy, [which] is the first prerequisite for seizing and holding the initiative.” Desert Shield’s training facilitated the agility demonstrated by forces upon the execution of Desert Storm.[28]

General Luck and XVIII Airborne Corps used AirLand Battle’s tenet of agility by disseminating lessons learned from Desert Shield to combat risk while facilitating tempo. Pamphlets and handbooks circulated through department of the Army staff and US Army Training and Doctrine Command to share the knowledge of hard-learned lessons in the desert through official channels. This information and lessons learned greatly increased the incoming units learning curve for operating in the desert. As an example, initially, the AH-64 encountered issues with “losing control of the Hellfire caused by laser backscatter from the fine sand suspended in the air.” AH-64 crews solved the issue before executing their deep attack mission in support of Operation Desert Storm and disseminated the lessons to adjacent and incoming units.[29]

Task Force Normandy

“One of the smallest yet most successful and important Joint-Army-Air Force operations in the initial strikes in Operation Desert Storm was Task Force Normandy.” The TF consisted of eight Army AH-64 Apaches and four Air Force MH-53 Pave Low helicopters. The TF conducted a deep attack into Iraq to destroy two early warning sites to blind the Iraqi’s air defense system prior to commencing the air campaign. US forces had to destroy the early warning sites simultaneously to avoid alerting the air defense system. TF Normandy meticulously planned and conducted many rehearsals to mitigate risk during their deep attack. This resulted in successfully

[28] First quote from Scales, *Certain Victory*, 151; second quote from Ward, *The Division Artillery*, 95; Scales, *Certain Victory*, 151

[29] Scales, *Certain Victory*, 151.

blinding the Iraqis and serves as an example of operational reach and synchronization within AirLand Battle doctrine.[30]

"Deep operations require boldness and audacity and yet carry an element of risk due to overextension." TF Normandy assumed many risks besides conducting a deep attack into Iraq at night while flying nap of the earth. The teams trained for three months developing the habitual relationships necessary because "between inter-service aircrews there was a natural and mutual mistrust within the aviation community" and finding solutions to the different equipment needs, tactics, training, and procedures. As General Donn A. Starry accurately said, "deep attack is not a luxury; it is an absolute necessity to winning." Despite the higher risk, the United States approved TF Normandy to commence the attack against the two targets as seen below in Figure 4. The TF gained approval because of their training, proven synchronization, and necessity of the mission to blind the Iraqi air defense.[31]

[30] Williams, *A History of Army Aviation*, 246; Scales, *Certain Victory*, 158-159; Paul E. Berg and Kenneth E. Tilley, "Task Force Normandy: The Deep Operation that Started Operation Desert," in *Deep Maneuver: Historical Study of Deep Maneuver in Large-Scale Combat Operations,* ed. Jack D. Kem (Fort Leavenworth, KS: Army University Press, 2018), 140-142.

[31] First quote from Jack D. Kem, "Introduction," in *Deep Maneuver: Historical Study of Deep Maneuver in Large-Scale Combat Operations*, ed. Jack D. Kem (Fort Leavenworth, KS: Army University Press, 2018), xii; second quote from Berg and Tilley, "Task Force Normandy," 145; third quote from Kem, "Introduction," xi; Williamson Murray, *Air War in the Persian Gulf* (Baltimore, MA: Nautical and Aviation Publishing, 1995), 281; Berg and Tilley, "Task Force Normandy," 145-147.

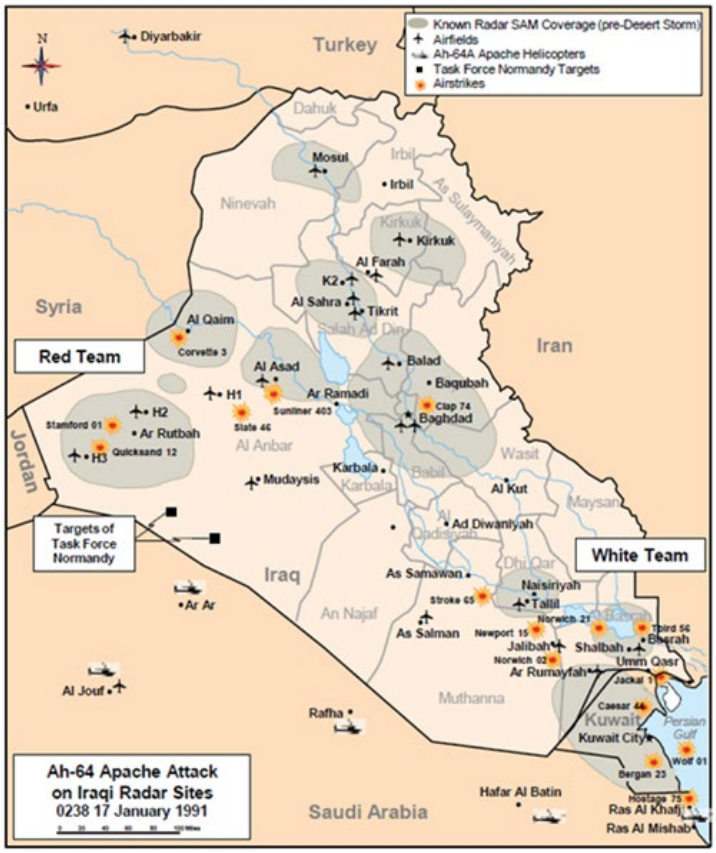

Figure 4. AH 64 Apache Attack on Iraqi Radar Sites. “Task Force Normandy,” 141.

To reach twenty miles deep into Iraqi territory a great debate arose for the best aircraft and team for the mission. The qualifications came down to those discussed in AirLand Battle, “using speed, maneuver and firepower that is both precise and massive.” The AH-64s had the speed and most accurate and massive firepower but were lacking in their ability to maneuver at night. The Air Force MH-53s did not have adequate firepower to conduct the attack, but did have the global positioning system capabilities that the AH-64 lacked. Therefore, the MH-53s lead them to a designated separation point. The deep attack was only possible using both airframes working together. Additionally, UH-60s in proximity with AH-64 mechanics were on hand to quickly react to downed or damaged aircraft. The timing and tempo of Desert Shield allowed the TF to focus on preparing their mission. The three months of training afforded them the time to solve problems such as chemical lights to mark the designated release points and limited reach of the AH-64 by switching out a rocket pod and replacing with an external fuel tank. The

synchronization set the smooth tempo of TF Normandy as a "maximum economy of force, with every resource used where and when it will make the greatest contribution to success so that nothing is wasted or overlooked."[32]

Forward Operating Base Cobra and Air Assault to Highway 8

The establishment of FOB Cobra and the air assault to Highway 8 tested the tempo and synchronization of the 101st Airborne Division. General James Henry Binford Peay III had assembled six kilometers to the south of the Iraqi border "the largest air armada the United States had ever committed to a single air assault operation." AH-64 Apaches led a scouting party, and escorted the sixty-six UH-60 Blackhawks and thirty CH-47 Chinooks. The air assault transported the first 500 soldiers as well as sling loaded howitzers and high mobility multipurpose wheeled vehicle (HMMWV) 110 miles into Iraq to set up FOB Cobra for the next stage in the air assault, cutting off the Iraqi supply line on Highway 8 along the Euphrates River as seen in Figure 5 below. This risky air assault served as an excellent example of the use of an air assault to reach deep into enemy territory and disrupt lines of reinforcement and supply.[33]

[32] First quote from Houland, *Gulf War,*109; second quote from Scales, *Certain Victory*, 107; Berg and Tilley, "Task Force Normandy," 142-144; Scales, *Certain Victory,* 157.

[33] Scales, *Certain Victory*, 217, 218; Murray, *Air War in the Persian Gulf*, 277.

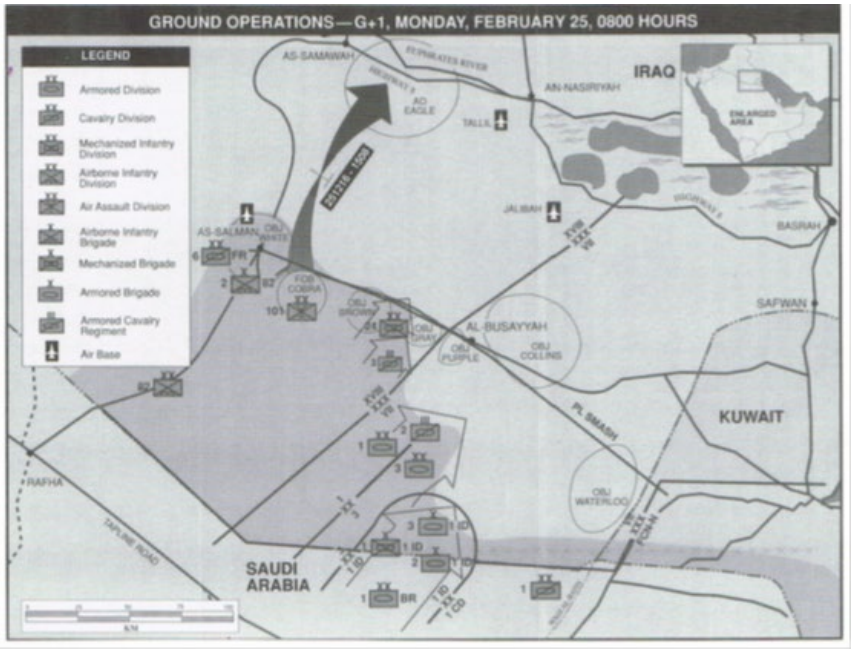

Figure 5. Ground Operations-G+1, Monday, February 25. *Certain Victory*, 304.

The air assault required intense planning as it required three turns to lift the whole brigade. The AH-64 Apaches and AH-1 Cobras scouted for possible enemy threats around FOB Cobra to maintain the FOB's security. The AH-1s discovered an Iraqi infantry battalion dug into the ridge along the east-west road. After discovery, the AH-1 crews landed and conferred with Infantry Company Commander Captain John Russell to establish friendly positions and plan of action. The size of the enemy footprint required support from Air Force A-10s. Fortunately, there was an embedded Air Force liaison officer with the Air Force unit. This enabled the force to maintain their tempo by quickly creating a Joint Air Attack Team of Air Force A-10s and Army Cobras and Apaches. The Joint Air Attack Team bombarded the Iraqi position, leading to 340 Iraqis surrendering, securing FOB Cobra, and providing mission security of the air assault to Highway 8.[34]

[34] Scales, *Certain Victory*, 219; Murray, *Air War in the Persian Gulf*, 277; 101st Airborne Division, "After Action Report Operation Desert Shield/Desert Storm" (Command Report, 13 June 1991), 45-47.

Once the fifteen kilometers perimeter around FOB Cobra was secure, the next part of the mission began with the 101st and 229th Attack Helicopter Battalion AH-64s scouting landing zones and enemy near Highway 8. The 229th Attack Helicopter Battalion augmented 101st, providing flexibility to the CAB to conduct their deep attack mission. The reconnaissance and escort for UH-60 Blackhawks was crucial to the success of the deep insertions of long-range surveillance detachments. The weather changed to rain and therefore the AH-64 reconnaissance teams had to determine the available landing zones that were suitable for the air assaulting soldiers and vehicles as seen in Figure 6 below. The reconnaissance and long-range survival detachment maintained the tempo for the mission and mitigated risk of delay due to weather.[35]

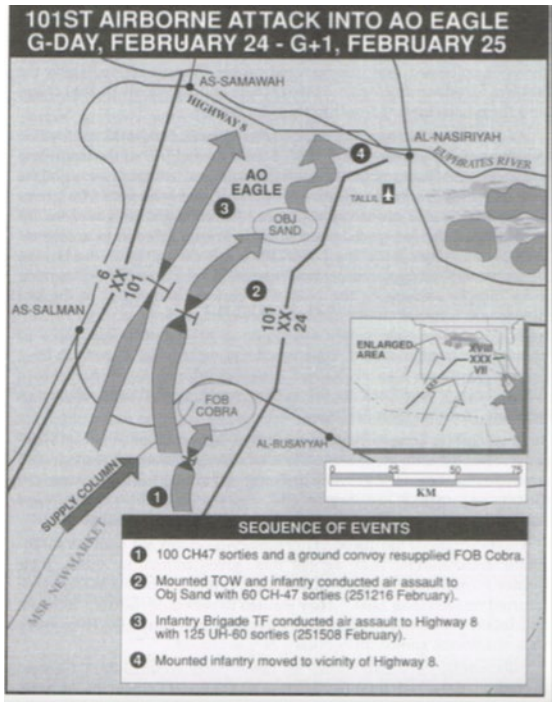

Figure 6. 101st Airborne Attack into AO Eagle. *Certain Victory*, 221.

The next step was the two-prong insertion of an infantry division and anti-armor, supply, and communication vehicles. The AH64 reconnaissance mission on landing zones enabled sixty UH-60s to insert the first 500 infantry soldiers into unobstructed landing zones adjacent to

[35] Scales, *Certain Victory*, 220; US Army Aviation Warfighting Center, *The United States Army in the Gulf War* (Fort Rucker, AL*:* US Army Aviation Warfighting Center, 1991), 30.

Highway 8. In just thirty-one hours, in a bold and quick deep attack, the 101st had cut off "the key Iraqi Basrah-Baghdad lifeline." All four of the tenets of AirLand Battle doctrine; initiative, agility, depth, and synchronization, were a part of the air assault to Highway 8. The air assault was bold and risky, however, the 101st mitigated the risk through reconnaissance and building up to this assault with other, smaller assaults.[36]

Pre-Ground Day Raids

Before the start of the hundred-hour ground war, Army Aviation played a key role in shaping the battlefield with pre-ground day raids and feints that contributed to the success of the "great wheel." The pre-ground day raids served a dual purpose of interdicting the enemy's supply depots, surveillance posts, armored vehicles, antiaircraft positions, and securing the main supply routes. The second purpose was training for future deep attacks in a lower risk environment and building relationships with armor and infantry divisions that would prove crucial during the ground war.[37]

The biggest feint in the pre-ground day raids involved the VII Corps artillery and the AH-64 from the 11th Aviation Brigade serving as "a carefully rehearsed drill for later deep attacks." Generals Tommy Franks and Robert Abrams observed the feint from the artillery command post to pinpoint any improvements before future riskier deep attacks of the ground war. The pre-raids mitigated a lot of the risk by providing training, reviewing opportunities, and ensuring main supply routes were clear, which are crucial to support aviation missions. "Fuel is the lifeblood" of aviation, as an attack helicopter can burn an average of two and half gallons per minute. Without sufficient and well-placed refueling points, aviation's tempo is severely hindered.[38]

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[36] Scales, *Certain Victory*, 220; Murray, *Air War in the Persian Gulf*, 279.

[37] Scales, *Certain Victory*, 221.

[38] First quote from Scales, *Certain Victory*, 203; second quote from Scales, *Certain Victory*, 220.

The pre-Ground Day raids not only opened main supply routes Texas and Newmarket, but lead to several Iraqi units to surrender. Aviation also teamed up with the Psychological Warfare Military Intelligence Battalion to use loudspeakers attached to some Blackhawks and drop leaflets to coax the Iraqis out of the bombarded bunkers, as seen in Figure 7 below. The 101st, with coordination of 187th Infantry, recovered 406 prisoners when they secured the site. Intel recovered from the site, along with information gained by debriefing the prisoners, benefited the planning of future deep attacks. The synchronization with psychological warfare and infantry battalions, allowed the combined arms team to utilize the strengths of many different branches to create an optimal tempo of mission and foster success.[39]

Figure 7. Psychological Warfare with a UH-60. *Certain Victory*, 199.

Concluding Analysis of Gulf War

The Gulf War comprised of Desert Shield and Storm lent itself very well to AirLand Battle doctrine. Iraq had a large army, but they were not well trained, and many of their resources were outdated. The transparent outline of Iraq's capabilities and weaponry acquired in a recent long war with Iran, allowed the United States to adequately prepare to counter and overmatch the threats posed by Iraq. Desert Shield also proved as a training ground for future missions, such as TF Normandy and the 101st air assault to Highway 8. The training time gained during Desert

[39] Scales, *Certain Victory*, 199-200.

Shield, and the feints during the Great Wheel, demonstrated the Army's operational reach and high tempo.

The amount of planning time afforded to Desert Shield and Desert Storm, while Saddam Hussein was stalling diplomatic sanctions, will likely be unavailable in LSCO. The buildup time to conflict could be significantly faster and would require swift reaction of US forces to mobilize in theater. Iraq was not a peer threat and did not have the advantage of observing the United States implement the AH-64 and other new technologies before the Gulf War. Our current competitors and adversaries have observed the US in seventeen years of COIN and have observed how the United States fights, implements its technologies, and reacts to changes on the battlefield. New airframes, such as new UAS systems or future vertical lift platforms, must prove themselves effective in LSCO, just like the AH-64 did in Desert Storm. The proliferation of technology and multi-domain theaters will create more of a challenge for Army Aviation than in Desert Shield and Desert Storm. The timeless tenets of AirLand Battle doctrine are still current for a contemporary LSCO. In a current day LSCO Army Aviation needs to maintain a high tempo, long operational reach, and react quickly when a multi-domain window of opportunity opens.

Gaps and Recommendations for Future Army Aviation

Large Scale Combat Operations in a multi-domain environment is a drastic change from the last seventeen years of COIN. The culture of the Army evolved from fighting decentralized in brigades and now towards headquarters seen as the resource integrator, versus a resource provider. Changing the culture will take time, especially while the Army handles additional gaps in doctrine, training, and capabilities. World conflict will not wait for such an evolution in Army culture. The echelon above brigade (EAB) must be well organized and able to decongest a complex battlefield, to pinpoint the areas of convergence and dis-integrate them. Unlike the historical case study, potential adversaries can contest the airspace and match US air superiority. One of Army Aviation's main roles discussed in this paper is the capability to reach deep into

contested areas, such as in the case study with TF Normandy and the 101st air assault to Highway 8.[40]

In the current operational environment, our adversaries have developed air defense systems to deny Army Aviation's freedom of maneuver in multi-domain operations (MDO). Unfortunately, it is not only an air defense system, but the Anti-Access/Area Denial (A2/AD) contesting many of the domains. The A2/AD system, depicted in Figure 8 below, illustrates the United States' peer threats A2/AD system. Russia and China have shared some of their A2/AD systems with other countries, which then serve as a testing ground of the A2/AD systems. The United States will be able to find weaknesses in the systems, and at the same time Russia and China will be watching to address those weaknesses in their A2/AD systems.[41]

[40] Erick Sweet, "Integration of Aviation Ops at Echelons Above Brigade," *Aviation Digest* (October-December 2015) 6.

[41] Peter Quinn, *Air Launched Effects Concept of Employment: Army Aviation Multi-Domain Force Multiplier* (Fort Rucker, AL: USAACE, 2018) 1-2.

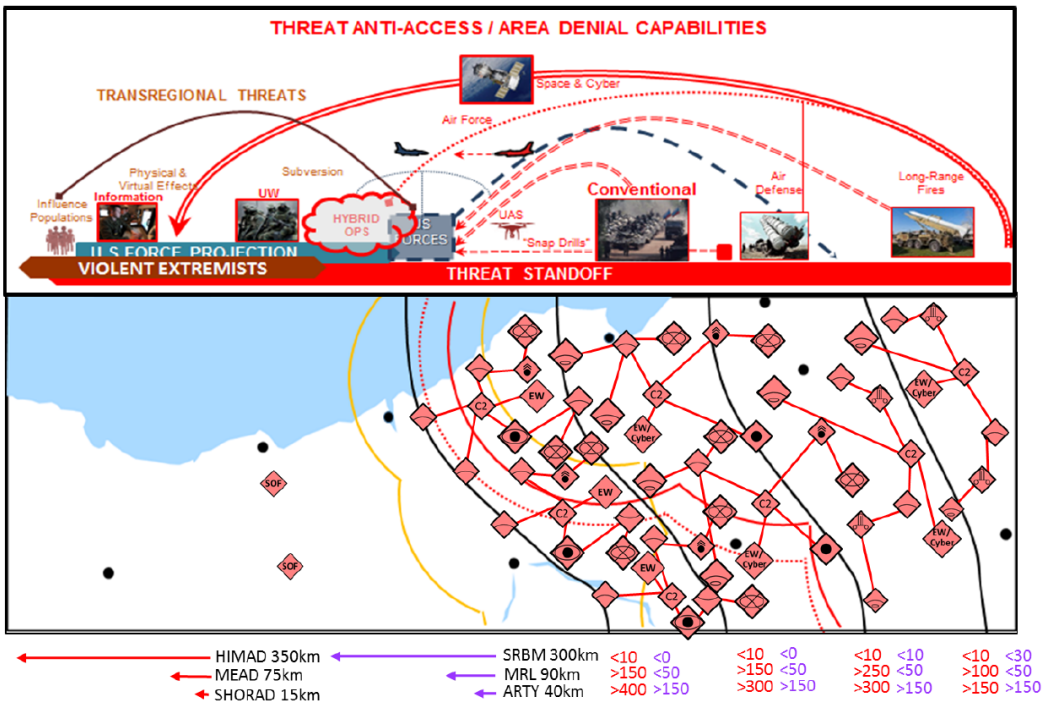


Figure 8. Threat Anti-Access/Area Denial Capabilities. *TRADOC Pamphlet 525-3-8*, 36.

Army Aviation will switch their focus to employ multiple cross-domain maneuvers designed by EAB to create windows of opportunity for maneuver forces. To achieve overmatch when facing a peer-adversary, Army Aviation must have the capability to reach, provide close air support, lethality, and situational understanding. For the consideration of this paper, the focus will be the gaps in capability to reach and play a crucial role in AGOs and ensuring freedom of maneuver. The second part of this discussion will analyze the training gaps for current and future Army Aviators, as well as EAB, to successfully utilize the asymmetric advantages that Army Aviation provides in LSCO.[42]

Reach: Range, Speed, Survivability, and Maneuverability

According to Army Aviation's equipment modernization strategy, reach is a part of the first four of seven key Army Aviation challenges and gaps, as identified in the Army's capability

[42] US Department of the Army, *TRADOC Pamphlet 525-3-8, The US Army Concept for Multi-Domain Combined Arms Operations at Echelons Above Brigade 2015-2045* (Fort Eustis, VA: Government Printing Office, 2018), 6.

needs analysis. Army Aviation requires platforms to have adequate range, speed, survivability, maneuverability, and deploy quickly to strategic locations with little notice. Two of the major differences between COIN and LSCO are going to be the theater and availability of troops and divisions already on the ground, such as our contingent in Iraq and Afghanistan. Regarding LSCO, the theater could be immense and the range of UAS platforms could fall short of intelligence, surveillance, and reconnaissance requirements. The United States would have to project into an undeveloped theater and fight to gain a foothold, unlike the last seventeen years. The Apache AH-64D/E currently has lower combat range and cruise speed than the assault and air movement airframes.[43]

The deficient range capability of the AH-64 is priority number six out of sixty-seven high-priority programs for the Army fiscal year 2019 budget. The Army's improved turbine engine program attempts to resolve this shortfall, and intends to expand the program to the UH-60M. This program seeks improved fuel consumption and greater power to support increased maneuverability. Given the importance of range to aviation operations, the Army recently took great lengths to test the Army's range of the UAS MQ-1C extended range. The extended range Gray Eagle underwent an extensive fourty-two day training mission with F Company from 160th Special Operations Aviation Regiment Airborne (SOAR) at the National Training Center (NTC) in Fort Irwin, California. The MQ-1C extended range satisfied the demand for a combat radius of 1,000 kilometers and fourteen hours of loitering time. It also set the standard of forty hours of continuous flight with a common sensor payload and twenty-four hours with a payload of two Hellfire missiles. Army Aviation is making attempts to fill capability gaps, but it takes valuable

[43] US Army Aviation Center of Excellence, *Army Aviation Equipment Modernization Strategy: Equipping the Aviation Force to Win in a Complex World* (Fort Rucker, AL: US Army Aviation Center, January 2016), 3.

time, and money as the MQ-1C Extended Range three-year project cost over thirteen million dollars but met with success.[44]

Future Vertical Lift (FVL) works toward improving future airframes with greater range, power, and sustainability. FVL, elevated into one of the six cross-functional teams in the new modernization strategy of the Army, as seen below in table 1. The new lines of effort are the future attack-reconnaissance aircraft, the future long-range assault aircraft, an advanced UAS, and a modular system approach. The challenge facing FVL is creating strategies and procuring technology to defeat (or make small windows of opportunity against) A2/AD systems as seen below in Figure 9. Another capability gap is the susceptibility of cyber-attack. FVL is working on implementing a "digital backbone that affords a cyberphysical interface" to not only protect, but enable quick, fleet wide updates to be proactive against an emerging threat. The capability to implement updates to current systems is usually a long process, but that will soon change with the installment of the CAB architecture integration lab. The Army does not have rights to most of the software on the aircraft, and any improvements or additions must go back to the manufacturing company for testing and approval. This is a timely and costly process. The UH-60V will be the first aircraft with the open systems architecture mission computer. The Army will own the rights to the software and rapidly speed up the process of new technology insertions in the refurbished UH-60L.[45]

[44] Government Accountability Office, GAO-19-132, *Army Modernization Priorities and Assigned Cross-Functional Teams* (Washington, DC: Government Printing Office, 2019), 14; Joshua Durham, "Testing the Army's Extended Range Gray Eagle UAS," 52-53.

[45] William Lewis and Carvil Chalk, "Science and Technology for Future Vertical Lift," *Army Aviation* (January 2019): 45; US Army Aviation Center of Excellence, *Army Aviation Equipment Modernization Strategy*, 8; Thomas H. Todd III, "PEO Aviation Meeting the Demands of the Future Battlefield," *Army Aviation* (December 2018): 10.

Table 1. Army Modernization Priorities and Assigned Cross-Functional Teams

Army priority	Description of priority	Cross-functional team location
Long-Range Precision Fires	Capabilities, including munitions that restore Army dominance in range, lethality, and target acquisition.	Long-Range Precision Fires – Fort Sill, Okla.
Next Generation Combat Vehicle	Manned and unmanned combat vehicles with modern firepower, protection, mobility, and power generation.	Next Generation Combat Vehicle - Detroit Arsenal, Mich.
Future Vertical Lift	Manned and unmanned platforms capable of attack, lift, and reconnaissance missions on modern and future battlefields.	Future Vertical Lift – Redstone Arsenal, Ala.
Army Network	A mobile system of hardware, software, and infrastructure that can be used to fight cohesively in any environment where the electromagnetic spectrum is denied or degraded.	Network Command, Control, Communication, and Intelligence – Aberdeen Proving Ground, Md.
		Assured Positioning, Navigation, and Timing – Redstone Arsenal, Ala.
Air and Missile Defense	Capabilities that ensure future combat formations are protected from modern and advanced air and missile threats.	Air and Missile Defense – Fort Sill, Okla.
Soldier Lethality	Capabilities, equipment, and training for all fundamentals of combat—shooting, moving, communicating, protecting, and sustaining. This includes an expansion of simulated training.	Soldier Lethality – Fort Benning, Ga.
		Synthetic Training Environment – Orlando, Fla.

Source: Government Accountability Office, *GAO-19-132*, 8.

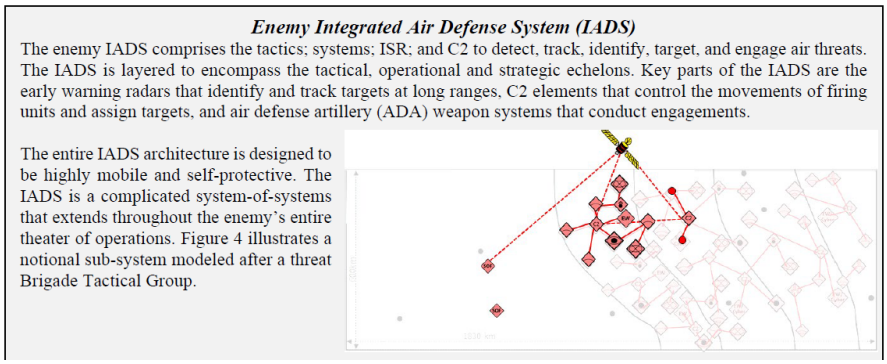
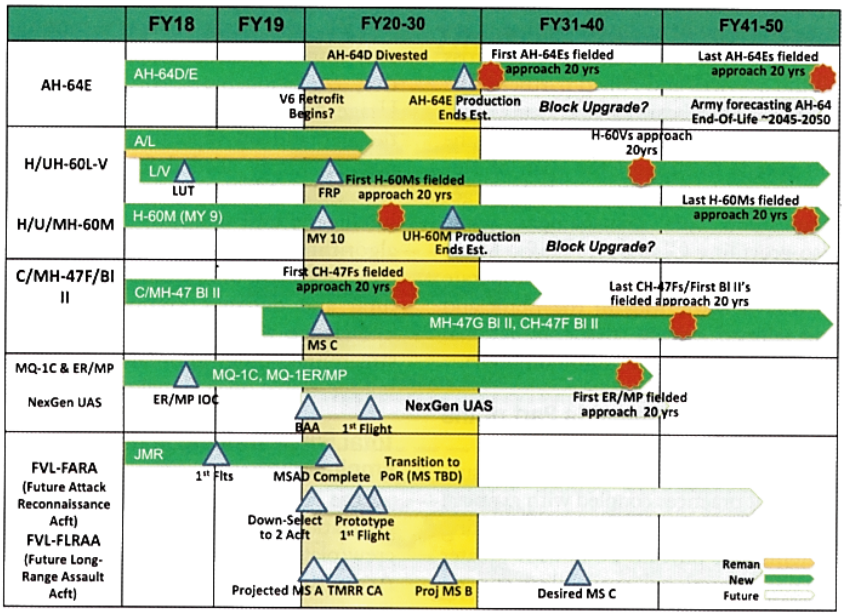


Figure 9. Enemy Integrated Air Defense System. *TRADOC Pamphlet 525-3-8*, 42.

FVL's challenge is the task of making the expeditionary aviation forces self-deployable, by increasing their range, as well as maintenance requirements. Several units that stand at the ready for deployment of large distances into US Indo-Pacific Command rely heavily on C17's for transport. The transportation issues arise at the low supply of C17's to mobilize CH-47s, UH-60s, AH-64s, and UAS. A C-17 can only take one CH-47 at a time, or two UH-60s, and that is after units have prepared the aircraft for transportation in the C-17. Upon landing, units must conduct hours of maintenance and test flights. It can take several weeks to mobilize just an aviation expeditionary force, which is not quick enough for mobilization in support of LSCO. Once the expeditionary forces mobilize, they need the flexibility of movement, which is typically dependent on sustainment. Aviation is reaching a pivotal point in the modernization of the fleet

with investing in the legacy airframes to ensure readiness to fight LSCO today, versus the future fleet with upgraded capabilities. As seen below in table 2, the modernization chart has most of the legacy fleet in service until fiscal year 2050. The CH-47F, with the digital cockpit upgrades, cost the aircraft 4,000 pounds of payload. Army Aviation is attempting to regain the 4,000 pounds of capability through engine and rotor blade enhancements. The Army can only upgrade the legacy fleet to a certain point, as seen with the CH-47, and aviation must balance when to invest in new models over modifying the current fleet. The Army has the largest vertical fleet of the service, yet only spent twenty-seven and a half percent of the total military services rotary wing aviation spending on research and development. The Army needs to find a balance between sustaining the legacy fleet and investing in FVL.[46]

Table 2. Army Aviation Major Fleet Modernization Perspective



Source: Army Aviation "The Future of Vertical Lift–The Future of Army Aviation," 76.

[46] US Army Aviation Center of Excellence, *Army Aviation Equipment Modernization Strategy*, 8; Gabriel Coll, Andrew Hunter, and Robert Karlen, "Beating the Air into Submission: Investing in Vertical Lift Modernization" (Center for Strategic and International Studies Briefing, February 2019), 3.

Sustainment

FVL's future goals include maintenance free intervals of their platforms for thirty days or sixty hours. Sergeant Major Mike Dove, Command Sergeant Major of Army Aviation and Missile Command (AMCOM) Life Cycle Management Command (LCMC), commented on the maintenance intervals as "a lofty goal" during the Cribbins Aviation product sustainment symposium, but later compared them to the commercial airline fleet maintenance schedule. Though it has not been much of a concern the last seventeen years in COIN, Army Aviation maintenance capability is a major concern for LSCO. Units delegated aircraft reset to contractors during COIN, along with other maintenance duties, but that may not be possible during LSCO. Army maintenance companies are now returning to completing phase inspections to gain battle readiness again, but it will take time and initiative in each division to wean maintenance companies off a strong contractor's presence. The reset program, now a part of CAB responsibility has undergone a new concept to rate aircraft reset needs based on a holistic approach of the aircraft, as seen in Figure 10, instead of just deployment cycle. The sustainment decision support tool makes the process more efficient, and takes into consideration more factors, such as operational tempo.[47]

[47] Mike Dove, "Final Report from the AAAA Cribbins Symposium," *Army Aviation* (January 2019): 16; Anthony W. Hudson and John Gipson, "1ID CAB Aviation Maintenance in a Post-ARFORGEN World," *Army Aviation* (January 2019): 42-43; Shawn T. Prickett and James P. Snyder, "Sustaining the Fleet–Leveraging Condition Based Reset," *Army Aviation* (January 2019): 36-37.

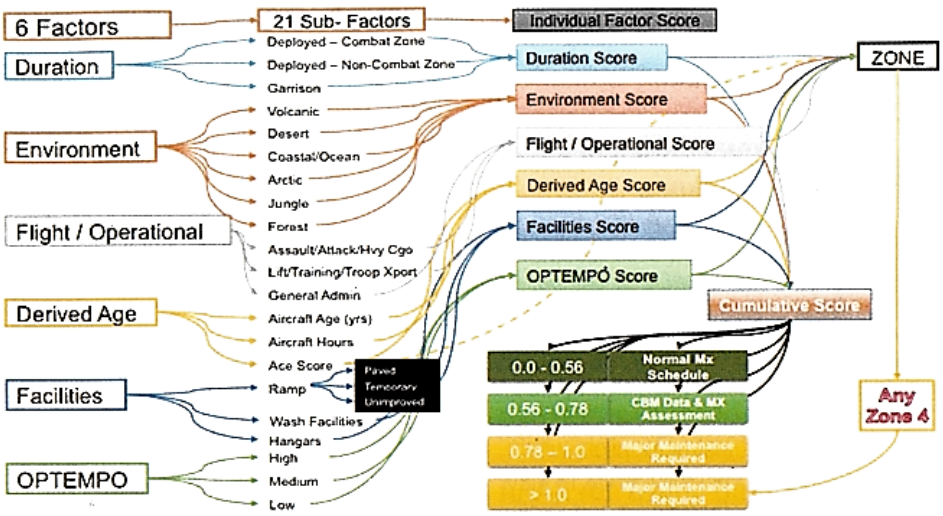


Figure 10. Condition Based Decision Support Tool Factors. "Sustaining the Fleet," 36.

A peer threat can target the Army's center of gravity, mainly the supply chain and maintenance capabilities, limiting the Army's operational reach. Maintenance will have to be agile, organically mobile, and expeditionary, as shown in Figure 11 below, to avoid becoming an easy target. The same will also be true for aviation aircraft. The CAB must be able to operate while breaking up maintenance organizations into smaller formations in multiple locations. If broken down into platoons, the formations of aircraft will become less of a target and less of a risk to the CAB. LSCO could require maintenance mobility time frames of every twenty-four to forty-eight hours as the CAB maneuvers.[48]

[48] Prickett and Snyder, "Sustaining the Fleet," 36-37.

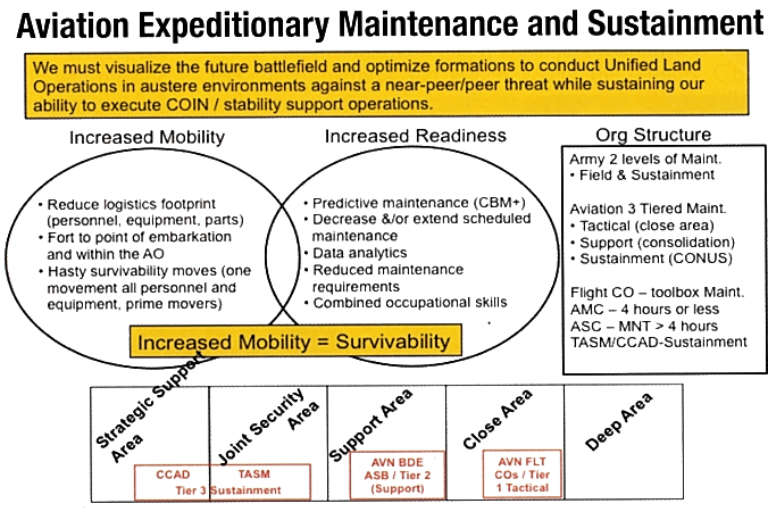


Figure 11. Aviation Expeditionary Maintenance and Sustainment. "Expeditionary Sustainment in Support of Large Scale Operations," 31.

AMCOM operated on the "Just-In-Time" inventory approach due to the logistics modernization program. The logistics modernization program focused on the most efficient method to keep the lowest possible stock on hand. The logistics modernization program was efficient and effective for Army Aviation's efforts in COIN, but represents another shock in Army culture in the change needed for fleet readiness of in-depth supply chains. The identified gaps in sustainment for LSCO, and goals set by AMCOM, includes ninety days of stock on hand with no backorder of more than thirty days for critical readiness parts. AMCOM identified the top readiness drivers as a priority for each aircraft to build enough supply depth. The question arises if AMCOM will be able to predict and anticipate the supply needs of LSCO, especially with the previous supply state of mind from the logistics modernization program, "Just in Time." AMCOM is setting the best goals, but LSCO is unknown. There are still capability gaps in the supply chain and formations of maintenance that need to adjust before the US engages in a conflict with near or peer threats. Maintenance is just one factor in the survivability of the aircraft.[49]

[49] David K Almquist and Brent Swart, "AMCOM-Working to Attain Strategic Supply Chain Depth," *Army Aviation* (October 2018): 56-57; Douglas M. Gabram, "Attacking Aviation Readiness Drivers," *Army Aviation* (October 2018): 11.

Another integral part of survivability of Army Aviation in LSCO is equipment, current technology, and strategy to defend against a near or peer threat. The project management office for aircraft survivability equipment (PMO ASE) is fielding many systems, such as the advanced threat infrared countermeasures for CH-47 aircraft, to defend against man-portable air-defense systems. The PMO ASE found success and continues to test new updated versions to include the AN/AVR-2B laser detecting set, a passive laser warning system to increase aircrew situational awareness. The capability gap of facing an A2/AD system is still an ongoing issue, as PMO ASE is still pursuing multi-spectral detect and defeat technology to outmatch our near and peer threats. The PMO ASE made small successes on the path to defending against A2/AD systems, but are not currently enough for LSCO.[50]

Training Gaps

The NTC at Fort Irwin, California works to revitalize their training to fit an MDO scenario for live training against a near-peer threat. The slogan used by NTC is "Ready now to win against a near-peer threat. Readiness for ground combat remains our number one priority." NTC pushes to increase the tempo, lethality, complexity, and limited communication of an MDO with a peer threat. NTC brought to light the lack of knowledge of efficient use of Army Aviation, especially the UAS. One of the many lessons learned of NTC is to "learn faster, and synchronize combined arms faster than the enemy." Fighting at echelon is difficult due to the complex synchronization, especially when units are unfamiliar with how to employ Army Aviation in LSCO. NTC is striving to provide realistic training. However, electronic warfare and cyber-attacks are not yet present, and as such, units lack repetitions on operating with such threats. NTC is only capable of providing a near-peer threat in terms of capabilities which was a large transition from COIN. If the purpose of NTC, according to the commander of operations at NTC,

[50] Kevin S. Chaney, "Project Manager Aircraft Survivability Update," *Army Aviation* (October 2018): 29-31.

Colonel Christopher R. Norrie, is to "ensure that units have their hardest day in the desert so that no soldier goes untrained into combat," then their ultimate goal should be to train against a peer threat instead of a near-peer threat.[51]

NTC's goal is not only to train the brigade, but also build up and train their leadership. One observation of Army Aviation made at NTC, was the diminished amount of platoon leaders serving as air mission commanders. CABs need to instill the younger officers with the experience they will need in mitigating risk, planning, and leading flight formations, and the burdens of mission success for the future company and battalion commands. Company commanders are the prime educators for their unit's air mission commander. If they lack in experience, it will reflect on the knowledge of the air mission commander. NTC is an excellent learning environment for young officers, but only if given the leadership roles that "will guarantee competent leaders and commanders at echelon that lead and fight in a complex environment," according to deputy commander of the Combat Readiness Center, COL Christopher Waters.[52]

The Joint Readiness Training Center (JRTC) has also been evolving its training techniques. JRTC focuses on the peer-threat faced by the United States in LSCO. JRTC expanded its training area in response to the break from COIN to mass combat capabilities and focus on combined arms integration. The fourteen-day crucible challenges brigades to integrate into the division level fight, not just at the brigade or battalion level. Similar to NTC, JRTC also needs to incorporate electronic warfare and cyber-attacks into training scenarios. The terrain of JRTC, although expanded, has little-improved roads to simulate urban conditions that will be a part of LSCO. The terrain does simulate lack of open areas as an urban environment would for massing

[51] First quote from Christopher R. Norrie, Thomas E. Lamb, and Michael J. Culler, "Ready Now-Our Number One Priority," *Military Review* (September-October 2018): 61; second quote from Norrie, Lamb, and Culler, "Ready Now-Our Number One Priority," 67; third quote from Norrie, Lamb, and Culler, "Ready Now-Our Number One Priority," 62.

[52] Christopher W. Waters, "The Importance of Platoon Leaders Serving as Air Mission Commander," *Army Aviation* (December 2018): 19.

combat power but lacks the substantial noncombatant population challenge. JRTC is ever evolving and successfully breaking down the culture and norms established by the last seventeen years of COIN. JRTC is setting a foundation for fighting at EAB but still requires additional improvements to prepare units for LSCO by including electronic warfare, cyber warfare, and A2/AD.[53]

160th SOAR is trying to bridge the gap of tactics against defeating the A2/AD systems. SOAR identified the gap in training for advanced weaponry tactics compared to other sister aviation services, such as the Marine Corps' weapons and tactics instructor course, and the Air Force weapons school. SOAR is trying to solve the A2/AD threat and other challenges presented by an MDO by creating advancements in education and training. SOAR's motto is to "own the night," which without any changes and advancements will not be a given, as even SOF can no longer count on air superiority or unimpeded night operations. Figure 12 below demonstrates SOAR's vision for their tactics program. The vision is to fuse intelligence, electronic warfare, and Army Aviation Mission Survivability Officers (AMSO). The school will combine their expertise to enhance their crews' survivability. The key to fighting in an MDO is a combined effort to attack in multiple domains, but that is not possible without first establishing habitual relationships within the multiple domains.[54]

[53] David Doyle and Aaron Coombs, "How Has the JRTC Changed to Adapt to LSCOs?" *Military Review* (September-October 2018): 74-79.

[54] Sean Karrels and Brett McFarland, "Bridging the Aviation Education Gap," *Army Aviation* (June 2018): 28-31.

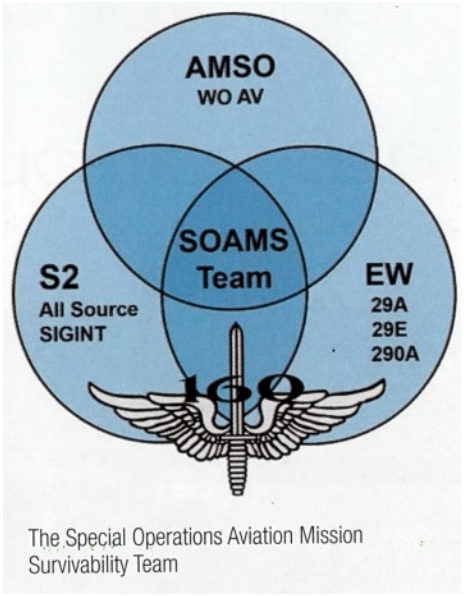


Figure 12. The Special Operations Mission Survivability Team. "Bridging the Aviation Education Gap," 28.

Mission command training program (MCTP) and the warfighter exercises observations are like the gaps observed by the 160th SOAR. The failure to integrate and synchronize resources degrade the efficiency of the AGO. The three main contributors to a failure of AGO at the warfighter exercises were "synchronization of operations in the deep area, integrated targeting at the division and higher level, and tasking and employment of the Gray Eagle UAS." The first and second issues are due to the decentralized mindset of a CAB from the many years of COIN. Headquarters must take an active role and integrate the CAB and artillery to ensure mission success. The third is concerning with misuse of UAS. UAS has so many capabilities, as seen in Figure 13 below, and division and corps must learn how to best utilize the UAS in multiple situations. The under or over utilization of Army Aviation at EAB is a concern for aviation. Vertical lift can be an asset by leveraging windows of opportunity for an AGO in an MDO, but only if used efficiently. The MCTP is working on training EABs to understand how to integrate the UAS, MUM-T, close support, air assaults, and deep attacks into their plans. The doctrine exists on how to employ MUM-T, but the training is still evolving to accomplish the guidelines set in *FM 3-04*. Flight school level and brigade level need new training simulators to incorporate

UAS drivers and AH-64 teams to train together in a live virtual environment to develop the MUM-T relationships and familiarity.[55]

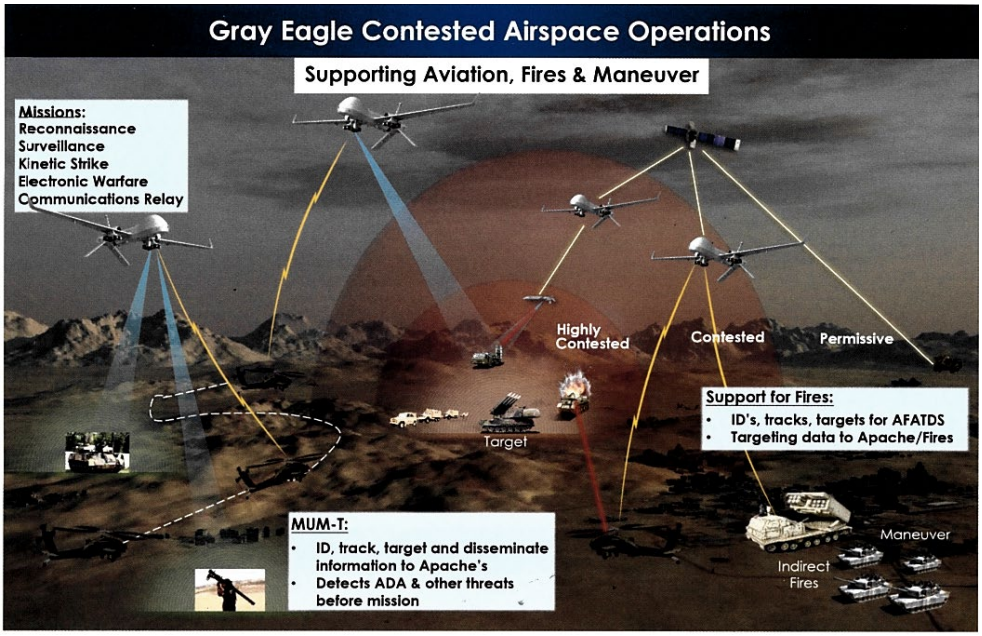


Figure 13. Gray Eagle Contested Airspace Operations. "Gray Eagle in Large Scale Combat Operations," 32.

Conclusion

> Aviation is critical then, critical today, and critical tomorrow.
>
> — Sergeant Major Woody Sullivan, "Greetings," *Army Aviation*

Army Aviation needs to integrate into a cross-functional team to be successful against the current near and peer threats in LSCO. The threat of robust A2/AD systems means Army Aviation needs to train toward the realization of limited air superiority and freedom of maneuver. Commanders and training centers need to update training to match the new Army Aviation doctrine standards set in *FM 3-04*. The Army took proactive steps by creating new doctrine to address the LSCO challenge, just as the Army did with AirLand Battle doctrine nearly half a century ago. AirLand Battle doctrine was written in the 1970s, well before being validated in

[55] Sweet, "Integration of Aviation OPS at EAB," 6; US Army Aviation Center of Excellence, *Army Aviation Equipment Modernization Strategy*, 11.

Operation Desert Storm. In addition, AirLand Battle was put to the test with exercises at JRTC, NTC, and in Operation Desert Shield. The Army may not have ten years to perfect the new doctrine before LSCO against a near or peer threat, so training environments need to be as rigorous as a complex MDO will be. JRTC and NTC have made significant advancements in training for COIN to LSCO, but both need to integrate more domains to enable cross teaming and training against the specific air defense systems of our peer threats.

To be successful against peer threats, Army Aviation needs to continue modernizing the fleet to compete with new threats in MDO. The legacy fleet, based on thirty-one year-old airframes, will only reach so far in capabilities for Army Aviation. The Army needs to keep investing more heavily in FVL's new airframes, while still balancing the upgrades for the legacy fleet to ensure the ability to fight today. The Army needs to continue developing and implementing CAB architecture software and hardware to increase prototype capabilities and expedited technology insertion. Army Aviation needs to update the AH-64 crew trainers to include cross training with UAS, to develop a seamless relationship with MUM-T. UAS operators and AH-64 crews need to train how they will fight; as a team. Army Aviation continues to improve and learn from the new doctrine in place for fighting in LSCO. Training and dissemination of lessons learned at warfighter exercises, JRTC, NTC, and past near-peer LSCO, such as Desert Storm, are key to improving and challenging future aviators who will be charged with fighting in complex MDO.

Bibliography

101st Airborne Division. “After Action Report Operation Desert Shield/Desert Storm.” Command Report, 13 June 1991.

Almquist, David K., and Brent Swart. “AMCOM–Working to Attain Strategic Supply Chain Depth.” *Army Aviation* (October 2018): 56-58.

Anderson, Scott, and Nathan Greer. “Unmanned Aircraft Systems: Building the Next Generation of UAVs.” *Army Aviation* (November 2018): 26-29.

Ankrum, Lloyd. “UAS Training and Initiatives.” *Army Aviation* (November 2018): 16-17.

Bartles, Charles K., and Lester W. Grau, eds. *Mountain Warfare and Other Lofty Problems: Foreign Perspectives on High-altitude Combat.* Solihull, West Midlands, England: Helion, 2016.

Berg, Paul E., and Kenneth E. Tilley. “Task Force Normandy: The Deep Operation that Started Operation Desert.” In *Deep Maneuver: Historical Study of Deep Maneuver in Large-Scale Combat Operations,* edited by Jack D. Kem, 139-156. Fort Leavenworth, KS: Army University Press.

Blackmon, Jimmy F. *Pale Horse: Hunting Terrorists and Commanding Heroes with the 101st Airborne Division.* New York: St. Martin's Press, 2016.

Blumberg, Herbert H., and. Christopher C. French, eds. *The Persian Gulf War: Views from the Social and Behavioral Sciences.* Lanham, MD: University Press of America, 1994.

Bogardus, Bryan. “Product Manager Air Warrior 2018 Update to the Field.” *Army Aviation* (October 2018): 46-47.

Bowes, Eric R., and Luciana Spencer. “Communication is Key: ARAT Stays Connected to the Soldier.” *Army Aviation* (October 2018): 38-40.

Britten, Wyatt A. “Army Aviation and the Mission Command Warfighting Function.” Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2017.

Butler, Howard K. *Desert Shield and Desert Storm : An Aviation Logistics History.* St. Louis, MO: US Army Aviation Systems Command, 1991.

Calhoun, Mark T. “Close Air Support and Bombardment Theory: Operation Cobra.” In *Lethal and Non-Lethal Fires: Historical Case Studies of Converging Cross-Domain Fires in Large Scale Combat Operations,* edited by Thomas G. Bradbeer, 163-182. Fort Leavenworth, KS: Army University Press, 2018.

Cavaco, Michael D. “Developing Depth in Aviation Formations.” *Army Aviation* (January 2019): 14-15.

Chaney, Kevin S. “Project Manager Aircraft Survivability Equipment Update.” *Army Aviation* (October 2018): 28-30.

Cody, Richard A. “The Future of Vertical Lift–The Future of Army Aviation.” *Army Aviation* (December 2018): 70-77.

Cole, Kenneth, and Kevin Scherrer. “Large-Scale Aviation Training in Preparations for Large-Scale Combat.” *Army Aviation* (November 2018): 56-57.

Coll, Gabriel, Andrew Hunter, and Robert Karlen. “Beating the Air into Submission: Investing in Vertical Lift Modernization.” Center for Strategic and International Studies Briefing, February 2019.

Coram, Robert. *Boyd: The Fighter Pilot Who Changed the Art of War.* New York: Back Bay Books/Little, Brown, 2004.

Darack, Ed. *The Final Mission of Extortion 17: Special Ops, Helicopter Support, SEAL Team Six, and the Deadliest Day of the U.S. War in Afghanistan.* Washington, DC: Smithsonian Books, 2017.

Demirjian, Michael, Seneca Pena-Collazo, and Nathan Whitney. “Gray Eagle in Large Scale Combat Operations: Can It Only Survive in COIN?” *Army Aviation* (November 2018): 30-32.

Desaulniers, Linn K., and Thomas J. Barthel. “Expeditionary Sustainment in Support of Large Scale Combat Operations.” *Army Aviation* (January 2019): 30-31.

Dorr, Robert F. *Chopper: Firsthand Accounts of Helicopter Warfare World War II to Iraq.* New York: Berkley Publishing Group, 2005.

Dove, G. Mike. “Final Report from the AAAA Cribbins Symposium.” *Army Aviation* (January 2019): 16-19.

Doyle, David, and Aaron Coombs. “How Has the Joint Readiness Training Center Changed to Adapt to Large-Scale Combat Operations?” *Military Review* 98, no. 5 (September-October 2018): 111-118.

Durham, Joshua. “Testing the Army’s Extended Range Gray Eagle UAS.” *Army Aviation* (November 2018): 52-53.

Gabram, Douglas M. “Attacking Aviation Readiness Drivers.” *Army Aviation* (October 2018): 10-11.

Gayler, William K. “The Unmanned Aircraft Systems Center of Gravity.” *Army Aviation* (November 2018): 10-12.

Government Accountability Office. GAO-19-132, *Army Modernization Priorities and Assigned Cross-Functional Teams.* Washington, DC: Government Printing Office, 2019.

Hiro, Dilip. *Desert Shield to Desert Storm: The Second Gulf War.* New York: Routledge, 1992.

Holmes, Sharon L. “Army Attack Aviation and Joint Air Integration : Doctrinal and Institutional Barriers.” Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2000.

Houlahan, Thomas. *Gulf War: The Complete History*. New London, NH: Schrenker Military Pub., 1999.

Hudson, Anthony W., and John Gipson. "1ID CAB Aviation Maintenance in a Post-ARFORGEN World." *Army Aviation* (January 2019): 42-43.

Kanovsky, Eliyahu. *The Economic Consequences of the Persian Gulf War: Accelerating OPEC's Demise.* Washington, DC: Washington Institute for Near East Policy, 1992.

Karrels, Sean, and Brett McFarland. "Bridging the Aviation Education Gap." *Army Aviation* (June 2018): 28-31.

Kem, Jack D. "Introduction." In *Deep Maneuver: Historical Study of Deep Maneuver in Large-Scale Combat Operations*, edited by Jack D. Kem, xi-xvi. Fort Leavenworth, KS: Army University Press, 2018.

Kinney, Dan. "Unitech Composites Enable Weaponization of the Venerable UH-60 Black Hawk." *Army Aviation* (December 2018): 30-33.

Knights, Michael. *Cradle of Conflict : Iraq and the Birth of Modern U.S. Military Power*. Annapolis, MD: Naval Institute Press, 2005.

Kuykendall, Roger D. "Powering the Future: The Aviation Turbine Engines Project Office Update." *Army Aviation* (December 2018): 60-62.

Lewis, Dr. William, and Carvil Chalk. "Science and Technology for Future Vertical Lift." *Army Aviation* (January 2019): 44-45.

Lindsay, Douglas T. "US Army Attack Aviation in a Decisive Action Environment: History, Doctrine, and a Need for Doctrinal Refinement." Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2016.

Lundy, Michael D. "Meeting the Challenge of Large-Scale Combat Operations Today and Tomorrow." *Military Review* Special Edition (September-October 2018): 111-118. Accessed January 17, 2019. https://www.armyupress.army.mil/Journals/Military-Review/English-Edition-Archives/September-October-2018/.

Meacham, William C. *Lest We Forget: The Kingsmen, 101st Aviation Battalion, 1968*. New York: Ivy Books, 1999.

Moten, Mathew, ed. *War Termination: The Proceedings of the War Termination Conference, United States Military Academy West Point*. Fort Leavenworth, KS: Combat Studies Institute Press, 2010.

Murray, Williamson. *Air War in the Persian Gulf*. Baltimore, MA: Nautical and Aviation Publishing, 1995.

Norrie, Christopher R., Thomas E. Lamb, and Michael J. Culler. "Ready Now–Our Number One Priority." *Military Review* (September-October 2018): 61-69.

Novosel, Michael J. *Dustoff: The Memoir of an Army Aviator*. Novato, CA: Presidio Press, 1999.

Olive, Steven G. “Abdicating Close Air Support: How Interservice Rivalry Affects Roles and Missions.” Strategic Research Project, US Army War College, Carlisle Barracks, PA, 2007.

Owen, Robert C. *Air Mobility: A Brief History of the American Experience.* Washington, DC: Potomac Books, 2013.

Prickett, Shawn T., and James P. Snyder. “Sustaining the Fleet–Leveraging Condition Based Reset.” *Army Aviation* (January 2019): 36-37.

Putney, Diane T. *Airpower Advantage: Planning the Gulf War Air Campaign 1989-1991*. Washington, DC: Library of Congress, 2004.

Quinn, Peter. *Air Launched Effects Concept of Employment: Army Aviation Multi-Domain Force Multipliers.* Fort Rucker, AL: USAACE, 2018.

Raub, Jason S. “Decline in Air Assaults Operations.” Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2016.

Roland, Joseph B., and Frank Volpe. “The Future of Unmanned Aircraft Systems.” *Army Aviation* (November 2018): 14-15.

Rugen, Wally T., and Andrew W. Batten. “Future Vertical Lift Cross Functional Team Update.” *Army Aviation* (December 2018): 66-68.

Scales, Robert H. *Certain Victory: The US Army in the Gulf War.* Fort Leavenworth, KS: US Army Command and Staff College Press, 1994.

Soboliev, Denys. “Development of Helicopter Capabilities in the U.S. Army During the Korean and Vietnam Wars.” Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, 2016.

Sullivan, R. Woody. “Greetings.” *Army Aviation* (December 2018): 14.

Sweet, Erick. “Integration of Aviation Ops at Echelons Above Brigade.” *Aviation Digest* (October-December 2015): 6-10.

Todd III, Thomas H. “PEO Aviation Meeting the Demands of the Future Battlefield.” *Army Aviation* (December 2018): 10.

US Army Aviation Center. *US Army Aviation Desert Operations: Tactics, Techniques, and Procedures Southwest Asia Focus*. Fort Rucker, AL: US Army Aviation Center, 1990.

———. *US Army Aviation Training Strategy: Training Aviation Warfighters for Decisive Action*. Fort Rucker, AL: US Army Aviation Center, 2016.

US Army Aviation Center of Excellence. *Army Aviation Equipment Modernization Strategy: Equipping the Aviation Force to Win in a Complex World.* Fort Rucker, AL: US Army Aviation Center, January 2016.

US Army Aviation Systems Command. *Operation Desert Shield and Desert Storm After Action Report : Period 1Aug90-6Mar91.* St. Louis, MO: US Army Aviation Systems Command, 1991.

———. *Operation Desert Shield and Desert Shield After Action Report: First Update Period 7Mar91-15Jun91.* St. Louis, MO: US Army Aviation Systems Command, 1991.

US Army Aviation Warfighting Center. *Aviation Warfighting Treatise*. Fort Rucker, AL: US Army Aviation Warfighting Center, 1993.

———. *United States Army Aviation in the Gulf War.* Fort Rucker, AL: United States Army Aviation Warfighting Center, 1991.

US Army First Cavalry Division. "Combat Operations and Lessons Learned, 10 November 1966 to 31 January 1967." 1st Cavalry Division Airmobile, APO US Forces 96490, 1967.

———. "Lessons Learned no. 3: Communications Within the 1st Air Cavalry Division." 1st Cavalry Division, APO US Forces 96490, 1966.

———. "Tactical Standing Operating Procedures: 1st Cavalry Division Airmobile." 1st Cavalry Division, APO US Forces 96490, 1971.

US Department of the Army. *Army Doctrine Publication (ADP) 1-0, The Army*. Washington, DC: Government Printing Office, 2012.

———. *Army Doctrine Publication (ADP) 3-0, Operations*. Washington, DC: Government Printing Office, 2017.

———. *Army Doctrine Publication (ADP) 6-0, Mission Command*. Washington, DC: Government Printing Office, 2012.

———. *Army Doctrine Reference Publication (ADRP) 3-0, Unified Land Operations.* Washington, DC: Government Printing Office, 1986.

———. *Field Manual (FM) 3-0, Operations*. Washington, DC : Government Printing Office, 2017.

———. *Field Manual (FM) 3-04, Army Aviation*. Washington, DC : Government Printing Office, 2015.

———. *Field Manual (FM) 6-0, Command and Staff Organization and Operations*. Washington, DC: Government Printing Office, 2014.

———. *Field Manual (FM) 100-5, Operations.* Washington, DC: Government Printing Office, 1986.

———. *TRADOC Pamphlet 525-3-8, The US Army Concept for Multi-Domain Combined Arms Operations at Echelons Above Brigade 2015-2045.* Fort Eustis, VA: Government Printing Office, 2018.

US Department of Defense. Joint Staff. *Joint Publication (JP) 2-0, Joint Intelligence*. Washington, DC: Government Printing Office, 2013.

———. *Joint Publication (JP) 3-0, Joint Operations*. Washington, DC: Government Printing Office, 2011.

VanMeter, James O. “This Isn’t the TACOPS of Old- This is AMSO of Today.” *Army Aviation* (October 2018): 32-34.

Ward, Lincoln R. “The Division Artillery: Linking Strategy to Tactics in Operations Desert Shield/Storm” *Lethal and Non-Lethal Fires: Historical Case Studies of Converging Cross-Domain Fires in Large Scale Combat Operations,* edited by Thomas G. Bradbeer, 91-106. Fort Leavenworth, KS: Army University Press, 2018.

Waters, Christopher W. “The Importance of Platoon Leaders Serving as Air Mission Commander.” *Army Aviation* (December 2018): 18-19.

Williams, James. *A History of Army Aviation: From Its Beginnings to the War on Terror*. Lincoln, NE: iUniverse, 2005.

Woods, Kevin M. *Saddam’s Generals: Perspectives of the Iran-Iraq War*. Alexandria, VA: Institute for Defense Analyses, 2011.

———. *The Mother of all Battles: Saddam Hussein's Strategic Plan for the Persian Gulf War.* Annapolis, MD: Naval Institute Press, 2008.