Defeating the Integrated Air Defense System: A Quest for Combined Arms Maneuver

A Monograph

by

MAJ Yandy Orozco
US Army

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

2020

REPORT DOCUMENTATION PAGE

Form Approved

OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From-To)*
28-06-2019	Master's Thesis	JUN 2019-MAY 2020

4. TITLE AND SUBTITLE
Defeating the Integrated Air Defense System: A Quest for Combined Arms Maneuver

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
MAJ Yandy Orozco

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: ATXL-SWD-GD
Fort Leavenworth, Kansas 66027-2301

8. PERFORMING ORG REPORT NUMBER

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

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

This monograph demonstrates both an Anti-Access Area Denial (A2AD) problem and a unique historical example of a solution. As part of the analysis, this paper makes the assumption that US Army ground forces may operate in a contested environment without the protection and support of the air domain that has been the predominant requirement for ground maneuver since the Second World War. Therefore, the monograph explores the problem that land forces may face when confronted with the need to fight without air superiority and the conditions for regaining air superiority. The central argument of this monograph is that success of large-scale combat operations (LSCO) in Multi-Domain Operations (MDO) for the US Army may have the requirement in the future to attempt to eliminate the enemy's air defense systems through ground maneuver by maximizing other domain means. The study analyzes and compares two historical cases: the Yom Kippur War and the German Mortain offensive of WWII. These case studies provide context on how operational commanders may attempt to employ ground forces in an environment in which maneuver occurs without attendant air superiority. They are examples of success and failure in modern war when faced with an inability to support ground maneuver by air. In both cases, the criteria of deep maneuvers, fires, and air superiority provide a means to analyze and interpret how theater commanders succeeded – or not – in their quest for combined arms maneuver in conditions that denied the air support assumed essential in modern war.

15. SUBJECT TERMS
Anti-Access Area Denial, Integrated Air Defense System, Israel, Egypt, Mortain Offensive

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
					MAJ Yandy Orozco
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. PHONE NUMBER** *(include area code)*
(U)	(U)	(U)	(U)	38	(786) 208-6548

Monograph Approval Page

Name of Candidate: MAJ Yandy Orozco

Monograph Title: Defeating the Integrated Air Defense System: A Quest for Combined Arms Maneuver

Approved by:

_____, Monograph Director
G. Stephen Lauer, PhD

_____, Seminar Leader
Leroy B. Butler, LtCol

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

Accepted this 21st day of May 2020 by:

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

Abstract

Defeating the Integrated Air Defense System: A Quest for Combined Arms Maneuver by MAJ Yandy Orozco, USA, 38 pages.

This monograph demonstrates both an Anti-Access Area Denial (A2AD) problem and a unique historical example of a solution. As part of the analysis, this paper makes the assumption that US Army ground forces may operate in a contested environment without the protection and support of the air domain that has been the predominant requirement for ground maneuver since the Second World War. Therefore, the monograph explores the problem that land forces may face when confronted with the need to fight without air superiority and the conditions for regaining air superiority. The central argument of this monograph is that success of large-scale combat operations (LSCO) in Multi-Domain Operations (MDO) for the US Army may have the requirement in the future to attempt to eliminate the enemy's air defense systems through ground maneuver by maximizing other domain means.

The study analyzes and compares two historical cases: the Yom Kippur War and the German Mortain offensive of WWII. These case studies provide context on how operational commanders may attempt to employ ground forces in an environment in which maneuver occurs without attendant air superiority. They are examples of success and failure in modern war when faced with an inability to support ground maneuver by air. In both cases, the criteria of deep maneuvers, fires, and air superiority provide a means to analyze and interpret how theater commanders succeeded – or not – in their quest for combined arms maneuver in conditions that denied the air support assumed essential in modern war.

Contents

Acknowledgements

First and foremost, I would like to thank my amazing wife, Angelica, for her unending support throughout this project. Thank you to the Army and the School of Advanced Military Studies for the opportunity to grow as a leader. Lastly, I wish to express my sincere thanks and gratitude to Dr. Steve Lauer for his assistance, wisdom, and patience. His insightful observations, dedication, and brilliant academic mind were invaluable assets.

Abbreviations

A2AD	Anti-Access Area Denial
APC	Armored Personnel Carrier
ATGM	Anti-Tank Guided Missile
CAS	Close Air Support
FM	Field Manual
IADS	Integrated Air Defense System
IAF	Israeli Air Force
IDF	Israeli Defense Forces
LSCO	Large Scale Combat Operations
MDO	Multi-Domain Operations
OPLAN	Operational Plan
SAMS	Surface-to-Air Missile System
US	United States

Section 1: Introduction

As a military organization responsible for executing large-scale combat operations (LSCO), the US Army is competing against peer adversaries who are constantly evolving to match America's military might. These adversaries have developed technological capabilities that can prevent convergence in multi-domain operations. To compete, penetrate, and disintegrate these adversaries in future conflicts, the US Army evolves and adapts to challenges on the battlefield. Russia is a serious peer threat that can challenge US Army dominance in large-scale combat operations. Since Operation Desert Storm, Russia watched the American way of war closely. As General Mark A. Milley stated, Russian leaders know that "we excel in a way of war that emphasizes joint and combined operations; technological dominance; global power projection; strategic, operational and tactical maneuver."[1] As a result, an observant Russia learned to exploit the operational environment by developing weapons that create operational stand-off and deny the effective employment of conventional forces.

Currently, Russia's aggressive behavior towards European states–as she seeks to regain Soviet-era prominence–is increasing the likelihood of a future armed conflict in Europe. Since Russia studied how US forces deploy and conduct operations, the US Army will have to find adaptive ways to achieve convergence of domains on the battlefield. A revisionist Russia modernized and developed capabilities to counter the US Army's ability to execute air-ground integration of movement, maneuver, and fires. Russia's sophisticated long-range air defenses will deny US air superiority. Its proliferation of man-portable systems and advanced unmanned air and ground systems are a significant threat to US formations and key nodes. That US Army

[1] Gen. Mark A. Milley, "Foreword," in US Department of the Army, Training and Doctrine Command (TRADOC) Pamphlet 525-3-1, *The U.S. Army in Multi-Domain Operations 2028* (Washington, DC: Government Printing Office, 2018).

ground forces may operate in a contested environment without the protection and support of the air domain is a key assumption of this paper and its analysis.

According to Joint Publication (JP) 3-01, *Countering Air and Missile Threats*, the best method of "countering air and missile threats is to destroy or disrupt them prior to launch using offensive operations."[2] However, performing such a task against a peer threat like Russia is not an easy proposition. Russia currently possesses an integrated air defense system (IADS) consisting of a layered structure of long, medium, and short-range surface-to-air missiles that can shoot down combat aircraft at various altitudes.[3] The S-400 "Triumph" surface-to-air missile system (SAMS) represents the bedrock of Russia's highly sophisticated air defense umbrella.[4]

The Russian S-400 is a highly mobile system capable of intercepting enemy aircraft at a range of four hundred kilometers. The system covers not only the Baltic states from the Kaliningrad Oblast but also vast portions of Poland as well. This means that Russian ground forces operating near the Suwalki gap and Baltic states are under the protection of a mobile and capable IADS. Enemy warplanes daring to penetrate Russian airspace will encounter a deadly aerial minefield of S-400 batteries and battalions along Russia's western border. The addition of fifty-six S-400 battalions by the end of 2020 will only increase the lethality and capability of Russia's IADS.[5]

---

[2] US Department of Defense, Joint Staff, Joint Publication (JP) 3-01, *Countering Air and Missile Threats* (Washington, DC: Government Printing Office, 2017), IV-1.

[3] US Army, TRADOC Pamphlet 525-3-1, *The U.S. Army in Multi-Domain Operations 2028*, 12-13.

[4] Adam Cabot, "Fortress Russia: How Can NATO Defeat Moscow's A2/AD Strategy and Air Defenses?" *The Buzz* (blog), *The National Interest*, November 3, 2018, accessed February 14, 2020, https://nationalinterest.org/blog/buzz/fortress-russia-how-can-nato-defeat-moscows-a2ad-strategy-and-air-defenses-35087.

[5] "S-400 Triumf," Missile Threat: CSIS Missile Defense Project, accessed February 27, 2020, https://missilethreat.csis.org/defsys/s-400-triumf/; "S-400 Triumph Air Defence Missile System," Army Technology, accessed February 27, 2020, https://www.army-technology.com/projects/s-400-triumph-air-defence-missile-system/.

The recent Russian military exercise, Vostok 2018, demonstrated how a layered air defense system of S-400, medium-range Buk, and short-range Tor and Pantsir-S1 systems could deter a massed air attack.[6] The exercise showed how well-trained crews could maximize the capabilities of the S-400 to inflict significant damage against NATO aircraft attempting to penetrate Russian airspace. The range of the S-400 allows it to target enemy enabler aircraft like aerial refueling tankers and airborne early warning and control aircraft.[7] Additionally, the system's flexible targeting capabilities can guard against different threats and attacks, while its anti-stealth capabilities can detect and bring down stealth capable fighters like the F-35.[8]

According to experts, options for defeating the sophistication of the Russian air defenses consist of suppression tactics such as electronic warfare, air-to-surface anti-radiation missiles, tomahawks cruise missiles, and stealth technology.[9] The problems with these methods, however, are cost, reliability, and targeting. Russia's large SAMS fleet makes suppression a daunting task, and success is not guaranteed. The suppression of Russia's IADS requires substantial employment of anti-SAMS missiles and aircraft with a high risk of incurring significant losses. Additionally, the S-400 is difficult to locate and target because of the speed in which they can fire

[6] Michael Kofman, "Vostok 2018–Day 2 (September 12)," *Russia Military Analysis*, September 13, 2018, access on February 16, 2020, https://russianmilitaryanalysis.wordpress.com/2018/09/13/vostok-2018-day-2-september-12/.

[7] "Why the S-400 Missile is Highly Effective–If Used Correctly," *Stratfor: Worldview*, July 12, 2019, accessed on February 16, 2020. https://worldview.stratfor.com/article/why-s-400-s400-missile-long-range-turkey-russia-syria-effective.

[8] "Why the S-400 Missile is Highly Effective–If Used Correctly," Stratfor: Worldview; Soibhan O'Grady, "What is the Russian S-400 air defense system, and why is the U.S. upset Turkey bought it?," *The Washington Post*, July 17, 2019, accessed on February 16, 2020, https://www.washingtonpost.com/world/2019/07/12/what-is-russian-s-air-defense-system-why-is-us-upset-turkey-bought-it/; Stephen Bryen, "Why Russia's S-400 Anti-Air System is Deadlier Than You Think: A Very Powerful Weapon," *The Buzz* (blog), *The National Interest*, November 9, 2019, accessed on February 16, 2020, https://nationalinterest.org/blog/buzz/why-russias-s-400-anti-air-system-deadlier-you-think-94541.

[9] Adam Cabot, "Fortress Russia: How Can NATO Defeat Moscow's A2/AD Strategy and Air Defenses?" *The Buzz* (blog), *The National Interest*, November 3, 2018, accessed on February 17, 2020, https://nationalinterest.org/blog/buzz/fortress-russia-how-can-nato-defeat-moscows-a2ad-strategy-and-air-defenses-35087.

and maneuver. Meanwhile, stealth technology remains unproven against the S-400 ground radar systems. Even though aircraft like the B-2 Bomber, F-22, and F-35 have low radar signatures, they are not impervious to evolving radar technology and attack aircraft. The angled shape and design of the F-22 and F-35 fighters make these aircraft vulnerable to developing radar systems.[10]

The Israelis found out the hard way the difficulties of facing a layered and sophisticated ground-based air defense system. Declassified CIA documents on the 1973 Arab-Israeli war show the magnitude of the Soviet SAMS' effectiveness against the Israeli Air Force (IAF).[11] The Egyptian SAMS network, in particular, had significant success in disrupting Israeli strike missions and protecting Egyptian ground forces. The Egyptians operated within a bubble of protection until the Israeli devised a unique way of defeating their air defense umbrella.

The Egyptian scenario in the Yom Kippur War represents a possible outcome during a conflict against Russia. Like the Egyptians, Russian troops will operate under their protective air umbrella, where standard suppression tactics against Russia's IADS may not work, forcing operational commanders to search for other alternatives. The Israeli solution to this problem in 1973, although atypical, is an example of how this can be accomplished. Israeli commanders relied on ground forces to knock off the Egyptian air defenses by combining deep penetrations, ground artillery fires, and air superiority.

This paper argues that the success of LSCO in Multi-Domain Operations (MDO) may depend on ground maneuver forces eliminating the enemy's air defense systems. The application of deep maneuvers, fires, and air superiority–by and in support of ground maneuver forces–represents the evaluation criteria through which this paper examines how operational

[10] Cabot, "Fortress Russia: How Can NATO Defeat Moscow's A2/AD Strategy and Air Defenses?"

[11] CIA Intelligence Report, "The 1973 Arab-Israeli War: Overview and Analysis of the Conflict," The Central Intelligence Agency Online Library, September 1975, accessed January 23, 2020, https://www.cia.gov/library./readingroom/.docs/1975-09-01A.pdf.

commanders can use ground forces to burst an air defense bubble and reestablish air dominance. Since combined arms ground maneuver, as we understand it today, consists of integrated air-ground maneuver, IADS sophistication may negate the required air support for a successful combined ground maneuver.[12] In today's operational environment, many adversaries possess similar sophistication in land-based radar and electronic intercepts capabilities to prevent successful LSCO. A possible solution to this problem is for theater commanders to use ground maneuver forces for deep penetrations into enemy territory to neutralize the enemy's air defenses, regain air superiority, and reestablish air-ground convergence.[13]

The Yom Kippur War and the Mortain offensive of WWII are comparative case studies that provide context on how operational commanders may attempt to employ ground forces in an environment in which maneuver occurs without attendant air superiority. These contrasting cases are examples of the success and failure in modern war when faced with an inability to support ground maneuver by air. In both cases, the criteria of deep maneuvers, fires, and air superiority provide a means to analyze and interpret how theater commanders succeeded–or not–in destroying air defenses with ground maneuver forces. Both cases illustrate the important role deep maneuver, fires, and air superiority play against the sophistication of air defenses. Additionally, the case comparison demonstrates the differences and challenges associated with the employment of deep maneuver and fires – in a contested and non-permissive environment for air operations–to regain the integrated air-ground maneuver advantage over the enemy.

The US Army describes deep maneuver as the extension of military operations in time, space, and purpose to gain an advantage over an enemy in a highly contested environment.[14] The

[12] US Army, TRADOC Pamphlet 525-3-1, 13.

[13] US Army, TRADOC Pamphlet 525-3-1, GL-2, defines convergence as integration of capabilities in all domains to overmatch the enemy.

[14] US Department of the Army, Army Techniques Publication (ATP) 3-94.2, *Deep Operations* (Washington, DC: Government Printing Office, 2016), 1-2.

deep maneuver force employs a combination of movement and fires to gain a position of advantage to defeat the opposing enemy force.[15] Therefore, deep maneuver plays a critical role in warfighting. Similarly, fires help maneuvering units to seize, retain, and exploit the initiative by creating both lethal and nonlethal effects on targets with indirect fire weapon systems.[16] In doing so, fires achieve the key tasks of targeting, delivering, and integrating all forms of artillery fire against an opposing force.[17] Likewise, air superiority enables ground combat operations through "control of the air by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats."[18]

In the Yom Kippur War, Egypt's integration of anti-tank weapons and sophisticated Soviet anti-aircraft systems prevented Israeli Defense Forces (IDF) from applying their concept of armored maneuver and close air support. The IDF commanders solved this operational dilemma by employing their ground maneuver forces to regain air-ground convergence and defeat the Egyptian air defenses. The Israeli operational commanders employed deep maneuver and fires to enable air supremacy by the ground destruction of the Egyptian IADS.

In the case of the Mortain counteroffensive, the German army's performance represents a contrasting example to what the Israelis did during the Yom Kippur War. After D-Day, the German Seventh Army launched a counterattack–known as Operation Luttich–in the vicinity of the French town of Mortain to cut the American penetration and breakout from the Normandy bridgehead without appropriate air cover and fires. The German inability to integrate air-ground maneuver degraded the army's performance and prevented operational success. German troops

---

[15] US Department of the Army, Field Manual (FM) 3-0, *Operations* (Washington, DC: Government Printing Office, 2017), 2-202.

[16] US Department of the Army, Army Doctrine Reference Publication (ADRP) 3-09, *Fires* (Washington, DC: Government Printing Office, 2017), 1-1; US Department of the Army, Army Techniques Publication (ATP) 3-09.90, *Division Artillery Operations and Fire Support for the Division* (Washington, DC: Government Printing Office, 2017), vii.

[17] US Army, ADRP 3-09, 1-1 & 1-2.

[18] US Department of Defense, Joint Staff, *DOD Dictionary of Military and Associated Terms* (Washington, DC: Government Printing Office, August 2017), 13.

were unable to launch a successful deep maneuver against American defenses, and their fires lacked effectiveness due to overwhelming Allied air superiority over the Normandy sky. The German ground maneuver had no air component and no ability to interdict the airbases in England during its offensive, suffering catastrophic defeat in its failure to achieve combined arms superiority.

This research references primary sources, including US military doctrine and first-hand accounts that offer a lens through which this project analyzes the historical case studies. For the Yom Kippur War case study, autobiographical work from individuals who fought on the Israeli and Egyptian side provide the bulk of the primary sources. Of interest here are General Saad El Shazly's *The Crossing of the Suez* and General Avraham Adan's *On the Banks of the Suez: An Israeli General's Personal Account of the Yom Kippur War*.[19] These two volumes provide first-hand accounts of the war as it unfolded. Other primary sources are US army doctrine publications and field manuals like Field Manual (FM) 3-0, *Operations* and Army Doctrine Reference Publication (ADRP) 3-09, *Fires*.[20] In terms of secondary sources, academic books and research monographs also provide detailed information on the topic.

General Saad El Shazly's autobiographical work, *The Crossing of the Suez*, represents the Egyptian perspective of the 1973 war against Israel. Shazly's work shows how the Egyptian military matched military means to political ends. As a strategist and lead planner of the war, Shazly provides valuable insight on the different phases of the Egyptian war plan, as well as a detailed account of how the Egyptian military established an integrated air defense system to deter Israeli air supremacy.[21] He describes the conflict from a resource constraint Egyptian

---

[19] Avraham Adan, *On the Banks of the Suez: An Israeli General's Personal Account of the Yom Kippur War* (New York, NY: Presidio Press, 1980); Saad El Shazly, *The Crossing of the Suez* (San Francisco, CA: American Mideast Research, 1980).

[20] US Army, FM 3-0; US Army, ADRP 3-09.

[21] Shazly, *The Crossing of the Suez*, 306.

military perspective and details the steps taken to overcome these challenges. Although Shazly's military memoir is not an unbiased account of the conflict, its value lies in the candid assessment of the Egyptian operational plan.[22]

On the other hand, Avraham Adan's war memoir, *On the Banks of the Suez*, represents the Israeli view and account of the 1973 war. General Adan's account of his experiences as a division commander represents an important contribution to the historiography of the latest Arab-Israeli war. Of interest to this study is Adan's description of key events, especially the Deversoir-Suez offensive, where Israeli ground forces employed a unique combination of deep maneuver, fires, and air support to defeat the sophistication of the Egyptian air defenses and regain air superiority over the Sinai sky.[23]

Secondary sources, such as Abraham Rabinovich's *The Yom Kippur War*, are critical to the Yom Kippur war case study because they complement primary sources by corroborating key facts and events. Rabinovich's work provides a well-balanced narrative of the war based on the Israeli, Egyptian and Syrian perspectives. The book's "boots on the ground" details inform the analysis in this paper. Rabinovich relied on more than 130 interviews with veterans, as well as his work as a reporter during the conflict, for his research on the war.[24]

For the Mortain offensive case study, the depth and breadth of available primary historical manuscripts are limited. However, *The U.S. Army in World War II, The Europe Theater of Operations: Breakout and Pursuit* provides a wealth of information.[25] The archives at the Ike Skelton Combined Arms Research Library also provide a detailed description of the operation. The Dwight D. Eisenhower's *Report by The Supreme Commander to the Combined Chiefs of*

---

[22] Ibid., 24-26.

[23] Adan, *On the Banks of the Suez*, 263-307.

[24] Abraham Rabinovich, *The Yom Kippur War* (New York, NY: Shocken Books, 2004), xv.

[25] Martin Blumenson, *U.S. Army in World War II, The Europe Theater of Operations: Breakout and Pursuit* (Washington, DC: Government Printing Office, 1961).

Staff on the Operations in Europe of the Allied Expeditionary Force, 6 June 1944 to 8 May 1945 and the US 30th Infantry Division's "After Action Reports" are of special interest.[26] In terms of secondary sources, *Saving the Breakout: The 30th Division's Heroic Stand at Mortain, August 7-12, 1944*, and *Victory at Mortain* are other scholarly works used in this research.[27]

Mark Reardon's *Victory at Mortain* informs the Mortain offensive case study analysis because it chronicles the German attempt at decisively influencing the course of the war in western Europe following the D-Day invasion.[28] In examining the reasons why multiple panzer divisions attacked a single American division defending the French town of Mortain, Reardon provides crucial insight into the relationship between combat at the tactical level, operational maneuver, and decision making by senior field commanders.[29] Meanwhile, Alwyn Featherston's book, *Saving the Breakout*, is an attempt by the author to resuscitate the battle of Mortain from the forgotten annals of history.[30] In his study, Featherston identifies how the lack of air support and inability to interdict air bases in England prevented German ground maneuver forces from achieving combined arms superiority over the Americans.[31]

The following sections in this research include the two case studies – the Yom Kippur War and the German Mortain offensive–and a conclusion to demonstrate that success in LSCO may depend on ground maneuver forces destroying the opposing force's air defenses. Section Two and Three compare and contrast the two historical cases to demonstrate both an Anti-Access

---

[26] Dwight D. Eisenhower, *Report by The Supreme Commander to the Combined Chiefs of Staff on the Operations in Europe of the Allied Expeditionary Force, 6 June 1944 to 8 May 1945* (Washington, DC: Center of Military History, 1994), accessed February 23, 2020, https://history.army.mil/html/books/070/70-58/CMH_Pub_70-58.pdf.

[27] Mark J. Reardon, *Victory at Mortain* (Lawrence, KS: University Press of Kansas, 2002); Alwyn Featherston, *Saving the Breakout: The 30th Division's Heroic Stand at Mortain, August 07-12, 1944* (Novato, CA: Presidio Press, 1993).

[28] Reardon, *Victory at Mortain*, x.

[29] Ibid.

[30] Featherston, *Saving the Breakout*, xiv.

[31] Ibid.

Area Denial (A2AD) problem and a unique solution. Section Two examines the uniqueness of the Israeli success against a layered and sophisticated Egyptian air defense system by highlighting the unique nature in which Israeli commanders employed deep maneuvers with ground forces, along with ground fire support, to regain air dominance and defeat the Egyptian SAMS umbrella.

Conversely, section three illustrates the difficulties of facing an enemy force that operates under the protection of an air defense umbrella. It looks at the German Mortain offensive as a likely outcome that today's operational commanders may face against a peer threat like Russia. The section highlights the challenges German forces encountered without adequate air support against an Allied force that operated within their air defense bubble. Finally, the conclusion section offers concluding thoughts on both case studies and reinforces the central thesis of this project.

Section 2: The Yom Kippur War

In examining the Yom Kippur War, one finds a positive, though unique, case study where combined arms ground maneuver in LSCO enabled the destruction of a highly sophisticated IADS. During the conflict, Egypt's integration of anti-tank weapons and Soviet-supplied SAMS denied the IDF the freedom of action required for the application of ground maneuver. The Egyptian layered standoff curtailed the IDF's ability to employ armored forces with close air support (CAS). In order to solve this operational dilemma, Israeli commanders executed deep maneuvers with ground forces, using ground fire support to regain air dominance over the Suez Canal. The breakthrough battle that ensued ended with the penetration and disintegration of the Egyptian air defense umbrella, giving Israeli forces the freedom of maneuver to achieve their strategic objectives.

At the time of the conflict, Egyptian President Anwar Sadat faced serious challenges both at home and abroad. The sudden death of Gamal Abdel Nasser left Egypt and other Arab nations without an iconic regional leader, and Sadat with a legitimacy crisis. Sadat felt that the unresolved political and military deadlock in the region threatened his rule on the Middle East's

most populous nation. Recapturing the Sinai and expelling Israeli forces from the peninsula was the quickest way for Sadat to consolidate power and eliminate the specter of a military coup. Political expediency drove the Egyptian leader to plan a war of limited objectives against Israel. He envisioned a limited war as a means to not only seal his legitimacy as president, but also restore Egypt's national honor.[32]

According to the Prussian military philosopher Carl von Clausewitz, limited wars serve as bargaining chip for politicians to achieve limited political objectives. The primary military aim is capturing a small or large piece of terrain because the defeat of adversaries by military means alone is impossible.[33] For Sadat, limited military objectives in a surprise attack against Israel – such as crossing the Suez Canal and establishing a foothold in the Sinai Peninsula – would enable a diplomatic offensive to retake lost territory, erase the ignominious defeat of the Six Day War, and break the region's political and military stalemate.[34]

To accomplish these objectives, the Egyptians developed three war plans: Operation High Minarets, Operation Granite Two, and Operation Badr.[35] For both, Operation High Minarets and Operation Badr, the resources available matched the established objectives. President Sadat, however, considered these operational plans (OPLAN) politically unacceptable for omitting the capture of key Sinai passes. The capture of the passes was a key political requirement, put in place by Sadat, to secure the Syrian government's commitment to the war and appease their

---

[32] Frank Aker, *October 1973* (Hamden, CT: Archon Books, 1985), 14-16; Adan, *On the Banks of the Suez*, 61; Kenneth M. Pollack, *Arabs at War: Military Effectiveness, 1948-1991* (Lincoln, NE: Nebraska University Press, 2002), 64-71.

[33] Carl von Clausewitz, *On War*, ed. and trans. Peter Paret and Michael Howard (Princeton, NJ: Princeton University Press, 1984), 601.

[34] Rabinovich, *The Yom Kippur War*, 15-16.

[35] Shazly, *The Crossing of the Suez*, 17-39.

strategic concerns. The Egyptian leader favored Granite Two as the most suitable, feasible, and acceptable plan.[36]

The demand for seizing the passes involved sending armored formations outside the static protection of the SAMS umbrella. However, Egyptian military commanders considered such maneuver unfeasible without the protection of a mobile air defense system. They knew that the IAF would wreak havoc on Egyptian armored forces before they could reach the passes.[37] Nonetheless, the Clausewitzian assertion that the political aim is king in limited wars precluded the purely military considerations.[38] President Sadat focused the political risks and concerns over the objections of military commanders and ordered the execution of Granite Two.[39]

Operation Granite Two had two phases. The first phase involved crossing the Suez Canal to destroy the Israeli Bar-Lev line on the east and establish defensive positions north to south along the canal. While executing a wet gap crossing at multiple sites with five divisions, Egyptian infantry and armored forces were to destroy the Israeli outposts along the Bar-Lev line, establish divisional bridgeheads to facilitate a five-mile penetration east of the canal, and assume a defensive posture to stop the Israeli counterattacks.[40] Meanwhile, the second phase involved the controversial maneuver towards the Sinai passes, but only after an operational pause to allow the consolidation and reorganization of forces. Military planners hoped to use the "operational pause" as another opportunity to convince Sadat to reconsider the idea of attacking the Sinai passes.[41]

---

[36] Ibid., 36-39.

[37] Shazly, *The Crossing of the Suez*, 237.

[38] Clausewitz, *On War*, 605.

[39] Shazly, *The Crossing of the Suez*, 254-255.

[40] US Department of the Army, Army Techniques Publication (ATP) 3-90.4, *Combined Arms Mobility* (Washington, DC: Government Printing Office, 2016), 1-2. Wet-gap crossing is the crossing of rivers and other gaps. It is one of the most critical, complex, and vulnerable combined arms missions.

[41] Shazly, *The Crossing of the Suez*, 36, 307-308.

The plan also consisted of a four-layered defensive line. The first defensive layer had minefields at the front and flank of Egyptian positions. The second and strongest layer included a web of AT-3 "Sagger" anti-tank guided missile (ATGM) and RPG-7 rocket launchers, employed by mounted and dismounted infantry units, with support from tanks and Sagger-carrying armored personnel carriers (APC). In addition, tanks on the Egyptian side of the canal provided direct fire support, while commando groups formed "tank killer" teams, dispersed in advanced concealed positions to ambush the advancing Israeli armored formations.[42]

The third defensive layer consisted of a sophisticated IADS umbrella made of missiles (SA-2, SA-3, and SA-6) and anti-aircraft guns positions on Egyptian territory. As Israeli historian Tal Tovy explained, the air defense fire zones overlapped, providing mutual support between batteries, while mobile batteries enhanced the stationary formations by changing positions, "thus surprising the Israeli attacks and closing the gaps in case some of the stationary batteries were hit."[43] On the Sinai side of the canal, infantry soldiers armed with SA-7 shoulder-launched missiles and ZSU-23X4 anti-aircraft guns added another reinforcing layer of sophistication to the air defense plan. As the battle unfolded, this IADS umbrella intercepted at varying altitudes most Israeli attack planes and impaired the IAF's ability to support the ground maneuver forces. The artillery, as a fourth layer in the defensive plan, disrupted and defeated any Israeli attempt at crossing the Suez Canal.[44]

On 6 October 1973, two hundred Egyptian aircraft flew across the Suez Canal to bomb Israeli targets. As the planes crossed the canal, 2,000 artillery pieces opened fire on IDF positions along the Bar-Lev line. Simultaneously, twelve waves of approximately 4,000 soldiers each

---

[42] Tal Tovy, "Egypt vs. Israel: Combined Arms in the Yom Kippur War and the Lessons for the US Army," in *Bringing Order to Chaos: Historical Case Studies of Combined Arms Maneuver in Large-Scale Combat Operations*, ed. Peter J. Schifferle (Fort Leavenworth, KS: Army University Press, 2018), 171.

[43] Tovy, "Egypt vs. Israel," 171.

[44] Ibid.

crossed the Suez Canal, reduced the Israeli strongpoints, and established multiple bridgeheads. Within twenty-four hours, five army divisions were ten miles inside the Sinai Peninsula, occupying defensive positions, ready for the Israeli counterattack.[45]

During this initial phase of the conflict, the IDF Southern Command faced a dire situation. In desperation, the commanding general at the time, General Shmuel Gonen, ordered a series of uncoordinated counterattacks with three armored divisions against an overwhelming enemy force. These armored divisions faced a prodigious number of Egyptian troops equipped with Saggers, anti-tank guns, RPGs, recoilless rifles, and tanks.[46] The odds favored the Egyptians, but action was better than inaction for Israel; the IDF spirit of "let's do and then talk."[47] The Israelis hoped for the IAF to lessen the blow by doing much of the heavy lifting and turning the tide in their favor.[48]

From 6 to 11 October, the IAF had little success against the sophistication of the Egyptian IADS. The interconnected SAMS batteries degraded the acquisition of ground targets by Israeli planes. The nonpermissive environment prevented fighters from flying over their targets, thus forcing them to use the inefficient and inaccurate technique of distance bombing.[49] In twenty-four hours, the IAF conducted 120 unsuccessful sorties, lost twenty-seven planes at the southern front, and only managed to interdict and destroy twenty Egyptian transport helicopters.[50]

---

[45] Shazly, *The Crossing of the Suez*, 222-223, 229.

[46] Rabinovich, *The Yom Kippur War*, 121.

[47] Adan, *On the Banks of the Suez*, 156.

[48] Rabinovich, *The Yom Kippur War*, 121.

[49] Ibid.

[50] Rabinovich, *The Yom Kippur War*, 130; Shazly, *The Crossing of the Suez*, 231.

Although the IAF fought bravely, the Egyptian air defenses inflicted approximately 30-40 percent losses in the first five days of fighting.[51] Major General Emanuel Sakal points out that the IAF entered the war with 320 warplanes, and in three days lost a total of one hundred fighters.[52] The Egyptian IADS, however, were not by any means impenetrable, but the IAF still operated within the paradigm of previous wars. As Abraham Rabinovich explained, IAF leaders "permitted themselves to believe that the air force, still wreathed with the magical aura of the Six Day War, would somehow find a way to deal with enemy ground forces."[53] Although the air force enjoyed the latest technological advances, the pilots lacked the tactical innovation to exploit it.[54]

The ground forces experienced a similar outcome. One division lost two-thirds of its tanks–a total of 170 out of 280–in less than twenty-four hours.[55] Another division had three battalions completely wiped out, multiple battalion commanders killed or wounded, and seventy tanks disabled. Egyptian authorities estimated Israeli losses at 2,000 killed or wounded, 800 tanks disabled, and several dozen downed aircraft.[56] IDF General Avraham Adan, a division commander during the war, wrote that when the counterattack ended, "Southern Command had only one division left intact," with the other two combat ineffective.[57] With such unprecedented losses, the Israeli leadership were left facing a standoff at the southern front that lasted from 11 to 13 October.[58]

---

[51] Craig H. Pearson, "Joint Army Aviation/Air Force Deep Operations at Night: Is It Tactically Feasible and If So, How?" (monograph, US Army Command and General Staff College, Fort Leavenworth, Kansas, 1985), 4.

[52] Emanuel Sakal, *Soldier in the Sinai: A General's Account of the Yom Kippur War* (Lexington, KY: University Press of Kentucky, 2014), 346-347.

[53] Rabinovich, *The Yom Kippur War*, 140.

[54] Pearson, "Joint Army Aviation/Air Force Deep Operations at Night," 4-5.

[55] Rabinovich, *The Yom Kippur War*, 139.

[56] Shazly, *The Crossing of the Suez*, 232 & 240.

[57] Adan, *On the Banks of the Suez*, 163-164.

[58] Shazly, *The Crossing of the Suez*, 242 & 248.

The big break for the Israelis came on 14 October, when the Egyptians decided to attack and capture the Mitla and Gidi passes. By Sadat ordering the attack, the Egyptian armored and infantry forces lost the protection of their static air defense umbrella. As soon as the IDF spotted the Egyptian movement, Israeli armored, artillery, and infantry intercepted and stopped the advanced. Israeli planes, in no danger of being hit by anti-aircraft missiles, supported the ground forces with CAS. Without support from their own air force, the Egyptian attacked failed. One of the largest tank battles since War World II resulted in the loss of 200 tanks, a crushing Egyptian defeat.[59]

With the Egyptian attempt to capture the Sinai passes foiled, the problem for Southern Command became the Egyptian defenses, especially the SAMS umbrella. Even though the bulk of the armor had been destroyed, the Egyptian air defenses remained intact. Immediately, Lieutenant General Chaim Bar-Lev called a meeting with all division commanders to discuss the next steps in the operation. The Egyptian SAMS network became a key topic of discussion. Israeli leaders agreed to retake the initiative with a deep maneuver strike. They hoped to break the IADS umbrella with ground maneuver forces, fully reestablish integrated air-ground maneuver, and regain air superiority. Regaining air supremacy was a critical requirement for a successful deep maneuver. To do this, they had to find ways of protecting armored forces from the Egyptian infantry.[60]

The deliberations produced Operation *Abirei-Lev* – also known as Operation Gazelle. The operational objective consisted of destroying Egyptian forces west of the Suez Canal to encircle the Egyptian Third Army. To accomplish this, one Israeli division would maneuver between the Egyptian Second and Third Army in vicinity of the Bitter Lake to set the conditions for a wet gap

[59] George W. Gawrych, *The Albatross of Decisive Victory* (Wesport, CT: Greenwood Press, 2000), 208; Trever N. Depuy, *Elusive Victory: The Arab-Israeli Wars, 1947-1974* (New York, NY: Harper & Row, 1978), 485-491; Tovy, "Egypt vs. Israel," 176-177.

[60] Depuy, *Elusive Victory*, 495.

crossing at the canal. Afterwards, two Israeli divisions would follow through for deep penetrations north and south into Egypt. Secondary objectives included the capture of multiple bridges across the Ismailia Canal and the key terrain of the Geneifa Hills, where most SAMS batteries were situated. The operation covered an area of one hundred kilometers long and thirty kilometers wide to the north and fifty to the south.[61]

Operation Gazelle began on 15 October. Without CAS to suppress the Egyptian artillery and infantry, the IDF could not establish a foothold on the eastside of the canal for a wet gap crossing. After more deliberations with his generals, Bar-Lev reached the following conclusions: (1) mechanized infantry was essential to the protection of the armored divisions; (2) bringing more artillery batteries to the frontlines would disrupt the Egyptian infantry and support the movement of the Israeli armored and mechanized formations; (3) most importantly, the reestablishment of air superiority depended on ground forces puncturing the IADS umbrella with deep maneuver.[62]

In order to penetrate deep into Egyptian territory, the IDF incorporated infantry troops and artillery as part of a new combined arms methodology. The infantry protected the flanks of the armored forces while the artillery disrupted coordinated attempts by the Egyptian infantry to destroy Israeli tanks. General Adnan, whose division led the main effort, described the adjustments in the following way:

> We knew what to watch out for, from what directions, and at what ranges such attacks could be expected. Moreover, all units had observers whose job was to warn of incoming antitank missiles. They would call out, "Missile from left!" or "Missile from right!"–and the tanks would succeed in maneuvering so as to avoid the missile. Everyone thought that whenever the Zeldas (armored personnel carriers) had been sent in ahead of the tanks the results were excellent, as armored personnel carriers had been able to deal with the Egyptian infantry that had moved into close range. After we had analyzed battle techniques and tactics of cooperation among tanks, armored personnel carriers, and artillery, I decided to redistribute our Zeldas. We would be fighting with small tank

[61] Adan, *On the Banks of the Suez*, 253.

[62] Sakal, *Soldier in the Sinai*, 246-247, & 325.

> battalions … but now each battalion would have armored infantry troops mounted on Zeldas grouped to protect its flanks.[63]

Aside from alerting the tanks on incoming Sagger missile, the mechanized infantry also employed their own mortars and machine guns ahead of the armored formation to deter the enemy antitank missile crews from firing on the advancing Israeli tanks.[64]

The mobilization of artillery to the front added another layer of protection and facilitated the deep maneuver of tanks. Armored formations advanced safely "behind a rolling barrage of artillery fire, not heavy enough to do much harm to Egyptian armor or entrenched infantry but very effective against antitank missiles, whose operators could not keep a target in their sights long enough amid the explosions, even if they braved the dangers of exposing themselves."[65] The IAF contributed as well by serving as "flying artillery."[66] Israeli tank divisions that engaged Egyptian forces outside of the IADS umbrella would call on the air force for fire support. This technique caused the destruction of the 1st Egyptian Mechanized Brigade.[67]

With this new combined arms ground maneuver methodology, the IDF broke through the defensive line and penetrated deep into Egyptian territory. General Ariel Sharon's division reached the Bitter Lake, secured a bridgehead near the wet gap crossing, and marshalled Adnan's division across the Suez Canal. Once two Israeli divisions crossed the canal, they launched a deep penetration targeting Egyptian forces and SAMS sites. The IAF had attempted to neutralize the SAMS, losing one plane for every SAMS battery destroyed, but the difference maker became the deep maneuver by ground forces.[68]

---

[63] Adan, *On the Banks of the Suez*, 221.

[64] Adan, On the Banks of the Suez, 221-222; Pollack, *Arabs at War*, 113.

[65] Luttwak, *Strategy*, 38.

[66] Sakal, *Soldier in the Sinai*, 327.

[67] Thomas A. Kolditz, "Exploring the Conditions for Decisive Operational Fires" (monograph, US Army Command and General Staff College, Fort Leavenworth, Kansas, 1985), 23-24.

[68] Sakal, *Soldier in the Sinai*, 354.

As General Adnan's division moved southward to the Geneifa Hills, armored and mechanized infantry forces attacked and overran more than forty SAMS sites. One battalion attacked a missile site where Egyptians, in a desperate attempt to foil the attack, fired in direct mode the antiaircraft missiles at the attacking Israeli forces.[69] The assault on the SAMS sites not only caused the IADS umbrella to collapse, as Egyptian leaders moved them closer to Cairo, but also restored the integration of air-ground maneuver. The IAF quickly regained air superiority over the Sinai sky; and with CAS restored, the armored divisions completed their deep operations in lethal fashion. By 24 October, Israeli forces controlled the Suez Canal and encircled the Egyptian Third Army.[70]

Air superiority optimized the maneuverability of the Israeli tanks. The Armored divisions maneuvered and engaged deep targets without the specter of attacks from a menacing air force, as Egyptian warplanes proved incapable of winning air battles or hitting targets accurately. Israeli planes and pilots outmatched and outclassed Egyptians planes and pilots. During one air engagement two Israeli Phantoms with novice pilots confronted twenty-six Egyptian MiGs and downed seven of them.[71] In another significant air battle Egyptians losses amounted to twenty aircraft while the Israeli only lost six. Accuracy was another issue. Multiple attempts to bomb Israeli bridges in the Suez Canal were unsuccessful. Once the air defense umbrella collapsed, the Egyptians stopped sending planes to the canal zone to strike Israeli targets.[72]

The deep maneuver – made possible by deep artillery fire and infantry to enable both CAS and air interdiction – played a critical role in the Israeli victory during the Yom Kippur War. It led to the destruction of a potent and sophisticated air defense system. Israeli field commanders

---

[69] Adan, *On the Banks of the Suez,* 320.

[70] Adan, *On the Banks of the Suez,* 320.

[71] Rabinovich, *The Yom Kippur War*, 129.

[72] Adan, *On the Banks of the Suez,* 282, 324, & 330.

understood the dynamics and pitfalls of such a battle. They demonstrated a "clear drive and tenacity with willingness to take risks," while learning from good and bad lessons.[73] General Bar-Lev, in particular, showed characteristics of a good deep maneuver commander by learning, taking risks, and having the *coup d'oeil* for details and realities of the situation.[74]

Nonetheless, it is important to highlight that the Israelis fought under unique circumstances. They enjoyed a clear technical and operational advantage over the Egyptians. The Egyptian military was far weaker and less capable than the IDF. The capability gap between the IAF and the Egyptian air force is a prime example. Israeli pilots overmatched and outclassed the performance of Egyptian pilots, even when the Egyptians operated in favorable conditions under a protective air bubble. The Israelis were better trained and equipped than their counterparts. The Egyptian pilots' poor performance against ground and air forces cannot be discounted as a contributing factor in the Egyptian defeat.

The immobility of the Egyptian SAM-2 and SAM-3 batteries was another key factor as well. The SAMS batteries' static positions increased their vulnerability to Israeli strikes. Since these systems could not move after each engagement, they became easy target for the IAF and the IDF ground forces. In a conflict against a tough opponent like Russia, it is unlikely that a modern Russian air force and highly mobile IADS network would perform as poorly as the Egyptians did; especially when operating under the protection of a sophisticated layer of S-400s.

In the end, the Yom Kippur War demonstrated three important things. First, without the destruction of SAMS sites airpower is indecisive. Once the SAMS umbrella collapsed, Israeli airpower became decisive in support of the ground maneuver and protection through air interdiction. Second, the employment of ground maneuver forces without precision fires is

[73] Ronnie L. Coutts, "The Israeli Experience: The Apogee of Blitzkrieg," in *Deep Maneuver: Historical Case Studies of Maneuver in Large-Scale Combat Operations*, ed. Jack D. Kem (Fort Leavenworth, KS: Army University Press, 2018), 134.

[74] Coutts, "The Israeli Experience: The Apogee of Blitzkrieg," 134.

ineffective and indecisive. The Israelis sent their ground forces against the Egyptian defensive line with limited artillery support. As a result, Egyptian infantry operated without concern for Israeli artillery fire. Third, the war confirmed that decisive operations are better when precision airpower and combined arms ground maneuver are integrated.

Once IDF commanders sent more artillery forward to support the armored forces, the Egyptian infantry lost its effectiveness and the defensive line collapsed. With the armored advanced unimpeded, the Egyptian air defense umbrella broke apart, and the Israelis fully integrated the IAF into the fight by providing air support to the ground maneuver force. None of these would have been possible, however, without the unique approach in which Israeli commanders combined deep maneuver and fires, and optimized air superiority to defeat a weaker enemy.

Section 3: The Mortain Offensive

The August 1944 German offensive, in vicinity of the French town of Mortain, stands as a contrasting case to the uniqueness of the Israeli scenario during the Yom Kippur War. The Mortain offensive case study represents a likely scenario of what could happen when an adversary like Russia operates unhindered in a protective air bubble that denies air-ground synergy to maneuvering forces. For the Germans at the time, their inability to penetrate American defenses with deep maneuver and air interdiction had catastrophic consequences. The operation failed because German operational commanders could not overcome the challenges of Allied air power. Once German troops stepped inside the American air umbrella, Allied planes hindered their ability to achieve combined arms superiority, turning the operation into a five-day slugfest with Allied planes pounding the German panzer divisions.

When Allied forces crossed the English Channel and established a lodgment in Normandy, they launched a series of attacks along the left flank of the Allied line to help set the conditions for what became known as Operation Cobra–the US Army's plan for breaking out of Normandy. Operation Cobra began on 25 July with an attack against the German defenses on the

Allied right flank. The intent was to break through the defenses and create a corridor for the American advance towards the Brittany peninsula. The German High Command, after being distracted by Allied attacks near the city of Caen, eventually figured out the scheme.[75]

To stop the American breakout, Hitler and his generals envisioned a bold plan. The plan called for German units to continue holding a defensive line against the British on the northern sector while armored forces attacked the US First Army–under the leadership of Lieutenant General Omar Bradley–in the south near the city of Avranches. This coastal city stood where lines of communication bottlenecked into the important Brittany peninsula. By capturing Avranches, Hitler hoped to not only deny American access to Brittany, but also neutralize the breakout.[76]

This conceptual plan, however, unsettled Field Marshal Guenther von Kluge. As the German Supreme Commander in the West, Kluge opposed the idea of going on the offensive. He reasoned that the German Army lacked the appropriate number of forces in France to successfully execute a counteroffensive.[77] He preferred a defensive posture instead, where German forces could still block the American movement, and at the same time withdraw behind the Seine river.[78] Despite Kluge's reservations, Hitler had the final say on the matter. As ordered, Kluge planned the ill-advised Operation Luttich – the German Seventh Army counterattack against American forces at Mortain.[79]

During the planning and preparation phase for the operation, the German leadership maintained a high level of operational security. The attack began at night under strong fog cover,

---

[75] Mark Edmond Clark, "The German Army's Operation 'LÜTTICH': A 1944 Approach to an AirLand Battle Strategy," *Army History*, no. 28 (1993): 36.

[76] Clark, "The German Army's Operation 'LÜTTICH,'" 36.

[77] John Eisenhower, *The Bitter Woods* (New York, NY: G.P. Putnam's Sons, 1969), 51-52.

[78] David Mason, *Breakout: Drive to the Seine* (New York, NY: Ballantine Books, 1968), 91-92.

[79] Clark, "The German Army's Operation 'LUTTICH,'" 36-37.

without the customary preparatory artillery fire, and in complete radio silence. The German High Command also allocated all available reserves from southern France to reinforce the Seventh Army, and dedicated three hundred fighters from the Luftwaffe to support the operation.[80] All of these happened with American forces ignorant of the pending attack.[81]

General Omar Bradley, however, had indications that the Germans planned on conducting a major operation. Intelligence reports indicated a large buildup of German troops near Mortain. This prompted the American commander to take precautionary steps against a possible German attack by realigning three divisions in both sides of the See river. By 6 August, the 3rd Armored and 4th Infantry divisions occupied defensive positions along the northern bank, and the 30th Infantry division defended along the southern bank of the river, in vicinity of Mortain. Mortain's geographic location had significant operational value for the Americans and Germans, as the town connected numerous population centers in the region to the key coastal city of Avranches.[82]

On 6 August, Kluge's Seventh Army initiated the attack along three main fronts. The 116th Panzer division moved north along the See River towards the town of Cherence, while the Second SS Panzer division advanced south towards Mortain. Between the 116th Panzer and the Second SS stood the Second Panzer division, responsible for attacking along the southern bank of the See River. Meanwhile, the First SS Panzer division acted as an exploitation force with the task of seizing Avranches. The German forces in northern Normandy had the task of fixing the British troops near Caen to prevent any attempt at reinforcing the Americans in the south.[83]

---

[80] Mason, *Breakout*, 93-94; Reardon, *Victory at Mortain*, 63.

[81] Richard P. Hallion, "Air Power and the Battle for Normandy," *Air Power History* 41, no. 2 (1994): 56; Reardon, *Victory at Mortain*, 63, 93; Clark, "The German Army's Operation 'LUTTICH,'" 37.

[82] John Keegan, *Six Armies in Normandy* (New York, NY: Viking, 1982), 245-246; Reardon, *Victory at Mortain*, 65.

[83] Clark, "The German Army's Operation 'LUTTICH,'" 37.

The 30th Infantry division, occupying the Cherence to Mortain defensive line, absorbed the brunt of the German attack. On 7 August, the Second SS Panzer division successfully attacked through the town of St. Hillaire, until the "Old Hickory" division checked its advance with heavy artillery and Allied airpower outside of Mortain in vicinity of Hill 317. Meanwhile, the Second Panzer division suffered a similar outcome north of Mortain in the town of Juvigny. The 116th Panzer achieved some success, but logistical issues and overwhelming Allied airpower bogged down its advance as well.[84]

By 8 August, the German assault came to a halt as Panzer formations ran into a wall of Allied air power. The German armored divisions suffered the same outcome as the Egyptians at the Sinai Passes twenty-nine years later: the destruction of their "closely packed columns of troops and vehicles by constant and merciless fighter-bomber strikes in concert with action on the ground."[85] This massive Allied air response came as a result of ULTRA codebreakers confirming the German offensive. Upon receiving the confirmation message, General Bradley ordered "all-out" air support for the embattled 30th Infantry Division.[86]

Field Marshal Kluge tried countering Bradley's "all-out" air support directive by using his own fighters to deny American air superiority over Mortain. However, the Germans were not successful. As Richard Hallion explains, "the Luftwaffe centralized its few fighter resources and attempted to intervene over the battlefield, but the deep cover American air superiority sweeps gobbled them up as they took off, and 'not one' appeared over the battlefield."[87] The US Ninth Air Force became the Luftwaffe and German army's main tormentor. The Ninth had the task of "warding off the Luftwaffe attempts to intervene in the battle, and the British Typhoons,

---

[84] Thirtieth Infantry Division G2, "After Action Report August 1st–31st 1944," Available at the Ike Skelton Combined Arms Library, N12139; Blumenson, *Breakout and Pursuit*, 556-557.

[85] Hallion, "Air Power and the Battle for Normandy," 56.

[86] Ibid., 57.

[87] Hallion, "Air Power and the Battle for Normandy," 57.

accompanied by the American rocket-armed 406th Fighter Group," were responsible for attacking the Panzer divisions.[88]

From 7 to 8 August, Allied warplanes appeared over the Mortain sky attacking the clustered Panzers at St. Barthelemy and Juvigny. The attack caused both physical and psychological damage in the retreat of the First SS Panzer division. According to reports, American troops found ten intact Panzer in the area, an indication that German crews abandoned their vehicles without any attempt at recovering them. The situation for German ground troops worsened as Luftwaffe fighters disappeared from the Mortain sky and Allied planes conducted deep air interdiction.[89]

The Royal Air Force Typhoons played a key role in supporting the American defensive line. These rocket-firing planes flew 294 sorties and destroyed eighty-three Panzers within the first twenty-four hours of combat.[90] The 245 Typhoon squadron, in particular, earned battle recognition from Allied leaders for their performance. The squadron decimated the First SS Panzer division with strike cycles that consisted of firing all available ammunition and returning to base for rearming and refueling. Their relentless rocket attacks hit the tightly packed tanks and transports throughout the Norman countryside. In Allied battle reports, 7 August became known as the "Day of the Typhoon."[91]

Besides the Royal Air Force, American air power also left its mark as well. During the battle, the American 406th Fighter group inflicted heavy losses on the German armored divisions. In one particular engagement, the Fighter group's rocket-armed P-47D thunderbolts "launched

---

[88] Reardon, *Victory at Mortain*, 137.

[89] Reardon, *Victory at Mortain*, 137.

[90] Scott G. Walker, *Targeting for Effect: Analytical Framework for Counterland Operations* (Maxwell Air Force Base, AL: Air University Press, 1998), 54, accessed January 12, 2020, https://www.jstor.org/stable/resrep13952.12.

[91] Dwight D. Eisenhower, *Report by The Supreme Commander*, 43-44; Blumenson, *Breakout and Pursuit*, 457-460; Hallion, "Air Power and the Battle for Normandy," 57.

forty-eight rockets, claiming seven tanks, one staff car, five half-tracks, and two trucks as destroyed."[92] The CAS and deep air interdiction by the Allied air force degraded the effectiveness of both the Luftwaffe and German ground forces.[93]

For the Germans, the critical integration of air-ground maneuver to achieve combined arms superiority never materialized. The German air force constantly operated in a contested air domain. Equipped to provide CAS, the Luftwaffe fighters were ill-prepared for air interdiction operations against Allied planes. Disagreements between ground commanders and Luftwaffe leaders became the root cause of the problem. While German ground commanders wanted the Luftwaffe to fend off the attacking Allied planes, Luftwaffe leaders insisted on arming fighters for ground attacks. As the air battle unfolded over the Normandy sky, Allied planes outmatched their German counterpart. In the first forty-eight hours of air combat, the Luftwaffe lost eighteen fighters.[94]

German commanders, including Field Marshal Kluge, fell in a state of disbelief at the magnitude and effectiveness of the Allied air attacks.[95] They tried wresting away the air superiority from the Allied force, but failed because the Luftwaffe could not match the overwhelming number and firepower of Allied planes. Deep Allied air interdiction further exacerbated the problem by preventing synergy between air and ground forces. To make matters worse, German commanders ran out of options and solutions for executing a deep maneuver to capture the city of Avranches. As a result, Operation Luttich's operational and strategic objectives became untenable.

---

[92] Reardon, *Victory at Mortain*, 138.

[93] Featherston, *Saving the Breakout*, 131.

[94] Featherston, *Saving the Breakout*, 132-133; Reardon, *Victory at Mortain*, 42, 138.

[95] Bradford J. Shwedo, *XIX Tactical Air Command and ULTRA: Patton's Force Enhancers in the 1944 Campaign in France* (Maxwell Air Force Base, AL: Air University Press, 2001), 53, accessed March 01, 2020, https://www.jstor.org/stable/resrep13950.1.

The uncoordinated German attack made it manageable for the 30th Infantry division to defend and hold the line against multiple armored divisions. Each piecemeal attack was met with air and artillery fire. Additionally, the expected Luftwaffe support to German ground troops never materialized due to the effectiveness of Allied air interdiction.[96] The Luftwaffe fighter pilots spent more time in aerial combat than in providing support to ground maneuver forces. Their futile attempt at denying Allied air superiority obviated the much-needed support for the Panzer divisions' deep penetration efforts.[97]

In deep maneuvers, armored forces move faster when air cover, indirect ground fires and infantry protect their front and flanks.[98] Without attendant air superiority, German ground forces floundered as they moved across time and space to gain an advantage over the American defenders. The absent air cover slowed the German armored and exposed it to Allied airpower, which severely hindered the Germans' ability to employ movement and fires against the American defenses at Mortain. Once the Panzer formations slowed their movement and clustered along the Mortain country roads, they became easy target for Allied planes. When this happened, the failure of the German deep maneuver became a foregone conclusion.

Similarly, artillery fire helps maneuvering units to seize, retain, and exploit the initiative. At Mortain, German artillery was highly ineffective against American positions. Persistent Allied CAS turned artillery and infantry coordination into an impossible task.[99] As Mark Reardon explained, artillery support "for the attacking Germans was conspicuous by its absence."[100] The

---

[96] Clark, "The German Army's Operation 'LUTTICH,'" 37-38.

[97] German Seventh Army, "War Diary," Volume 2, 16 July 1944 to 16 August 1944, Translations, Available at the Ike Skelton Combined Arms Library, N-9821-B, 7 AUG 1944; Blumenson, *Breakout and Pursuit*, 371.

[98] Walker, *Targeting for Effect*, 55.

[99] Reardon, *Victory at Mortain*, 142.

[100] Reardon, *Victory at Mortain*, 146.

German artillery became a nonfactor as commanders stopped employing indirect fire assets to suppress American positions or cover the movement of attacking troops.[101]

Ultimately, the Americans succeeded because their protective air umbrella enabled freedom of maneuver in a defensive battle. Allied air supremacy saved the day by preventing the success of an operation that could have prolonged the Allied campaign in France.[102] The Germans failed because they could not overcome the challenges of an operational environment where the enemy had the protective advantage of an air defense bubble. Once German troops stepped inside the American air bubble, Allied planes stopped them from achieving combined arms superiority. The German Mortain offensive, as a historical case study, is a poignant example of what happens when an enemy force operates unchecked under the protection of an air umbrella.

Section 4: Conclusion

Historian John L. Gaddis explains that those who study the past are much "better off than the participant in the present" because they have an expanded horizon.[103] In other words, people who understand the past make better sense of the future.[104] With this in mind, Army leaders must focus on existing capability gaps, while relying on history for context, to innovate, fill the gaps, and overcome future battlefield challenges. What the Egyptian and Israeli leadership did to innovate and fill capability gaps before the Yom Kippur War is a good and bad example of how this can be done.

Israel and Egypt took divergent paths in their preparation for future conflicts. Before the Yom Kippur War, Israeli leaders viewed their successes in previous wars as a validation of their

---

[101] Ibid.

[102] Hallion, "Air Power and the Battle for Normandy," 57.

[103] John L. Gaddis, *The Landscape of History: How Historians Map the Past* (New York, NY: Oxford University Press, 2002), 4.

[104] Gaddis, *The Landscape of History*, 4.

tactics, techniques, and procedures. Edward Luttwak argues that the Israeli victory in the 1967 war engendered a confirmation bias toward combat-proven habits, procedures, structures, tactics, and methods. He called it the paradoxical logic of strategy. For the Israeli army, according to Luttwak, the Six-Day War validated their ground maneuver concept of unsupported armor assaults and air interdiction. It also validated the tactical and operational advantages of independent armored formations–skilled in gunnery and mobility.[105]

"The Israeli army," wrote Luttwak, "made no great efforts to strengthen its tank units with self-propelled artillery and high-grade infantry equipped with modern armored carriers."[106] When war came in 1973, Egyptian troops inflicted heavy losses because the IDF lacked the artillery and infantry support for the advancing armored forces. Similarly, after an excellent IAF performance in 1967, Israeli authorities favored the acquisition of combat aircraft over anti-radar electronic-warfare equipment.[107]

Conversely, Egypt's defeat in 1967 became the catalyst of significant change within the Egyptian military. Egyptian leaders understood their operational gaps and took major steps, such as improving Egypt's air defense capabilities, to fix these problems. As it turns out, defeat became a far better teacher for the Egyptians. The defeat in 1967 sharpened Egyptian faculties and forced innovation within the armed forces. Egyptian leaders identified shortcomings while avoiding senseless technological competition with the Israeli army. Egypt accepted Israeli military superiority and took measures to counter it. For example, since Israeli tanks outmatched Egyptian tanks, Egyptian leaders adopted a doctrine based on countering the threat of Israeli armored forces. Instead of buying aircraft to compete with the technologically advanced IAF,

---

[105] Edward N. Luttwak, *Strategy: The Logic of War and Peace* (Cambridge, MA: The Belknap Press of Harvard University Press, 2001), 16, 19.

[106] Luttwak, *Strategy*, 19.

[107] Ibid., 19-20.

Egypt asked the Soviets for SAMS batteries. Through experience and history, Egypt learned, adapted, and innovated.[108]

Like the Egyptians, Russia followed a similar path after the collapse of the Soviet Union. Russian military leaders proactively analyzed the past to understand what the future conflict for a resource constraint Russia looked like. Their analysis after Desert Storm on the American way of war engendered not only a better understanding of Russia's operational capabilities and limitations but also countermeasures to exploit American operational weakness. The development of the S-400 "Triumph" SAMS, as part of a highly sophisticated A2AD system, is a product of Russia's careful study to negate the US Army's concept of LSCO in the MDO fight.[109]

Similarly, the US Army has to avoid making the same mistake the Israelis made after 1967. American commanders cannot fall into the trap of preparing for the last war as they create a "ready to fight tonight" army. Army leaders must study the past to create solutions for the complex challenges of the future by employing a well-trained and equipped force. The reliance on technological overmatch alone may not be enough to overcome a layered A2AD defense; operational and tactical ingenuity is required. As a result, US Army commanders have to understand how to be reflective practitioners and exercise what Donald Schön calls reflection-in-action, to affect outcomes in difficult situations.[110]

Without fires and air superiority, in modern war from 1940 to the present, deep mechanized maneuver is historically bound to fail – both historical cases in this study proved the magnitude of this problem. Both cases demonstrate the difficulty of operating in contested spaces without attendant air superiority. The lack of air support to ground maneuver forces during the

---

[108] Luttwak, *Strategy*, 20.

[109] US Army, FM 3-0, 5-3. In LSCO, the US Army, as a land power, is responsible for providing maneuver and fires by deploying significant combat power in areas where the enemy has an initial advantage.

[110] Donald A. Schön, *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions* (San Francisco, CA: Jossey-Bass, 1987), 29.

Israeli and German assaults had catastrophic consequences for both armies. In the Israeli case, the IAF's inability to support the IDF's armored formations resulted in significant losses and led to a temporary stalemate at the southern front. For the Germans, their operation met complete failure after armored formations ran into a wall of Allied airpower, and German leadership ran out of options in the air and land domain to challenge Allied dominance over the Normandy sky.

The Mortain case is a telling example of what will likely happen today when military forces fight an enemy that enjoys the tactical, operational, and strategic stand-off advantage from A2AD sophistication to enable control of the air domain and negate the execution of combined arms maneuver. During the German offensive, Allied forces operated inside a protective air bubble, with German forces unable to prevent Allied airpower from inflicting heavy losses. The protection of Allied airpower facilitated an American coup de grace via a combined air-artillery-armor assault that shattered the German Panzer divisions, similar to what transpired in Desert Storm and the Korean War. Today, US forces may suffer a similar outcome against a Russian adversary. The range and mobility of Russian A2AD systems, as well as Russian airpower, will likely make US ground maneuver in the plains of eastern Europe look like the Mortain offensive.

In the Yom Kippur War, the IDF solution to regaining air superiority over the Egyptians happened at a time and place under special circumstances; and it may not work for the US Army against a common foe like Russia. Unlike the static Egyptian SAMS network that the IDF encountered, Russia's air defenses are highly sophisticated, mobile, and difficult to target. In comparison, the IDF deep ground maneuver occurred within the constrained space of the Sinai Peninsula, while the vast plains of eastern Europe present a significant operational challenge to the US Army. Additionally, the IAF pilots faced a poorly trained and equipped Egyptian Air Force, an unlikely advantage for the US Air Force when facing Russian airpower. In short, any attempt by Army leaders at recreating the IDF success in eastern Europe may encounter results similar to the Mortain offensive, unless cross-domain synergy is achieved to allow ground forces the freedom of maneuver to knock off Russia's layered A2AD network.

As senior US Army leaders consider the future challenges of overcoming the sophistication of modern IADS, they must think about maximizing the means of other domains in ways that achieve convergence to enable ground forces freedom of maneuver. Maximizing the capabilities of other domains may help in the quest for reestablishing combined arms maneuver by facilitating the suppression and elimination of the enemy's IADS. US ground maneuver forces can accomplish this task by using independent maneuver, cross-domain fires, and maximizing human potential. These elements provide ground forces with the window of opportunity to maximize other domains and neutralize the IADS in contested spaces.[111]

Through independent maneuver, ground forces use organic assets to achieve internal convergence when physically isolated in combat operations from the support of other domains. Additionally, it provides maneuvering units the ability to mass combat power with fires and maneuver at decisive points in the battle to help reestablish cross-domain synergy.[112] The actions of IDF units in the 1973 war is a comparative example of how independent maneuver might work. As IDF armored formations found themselves isolated without support from the air domain, Israeli commanders relied on their organic mechanized infantry and ground fires to concentrate combat power at decisive spaces to neutralize the Egyptian ground threat and create a window of opportunity for the resurgence of cross-domain convergence–air-ground integration. Similarly, American commanders may employ organic capabilities at division and corps level to protect themselves from Russian threats until they can regain air-ground convergence.

Employing cross-domain synergy is another way that operational commanders may enable the task of employing ground forces in a nonpermissive environment to destroy the enemy's stand-off capabilities. Cross-domain synergy beyond traditionally employed fires not only provides options to ground maneuver commanders but also allows them to overcome the

[111] US Army, TRADOC Pamphlet 525-3-1, 19.

[112] Ibid., 19, C-7, D-6, GL-5.

functional separation imposed by the A2AD systems.[113] Electronic warfare, air-to-surface anti-radiation missiles, drones, cruise missiles, rocket artillery, cyber/space capabilities combine to degrade and limit A2AD effectiveness. Corps and theater-level commanders can employ these methods to shape the battlefield by softening the layered stand-off of air defenses, and aid ground maneuver formations gain an edge over the enemy.

Overall, the difficulty of conducting LSCO without the protection and support of the air domain is unquestionable. Air superiority optimizes ground capabilities in the land domain to create cross-domain synergy during combined arms maneuver. Therefore, the defeat of air defenses is a prerequisite for effective combined arms in LSCO. As such, American theater commanders may have to employ ground maneuver forces – accompanied by cross-domain convergence – in a deep maneuver strike to complete the destruction of the Russian layered A2AD. They may have to do this in a difficult "peeling the onion" approach that defeats one defensive layer at a time, as Russian forces maneuver under their protective IADS, with US Army armored and infantry forces maneuvering within an envelope of friendly air cover support while cross-domain fires play a key role in IADS suppression.[114] There are certain capability gaps, however, that senior commanders have to address to establish the right conditions.[115]

The disparity in long-range fires between the US Army and the Russian military is a key area of concern that senior army leaders must address. Aside from the sophistication of an A2AD system, Russia's long-range fires outgunned US systems, and can inflict significant losses. This capability gap threatens the US ground forces' ability to penetrate Russian defenses and defeat

[113] US Army, TRADOC Pamphlet 525-3-1, 19.

[114] D. Sean Barnett, Scott Boston, John Gordon, Katharina Ley Best, Dan Madden, Igor Mikolic-Torreira, Danielle C. Tarraf, and Jordan Willcox, *Army Fires Capabilities for 2025 and Beyond* (Santa Monica, CA: RAND Corporation, 2019), 23, accessed on March 01, 2020, https://www.rand.org/pubs/research_reports/RR2124.html.

[115] Barnett et al., *Army Fires Capabilities for 2025 and Beyond*, 21.

the IADS. According to a Rand Corporation report, the US Army has to address these fundamental challenges:

- US artillery systems are largely outranged by Russian systems, especially in the area of cannons.
- Their Russian counterparts will significantly outnumber US artillery.
- US artillery may face significant counterfire threat because of the range and numbers issues mentioned above, and because of Russian targeting capabilities in the Baltic region.
- Coordination of joint fires (artillery, air, aviation) will be a complex problem that will require significant planning and intelligence analysis.
- US artillery and other fires capabilities are reliant on target systems that evolved to support COIN operations and may not be reliable sources of targeting when facing adversaries with capable IADS, EW, and cyber capabilities.
- US artillery and other fires capabilities may not be able to focus as much as desired on supporting US ground forces because of the need to support NATO air forces through suppression of enemy air defenses (SEAD).
- US artillery may not be prepared for the levels of ammunition expenditure that may be required when fighting a near-peer conventional opponent.
- US artillery effectiveness may be reduced by the need to avoid/defend against attacks by Russian SOF (*Spetnaz*) in NATO's rear area.
- Heavy equipment and ammunition would have to be prepositioned forward to allow US artillery to deploy and participate in the conflict in a timely manner.[116]

Although these challenges lie outside the scope of this monograph, they are a way ahead for future research into the problem of maneuver against the sophistication and lethality of Russian A2AD and other combat systems. If we do not address them, any attempt at employing ground maneuver units in a contested environment against sophisticated layered stand-off systems will likely result in another German-like Mortain offensive.

Cross-domain synergy represents a critical prerequisite for a successful deep maneuver strike. It is the spirit of the MDO concept of convergence. Army leaders must continue to explore challenges and solutions associated with a scenario where maneuver formations lack the protection and support of the air domain because of IADS sophistication. As Gaddis suggested, they can start by studying the past to make sense of the future. Leaders have to be ready for operations in contested spaces, where reliance on the full spectrum of domains may play a greater role than the traditional air domain: the arbiter of US success in maneuver.

[116] Barnett et al., *Army Fires Capabilities for 2025 and Beyond*, 23-24.

Bibliography

Primary sources

Adan, Avraham. *On the Banks of the Suez: An Israeli General's Personal Account of the Yom Kippur War*. New York: Presidio Press, 1980.

Blumenson, Martin. *U.S. Army in World War II, The Europe Theater of Operations: Breakout and Pursuit*. Washington, DC: Government Printing Office, 1961.

CIA Intelligence Report. "The 1973 Arab-Israeli War: Overview and Analysis of the Conflict," September 1975. The Central Intelligence Agency Online Library. Accessed January 23, 2020. https://www.cia.gov/library./readingroom/.docs/1975-09-01A.pdf.

El Shazly, Saad. *The Crossing of the Suez*. San Francisco, CA: American Mideast Research, 1980.

Eisenhower, Dwight D. *Report by The Supreme Commander to the Combined Chiefs of Staff on the Operations in Europe of the Allied Expeditionary Force, 6 June 1944 to 8 May 1945*. Washington, DC: Center of Military History, 1994.

German Seventh Army. *War Diary. Vol. 2. 16 July 1944 to 16 August 1944*, Translations. Ike Skelton Combined Arms Library, Fort Leavenworth, KS, N-9821-B.

Sakal, Emanuel. *Soldier in the Sinai: A General's Account of the Yom Kippur War*. Lexington, KY: University Press of Kentucky, 2014.

US 30th Infantry Division G2. *After Action Report August 1st – 31st 1944*. Ike Skelton Combined Arms Library, Fort Leavenworth, KS, N12139.

US Department of Defense, Joint Staff. Joint Publication (JP) 3-01, *Countering Air and Missile Threats*. Washington, DC: Government Printing Office, 2017.

———. *DoD Dictionary of Military and Associated Terms*. Washington, DC: Government Printing Office, 2017.

US Department of the Army. Army Doctrine Reference Publication (ADRP) 3-0, *Operations*. Washington, DC: Government Printing Office, 2017.

———. Army Doctrine Reference Publication (ADRP) 3-09, *Fires*. Washington, DC: Government Printing Office, 2017.

———. Army Techniques Publication (ATP) 3-94.2, *Deep Operations*. Washington, DC: Government Printing Office, 2016.

———. Army Techniques Publication (ATP) 3-90.4, *Combined Arms Mobility*. Washington, DC: Government Printing Office, 2016.

———. Army Techniques Publication (ATP) 3-09.90, *Division Artillery Operations and Fire Support for the Division.* Washington, DC: Government Printing Office, 2017.

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

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

Secondary sources

Aker, Frank. *October 1973*. Hamden, CT: Archon Books, 1985.

Clark, Mark E. “The German Army's Operation ‘LÜTTICH’: A 1944 Approach to an AirLand Battle Strategy.” *Army History*, no. 28 (1993).

Clausewitz, Carl von. *On War*. Edited and translated by Michael Howard and Peter Paret. Princeton, NJ: Princeton University Press, 1984.

Coutts, Ronnie L. “The Israeli Experience: The Apogee of Blitzkrieg,” in *Deep Maneuver: Historical Case Studies of Maneuver in Large-Scale Combat Operations*. Edited by Jack D. Kem. Fort Leavenworth, KS: Army University Press, 2018.

Depuy, Trever N. *Elusive Victory: The Arab-Israeli Wars, 1947-1974*. New York, NY: Harper & Row, 1978.

Eisenhower, John. *The Bitter Woods*. New York, NY: G. P. Putnam’s Sons, 1969.

Featherston, Alwyn. *Saving the Breakout: The 30th Division’s Heroic Stand at Mortain, August 07-12, 1944*. Novato, CA: Presidio Press, 1993.

Gaddis, John L. *The Landscape of History: How Historians Map the Past*. New York, NY: Oxford University Press, 2002.

Gawrych, George W. *The Albatross of Decisive Victory*. Westport, CT: Greenwood Press, 2000.

Hallion, Richard P. “Air Power and the Battle for Normandy.” *Air Power History*, Vol. 41, No. 2 (1994).

Keegan, John. *Six Armies in Normandy*. New York, NY: Viking, 1982.

Luttwak, Edward N. *Strategy: The Logic of War and Peace*. Cambridge, MA: The Belknap Press of Harvard University Press, 2001.

Mason, David. *Breakout: Drive to the Seine*. New York, NY: Ballantine Books, 1968.

Pollack, Kenneth M. *Arabs at War: Military Effectiveness, 1948-1991*. Lincoln, NE: Nebraska University Press, 2002.

Rabinovich, Abraham. *The Yom Kippur War*. New York, NY: Shocken Books, 2004.

Reardon, Mark J. *Victory at Mortain*. Lawrence, KS: University Press of Kansas, 2002.

Schön, Donald A. *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions*. San Francisco, CA: Jossey-Bass, 1987.

Shwedo, Bradford. *XIX Tactical Air Command and ULTRA: Patton's Force Enhancers in the 1944 Campaign in France*. Maxwell Air Force Base, AL: Air University Press, 2001. Accessed March 1, 2020. https://www.jstor.org/stable/resrep13950.1.

Tovy, Tal. "Egypt vs. Israel: Combined Arms in the Yom Kippur War and the Lessons for the US Army," in *Bringing Order to Chaos: Historical Case Studies of Combined Arms Maneuver in Large-Scale Combat Operations*. Edited by Peter J. Schifferle. Fort Leavenworth, KS: Army University Press, 2018.

Walker, Scott G. *Targeting for Effect: Analytical Framework for Counterland Operations*. Maxwell Air Force Base, AL: Air University Press, 1998. Accessed January 12, 2020. https://www.jstor.org/stable/resrep13952.12.

Other sources

Army Technology. "S-400 Triumph Air Defence Missile System." Accessed February 27, 2020, https://www.army-technology.com/projects/s-400-triumph-air-defence-missile-system/.

Barnett, D. Sean, Scott Boston, John Gordon, Katharina Ley Best, Dan Madden, Igor Mikolic-Torreira, Danielle C. Tarraf, and Jordan Willcox. *Army Fires Capabilities for 2025 and Beyond*. Santa Monica, CA: RAND Corporation, 2019. Accessed on March 01, 2020. https://www.rand.org/pubs/research_reports/RR2124.html.

Bryen, Stephen, "Why Russia's S-400 Anti-Air System is Deadlier Than You Think: A Very Powerful Weapon." *The Buzz* (blog). *The National Interest*. November 9, 2019. Accessed on February 16, 2020. https://nationalinterest.org/blog/buzz/why-russias-s-400-anti-air-system-deadlier-you-think-94541.

Cabot, Adam. "Fortress Russia: How Can NATO Defeat Moscow's A2/AD Strategy and Air Defenses?" *The Buzz* (blog). *The National Interest*. November 3, 2018. Accessed on February 17, 2020. https://nationalinterest.org/blog/buzz/fortress-russia-how-can-nato-defeat-moscows-a2ad-strategy-and-air-defenses-35087.

Kofman, Michael. “Vostok 2018 – Day 2 (September 12).” *Russia Military Analysis: A Blog on the Russian Military*. September 13, 2018. Accessed on February 16, 2020. https://russianmilitaryanalysis.wordpress.com/2018/09/13/vostok-2018-day-2-september-12/.

Kolditz, Thomas A. “Exploring the Conditions for Decisive Operational Fires.” Monograph, US Army Command and General Staff College, Fort Leavenworth, Kansas, 1985.

Missile Threat: CSIS Missile Defense Project. “S-400 *Triumph*.” Accessed February 27, 2020, https://missilethreat.csis.org/defsys/s-400-triumf/.

O’Grady, Soibhan. “What is the Russian S-400 air defense system, and why is the U.S. upset Turkey bought it?” *The Washington Post*. July 17, 2019. Accessed on February 16, 2020. https://www.washingtonpost.com/world/2019/07/12/what-is-russian-s-air-defense-system-why-is-us-upset-turkey-bought-it/.

Pearson, Craig H. “Joint Army Aviation/Air Force Deep Operations at Night: Is It Tactically Feasible and If So, How?” Monograph, US Army Command and General Staff College, Fort Leavenworth, Kansas, 1985.

Stratfor: Worldview. “Why the S-400 Missile is Highly Effective–If Used Correctly.” July 12, 2019. Accessed on February 16, 2020. https://worldview.stratfor.com/article/why-s-400-s400-missile-long-range-turkey-russia-syria-effective.