Artificial Intelligence – Conquering a Relative Disadvantage

A Monograph

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The US military is in a position it has not experienced since the end of the Cold War, one of having to play catch up with its peer adversaries. While the United States focused on counter-insurgency operations, its adversaries watched, learned, and developed capabilities which put the military in a position of relative disadvantage. Russia in particular demonstrated a reconnaissance-strike capability during the Russo-Ukraine war which the US military could not match. As the United States endeavors to close these gaps, the question becomes in what new technologies should it invest? Artificial Intelligence is an emerging technology with limitless military applications. Where can the US military leverage this technology to re-establish overmatch against its peer competitors is the question this research paper seeks to answer. Human-AI teaming in the form of autonomous drones linked to strategic and operational level fires enabled by AI assisted deconfliction measures is one area the US military will close a demonstrated capability gap and regain overmatch without sacrificing acceptable risk levels.

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Abstract

Artificial Intelligence – Conquering a Relative Disadvantage, by MAJ Douglas W. Stansbury, 37 pages.

The US military is in a position it has not experienced since the end of the Cold War, one of having to play catch up with its peer adversaries. While the United States focused on counter-insurgency operations, its adversaries watched, learned, and developed capabilities which put the military in a position of relative disadvantage. Russia, in particular, demonstrated a reconnaissance-strike capability during the Russo-Ukraine war which the US military could not match.

As the United States endeavors to close these gaps, the question becomes in what new technologies should it invest? Artificial Intelligence is an emerging technology with limitless military applications. Where can the US military leverage this technology to re-establish overmatch against its peer competitors is the question this research paper seeks to answer.

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Acronyms

ADP	Army Doctrine Publication
AI	Artificial Intelligence
CAOC	Combined Air Operations Center
CDE	Collateral Damage Estimate
DoD	Department of Defense
EW	Electronic Warfare
FM	Field Manual
IADS	Integrated Air Defense System
IHL	International Humanitarian Law
ISR	Intelligence, Surveillance, and Reconnaissance
LAWS	Lethal Autonomous Weapon System
OIF	Operation Iraqi Freedom
OODA	Observe, Orient, Decide, Act
MUM-T	Man Unmanned Teaming
RUW	Russo-Ukraine War
SAM	Surface to Air Missile
UAV	Unmanned Aerial Vehicle
WFF	Warfighting Function

> As the Army and the joint force focused on counter-insurgency and counter-terrorism at the expense of other capabilities, our adversaries watched, learned, adapted, modernized and devised strategies that put us at a position of relative disadvantage in places where we may be required to fight . . . The risk of inaction is great; the less prepared we are to meet these challenges, the greater the likelihood for conflict with those who seek windows of opportunity to exploit.
>
> —General Michael D. Lundy, quoted in US Department of the Army, Field Manual (FM) 3-0, *Operations*

A Relative Disadvantage

General Lundy's ominous words acknowledge the United States finds itself in the unfamiliar territory of having to play catch up with its peer competitors. The Russian Federation's 2014 invasion of Ukraine demonstrated the US military no longer owned a monumental lead in military technology. The Russian Army that invaded Ukraine was not the antiquated force that failed in Afghanistan. It was fast, flexible, and debuted a reconnaissance-strike capability not previously seen on contemporary battlefields.[1] Russia is not America's only peer competitor on the rise. Since 1996, China's People's Liberation Army has transformed itself into a modern and capable military.[2]

The US military is in a position it has not experienced since the Cold War. During Operation Desert Storm and Operation Iraqi Freedom, the US military revealed it was significantly ahead of its closest competitors.[3] Since the early 1990s, most Soldiers have never

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[1] Amos C. Fox and Andrew J. Rossow, "Making Sense of Russian Hybrid Warfare: A Brief Assessment of the Russo-Ukrainian War," Land Warfare Papers (March 2017), 1, accessed August 18, 2018, https://www.ausa.org/sites/default/files/publications/LWP-112-Making-Sense-of-Russian-Hybrid-Warfare-A-Brief-Assessment-of-the-Russo-Ukrainian-War.pdf.

[2] Eric Heginbotham, Michael Nixon, Forrest E. Morgan, Jacob Heim, Jeff Hagen, Sheng Li, Jeffrey Engstrom, Martin C. Libicki, Paul DeLuca, David A. Shlapak, David R. Frelinger, Burgess Laird, Kyle Brady, Lyle J. Morris, *The U.S.-China Military Scorecard Forces, Geography, and the Evolving Balance of Power, 1996–2017* (Santa Monica, CA: RAND Corporation, 2015) iii, accessed October 15, 2017, https://www.rand.org/pubs/research_reports/RR392.html,.

[3] Robert Farley, "Fact: America's Military Might Peaked in the 1990s (And Its Not Coming Back)" *The National Interest*, May 18, 2017, 1, accessed October 16, 2018, https://nationalinterest.org/blog/the-buzz/fact-americas-military-might-peaked-the-1990s-its-not-coming-20742.

had to worry about facing an enemy with equipment and capabilities equal to their own. The sobering reality is the enemy has met and surpassed the American military in several key areas.

The 2017 version of *Field Manual (FM) 3-0, Operations*, acknowledged the US military had not maintained its superiority over its peer adversaries.[4] With the understanding the military operates in a fiscally constrained environment; the problem focuses on a question of investment. The military prioritizes the capabilities it explores and attempts to get the most value from each investment. Therefore, leaders must make difficult decisions about which future technologies to pursue to quickly close the identified capability gaps and re-establish US military overmatch. Artificial Intelligence (AI) is an emerging technology with significant military applications worthy of the military's continued investment.

The Primary Research Question

Artificial intelligence is one technology with the potential to close multiple capability gaps. The primary research question this paper seeks to answer is: where can the US military leverage the emerging technology of AI to re-establish overmatch against its peer competitors?

The study considered three supporting questions to aid in answering the primary research question. First, what is AI? There are many definitions out there, and this paper seeks to identify a single definition to provide clarity to the argument. Second, where is AI superior to the human mind and where is it inferior? The final supporting question is, where is the military currently seeking to employ AI?

The significance of the research rests on the potential of AI's military applications. Frank Hoffman of the National Defense University hailed AI as the seventh Military Revolution, combining the powers of the industrial revolution with the information age.[5] China and Russia

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[4] US Department of the Army, *Field Manual (FM) 3-0, Operations* (Washington, DC: Government Printing Office, 2017), 1.

[5] F. G. Hoffman, "Will War's Nature Change in the Seventh Military Revolution?" *Parameters* 47, no. 4 (2017): 1, accessed August 12, 2018, https://lumen.cgsccarl.com/login?url=https://search.proquest.com/docview/2051200095?accountid=28992.

are both pursuing AI; if either of these peer competitors is the first to succeed, the United States will find itself at an exponentially deepening disadvantage. [6] Understanding AI's characteristics help to illuminate its military possibilities.

AI's strength lay in its ability to process massive amounts of information and provide creative outputs. This ability has applications across the Intelligence and Fires Warfighting Functions (WFF). As a machine, AI does not have the human affliction of boredom or fatigue. Information saturates 21st century battlefields which make finding useable intelligence more difficult. The military who can most efficiently utilize the massive amounts of information available will dominate the battlefield.[7] By harnessing AI's attributes, the US military can regain the competitive edge it previously enjoyed.

Hypothesis

The study proposes one hypothesis for the military application of AI systems:

Teaming autonomous drones with operational and strategic level fires enabled by AI assisted deconfliction measures is one area where the US military will close a demonstrated capability gap and regain overmatch without sacrificing acceptable risk levels.

The proposed teaming of AI augmented Intelligence and Fires systems will enable the US military to regain a portion of overmatch with its peer competitors through speed and information. Artificially intelligent drones will hunt for the enemy without putting US servicemember's lives at risk. Teaming drones with operational and strategic fires enable rapid response. An AI augmented deconfliction system will quickly clear fire missions and greatly speed up the targeting cycle. Maintaining information and tempo superiority will enable the military to remain firmly within the enemy's decision cycle and place the enemy in a position of relative disadvantage.

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[6] Ecatarina Garcia, "The Artificial Intelligence Race: U.S. China and Russia," *Modern Diplomacy*, April 19, 2018, accessed October 16, 2018, https://moderndiplomacy.eu/2018/04/19/the-artificial-intelligence-race-u-s-china-and-russia/.

[7] Lawrence Freedman, *Strategy: A History* (New York: Oxford University Press, 2013), 245.

This study made two assumptions to guide the research and inform the recommendations. The first assumption was whichever nation first unlocks and applies AI militarily will have a significant competitive advantage over everyone else. Russian Federation President Vladimir Putin told a group of Russian students whoever reaches a breakthrough in AI will come to dominate the world.[8] Despite the obvious hyperbole evident in the statement, it illuminated how important US competitors believe a breakthrough in AI is. The second assumption was the United States will not allow autonomous robots to make lethal decisions. As of 2018, experts are still debating the ethical, legal, and moral implications of AI on the battlefield. In this study, a human is always present to make lethal decisions.

The study will review the current literature available on AI in chapter 2 to investigate the hypothesis, answer the primary and supporting questions, and introduce the two case studies used in the analysis. Chapter 3 will discuss the methodology the study will use to answer the primary research question and test the hypothesis. This chapter will also discuss limitations and delimitations of the study. Chapter 4 will analyze the two case studies to enable the research to draw conclusions and make recommendations. Finally, Chapter 5 will summarize the findings and make recommendations for future studies.

Summary

Over the last seventeen years, the United States has seen its military's competitive advantage evaporate in many areas. Peer adversaries studied the US military and developed capabilities that would place US soldiers at a relative disadvantage in a future conflict. As the United States seeks future capabilities, it must make difficult decisions about where to invest. AI is one area that the military cannot neglect. US peer competitors recognize the paradigm shifting possibilities presented by this powerful new technology. AI can provide one avenue for the US

[8] Sergei Karpukhin, "Putin: Leader in Artificial Intelligence Will Rule the World," *Associated Press*, June 15, 2017, 1, accessed August 19, 2018, https://www.cnbc.com/2017/09/04/putin-leader-in-artificial-intelligence-will-rule-world.html.

military to regain overmatch with peer competitors by teaming autonomous drones with operational and strategic fires enabled by AI augmented deconfliction systems.

Literature Review

> If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.
>
> —Sun Tzu, *Art of War*

Sun Tzu identifies knowing yourself, and the enemy as a vital component of victory.[9] General Lundy's comments in FM 3-0, *Operations*, illustrate the US Army understands its shortcomings in relation to its peer adversaries.[10] This awareness serves as the impetus for discussions on AI's applicability to the problems discussed in chapter 1. The supporting questions from chapter 1 provide organization to the literature review. The first section addresses the definition of AI. In 2018, multiple ideas existed about what AI is. The review discusses several types and definitions of AI to provide context for the discussion of AI systems throughout the paper. The review investigates the capabilities and limitations of AI. AI far outpaces the human mind in some respects. However, it is far behind in some tasks humans find simple. This section also explores the legal and ethical issues pertinent to using AI on the battlefield. There is a spirited debate about how much autonomy AI systems should have and what restrictions governments should enact on things like autonomous lethal decision making. The chapter closes with a discussion of what AI applications the military is pursuing on the battlefield. Before delving into the supporting questions, it is important to define the major capability gap this paper seeks to close.

[9] Sun Tzu, *The Art of War* (Boston, MA: Shambhala, 2005), 91.

[10] US Department of the Army, *Field Manual (FM) 3-0, Operations*, foreword.

Reconnaissance-Strike Capability Gap

The Russian Army displayed the ability to find and quickly destroy static Ukrainian formations with long range fires during the Russo-Ukraine War (RUW). The Russian Army accomplished this by layering their Unmanned Aerial Vehicles (UAV) as part of a highly integrated system which teamed Integrated Air Defense System (IADS) protected drones with long range indirect fires platforms, termed reconnaissance-strike.[11] The army used drones carrying multiple sensors and electronic warfare (EW) systems to find and disrupt Ukrainian formations while it simultaneously fed targeting information to Russian rocket batteries to destroy those formations. The Russian Army's reconnaissance-strike capability displays a real-time targeting system that outpaces all other militaries on the battlefield.[12]

Using UAVs to identify targets is hardly a novel concept as the United States has done this throughout the 21st century. As of 2018, the US military primarily focused its reconnaissance-strike capability on long range theater/strategic precision engagements.[13] These engagements teamed drones with aircraft, valuing precision over mass, and required relatively few deconfliction measures. The Russian Army prefers to use their drones at the operational level with mass artillery engagements featuring little time between target discovery and destruction.

The final point on Russia's reconnaissance-strike capability is fires clearance procedures. The US military's clearance procedures for an unanticipated target can be ponderous, as many different sections must contribute to ensuring the safety of Soldiers before firing.[14] For example – if a dismounted patrol discovers a target of opportunity, its headquarters must make sure there are

[11] Fox and Rossow, "Making Sense of Russian Hybrid Warfare: A Brief Assessment of the Russo-Ukrainian War," 10.

[12] Dr. Phillip A. Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War, Personal Observations," July 8, 2015, 12, accessed December 17, 2017, https://prodev2go.files.wordpress.com/2015/10/rus-ukr-lessons-draft.pdf.

[13] Ibid., 13.

[14] US Department of the Army, *Field Manual (FM) 3-09, Field Artillery and Fire Support Operations,* (Washington DC: Government Printing Office, 2014), 1-46.

no other friendly units in the area, no helicopters or aircraft along the route the artillery rounds will travel, and no civilians that could be accidentally affected by the round's impact. This process takes time. While the Russian Army undoubtedly has their procedures to ensure the safety of their troops, they are not as restrictive as the US military's, as evidenced by Russian artillery killing civilians and destroying their property during the RUW.[15]

Drone enabled reconnaissance-strike has been a mainstay on the battlefield for the last twenty years. The Russian philosophy of mass over precision produced impressive results on the battlefields of the RUW. The functionality of teaming multiple capabilities as part of an integrated fires systems, as well as somewhat less stringent fires deconfliction measures, produced a reconnaissance-strike capability which the United States cannot currently match.

What is AI?

There are many definitions of what constitutes an artificially intelligent system. Establishing a common understanding of AI for this paper provides context for the analysis in chapter 4 and the recommendations in chapter 5. There is also great debate over weak versus strong AI. Therefore, AI in this paper includes not only the overarching description of what makes something artificially intelligent but also the specific type of AI system. Almost as important as understanding what AI is, it is equally important to define what AI is not. Separating science from science fiction provides clarity for the recommendations in chapter 5.

The first accepted definition of AI came from a Stanford University professor named John McCarthy in 1956. He claimed programmers could so precisely describe intelligence that a machine could simulate it.[16] This early definition provided the key element of AI, a computer able to simulate human thinking.

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[15] Fox and Rossow, "Making Sense of Russian Hybrid Warfare: A Brief Assessment of the Russo-Ukrainian War,"10.

[16] Andy Chilson, "Artificial Intelligence Programming," *Futurics* 29, no. 1/2 (2005): 89, https://lumen.cgsccarl.com/login?url=https://search.proquest.com/docview/219812574?accountid=28992.

Experts revised John McCarthy's definition many times since 1956. Bernard Marr provided multiple examples of these revisions in his Forbes Magazine article "Key Definitions of Artificial Intelligence (AI) That Explain its Importance." The definitions continue the theme of machines able to mimic intelligent being thinking. Intelligent being thinking is cognition requiring judgments, such as visual perception, speech recognition, and decision making.[17] These areas provide insight into the types of problems AI seeks to overcome.

Marr's stated definitions of AI shift based upon the goals the artificially intelligent system is trying to achieve.[18] He specifically identified "Strong" and "Weak" systems as the two most common classifications of AI. Strong AI systems think at a level equal to humans and are capable of cognitive mental states.[19] Strong AI systems are most familiar as the ones portrayed in movies such as "The Terminator." Weak AI systems have some human-thinking like attributes which allow them to act as if they were intelligent.[20] Weak AI systems are present in everyday life, such as automated voice response systems and game-playing applications. Weak systems are limited systems that simulate specific portions of intelligent being thinking; strong systems can do anything a human can do. In 2018, programming was the limiting factor of AI.[21]

There are two schools of thought on AI programming. The first is a traditional approach to designing and writing large programs to represent complex ideas and differing types of data.[22] The second is "machine learning." In machine learning, rather than trying to use computer

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[17] Bernard Marr, "The Key Definitions of Artificial Intelligence (AI) That Explain Its Importance," *Forbes*, February 14, 2018, accessed October 16, 2018, https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/#230d84e54f5d.

[18] Ibid.

[19] Ibid.

[20] Chilson, "Artificial Intelligence Programming," 90.

[21] John Ball, "A.I. Is Too Hard for Programmers," *Computerworld*, last modified June 8, 2015, accessed October 16, 2018, https://www.computerworld.com/article/2928992/emerging-technology/a-i-is-too-hard-for-programmers.html.

[22] Ibid.

language to describe all contingencies, technicians program a computer to learn by interpreting data, classifying it, and learning from its successes and failures.[23] Machine learning is the cutting edge of AI development, combining the fields of computer and neural science, and unlocking the vast potential of human/machine teaming and augmentation.[24]

With a common understanding established, one must discuss what AI is not. Artificially intelligent machines are not sentient beings. They are machines which are no different than cars or refrigerators. There is a dangerous tendency for people to engender human emotions and qualities to AI machines called anthropomorphism.[25] People attributing human emotions to non-sentient robots can cloud the ethical argument of AI's use on the battlefield. Robots cannot be more ethical or more moral on the battlefield than humans. Only humans can ethically or morally apply a robotic system in war.[26]

What are AI's Capabilities and Limitations?

Artificially intelligent systems far surpass human cognition in some areas and lag frustratingly behind in others. A computer's power to perform millions of calculations at once far exceeds even the smartest human being. Indeed, many of the processes where AI is superior, a regular computer is superior as well. Ambiguous tasks are what separates regular computing from AI, and AI from humans. The human mind remains superior to AI systems in tasks that require judgement. But that gap is narrowing. In addition to the technological limitations of AI, there also exist human imposed moral and ethical limitations. Debates rage about how much autonomy is appropriate for a machine to have, especially as it relates to the battlefield.

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[23] Bernard Marr, "What Is Machine Learning - A Complete Beginner's Guide," *Bernard Marr & Co*., 2018, accessed October 16, 2018, https://www.bernardmarr.com/default.asp?contentID=1140.

[24] Ibid.

[25] Noel E. Sharkey, "The Evitability of Autonomous Robot Warfare," *International Review of the Red Cross* 84, no. 886 (June 2012): 781, accessed September 11, 2018, https://lumen.cgsccarl.com/login?url=https://search.proquest.com/docview/1370609152?accountid=28992.

[26] Ibid., 782.

The human brain's neurons can fire at around 200 times per second or 200 hertz. Computer processors are measured in gigahertz or billions of cycles per second. In addition to a processing advantage, computer signals travel over fiber optic cables about one million times faster than signals travel across neurons.[27] These facts illuminate the raw data processing advantage computers have over the human brain. In addition to speed, computers can process data for an indefinite amount of time without ever requiring food, breaks, or sleep. The human mind can only focus on relatively few cognitively taxing tasks for a limited amount of time before it impacts the clarity of thought.[28]

AI systems can combine a computer's processing speed with a human's ability to think creatively. AI systems are then useful for tasks which require analyzing large amounts of information to produce creative outputs. It can take several people working together to ensure fires are delivered safely on a battlefield. An artificially intelligent computer could perform a similar task almost instantaneously.[29]

AI is not without limitations. Human cognition is still superior in situations that are unclear, ambiguous or require visual perception.[30] The unclear and ambiguous situation limitation is especially concerning for the moral and ethical considerations of using autonomous systems on the battlefield. AI's visual perception limitation is improving but is still nowhere near what the human eye can discern. One very promising AI system the military is testing to track people and

[27] Frits van Paasschen, "The Human Brain vs. Computers," *Thrive Global*, January 16, 2017, accessed October 2, 2018, https://medium.com/thrive-global/the-human-brain-vs-computers-5880cb156541.

[28] General John R. Allen and Amir Husain, "On Hyperwar," *U.S. Naval Institute Proceedings* 143, no. 7 (July 2017): 32.

[29] Ibid.

[30] Hoffman, "Will War's Nature Change in the Seventh Military Revolution?" 20.

equipment in an urban setting can only correctly identify objects eighty percent of the time.[31] This system can also be fooled by changing locations or using it in unfamiliar terrain.[32]

The final limitation of AI is ethical. There is no consensus about how much autonomy humans should give machines on the battlefield. As of 2018, there are no laws or internationally recognized standards for AI's implementation in warfare. The debate centers around Lethal Autonomous Weapons Systems (LAWS).

The 1949 Geneva Convention and International Humanitarian Law (IHL) require an attack to satisfy three criteria to be considered humane: military necessity, discrimination between combatants and non-combatants, and proportionality. AI systems are unable to satisfy all three conditions.[33] AI lacks the visual acuity to differentiate between combatants, non-combatants and wounded or surrendering soldiers. AI system cannot make the distinction between an armed soldier and a police officer as both carry weapons and wear uniforms. However, IHL protects the former and not the latter.

Proportionality poses another difficulty for LAWS. When discussing proportionality as it relates to AI, proportionality is broken into two categories, easy and hard. The Army uses a Weak AI system named "Bug Splat" to help judge potential collateral damage and make suggestions for weapon selection.[34] Bug Splat represents easy proportionality, the difference between one weapon that will cause X amount of collateral damage versus a different weapon that will cause Y collateral damage. However, hard proportionality exceeds AI's ability to meet IHL standards. Hard proportionality concerns ambiguous questions such as the appropriateness of using lethal

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[31] Cheryl Pellerin, "Project Maven to Deploy Computer Algorithms to War Zone by Year's End," *U.S. Department of Defense*, last modified July 21, 2017, accessed September 11, 2018, https://dod.defense.gov/News/Article/Article/1254719/project-maven-to-deploy-computer-algorithms-to-war-zone-by-years-end/.

[32] Ibid.

[33] Stuart Russell, "Ethics of Artificial Intelligence," *Nature* 521, no. 7553 (May 28, 2015): 416, accessed August 12, 2018, https://lumen.cgsccarl.com/login?url=https://search.proquest.com/docview/1684645373?accountid=28992.

[34] Sharkey, "The Evitability of Autonomous Robot Warfare," 790.

force, cost versus benefit, and second and third order effects. A machine is ill-equipped to weigh the expected loss of civilian life against military advantage, or whether killing someone is likely to hinder future operations because of increased anger among a local populace.

The final moral issue with the use of LAWS is accountability. How does one hold an AI system that makes a mistake on the battlefield responsible? When a soldier commits an atrocity, the military can prosecute and punish those responsible. If an AI system does the same, who is at fault? The commander who used the AI system had no hand in programming the system; the programmers are nowhere near the battlefield and may not have anticipated the mission parameters the AI system faced. The lack of accountability issue could lead to a dehumanization of warfare.[35]

The United States has not made any final decisions about LAWS' future use. The 2018 stance is there must always be a human in the decision cycle containing lethal consequences.[36] Most member states who are party to the Convention on Certain Conventional Weapons in Geneva agree there needs to be "meaningful human control" in all lethal decisions.[37] For these reasons, the research only recommends AI systems where humans make every potentially lethal decision.

Information dominates today's battlefield in a way previously unseen. The combatant able to receive, manage, and synthesize raw data into timely decisions has a pronounced advantage.[38] Air Force Colonel John Boyd made famous the theory that one who could outthink and make decisions faster than an opponent would be victorious with his famous observe, orient, decide, act (OODA) theorem. Leveraging the capabilities and vast potential of human-AI teaming will place the US military permanently inside the enemy's decision cycle.

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[35] Sharkey, "The Evitability of Autonomous Robot Warfare," 799.

[36] Pellerin, "Project Maven to Deploy Computer Algorithms to War Zone by Year's End."

[37] Russell, "Ethics of Artificial Intelligence," 418.

[38] Freedman, *Strategy: A History*, 217.

Where is the US Military Seeking to Employ AI?

In April 2016, Deputy Secretary of Defense Robert Work announced the "Third Offset Strategy" to counter America's improving peer adversaries. In his speech, he stated AI would form the corner stone of the new strategy.[39] Human-machine teaming, also referred to as Manned-Unmanned Teaming (MUM-T), integrates people with semi-autonomous AI systems to enhance decision-making speed.[40] Similar to General John Allen's article "On Hyperwar," the Third Offset Strategy focuses on enabling the US military to make decisions faster and more accurately than its adversaries.

The Third Offset Strategy has vast implications for the intelligence community, which is increasingly overwhelmed by the vast amounts of available data. MUM-T offers a way to reduce analysts' workload by allowing AI enabled systems to focus on the mundane work of data analysis. MUM-T frees humans to concentrate on higher cognitive tasks such as mission analysis or operational planning.[41] One area of focus is video analysis. Deputy Secretary of Defense Work announced in a 2018 memorandum he is establishing the Algorithmic Warfare Cross-Functional Team to pursue a novel AI application called Project Maven.[42]

Project Maven is a computer vision program which uses the principles of machine learning to analyze video feeds to extract objects of interest from still or moving imagery. This project will alleviate humans from watching and analyzing the millions of hours of video data currently available to Department of Defense (DoD) personnel. Air Force Lieutenant General

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[39] Robert Work, "Remarks by Deputy Secretary Work on Third Offset Strategy, as Delivered by Deputy Secretary of Defense Bob Work," US Department of Defense, last modified April 28, 2016, accessed September 27, 2018, https://dod.defense.gov/News/Speeches/Speech-View/Article/753482/remarks-by-d%20eputy-secretary-work-on-third-offset-strategy/.

[40] "Integrating Army Robotics and Autonomous Systems to Fight and Win," *Institute of Land Warfare* 17, no. 2 (July 2017): 1, accessed September 11, 2018, https://www.ausa.org/sites/default/files/publications/SL-17-2-Integrating-Army-Robotics-and-Autonomous-Systems-to-Fight-and-Win.pdf.

[41] Hoffman, "Will War's Nature Change in the Seventh Military Revolution?" 23.

[42] Pellerin, "Project Maven to Deploy Computer Algorithms to War Zone by Year's End."

John Shanahan named one of the objectives of Project Maven was to "turn the enormous volume of data available to the DoD into actionable intelligence and insights."[43] Late in 2017, Project Maven deployed an undisclosed warzone in the Middle East. Analysts used Project Maven's software to analyze incoming video feeds from a Scan Eagle UAV employed over an urban center. The software correctly identified objects on the ground with eighty percent accuracy by the deployment's end.[44]

Rapidly turning data into actionable intelligence is only one half of the reconnaissance-strike capability gap. The other half involves deconflicting the battlespace to deliver timely indirect fires. Fires deconfliction represents another one of the mundane, yet critical, tasks absorbing human intellectual capacity. Here again, AI will rapidly synchronize many sensors and attack platforms to set the conditions for a human decision to deliver a strike.[45] Speedy and safe deconfliction represents the final piece of the puzzle to close the reconnaissance-strike capability gap without increasing the risk to US forces.

Project Maven is one step in the direction this paper's hypothesis proposed. MUM-T of autonomous drones who can not only fly by themselves but also analyze their video feeds to nominate targets for human consideration places the US military firmly on the path to overwhelming its adversaries and regaining overmatch.

Summary

The literature review considered a wide variety of sources to investigate the primary and supporting research questions. The review first established the definition of reconnaissance-strike

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[43] Cheryl Pellerin, "Project Maven Industry Day Pursues Artificial Intelligence for DoD Challenges," US Department of Defense, last modified October 27, 2017, accessed September 11, 2018, https://dod.defense.gov/News/Article/Article/1356172/project-maven-industry-day-pursues-artificial-intelligence-for-dod-challenges/.

[44] Marcus Weisgerber, "The Pentagon's New Artificial Intelligence Is Already Hunting Terrorists," *Defense One*, December 21, 2017, accessed August 12, 2018, https://www.defenseone.com/technology/2017/12/pentagons-new-artificial-intelligence-already-hunting-terrorists/144742/.

[45] Allen and Husain, "On Hyperwar," 33.

as a multi-layered reconnaissance, disruption, and attack system. The review then defined AI as a system that can mimic human thinking and produce creative outputs. AI far outpaces human thought with rote, well defined tasks. However, AI is still behind the human mind in ambiguous tasks or situations which require judgement. The literature review also found there are serious moral and ethical implications of using AI on the battlefield. There is no clear law or established regulation governing what AI systems can or cannot do in war. The review found as of 2018; AI systems are unable to meet Geneva Convention or IHL standards for lethal decision making. Finally, the review of literature explored the Third Offset Strategy and found AI to be the cornerstone of the strategy. Therefore, pursuing AI systems to help close the reconnaissance-strike capability gap is consistent with published policy.

The Approach

This chapter explains the methodology used to answer the primary research question and to test the research's hypothesis. It begins with a discussion of the case study methodology and then touches on the application of the methodology to the selected case studies. The chapter will examine the strengths and weaknesses of the case study methodology. The chapter closes with a short discussion of the limitations and delimitations of the research.

The Case Study Methodology

The research considered two comparative case studies to analyze the research question and test the hypothesis. The first case study is the Russian Army's demonstration of its reconnaissance-strike capability during the 2014 RUW. The second case study is the United States' 2003 invasion of Iraq. The author will compare how the US and Russian armies used MUM-T in conjunction with their operational and strategic level fires in the selected cases. The research will investigate how each army's deconfliction processes impacted their relative responsiveness. Throughout the examination, the author will propose instances where AI would

have enhanced the strengths or mitigated the weaknesses of each army's reconnaissance-strike capability.

The first case study examines how the Russian Army used MUM-T to great effect during the RUW. The points of emphasis in this case study are the Russian Army's philosophy of mass versus precision strike, layered drone capability, and the counter UAV fight. While the Russian Army performed very well during the RUW, their reconnaissance-strike capability exhibited some vulnerabilities the United States can exploit in a future conflict.

The second case study examines US drone operations in the initial invasion of Iraq during Operation Iraqi Freedom (OIF). The analysis emphasizes the differences in the US military's approach to MUM-T and its preference for precision over mass strikes. During OIF, the United States effectively teamed drones and aircraft at the strategic level but missed an opportunity to fully integrate UAVs and indirect fires systems at the operational levels. The United States' opponent during OIF lacked the EW capabilities the Russian Army displayed during the RUW. The analysis includes likely impacts of Russian Army level EW on US drone operations.

The hypothesis serves to focus the research on finding ways in which US decision making can outpace its peer adversaries in such a way as to mitigate any disparity in equipment. This is in keeping with the Third Offset Strategy's aim of avoiding an arms race with our competitors.[46] As such, both case studies close with a discussion of where and how AI would impact operations and how those impacts support the Third Offset Strategy.

The strength of the case study methodology is in its comparison of two closely related events to enable the author to see similarities and draw conclusions. Both cases involved armies engaged in large-scale combat operations. This is especially relevant now as large-scale combat

[46] Work, "Remarks by Deputy Secretary Work on Third Offset Strategy, as Delivered by Deputy Secretary of Defense Bob Work."

operations are the focus of the 2018 version of *FM 3-0, Operations.* Grappling with *FM 3-0's* requirements served as the inspiration for this thesis.[47]

The case study methodology's weakness in this instance is the limited use of AI in the selected case studies. The author will be offering possible instances where AI would have made a difference in the selected operations. These offerings are backed up by research and inference rather than concrete data.

Limitations and Delimitations

This paper is limited to unclassified research sources. This limits the depth and breadth of the discussion of both case studies and the discussion of current unclassified technologies. The study is likewise limited to comparing just two cases. With the small sample size, the conclusions and recommendations may not be universally applicable.

This study included two delimitations to keep the findings manageable. The first delimitation is cyber warfare. AI has incredible applications in the cyber warfare field. However, this study does not explore any of those applications. Similarly, the highly net-centric nature of the systems this research proposes in chapter 5 would likely be a target for an adversary's cyber warfare capability. This study does not discuss any network defense considerations. The same applies to protecting the hardware and software onboard the autonomous drones. The problem of protecting computer networks and equipment is best left to engineers and programmers designing the systems.

Analysis

This chapter analyzes two case studies to answer the research question and test the hypothesis. The chapter is broken into two sections, analysis of the RUW and analysis of OIF. Each section is identically organized to enable easy comparison. The sections begin with an

[47] US Army, *FM 3-0*, (2017), 1.

overview of the conflict to provide background and context for each case study. The sections continue with an overview of the respective combatant's reconnaissance-strike philosophy. The author will then provide two vignettes for each case study which illustrate the combatant's reconnaissance-strike capability in action. The sections will examine the respective strengths and weaknesses of each model of reconnaissance-strike. The sections will close with a discussion on how AI could have enhanced the strengths or mitigated the weaknesses of each model.

The Russo-Ukraine War

The RUW began in early 2014 when Russian separatists captured the disputed Crimea territory after the fall of Ukrainian president Viktor Yanukovych. The Russian Army invaded the Ukrainian Donbas region in late 2014 in support of the separatists, changing the conflict from a relatively bloodless superpower intervention to an actual war between Ukrainian and Russian regular forces. [48] Despite repeated diplomatic interventions, the region remains contentious as of 2018.[49] The RUW provided the West with the first demonstrations of the improved Russian reconnaissance-strike model.

The Russian reconnaissance-strike philosophy focuses on bringing together various capabilities to produce devastating effects on the battlefield. The Russian Army teams several different types of drones carrying a host of sensors together with their operational level fires to seek out and destroy enemy formations with massed rocket and artillery strikes. They augment their lethal strike capability with EW to disrupt their target's communication networks while protecting their drones and indirect fire batteries with a robust IADS umbrella.[50] By

[48] Dr. Phillip A. Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War: Personal Observations," The Potomac Foundation, July 8, 2015, 1, accessed August 18, 2018, https://prodev2go.files.wordpress.com/2015/10/rus-ukr-lessons-draft.pdf.

[49] Ibid.

[50] Fox and Rossow, "Making Sense of Russian Hybrid Warfare: A Brief Assessment of the Russo-Ukrainian War," 10.

synchronizing these capabilities, the Russian Army fielded a modern reconnaissance-strike model which produced remarkable results during the Donbas campaign of the RUW.

Dr. Phillip Karber witnessed Russian reconnaissance-strike in action near the city of Mariupol, Ukraine in the Donbas region. In September of 2014, Ukrainian soldiers observed a Russian drone flying overhead. Within fifteen minutes rockets from a BM-21 Multiple Launch Rocket System impacted and destroyed the Ukrainian position.[51] Shortly after the conclusion of the strike, the drone returned overhead to assess the battle damage. During a similar rocket strike, witnesses identified two types of drones monitoring their positions, one fixed wing drone orbiting at 2,500ft and a "quad-copter" hovering at 800ft.[52] Using multiple drones over a target area is an example of the Russian reconnaissance-strike philosophy of layering capabilities and sensors. Teaming the drones with rocket batteries to conduct a massed strike is another hallmark of Russian reconnaissance-strike.

The second vignette is probably the most famous and foreboding event to occur during the RUW. Around 4:00 am on July 11, 2014, Ukrainian soldiers near Zelenopillya, Ukraine heard drones overhead. At the same time, the Russian Army used EW to jam the Ukrainian Army's tactical radio network, making coordinated action impossible. Within minutes of hearing the first drone, scores of rockets and artillery rounds impacted the Ukrainian military's position. The combined strike lasted only two minutes but killed nearly thirty soldiers and destroyed two battalion's worth of equipment. The Zelenopillya strike was the deadliest single attack of the war.

As with the Mariupol strike, the Russian Army teamed multiple drone platforms with their operational level fires at Zelenopillya. However, the Zelenopillya strike was more robust combining tube and rocket artillery, EW, and special thermobaric munitions designed to destroy Ukrainian armored vehicles.[53] Much like the Mariupol strike, Zelenopillya demonstrated the

[51] Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War: Personal Observations," 13.

[52] Ibid., 14.

[53] Ibid., 18.

Russian Army's philosophy of layering multiple capabilities to achieve devastating battlefield effects.

Strengths of the Russian Reconnaissance-Strike Capability

The case study shows the destructive potential of the Russian reconnaissance-strike model. The Russian Army's EW provides a disruption and protection capability. The robust Russian IADS system protects their artillery batteries and drones from enemy aircraft. While not discussed in the two earlier vignettes, Russian IADS previously destroyed numerous Ukrainian fixed and rotary wing aircraft sent to attack the army's fires platforms.[54] The IADS threat also enhanced the effectiveness of the rocket and artillery strikes by preventing Ukrainian air medical evacuation helicopters from reaching areas of need.[55]

A second strength of the Russian reconnaissance-strike capability is its speed. The case study demonstrated artillery response times measured in minutes. The direct teaming of the drones to the artillery batteries partially explains the speed at which the Russian artillery can service targets. Two additional factors serve to make the Russian reconnaissance-strike model fast. The first is the Russian Army's preference for mass over precision. Massed strikes take less time to compute and deliver than the precision strikes US Army prefers. The second is their somewhat less stringent deconfliction measures. During the Donbas campaign, the Russian Army did not worry about civilian collateral damage. Indeed, the deliberate targeting of civilian structures and personnel are part of the Russian Hybrid Warfare philosophy.[56] One thing slowing US artillery response is the need to conduct Collateral Damage Estimates (CDE), which is an assessment of the likelihood that an attack will cause unwanted destruction to people or property around a target. The United States' operations in Iraq and Afghanistan showed CDE to be the

[54] Fox and Rossow, "Making Sense of Russian Hybrid Warfare: A Brief Assessment of the Russo-Ukrainian War," 13.

[55] Ibid.

[56] Ibid., 10.

most ponderous portion of delivering artillery fires.[57] By skipping CDE, the Russian Army removes a time-consuming step from its approval process.[58]

Weaknesses of the Russian Reconnaissance-Strike Capability

The Donbas campaign of the RUW illuminated three weaknesses of the Russian reconnaissance-strike model. The first weakness was the necessity for intensive pre-planning for the strike missions discussed earlier. While the Russian Army is very fast at delivering the strikes, there is a considerable process for synchronizing the capabilities and setting flight routes which can take several hours or even days.[59] The requirement for extensive pre-planning limits the Russian Army's ability to conduct dynamic re-tasking of elements to confront unexpected threats or exploit un-forecasted opportunities.[60]

The second weakness was difficulty with tracking and hitting moving targets. While the challenge of hitting a moving target with artillery is not just a Russian problem, they do not field a Predator type armed drone able to engage targets directly. The Russian Army must instead focus their massed artillery strikes on a geographical area through which the moving targets must transit to engage them successfully, which is considerably less effective.[61] The Russian Army will have to develop an armed drone or expand their MUM-T to include rotary or fixed wing aircraft to engage moving formations.

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[57] Donald L. Cherry, "Improving Joint Fires Support for 21st Century Hybrid Warfare" (Master's Thesis, Naval War College, 2012), 7, accessed October 29, 2018, http://www.dtic.mil/dtic/tr/fulltext/u2/a563799.pdf.

[58] Fox and Rossow, *Making Sense of Russian Hybrid Warfare: A Brief Assessment of the Russo-Ukranian War*, 10.

[59] Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War: Personal Observations,"14.

[60] Ibid.

[61] Ibid.

The final weakness was EW threats to drones. The Russian Army possesses a suite of EW capabilities which target enemy communications, GPS signals, and UAVs.[62] During the RUW, the most effective weapon against drones was EW.[63] As of 2018, there are no autonomous drones on the battlefield. Humans remotely pilot drones through radio and satellite communications. Drones likewise rely on GPS to remain aloft in the event they lose radio communications with their pilots. If you break these connections, the drones crash. Russia's enemies will undoubtedly take advantage of this weakness to prevent drones from enabling Zelenopillya like attacks against their formations.

AI Opportunities

AI will improve the Russian Army's reconnaissance-strike capability through autonomous drones. As previously discussed, EW is the most prevalent threat to drones on the battlefield. A pilotless drone would be immune to the hazards of EW as it would rely on its internal systems to remain aloft, rather than GPS and a remote operator. Most drones' small size, limited radar cross section, and weak IR signature make them notoriously difficult to target with surface to air missiles and anti-aircraft artillery.[64] Mitigating the EW threat would greatly increase a drone's survivability on the battlefield.

Operation Iraqi Freedom

In 2003, the United States invaded Iraq. OIF began with an intensive bombing campaign. Baghdad, as the capital city and seat of power, was heavily targeted. The invasion of Iraq enabled the US military to test its early MUM-T concepts and strategic reconnaissance-strike capability.

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[62] Asymmetric Warfare Group, *Russian New Generation Warfare Handbook* (Fort Meade, MD: Government Printing Office 2016), 23, accessed October 17, 2017, https://call2.army.mil/docs/doc7434/17-09_RNGW_V2.1.pdf.

[63] Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War: Personal Observations,"15.

[64] Ibid.

The US military tends to focus its reconnaissance-strike capability at the theater and strategic levels.[65] At these levels, US strikes are almost entirely precision engagements utilizing the vast inventory of US precision-guided munitions. The US military employs drones against three mission sets, the dull (long duration), the dangerous (high risk), or the dirty (chemical or biological weapon interdiction).[66] One area of divergence between the Russian reconnaissance-strike model and the US is armed drones. Unlike the Russian Army, some US drones can destroy targets.

The US bombing campaign over Baghdad is the first vignette for US reconnaissance-strike in action. The US military employed two primary types of drones over the city during the opening offensives of OIF. The first type of UAV was a reconnaissance drone, the RQ-4 Global Hawk, able to provide continuous reconnaissance of a target area in excess of thirty hours.[67] Global Hawk drones provided long duration reconnaissance over the city and was a key component in identifying targets for other platforms to destroy.

The second drone was the MQ-1 Predator. The Predator was the primary drone used by the Combined Air Operations Center (CAOC).[68] The CAOC supported joint, allied, and coalition air operations throughout the Iraq area of operations. As primary support for the CAOC, the Predators collected intelligence, attacked targets with guided missiles, shared targeting information with allied aircraft, and shared its streaming video feeds with military planners.[69]

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[65] Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War: Personal Observations," 13.

[66] Coskun Kurkcu and Kaan Oveyik, "U.S. Unmanned Aerial Vehicles (UAVs) and Network Centric Warfare (NCW): Impacts on Combat Aviation Tactics from Gulf War I Through 2007 Iraq" (Master's Thesis, Naval Postgraduate School, 2008), 34, accessed October 29, 2018, http://www.dtic.mil/dtic/tr/fulltext/u2/a480077.pdf.

[67] "RQ-4 Global Hawk," U.S. Air Force, accessed October 31, 2018, http://www.af.mil/About-Us/Fact-Sheets/Display/Article/104516/rq-4-global-hawk/.

[68] Kurkcu and Oveyik, "U.S. Unmanned Aerial Vehicles (UAVs) and Network Centric Warfare (NCW): Impacts on Combat Aviation Tactics from Gulf War I Through 2007 Iraq" 29.

[69] Ibid.

US strategic reconnaissance-strike proved highly capable in the skies over Baghdad. The Global Hawks were so successful, while they only accounted for five percent of the high altitude missions over Iraq, they accounted for fifty-five percent of the time-sensitive targeting of surface to air missile (SAM) batteries.[70] Combined teams of Global Hawks, armed Predator drones, and allied strike aircraft rendered Iraqi IADS ineffective as they destroyed thirteen SAM batteries, over fifty SAM launchers, and in excess of seventy SAM transport vehicles.[71] The US displayed impressive integration between drones and aircraft during OIF. Allied aircraft successfully targeted and destroyed enemy equipment within minutes of discovery. In addition to short target handoff cycles between drones and aircraft, Predator drones could instantly attack targets. This integration produced a fast and deadly reconnaissance-strike capability at the strategic level.

The second vignette shows the United States' early attempts at integration at the operational level. The Marines under General James Mattis began to scratch the surface of drone augmented reconnaissance-strike during their attack into Iraq. The 1st Marine Division used their RQ-2 Pioneer drones in an aerial observation role to support field artillery preparations.[72] Before the commencement of a ground attack, Marine Pioneer drones confirmed pre-planned target locations and adjusted artillery after rounds impacted. The success of using drones as a fire support platform prompted Marine Corps leaders to write a report stressing the need for drones to have an expanded role in operational level fires missions.[73]

Strengths of US Reconnaissance-Strike Capability

The OIF case study demonstrated three strengths of the US military's strategic reconnaissance-strike capability: MUM-T between drones and aircraft, the use of armed drones

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[70] Kurkcu and Oveyik, "U.S. Unmanned Aerial Vehicles (UAVs) and Network Centric Warfare (NCW): Impacts on Combat Aviation Tactics from Gulf War I Through 2007 Iraq," 30.

[71] Ibid., 30.

[72] Christopher J. Castelli, "Report: UAVs Must Have Fire Support Role: 1st Marine Division Used Pioneer as Fire Support Sensor in Iraq War," *Inside the Navy* 16, no. 27 (July 7, 2003): 13.

[73] Ibid.

against high risk targets, and long duration strategic reconnaissance drones. MUM-T between drones and aircraft netted impressive results during the initial invasion of Iraq. The ability of the drones to mark targets and share video feeds with allied aircraft enabled the timely destruction of targets, with some targeting cycles measured in minutes.[74] Armed drones, such as the Predator, increase the responsiveness and flexibility of the US strategic reconnaissance-strike capability by engaging targets which pose a higher risk to manned aircraft, such as Baghdad's air defense systems.

The US reconnaissance-strike philosophy of using drones to conduct higher risk missions is another strength. In the case of the counter-IADS campaign over Baghdad, Predator drones were able to provoke Iraqi air defense systems into engagements. The limited radar cross sections of the drones made them difficult to destroy with SAMs. Once targeted, armed drones were able to retaliate and eliminate the firing batteries immediately. The United States did not lose any manned aircraft to Iraqi air defense during the Baghdad air battle due to the armed drones' success.

Strategic UAVs, such as the Global Hawk, provide the US military with a persistent reconnaissance asset unmatched by peer competitors. The Global Hawk's ability to loiter more than thirty hours over an objective provided the US military with an unprecedented ability to monitor the enemy and identify targets for destruction.

Weaknesses of US Reconnaissance-Strike Capability

The case studies reveal three weaknesses of the US reconnaissance-strike capability. The first weakness is the under-developed relationship between drones and artillery batteries. The research found numerous examples of drone/aircraft teaming during the OIF campaign. However, there were few examples of operational level teaming between drones and rocket or artillery

[74] Kurkcu and Oveyik, "U.S. Unmanned Aerial Vehicles (UAVs) and Network Centric Warfare (NCW): Impacts on Combat Aviation Tactics from Gulf War I Through 2007 Iraq" 41.

batteries despite the Marines' success. The research revealed two primary causes for the lack of operational level teaming. The first is the US military's preference for precision over massed strikes. Drones, attack helicopters, and aircraft all carry proven and reliable precision guided munitions. Field artillery and rocket batteries are also able to employ precision guided munitions. However, there appears to be a lack of confidence among commanders regarding their accuracy, as evidenced by Joint Task Force commanders routinely withholding employment authority to the general officer level.[75] The second cause for the lack of operational teaming is also the second weakness of the US reconnaissance-strike capability.

Ponderous deconfliction measures slow the responsiveness of US reconnaissance-strike capability at the operational level. Without downplaying the complexity of the deep area battlefield in the case study, the skies over Baghdad have far fewer components to coordinate than those closer to the forward lines of troops. The CALL report, *Gap Analysis: Joint Fires, Tactics, Techniques, and Procedures,* identified a lack of defined boundaries between close and deep operations, differences in doctrine between services and branches, and the lack of a designated coordinator as additional challenges to optimizing fire support at the operational level.[76]

The final weakness of the US reconnaissance-strike capability is the lack of layered capabilities. The Russian Army augments its reconnaissance-strike with EW and IADS. There is no mention of similar coordination by the US military. Russian Army EW far exceeds US capabilities.[77] Because of this, the Russian Army can achieve effects in their reconnaissance-strike capability the US Army cannot match.

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[75] Cherry, "Improving Joint Fires Support for 21st Century Hybrid Warfare," 7.

[76] Center for Army Lessons Learned, *Gap Analysis: Joint Fires Tactics, Techniques, and Procedures* (Fort Leavenworth, KS: Combined Arms Center, April 8, 2014), vi, accessed October 29, 2018, https://call2.army.mil/docs/doc4089/08-14.pdf.

[77] Samuel Bendett, "America Is Getting Outclassed by Russian Electronic Warfare," *The National Interest*, last modified September 19, 2017, accessed October 31, 2018, https://nationalinterest.org/feature/america-getting-outclassed-by-russian-electronic-warfare-22380.

AI Opportunities

Advances in AI could improve the US reconnaissance-strike capability in two ways. The first is fires deconfliction. As described earlier, the deconfliction of a modern battlefield is a complex and time-consuming process. Understanding the locations of every person or piece of equipment an artillery strike may affect is far too much for one person. As such, deconfliction requires consulting numerous people, which takes time. General Allen in *On Hyperwar* envisioned an AI augmented decision-making system that could near instantaneously synchronize a group of sensors and shooters to deliver an effect without jeopardizing allied forces.[78] The military already uses a weak AI system to aid Soldiers in selecting the appropriate weapon system to minimize collateral damage. A system such as the one General Allen described combined with a system like "Bug Splat" (weak AI application which aids in weapon selection and estimates collateral damage) could shorten the targeting cycle and enhance US reconnaissance-strike.

As in the Russian model, AI piloted drones is another area that could strengthen US reconnaissance-strike. OIF did not test US drones against anything resembling Russian Army EW capabilities. However, the Russian Army demonstrated its ability to down a German Army drone, comparable in design and capabilities to US drones, during the RUW.[79] More recently Russian EW attacks against US forces in Syria have disabled aircraft, jammed communications, and affected US drones.[80] The evidence indicates remotely piloted aircraft are unlikely to survive against a peer competitor with EW capabilities equal to the Russian Army.

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[78] Allen and Husain, "On Hyperwar," 32.

[79] Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War: Personal Observations," 15.

[80] Ben Brimelow, "General Reveals That US Aircraft Are Being 'disabled' in Syria — the 'Most Aggressive' Electronic Warfare Environment on Earth," *Business Insider*, April 26, 2018, accessed October 31, 2018, https://www.businessinsider.com/syria-electronic-warfare-us-planes-disabled-2018-4.

Autonomous drones also reduce manning requirements. In 2018, a Predator required a three-person crew, a pilot and two sensor operators.[81] Intelligence personnel must analyze the UAV provided video feeds to identify targets. Autonomous drones do not require any personnel to fly. The drones could also identify and nominate targets for approval from their video feeds using similar software under development for Project Maven. Autonomous drones could allow a single analyst to verify target nominations from several drones. Reducing the number of personnel required to analyze video would make more analysts available to focus on more cognitively demanding tasks such as mission planning and intel synthesis.[82]

Chapter 4 demonstrated the Russian and US militaries employ a highly successful – yet incomplete – reconnaissance-strike capability. The Russian model remains at the operational level and employs layered capabilities. The United States focuses its reconnaissance-strike capability at the strategic level, teaming drones and aircraft, and employing precision guided munitions. Both reconnaissance-strike models have inherent strengths and weaknesses. Chapter 5 will draw conclusions from the case studies and make recommendations for the future employment of AI.

Conclusions and Recommendations

> You cannot allow any of your people to avoid brutal facts. If they start living in a dream world, it's going to be bad.
>
> —General James Mattis, quoted in *Business Insider*

This monograph sought to investigate where the DoD could leverage the emerging technology of AI to re-establish overmatch against its peer competitors. The study investigated three supporting questions to answer the primary research question: what is AI, where is AI superior to the human mind and where is it inferior, and where is the Army seeking to employ AI? The study made the hypothesis teaming autonomous drones with operational and strategic

[81] Kurkcu and Oveyik, "U.S. Unmanned Aerial Vehicles (UAVs) and Network Centric Warfare (NCW): Impacts on Combat Aviation Tactics from Gulf War I Through 2007 Iraq" 16.

[82] Hoffman, "Will War's Nature Change in the Seventh Military Revolution?" 25.

level fires augmented by AI assisted deconfliction measures is one area where the US military will close a demonstrated capability gap with its peer competitors and regain overmatch without sacrificing acceptable risk levels. This chapter draws conclusions from the analysis in chapter 4 and makes recommendations for future employment of AI and areas for additional research.

Conclusions

The monograph draws four conclusions from the case studies in chapter 4. The first conclusion is the US reconnaissance-strike capability gap resides at the operational level. The second conclusion is Russian Army EW is the most dangerous threat to US drones. The third conclusion is the Russian reconnaissance-strike model is no faster than the US military's model. The final conclusion is US deconfliction measures are the most time-consuming process of the targeting cycle.

Conclusion #1

US reconnaissance-strike capability has a philosophical and technological gap at the operational level. Philosophically, the US military focuses on differing layers of destruction. Intelligence, Surveillance, and Reconnaissance (ISR) drones, armed drones, and attack aircraft all enable precision engagements. There is little focus on non-lethal disruption. The Russian Army layers ISR, disruption, and destructive capabilities to facilitate massed strikes which can yield Zelenopillya-type results.

The Russian Army protects its reconnaissance-strike assets with a robust IADS and EW capability. Russian IADS destroyed Ukrainian attack aircraft and helicopters, preventing them from engaging Russian firing batteries. The US military would use armed drones against this threat. However, the presence of Russian EW would make this impossible.

Conclusion #2

Russian EW is the greatest threat to US reconnaissance-strike. The RUW demonstrated breaking the linkages between drones, operators, and GPS was the most effective weapon against

UAVs. Recent actions in Syria established Russian EW is capable of downing US drones. The US reconnaissance-strike model relies on drones to identify targets in hostile areas, attack high-risk targets such as IADS, and share real time video feeds with other attack platforms. The Russian military's ability to bring down drones via EW jamming puts the entire US reconnaissance-strike model at risk. The missions which drones currently fulfill would have to go to piloted aircraft, placing US airmen and aircraft at much higher risk.

Conclusion #3

The Russian Army reconnaissance-strike model is no faster than the US military's model. The quick targeting cycles of the RUW were a result of extensive pre-planning rather than a faster deconfliction routine. The literature implies the US military is not as fast, as evidenced by Dr. Karber's statement "the strength of the Russian approach is its ability to deliver rapid massed fires . . . with a speed and intensity . . . heretofore not seen on any battlefield."[83] This is not the case. The OIF case study proved the US targeting cycles in coordinated targeting areas are equal to the Russian Army. The US military is much faster than the Russian Army at dynamic targeting.[84]

The US military can leverage its dynamic targeting advantage to close the operational reconnaissance-strike capability gap partially. However, the purpose of this paper was not to achieve parity with US peer competitors, but overmatch. Theoretically, Russia could easily speed its dynamic targeting process by copying US procedures. If that were to happen, the US CDE disadvantage would remain. Therefore, the US military needs to speed up its deconfliction procedures in a manner that would vastly out pace any competitor.

[83] Karber, "Draft 'Lessons Learned' from the Russo-Ukrainian War: Personal Observations," 14.

[84] Ibid.

Conclusion #4

US deconfliction measures are the slowest portion of the targeting cycle. This study is not making the argument US deconfliction measures are unnecessary. It is only positing the slowest portion of the targeting cycle is deconfliction and is the portion which requires the most attention. As technology continues to improve and the battlefield gets more and more complex, deconflicting fires will become exponentially more difficult. Army Warfighting Challenges 17 and 18 identify airspace deconfliction and the safe delivery of joint fires as one of the most difficult problems of the modern battlefield.[85] As one considers the sheer complexity of synchronization requirements to deliver an effect, which might transit several areas of operation and cross numerous coordination lines, one can see the necessity of the US military's robust procedures. It also illuminates the synchronization is far too complex for one person to carry out. It requires multiple personnel from differing services to deliver operational level fires safely.

The US military must find a way to deconflict faster to ensure it is not at a relative disadvantage to its peer competitors. Since it is unlikely the military will accept increased risk to personnel, equipment, or civilians, the DoD must pursue some type of augmentation to speed up the targeting cycle.

Recommendations

The study makes three recommendations regarding reconnaissance-strike. The first is for the US military to invest in AI piloted autonomous drones. The second is to develop an AI augmented deconfliction system to speed up the targeting cycle. The final recommendation is the United States not develop lethal autonomous weapon systems at this time.

[85] Director, Army Capabilities Integration Center, "Army Warfighting Challenges," Army Capabilities Integration Center, accessed January 21, 2018, http://www.arcic.army.mil/initiatives/armywarfightingchallenges.

Recommendation #1

The United States must invest in AI piloted autonomous drones. Autonomous drones provide two major benefits to the US military. First, they mitigate the Russian Army's EW threat. The RUW and continuing actions in Syria reveal the fragility of UAVs which are reliant on the electromagnetic spectrum to fly.

Autonomous drones would be able to fly in EW environments with little risk of loss. Much like a piloted aircraft, AI drones could maintain orientation and stay aloft without the need for GPS or a ground controller. Russian EW could hypothetically still jam the drone's communications; however, the drone would merely have to move out of the EW environment to transmit its intelligence.

Autonomous drones could be equipped to carry out both reconnaissance and EW missions. Such equipping would allow the United States to layer disruptive and destructive capabilities much like the Russian reconnaissance-strike model. Autonomous drones could fly into a contested environment, identify targets, and jam enemy systems. Autonomous drones could neutralize the EW threat, allowing armed UAVs to locate and destroy enemy IADS and targets of opportunity. These missions could enable US military aircraft to carry out precision strikes against key systems. Finally, teaming autonomous drones with operational level fires would enable Zelenopillya-like massed strikes against large concentrations of enemy units. This model would allow the US military to blend its precision philosophy with a massed strike capability.

Recommendation #2

The US military must develop an AI augmented deconfliction system. This system would require access to the locations of all friendly units and equipment. The DoD already has mission command systems enabling this capability, such as the Blue Force Tracker. The mission command systems would need to be expanded to include additional information, to include aircraft locations. It would also incorporate a system similar to "Bug Splat" to conduct CDE. This

single system could near instantaneously compute requested strike missions, conduct CDEs, and recommend additional required deconfliction measures. The system would send these recommendations to a human for final approval or disapproval.

The system described above would be able to deconflict strike missions much faster than any US peer adversary. It would also maintain the military's acceptable risk levels. Teaming the drones from Recommendation #1 with the deconfliction system described above would enable the US military not only to close the operational level reconnaissance-strike capability gap but gain clear overmatch.

Recommendation #3

The final recommendation is the United States not develop LAWS. Humans must make every potentially lethal decision on the battlefield. As of 2018, AI does not possess the necessary sophistication to meet Geneva Convention and IHL requirements for humane attacks. The United States must resist the temptation to pursue an ethically or morally ambiguous weapon system just because its peer adversaries do not share its reservations. Until technology improves to the point where AI can meet all requirements for humane employment, there is no place for LAWS in the US inventory.

Future Research

AI has many more applications on the battlefield than those this study describes. Cyber warfare and logistics would benefit from the human/machine teaming advocated in this monograph. Additionally, though this paper does not advocate for LAWS, there must be continued discussion about what is permissible under the Geneva Convention and IHL. For instance, could an armed autonomous drone conduct an attack if a human verified the target and approved the mission? This monograph will not wrestle with this question. However, future researchers should.

Summary

The study's analysis of the case studies revealed the initial hypothesis is correct. The AI systems the hypothesis recommends would regain reconnaissance-strike overmatch without increasing risk to the force. Further, the recommendations made in chapter 5 support the Third Offset Strategy and do not require a shift in published government policy. Finally, the recommendations made here do not violate Geneva or IHL standard, and the DoD could implement them immediately.

This monograph is in no way meant to be the final word on AI pursuit or policy. Advances in AI could change the current environment and spark new considerations for ethical employment on the battlefield. Military and political leaders must continue to discuss, debate, and wrestle with these important and complex issues and draw new conclusions. AI has the potential to change the world in which we live. The United States must remain on the cutting edge of AI development to ensure it remains the preeminent global power.

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