

Crossing the Lethal Distance

A Monograph

by

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Abstract

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The sensors and shooters of tomorrow's battlefields could bring about a new no man's land. Given trends in all-domain capability development, how should US Army forces cross the 25-kilometer lethal distance of tomorrow's battlefields? Development of sensor and shooter capabilities now and within the next ten years may imply denied spaces which transcend local tactical battlespaces. Understanding the nature of what such lethal areas look like is vital in shaping the US Army's future development. Simultaneously, it is just as important to clarify the intent of operational concepts and capabilities through the application of relevant military theory. The combination of this analysis helps identify areas of asymmetry and whether or not force modernization is on the right track.

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Abbreviations

ADP	Army Doctrine Publication
ADO	All Domain Operations
AFC	Army Futures Command
AI	Artificial Intelligence
APS	Active Protection Systems
ARV	Advanced Reconnaissance Vehicle
ATGM	Anti-Tank Guided Missile
CCDC	Combat Capabilities Development Command
CFT	Cross Functional Team
DIA	Defense Intelligence Agency
DMO	Distributed Maritime Operations
EMS	Electro-Magnetic Spectrum
ESS	Evolved Strategic Satellite
FVL	Future Vertical Lift
ISR	Intelligence, Surveillance, Reconnaissance
I2CEWS	Intelligence, Information, Cyber, Electronic Warfare and Space
JADO	Joint All Domain Operations
JCIDS	Joint Capabilities Integration and Development System
JFC	Joint Forces Command
LEO	Low Earth Orbit
LRPF	Long Range Precision Fires
LRV	Light Reconnaissance Vehicle
LSCO	Large Scale Combat Operations
MDO	Multi Domain Operations
MEO	Medium Earth Orbit

MOC	Maritime Operations Center
MRL	Multiple Rocket Launcher
NGCV	Next Generation Combat Vehicle
NLOS	Non-Line of Site
OE	Operational Environment
PLA	People’s Liberation Army
PNT	Position, Navigation, and Timing
RAS	Robotic and Autonomous Systems
SRBM	Short Range Ballistic Missile
TCW	Target Centric Warfare
TITAN	Tactical Intelligence Targeting Access Node
TLS	Terrestrial Layer System
UAS	Unmanned Aerial Systems
UAV	Unmanned Aerial Vehicles
UGV	Unmanned Ground Vehicles
WEZ	Weapons Engagement Zone

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Introduction

The challenge is not whether tanks are obsolete, but how a system of capabilities can be fielded and trained that gets the force to where it needs to be, with enough combat power to achieve the desired result. It is the system, not the platforms, and the balance within that system that we need to get right.

— Jack Watling, “The Key to Armenia’s Tank Losses: The Sensors, Not the Shooters”

The United States military no longer enjoys systems capability overmatch over its potential adversaries. Too bold of a statement, or hard truth to accept? Consider recent events from the last six years alone. A militarized annexation of the Crimean Peninsula, highly lethal proxy wars across the Middle East, competing spheres of influence along global commons of the South China Sea, and recent border disputes that explode into regional force-on-force battles in Nagorno-Karabakh. Each event points to a challenge of the post-Cold War US led world order, which includes assumed US military dominance. Consequently, the US military finds itself at “a historical inflection point” in which great powers once again compete to achieve worldwide influential parity and advantage.¹ To be competitive with the United States in the military sphere, regional hegemons are taking advantage of readily available information and technology to advance their military capabilities, and operational concepts. Simultaneously competitors observe US actions from the 1991 Gulf War to counterinsurgency efforts in Iraq and Afghanistan. “The result is a US military, and an Army in particular, that may find itself with the very real challenge of being out-gunned, out-ranged, out-protected, outdated, out of position, and out of balance against our adversaries.”² Should United States deterrence fail in such an environment, and a regional crisis moves the continuum of conflict from competition to armed conflict, the US

¹ US Department of the Army, Training and Doctrine Command Pamphlet 525-92, *The Operating Environment and the Changing Character of Warfare* (Washington DC: Government Publishing Office, October 2019), 5.

² *Ibid.*, 6.

military faces fundamental challenges due in large part to established yet predictable capabilities and patterns of operations.

The purpose of this study is to explore a particular element of one of these fundamental challenges, namely all-domain operations (ADO) in close combat. In the context of modernizing adversaries, the US military faces heightened competition in land, air, maritime, space, and cyberspace warfighting domains. “Adversaries possess significant integrated air defenses and long-range fires, as well as sophisticated intelligence, surveillance, and reconnaissance and information, electronic warfare, and cyber capabilities.”³ Each one of these capabilities link into warfighting systems designed to have a specific effect in one or several domains. For example, a reconnaissance scout armed with nothing but a pair of binoculars, a map, and a radio linked to an artillery battery represents a warfighting system. Together, that system exerts an extended influence over a limited piece of the land domain with a variety of effects ranging from disruption to the destruction of a target. When such a system is upgraded with modern technologies like armed unmanned-aerial systems (UAS), robotics, or long range direct and indirect weapons it represents an expansion in the range, area, time, or even function (reconnaissance, attack) of its domain influence. Great powers enhance their military capabilities to supplement warfighting systems that create extended lethal spaces in which friendly forces must fight and win.

Herein lies a major problem for the US Army. In large scale combat operations (LSCO), how might all-domain systems enable Army forces to close the lethal distance (last 25-kilometers based upon emerging technology) to engage enemy formations? To answer this question, this study attempts to define and explore three research tasks. First, it is necessary to understand the threat characteristics of a future operational environment (OE) that expands lethal distances from a Cold War four to a modern 25-kilometers. Second, investigation into current materiel capability solutions and proposed conceptual warfighting models supply the basis for an answer. Finally, an

³ David G. Perkins, “Multi-Domain Battle: The Advent of Twenty-First Century War,” *Military Review* (November-December 2017), 11.

evaluation of concepts based on warfighting theories enable assessment of any solution's potential to overcome the maneuver problem in the forecasted OE. To cross the lethal distance of future battlefields, Army forces must design and orchestrate its all-domain system capabilities to functionally dislocate adversarial system strengths.

Without first introducing scope and limitations into the study, its research and analysis could include variables inconsistent with the topic. Primarily, time and distance are of paramount importance. As this study discusses topics dealing with an undetermined future, the research only considers material with considerations across a ten-year horizon. Any detail past the year 2030 is subject to tremendous change. Further, the research only considers military systems and capabilities that provide lethal effects to the 25-kilometer distance. Anything more turns the research into an unfeasible study of comprehensive military capacity. Additionally, the study considers hybrid warfare of state and non-state actors, but as a contributing factor to the complexity of the 25-kilometer lethal area. For example, in the Syrian civil conflict the non-state groups of the Free Syrian Army fight conventional close battles with Assad regime forces, but supplement efforts with irregular strikes from various other non-state groups. Understanding the scope of the topic enhances the ability to make assumptions about the research that are both necessary and valid.

Since much of this study considers futuristic topics, a discussion on relevant assumptions is warranted. The first assumption is that fielded military capabilities, systems, and supporting concepts or doctrines will remain relatively unchanged for the near future. The study also assumes that military capabilities and military doctrine are inextricably linked. Prior to the outbreak of World War I, French military theorist Ardant du Picq stated, "When confidence is placed in superiority of material means, valuable as they are against an enemy at a distance, it may be betrayed by the actions of the enemy."⁴ Accepting the connection between capabilities

⁴ Ardant du Picq, *Battle Studies in Roots of Strategy: Book 2*, Edited by David Jablonsky (Harrisburg, PA: Stackpole Books, 1987), 114, accessed October 2020, <http://lumen.cgsccarl.com/login?>

and doctrine enables the discussion of warfighting systems by negating arguments based solely on the comparison of military hardware or methods alone. Finally, the exploration of a future operational environment relies on objective understanding of capabilities and methods. It is assumed that the reporting and intelligence on military capabilities, concepts, and doctrines are realistic and not propaganda.

Before moving any further, it is also necessary to briefly discuss definition of terms to understand the study and reduce confusion. Primarily, this study uses the term all-domain operations as the generic descriptor of the future warfighting concepts drafted by the US Army, Navy, Air Force, Marine Corps, and Joint Staff. Specifically, the terms close area and deep maneuver area describe the 25-kilometer distance as projected by the Multi-Domain Battle Operational Framework (Figure 1).

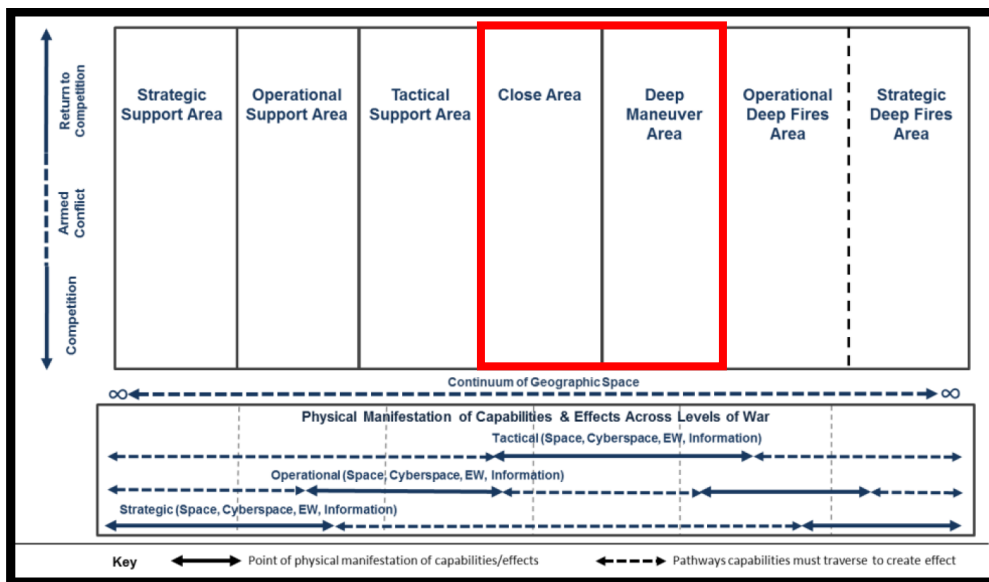


Figure 1. The Multi-Domain Battle Operational Framework. US Department of the Army, US Army Training and Doctrine Command, *Multi-Domain Battle: Evolution of Combined Arms for the 21st Century* (Washington, DC: Government Printing Office, 2017), 9.

Additionally, the study uses abstract terms used with specific meanings and applications to specific contexts. The term capabilities is used often to describe materiel resources that give

url=<http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=41932>.

combatants the means to carry out military action. Further the study uses the term systems as a grouping of capabilities designed to conduct specific functions like intelligence or maneuver. Additionally, it is important to remember the meaning and application of concepts and theories. Ultimately the study strives to understand and explain a phenomenon of interest, in this case warfighting in a future environment. To do this, the study uses concepts (ADO, threat analysis, military theorist writings) to sort, organize, and store information relevant to the phenomenon of interest.⁵ From these concepts it is possible to build a theory which explains and provides answers to the phenomenon, namely the orchestration of all-domain capabilities and systems to functionally dislocate enemy system strengths.⁶

This monograph is organized into six distinct sections to explore the value of functionally dislocating enemy systems to cross the 25-kilometer lethal distance. The first section introduces the topic, problem, and thesis of the study. The second section briefly reviews the prevalent sources used to research the topic. The third section defines the 25-kilometer lethal area through threat analysis. The fourth section explores current US capability modernization efforts alongside ADO conceptualizations. The fifth section uses the military theories of John Boyd and Robert Leonhard to analyze the forecasted operational environment. Finally, the last section provides recommendations in the fields of leadership development, doctrine, and materiel before concluding the monograph.

Literature Review

The purpose of the following literature review is to provide a brief description of the prevalent sources related to the topic, how they apply to the study, and if there are any gaps in current available information. In an effort to answer how Army forces cross the future 25-

⁵ Mary Jo Hatch and Ann L. Cunliffe, *Organization Theory: Modern, Symbolic, and Postmodern Perspectives*, 4th ed. (New York: Oxford University Press, 2018), 6.

⁶ *Ibid.*, 6.

kilometer lethal distance, the research centered around three major categories: threat analysis, US modernization efforts, and military theory.

The research of threat analysis aims to define the future threat environment based on available unclassified information. The critical question to answer is what methods, systems, and capabilities do adversaries use and develop to create a 25-kilometer lethal area? Since the topic centers on LSCO, the research focused efforts into the US pacing adversaries of Russia and China.

The primary sources used for the study of Russian methods of fighting are *The Russian Way of War* and *The Russian Reconnaissance Fire Complex Comes of Age*. Doctors Lester W. Grau and Charles K. Bartles at Fort Leavenworth's Foreign Military Studies Office authored each product after Russia's 2014 annexation of Crimea. Both works relay the systemic and "substantial differences between the Russian and US ways of warfare."⁷ The topic of the study relies on an understanding of the divergent methods countries use to prosecute warfighting at close range, and how those methods changed over time. Particular to this study is a recognition that Russian warfighting evolved from Soviet doctrine, and while some systems and supporting capabilities are the same, others changed with technological capacity.

Unlike Russia, products on Chinese warfighting concepts and doctrine are more difficult to come by. Research reports authored by the RAND Corporation admit that analysis is, "Lacking examples of the PLA (People's Liberation Army) in combat."⁸ *People's Liberation Army Operational Concepts* and *Systems Confrontation and Systems Destruction Warfare* assume this lack of tangible examples. Both pieces posit Chinese warfighting methods based on generic systems thinking as guidelines for Chinese military modernization. Two of the largest issues with

⁷ Lester W. Grau, and Charles K. Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces* (Fort Leavenworth, KS: Foreign Military Studies Office, 2016), XIV.

⁸ Edmund J. Burke, Kristen Gunness, Cortez A. Cooper and Mark Cozad, *People's Liberation Army Operational Concepts* (Arlington, VA: RAND, 2020), 2.

this type of analysis is that of language and the nature of theorizing. First, translation of available Chinese language supporting documents is often subject to variable interpretation. The resulting study and formation of theory from it could be highly subjective. This study assumes that the RAND translation and analysis of available Chinese sources is in keeping with China's intent on warfighting doctrine and modernization.

While the threat analysis can focus adversarial warfighting methods and doctrines into a few supporting documents, the study of capabilities that support those concepts requires a variety of sources. Primarily, this study uses the Defense Intelligence Agency's military power reports for Russia and China that, "foster a deeper understanding of its core capabilities".⁹ While the DIA reports provide general descriptions of capabilities that fit into adversarial warfighting systems, more detailed investigations of capability development and performance requires multiple specialized sourcing. Given the disparate source material and unclassified nature of this study, some open sources provide conflicting or inaccurate capability analysis, which is noted in the following sections where applicable.

The second research goal centers on US modernization efforts. Specific to this monograph topic is how the US visualizes the 25-kilometer lethal area in all-domain concepts and how Army Futures Command's Cross Functional Teams' (CFT) capability modernization priorities fit into these theories. The *TRADOC PAM 525-3-1: US Army in MDO 2028* was released in December 2018 shortly after the formation of Army Futures Command. The pamphlet seeks to refine warfighting concepts that "provides our azimuth to the future."¹⁰ A result of this focus is a broad description of all-domain operations, including its application in penetrating anti-access, area-denial networks. Relevant to this study is the application to, "exploit the resulting

⁹ *Russia Military Power: Building a Military to Support Great Power Aspirations* (Washington DC: Defense Intelligence Agency, 2017), accessed 02 AUG 2020, www.dia.mil/Military-Power-Publications, v.

¹⁰ US Department of the Army, Training and Doctrine Command Pamphlet 525-3-1, *The US Army in Multi-Domain Operations 2028* (Washington DC: Government Publishing Office, December 2018), iii.

freedom of maneuver to defeat enemy systems, formations and objectives.”¹¹ The key challenge is to specifically define where and how the all-domain concept fits into closing the lethal distance.

To help define specifics, the monograph uses Army Futures Command’s *US Army Concept for Maneuver in Multi Domain Operations 2028-2040*. The conceptual release is a subset in a series of concepts covering everything from fires to sustainment. The product attempts to solve the problem of, “how Army forces achieve positions of relative advantage and generate overmatch,” in the future operational environment.¹² Further, Futures Command acknowledges that the concept is meant to guide, “experimentation, force development, and supports the Joint Capabilities Integration and Development System process.”¹³ Given that the product contains its own assumptions, the monograph’s analysis must consider them in order to formulate concurring or distinguishable JCIDS recommendations.

In addition to discovering the theories and concepts that enable future all-domain success in the context of the close area, research must also include the materiel capabilities that support the concepts. Herein lies a major research gap. Given the futures context of the topic, much of the detailed information into future US capabilities is classified. In addition, what is released to the public is often published in disparate journals and articles. The US Army Futures Commands Cross Functional Teams (CFT), and US Army Combat Capabilities Development Command (CCDC) generate unconsolidated releases on the status of the programs. The monograph assumes that the research cannot provide a complete picture of capability development and considers that gap in the analysis of how future capabilities help US forces cross the lethal distance.

In order to provide an analytical framework for the previous two research objectives, the final research goal focuses on military theory. The first consideration is Colonel John Boyd’s

¹¹ Ibid., iii.

¹² US Department of the Army, Army Futures Command Pamphlet Version 1-0, *US Army Concept for Maneuver in Multi Domain Operations 2028-2040* (Washington DC: Government Publishing Office, July 2020), 1.

¹³ Ibid., 1.

Patterns of Conflict. The two products utilized in the research is the 1986 rendering of the presentation and a 1989 transcript of Boyd’s briefing to the Marine Corps University. The goal of the presentation by analysis and synthesis is to, “unveil the character of conflict, survival, and conquest,” and to, “discern a pattern of successful operations.”¹⁴ The transcript provides additional author’s context into the presentation. Through historical examples, Boyd isolates themes of military success and failure. The monograph research and resulting analysis uses these themes to evaluate the threat and US modernization efforts.

The second military theorist considered is Robert R. Leonhard. The monograph considers Leonhard’s loosely connected series of three books published from 1991 to 1998. *The Art of Maneuver: Maneuver-Warfare Theory and AirLand Battle* investigates doctrinal trends in the US Army and that by, “defining them, exposing their weaknesses, and breaking the cognitive logjam,” attempts to inject new recommendations into doctrinal development.¹⁵ *Fighting by Minutes* relates time to, “military weapons, units, leaders, and doctrines” at multiple echelons of command.¹⁶ *The Principles of War for the Information Age* focuses on a “mutation” of war that questions the effects of doctrine and technology development.¹⁷ Each volume offers recommendations by Leonhard that can assist in the critique of threat analysis, all-domain concepts, and CFT capability efforts.

¹⁴ Boyd, John R., “Patterns of Conflict”, Presentation edited by Chet Richards and Chuck Spinney for Defense and the National Interest (Atlanta, GA, 27 February 2005), accessed 02 AUG 2020, <http://www.d-n-i.net> or <http://www.projectwhitehorse.com/pdfs/boyd/patterns%20of%20conflict.pdf>, 3.

¹⁵ Robert R. Leonhard, *The Art of Maneuver: Maneuver-Warfare Theory and AirLand Battle* (New York, NY: Ballantine Books, 1991), 4.

¹⁶ Robert R. Leonhard, *Fighting by Minutes: Time and the Art of War*, 2nd ed. (Westport, CT: Praeger, 2017), 2-3.

¹⁷ Robert R. Leonhard, *The Principles of War for the Information Age* (New York, NY: Ballantine Books, 1998), 3.

Understand the Threat

Our adversaries and potential adversaries have studied and learned from our battlefield successes since the first Gulf War. With that knowledge, they are adapting their methods of warfare, while accelerating the modernization and professionalization of their combat forces.

— General David G. Perkins, “Multi-Domain Battle: The Advent of Twenty-First Century War”

One of the first steps of preparing a military operation is to understand the threat. In this case it is crucial to know the methods and capabilities that create the 25-kilometer lethal distance. It is assumed that the warfighting systems and supporting capabilities in this section remain relatively constant over ten years. Further, those capabilities can exert their influence over multiple extended battlefields, the assessment of which then moves from the purely tactical to that of the operational. Since current and future pacing capabilities are discussed, the classified nature of the material inhibits a full understanding. Any system or capability details that China and Russia release to the public should be consumed with partial skepticism, considering many of the same capabilities are also available for export. Using China and Russia as pacing guides, this section attempts to objectively understand threat effects into the 25-kilometer lethal area by discovering their general warfighting methods and the current/future capabilities which support it.

Given China’s geopolitical situation, how would they envision fighting in the 25-kilometer close area? It might be of help to take a top-down approach from the strategic to the tactical view. The general direction of the country is that of mass modernization in an effort to, “expand China’s national power, perfect its governance systems, and revise the international order.”¹⁸ As the military element of that national power, the People’s Liberation Army (PLA) and its constituent elements must discover its own ends, ways, and means of competing in a multipolar international environment. This begs the question; how can they do that?

¹⁸ US Department of Defense, *Military and Security Developments Involving the People’s Republic of China 2020*, Annual Report to Congress, (Washington DC,2020), v.

China's general military strategy seems to be a familiar defensive concept from our own doctrine. China characterizes its military strategy as one of "active defense", a concept it describes as strategically defensive but operationally offensive.¹⁹ This description conjures an image of a general mobile defense, which consists of a static fixing force and a mobile striking force. If taken in context of China's geopolitical environment, for example, the first and second island chains where the PLA exerts a presence could be the fixing force elements. In the event of escalating armed conflict, the PLA could mobilize a task oriented striking force to that location. Once on the ground, how would those PLA elements involved create a lethal 25-kilometer lethal area?

In the PLA 2013 publication *The Science of Military Strategy*, the Chinese military indicates an all-domain system approach to shaping a lethal close area. The document recommends "fusing" joint operational strength and integrating at the strategic, operational, and tactical levels of war.²⁰ This fusing occurs via what the PLA call "informatized warfare", which is the process of acquiring, transmitting, processing, and using information to conduct joint military operations across warfighting domains.²¹ The intelligence-oriented approach hopes to enable quick, unified effort to seize upon fleeting tactical opportunities. Once obtained, that information enables the PLA to employ the decisive part of their warfighting method, systems confrontation.

Systems confrontation and/or systems destruction warfare is the Chinese concept of two or more opposing warfighting systems interacting on a battlefield. An operational system is made up of five components: the command system, firepower-strike, information confrontation,

¹⁹ *China Military Power: Modernizing a Force to Fight and Win* (Washington DC: Defense Intelligence Agency, 2019), accessed 02 AUG 2020. www.dia.mil/Military-Power-Publications, 23.

²⁰ Burke, Gunness, Cooper, and Cozad, *People's Liberation Army Operational Concepts*, 6.

²¹ Defense Intelligence Agency, *China Military Power: Modernizing a Force to Fight and Win* China Military Power, 24.

reconnaissance-intelligence, and support systems.²² To execute systems confrontation, the PLA relies upon Target Centric Warfare (TCW) which is the concept of attacking critical points in an enemy's operational system to achieve decisive effects with minimal collateral damage.²³ TCW envisions a procedural sequence of events in space and time which involves: degradation and disruption of information flow, operational systems, operational architecture, and eventual disruption of the recon-control-attack-evaluate process.²⁴ Translated into the 25-kilometer lethal area, the PLA would capitalize on precise and lethal, long-range fires (direct and indirect) from dispersed weapon platforms connected by advanced communications.²⁵ While China views a more holistic approach to systems warfare, Russia relies on a more specific interaction of systems which shows consistent performance since World War II.

Russian warfighting also seems contingent on warfighting systems. As opposed to the PLA, the Russian military actively fights in many parts of the world which enables further understanding. The Russian doctrine of Precision Strike is essentially an evolution of the closely held doctrine of "deep battle" codified in the interwar years by Mikhail Tukhachevsky.²⁶ Today the Intelligence-Surveillance-Reconnaissance-Strike (ISR-Strike) Complex represents the incorporation of new technologies into general Russian strategic, operational, and tactical military strategies. Posited here, the ISR-Strike concept is a more focused concentration of what the Chinese might consider the reconnaissance-intelligence and firepower-strike systems. The Reconnaissance Fire Complex links intelligence data, precise targeting, a fire-direction center,

²² Burke, Gunness, Cooper, and Cozad, *People's Liberation Army Operational Concepts*, 8.

²³ *Ibid.*, 15.

²⁴ Jeffrey Engstrom. *Systems Confrontation and Systems Destruction Warfare: How the Chinese Peoples' Liberation Army Seeks to wage Modern Warfare*. Arlington, (VA: RAND, 2018), 16-18.

²⁵ Defense Intelligence Agency, *China Military Power: Modernizing a Force to Fight and Win* China Military Power, 57.

²⁶ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, 34.

and tactical artillery to destroy high-value targets in near-real time.²⁷ In the context of the 25-kilometer lethal area, cross-domain capabilities enable the application of the reconnaissance-intelligence and firepower-strike systems by fixing or isolating elements within that zone for queued destruction. Taken together, the Chinese and Russian warfighting systems require all-domain capabilities that can do four things: find, fix, finish, and protect.

Based on the perception of Chinese systems confrontation and Russian ISR-Strike, finding adversaries in the 25-kilometer lethal area is of paramount importance. On land, the ability to find in 2030 is characterized by advanced autonomous sensors linked by a command-and-control capability. Chinese reconnaissance platforms like the upgraded WZ551 armored personnel carrier or modern Type-08 wheeled armored vehicle are modified for special reconnaissance roles having been fitted with extensive communications equipment and a mast-mounted sensor pod containing day and night target acquisition and designation equipment.²⁸ As technology matures, ground reconnaissance may shift to an application of semi-autonomous/autonomous capabilities. The Uran-9 is a Russian multipurpose unmanned ground vehicle (UGV) which can provide reconnaissance and fire support.²⁹ These capabilities will likely link into a network-centric system which combines the operational systems of reconnaissance-intelligence with that of firepower-strike. The Russian Strelets is a Russian command and control network which employs a ‘targeting’ component worn by a single soldier in the form of a small tablet computer.³⁰ These capabilities can allow adversary forces to acquire and designate targets in near real time without becoming decisively engaged. In the air, China and

²⁷ Lester W. Grau, and Charles K. Bartles, *The Russian Reconnaissance Fire Complex Comes of Age* (Fort Leavenworth, KS: Foreign Military Studies Office, 2016), 3.

²⁸ Janes, “Military & Security Assessments Intelligence Centre China”, Country Military Capabilities, accessed September 8, 2020, <https://customer-janes.com.lumen.cgsccarl.com/MilitarySecurityAssessments/Country/China>.

²⁹ Janes, “Military & Security Assessments Intelligence Centre Russia”, Country Military Capabilities, accessed September 8, 2020, <https://customer-janes.com.lumen.cgsccarl.com/MilitarySecurityAssessments/Country/Russia>.

³⁰ Grau and Bartles, *The Russian Reconnaissance Fire Complex Comes of Age*, 14.

Russia placed increased emphasis on the inclusion of UAS of different types. The Russian Orlan-10 and Eleron-3SV are capabilities of a UAS company which is now assigned to each motorized rifle brigade and will become organic components to Russian artillery brigades in the future.³¹ Both China and Russia hope to weaponize UAS sensors as either weapons platforms or weapons themselves. The Chinese based company Ziyang exhibited armed swarming drones that uses artificial intelligence (AI) to perform guidance, target acquisition, and attack execution.³² Each air-reconnaissance effort seems geared towards shortening the time between finding a target and placing lethal fires on that target.

Through the cyberspace and space domains, China and Russia hope to employ capabilities which provide a more complete tactical and operational picture through the monitoring of the electro-magnetic spectrum (EMS) and multi-spectral global imaging. In the cyberspace sphere, Russian analysts determined that future ground forces require a system of seismic, acoustic and electro-optic reconnaissance sensors.³³ Like the traditional ground and air platforms, the systems that monitor the EMS and other environmental indicators will likely link into a battlefield network. To supplement these sensors, Russia and China will likely continue to build their electronic intelligence and early warning system constellation of satellites.³⁴ Space based platforms, which may be linked into a battlefield network, may assist China and Russia in building an informatized battlespace within a 25-kilometer area in which to place lethal effects.

Given the mobility of current and future combat formations, China and Russia employ cross-domain capabilities to fix or isolate enemy elements in the 25-kilometer lethal area. On the land and in the air, China and Russia currently field advanced long-range anti-tank guided

³¹ Ibid., 10.

³² US Department of Defense, *Military and Security Developments Involving the People's Republic of China 2020*, 142-143.

³³ Grau and Bartles, *The Russian Reconnaissance Fire Complex Comes of Age*, 15.

³⁴ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, 35.

missiles (ATGM) on multiple platforms which can threaten movement and maneuver formations.³⁵ The Chinese routinely demonstrate the use of the Red Arrow-10, a non-line of sight (NLOS) ATGM which can attack targets behind terrain at a distance of ten-kilometers.³⁶ The Russian Kornet-EM, with a maximum range of eight-kilometers, can be equipped on several ground platforms that include salvo fire capability in which two missiles are fired at the same or different targets within milliseconds of each other.³⁷ Similarly, aerial attack aviation of both China and Russia use advanced conventional capabilities which are closely integrated with artillery targeting and priorities.³⁸ Further, China and Russia will likely use advanced cyberspace and space capabilities to hold an adversary in the 25-kilometer lethal area.

While maintaining their own cyberspace systems to enable a networked battlefield, China and Russia employ cyber attacks to deny its use to an adversary. Military academics have suggested the Russian fusing of electronic warfare with their cyber operations, allowing offensive entry into enemy computers and networked systems and disrupt the use of the EMS.³⁹ In addition, Russian military journals observed Western operations that rely on long-range, space-supported precision-guided munitions.⁴⁰ Denying the linkage between ground and air-based weapons systems with space could render condition setting capabilities useless. China expands the demonstration of this denial through the testing of DN-2 and DN-3 orbital interceptors in low earth orbit (LEO) and medium earth orbit (MEO). A Chinese counter-space operation, “could

³⁵ Grau and Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces*, 199.

³⁶ Charlie Pierce, *ATGM Guidebook* (Redstone Arsenal, AL: Missile and Space Intelligence Center (MSIC)), 2016, 14.

³⁷ *Ibid.*, 68.

³⁸ Grau and Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces*, 386.

³⁹ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, 42.

⁴⁰ *Ibid.*, 36.

ensure US forces could not effectively, ‘see’, ‘sense’ or ‘hear’, much less navigate, target, and communicate.”⁴¹ Such impediments allows China and Russia the capability to physically and functionally isolate elements in a 25-kilometer lethal area.

Fires is the primary critical capability in the Chinese and Russian methods of systems warfare, especially for effects inside the 25-kilometer close area. Russian (and possibly by extension Chinese) military thinking, artillery is, “a maneuver element whose destructive capabilities may perform ground-gaining missions.”⁴² Russian modernization efforts with the Koalitsiy-SV 2S35 self-propelled howitzer and upgraded TORNADO-G, SMERCH, and URAGAN multiple-rocket launchers (MRL) are intended to be the future of Russian artillery units which extends ranges to 45-kilometers for traditional rounds and 70-kilometers for rocket assisted projectiles.⁴³ These echeloned elements could maneuver to dispersed locations on extended battlefields and still coordinate their fires into a decisive point located in the 25-kilometer lethal area.

In addition to traditional fires, Short-Range Ballistic Missile (SRBM) systems equipped with conventional high-explosive or cluster munitions could supplement areas where China or Russia do not have enough aerial assets to compete. While Russian maneuver brigades do not have organic SRBM capability, “they can be expected to support maneuver brigade commanders in high intensity conflict situations.”⁴⁴ Where China and Russia do maintain competitive aerial capability, it is highly likely the same UAS used to find targets also can be tasked to mass concentrated precision fires to finish those targets. China’s Wing Loong, Cloud Shadow and CH-

⁴¹ Tate Nurkin, *China’s Advanced Weapon Systems* (Jane’s by IHS Markit, 2018), accessed October 2020, https://www.uscc.gov/sites/default/files/Research/Jane's%20by%20IHS%20Markit_China's%20Advanced%20Weapons%20Systems.pdf, 138.

⁴² Grau and Bartles, *The Russian Reconnaissance Fire Complex Comes of Age*, 3.

⁴³ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, 84.

⁴⁴ Grau and Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces*, 263.

4/5 UAVs leverage long loitering times and Blue Arrow ATGM capabilities to combine finding and finishing functions as a means of systems destruction. Chinese designers note, “We demonstrate the CH-5s’s ability to win the initiative in any battlefield with its reconnaissance and strike capability.”⁴⁵ The Chinese Blue Arrow series, particularly the Blue Arrow-21 can be employed at a range of 25-kilometers from air platforms like UAVs or attack helicopters.⁴⁶ To coordinate the massing of echeloned firepower-strike capabilities, China and Russia depend upon a robust networked battlefield in cyberspace. For instance, The Russian Andromeda system is intended to provide situational awareness to the commander and allow for real-time exchange of information from the highest commander down to the squad, even individual soldier.⁴⁷ Further, Andromeda can interface with space based networks, counter electronic warfare capability, and conduct digital mapping through the EMS.⁴⁸ While recognizing western advantages in the air, China and Russia implement layered air defenses in the 25-kilometer lethal area both as a means of defeat and protection.

Key to the protection of critical capabilities in the 25-kilometer lethal area, China and Russia invest heavily in echeloned air defense. To support a kill chain of detection, identification, tracking, assignment, engagement, and assessment both pacing threats employ redundant and overlapping system capabilities.⁴⁹ For example, a defending Russian motorized rifle brigade contains two anti-aircraft battalions. One battalion, the air-defense missile artillery battalion, protects echeloned front-line elements. At least one battery is equipped with ground platforms like the 2S19 Tunguska which can operate as an integrated network of several platforms or as a

⁴⁵ Nurkin, *China’s Advanced Weapon Systems*, 161.

⁴⁶ Charlie Pierce, *ATGM Guidebook*, 34-35.

⁴⁷ Grau and Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces*, 286.

⁴⁸ *Ibid.*, 286.

⁴⁹ Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, 63.

singular platform. The other batteries consist of SA-18/SA-24 MANPADs which are split between front-line elements and brigade command posts.⁵⁰ The second air defense missile battalion, equipped with SA-13 or SA-15 missile platforms protect the brigade's artillery group.⁵¹ Given the systemic nature of such air-defense protection assets, they are contingent upon network capability. Consequently, cyber protection will likely find increased placement in Chinese and Russian warfighting systems. Russia views these capabilities as software defined-radio technology, which is designed to have better protection against surveillance and jamming.⁵²

Chinese and Russian methods of warfare represent a systems approach to fighting in the 25-kilometer lethal area. Each method requires capabilities that can find, fix, finish, and protect across multiple domains (Figure 2). Many of these capabilities are beginning to combine cross-domain functionality or even an ability to combine operational system function. Now that we can envision the threat operational environment up to 2030, the next step is to understand what US concepts and capabilities allow for the crossing of that environment.

⁵⁰ Grau and Bartles, *The Russian Way of War: Force Structure, Tactics, and Modernization of the Russian Ground Forces*, 92.

⁵¹ *Ibid.*, 92.

⁵² *Ibid.*, 287.

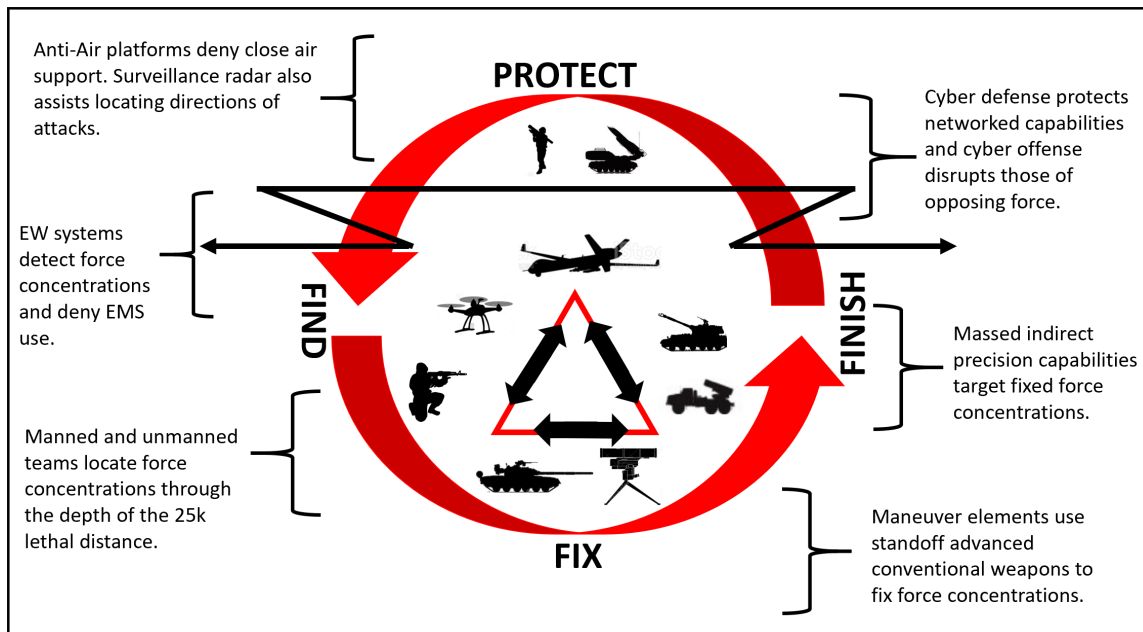


Figure 2. Author's adaptation of the Graphic Representation of the Russian Target Acquisition Cycle. US Department of the Army, Asymmetric Warfare Group, *RUSSIAN NEW GENERATION WARFARE HANDBOOK* (Washington, DC: Government Printing Office, 2016), 13.

Understand Ourselves

Now that pacing threats are explored, the same discovery process is applicable to the US military and its future warfighting concepts and capabilities. The following section addresses the applicability of US military service multi-domain concepts and the near-term capabilities that support it. While multi-domain concepts are more abstract, this monograph attempts to translate those ideas into what it could look like in the 25-kilometer lethal area. This means articulating the different convergences that can happen in the close and deep maneuver areas of a battlefield (Figure 3). As the discussion of capabilities continues, it is important to know that US Army Futures Command directs its Cross Functional Teams (CFT) to form portfolios of potential capabilities, not just one platform. To keep the monograph from delving into science fiction, the limitation of technology maturation allows for an objective look at what US capabilities could do by 2030 to enact all-domain operations.

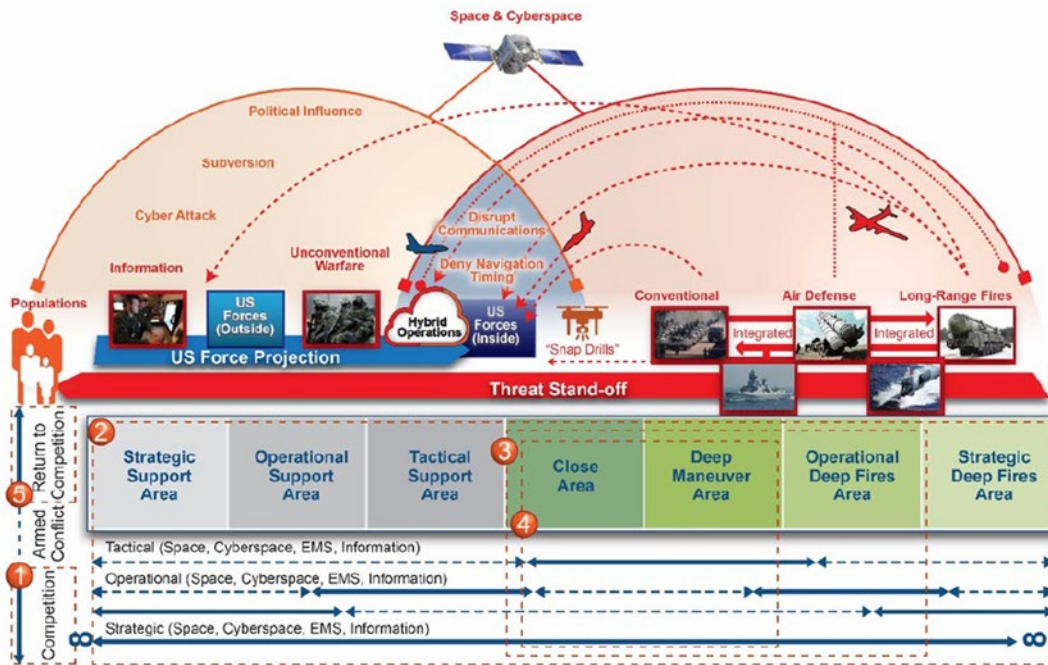


Figure 3. Problems superimposed on the MDO framework. US Department of the Army, TRADOC Pamphlet 525-3-1, *The US Army in Multi-Domain Operations 2028* (Washington, DC: Government Printing Office, 2018), 16.

So how does each US military service branch define all-domain operations, specifically around the 25-kilometer lethal area as described in the previous section? The US Air Force concept of Joint All Domain Operations (JADO) envisions a contribution of capabilities to, “rapidly sense, command and control, target, and support actions across warfighting domains.”⁵³ To the military observer, this seems like a supporting role to a supported commander around the close or deep maneuver area. The effects JADO hopes to achieve is to supplement an ability to adapt more effectively than an adversary, while simultaneously denying an enemy’s ability to adapt.⁵⁴ Superimposed over a 25-kilometer lethal area, the US Air Force would employ its cross-domain systems to set practical conditions for a supported commander’s freedom of maneuver.

⁵³ US Department of the Air Force. Operational Level Doctrine Annex 3-1, *Department of the Air Force Role in Joint All-Domain Operations (JADO)*, (Washington DC: Government Publishing Office, June 2020), 1.

⁵⁴ *Ibid.*, 4.

An effective way in describing the US Air Force's application of JADO in the 25-kilometer lethal area is through the war fighting functions of intelligence, fires, and maneuver. Through intelligence collection efforts, JADO envisions continuous ISR sensing through the warfighting domains to "feed multiple decision loops."⁵⁵ This constant information feed could mitigate mass uncertainty and provide supported commanders the ability to make decisions at the right time and place on a battlefield. The Air Force sees the application of fires through the, "Prevalence of precision guided munitions, enabled by PNT and augmented by non-kinetic capabilities," as essential elements of JADO.⁵⁶ The effects of this in the 25-kilometer lethal area is two-fold. First it allows for a convergence of the Air Forces capabilities in a decisive space, and protects friendly ground elements from having to concentrate in the close or deep-maneuver area to achieve similar effects.

The US Air Force and JADO sees movement and maneuver in two distinct ways. First, as a supporting element around the 25-kilometer lethal area, JADO advocates for schemes of maneuver that, "create opportunistic convergences."⁵⁷ A supported ground unit exercising flexible courses of action in concert with the Air Force could enable the timely exploitation of fleeting opportunities in the 25-kilometer lethal area. Second, JADO envisions movement and maneuver through the lens of the EMS, in space, and in cyberspace. Critical actions tied to those domains include: changing spectrum bands, frequency agility, re-positioning or re-orienting orbital asset optimization, and accessing adversary networks in support of offensive and defensive actions.⁵⁸ Each of these movement and maneuver actions, converged on a 25-kilometer zone, could allow a supported commander the ability to shoot, move, and communicate while disrupting an adversary's ability to fight with their own methods of warfare and capabilities.

⁵⁵ Ibid., 13.

⁵⁶ Ibid., 16.

⁵⁷ Ibid., 19.

⁵⁸ Ibid., 20.

The US Navy views future all-domain warfighting as an evolution of concepts, the current of which is Distributed Maritime Operations (DMO). The precursor to DMO is the concept of Distributed Lethality, “in which each surface combatant, amphibious warship, and logistics ship should have an offensive capability,” thereby introducing multiple dilemmas to an adversary.⁵⁹ Yet, in order for modern offensive capabilities to be effective, especially among dispersed locations, each vessel needs a sensing and protective capacity to be truly self-sufficient. DMO attempts to address the limitations of Distributed Lethality by, “integrating naval forces across the domains throughout a theater to provide targeting and coordinate fires.”⁶⁰ Much like the Air Force, the Navy could provide cross-domain support and converge their described offensive capabilities to a ground commander around the 25-kilometer lethal area.

Admiral Scott H. Swift (Retired) published a series of articles detailing concepts rendered possible by the US Navy’s input into all-domain operations. Swift describes a tactical grid of capabilities, overwatched by a fleet-level Maritime Operations Center (MOC) which is directed by a Joint Forces Command (JFC) to implement various “effects” at specific times and places.⁶¹ That tactical grid could very likely be integrated or supplemented with the supporting capabilities of other sister services. Once again, that tactical grid could grant crucial support to a ground commander who makes a decision on which capabilities to converge into a specific decisive area.

As a component of its Force Design 2030, the US Marine Corps recognizes a shortage of specific capabilities needed to compete in future war. The Commandant of the Marine Corps notes that in conjunction with Navy DMO, the Marines should affect the, “generation of

⁵⁹ Bryan Clark, and Timothy A. Walton, *Taking Back the Seas: Transforming the US Surface Fleet for Decision-Centric Warfare* (Center for Strategic and Budgetary Assessments, 2019), accessed October 2020, <https://csbaonline.org/research/publications/taking-back-the-seas-transforming-the-u.s-surface-fleet-for-decision-centric-warfare>, 21-22.

⁶⁰ *Ibid.*, 21-22.

⁶¹ Eyer, Kevin, and Steve McJessey, “Operationalizing Distributed Maritime Operations.” Distributed Maritime Operations Topic Week, Last modified March 5, 2019, accessed October 2020, <http://cimsec.org/operationalizing-distributed-maritime-operations/39831>, 6.

technically disruptive, tactical stand-in engagements that confront aggressor naval forces with an array of low signature, affordable, and risk-worthy platforms and payloads.”⁶² The underlying assumption of generating tactical stand-in engagements is the ability to survive and operate in an enemy’s Weapon Engagement Zone (WEZ), such as a 25-kilometer lethal distance. To that end the Marines envision the use of all-domain littoral regiments formed of a Littoral Combat Team, a Littoral Anti-Air Battalion, and a Littoral Logistics Battalion.⁶³

The US Army is the most likely to be involved in a LSCO fight against a peer adversary around the 25-kilometer lethal area. The general rule of the Army’s Multi-Domain Operations (MDO) concept is to converge all-domain effects on a decisive area to cut-off enemy elements (especially those in the 25-kilometer lethal area) from their support. Then to coordinate dispersed units to then defeat those isolated elements. Simply described, MDO is a multi-echeloned process to disrupt enemy follow-on forces and defeat them in detail through coordinated maneuver. Like some of the sister service concepts, MDO could be described as an evolution. In this case an adaptation of the US’s Cold War Air-Land Battle and World War II Soviet Deep-Battle. For the close area, the MDO concept envisions a sequence of conditions setting activities so that friendly maneuver elements can cross the 25-kilometer lethal area with mitigated resistance.

MDO describes how corps and divisions are tiered elements in penetrating, dis-integrating, and exploiting opportunities in the close and deep-maneuver areas. The corps shapes the close area for divisions through their multi-domain capabilities to penetrate and dis-integrate enemy long/mid-range fires and integrated air defense systems that would converge their effects into the 25-kilometer lethal area. The divisions likewise shape the deep maneuver area for the brigades through their own multi-domain capabilities.⁶⁴ Each echeloned effort is a proactive

⁶² David H. Berger, *Force Design 2030*, United States Marine Corps Headquarters, (Washington DC: Government Publishing Office), March 2020, 3.

⁶³ *Ibid.*, 5.

⁶⁴ US Department of the Army, *The US Army in Multi-Domain Operations 2028*, v.

measure to ensure that an adversary cannot mass multi-domain effects into the 25-kilometer lethal area, and that subordinate elements have the freedom of maneuver to exploit gained openings in the enemy's system of fighting.

MDO concepts further describe an abstract sequencing of events, echelons, and efforts through time and space. During the penetration effort, "Forward presence maneuver forces and partner nation conventional forces use the advantages of the defense," to deny an enemy its objectives.⁶⁵ This still implies there is a 25-kilometer lethal distance a maneuver force might cross before the arrival of additional expeditionary forces. During the penetration and dis-integration phases there are consolidated efforts to "complicate the enemy's collection plan and force the reallocation of assets at multiple levels," and to neutralize and/or strike enemy long and mid-range fire systems in the close area.⁶⁶ Unique to the dis-integration phase are activities through military deception in efforts to provoke adversary responses, thereby revealing their positions.⁶⁷ Through vague description, MDO envisions an attrition effort involving multiple echelons of command in which a fluid 25-kilometer lethal distance is shaped through all-domain capability applications.

Exploitation describes another series of potential tasks that would help a formation cross the 25-kilometer lethal area shaped by previous efforts. MDO indicates the use of division maneuver for two tasks: maneuver to isolate enemy elements, then maneuver to defeat those elements.⁶⁸ That maneuver, much like the Air Force's conceptualization of JADO maneuver, involves the convergence of cross-domain capabilities to further shape the

⁶⁵ Ibid., 34.

⁶⁶ Ibid., 34 and 40.

⁶⁷ US Department of the Army, *US Army Concept for Maneuver in Multi Domain Operations 2028-2040*, 46.

⁶⁸ US Department of the Army, *The US Army in Multi-Domain Operations 2028*, 43.

deep maneuver area.⁶⁹ Corps and divisions combine fires, maneuver, and deception to dislocate the enemy by physically, virtually, and cognitively isolating its subordinate units.⁷⁰ To affect the completion of the adversary defeat, dispersed brigades concentrate along multiple axis to defeat opposing adversaries in swift close maneuver, then disperse again before an adversary can mass effects on friendly elements.⁷¹ The conceptual description of MDO indicates a cyclical process of crossing several series of 25-kilometer lethal areas to effect either an isolation or defeat.

So what are the potential US capabilities that can enable all-domain operating concepts by 2030? Which capabilities demonstrate the required characteristics that allow friendly forces to find, fix, finish, and protect faster and better than the adversary? Which have the modularity to combine functions across domains and demonstrate upgradability?

Reconnaissance and counter-reconnaissance in the MDO environment are simultaneous and persistent activities. In the land domain, the designation of a dedicated combat platform for those tasks is essential in realizing the MDO concept. The Next Generation Combat Vehicle (NGCV) program assists with the Marine Corps Advanced Reconnaissance Vehicle (ARV) to replace the Light Armored Vehicle (LAV) series. Its stated purpose is to, “gain contact with and collect on peer-threat forces,” while simultaneously, “waging the counter-reconnaissance fight” through transformational capabilities.⁷² The verbiage of transformational implies a continual modification based upon

⁶⁹ Ibid., 23.

⁷⁰ Ibid., 25.

⁷¹ US Department of the Army, *US Army Concept for Maneuver in Multi Domain Operations 2028-2040*, 47.

⁷² Matt Gonzales, “MCSC, ONR and CD&I Collaborating to Inform ARV Path Forward,” News at Marine Corps Systems Command, May 7, 2020, accessed October 2020, <https://www.marines.mil/News/News-Display/Article/2180125/mcsc-onr-and-cdi-collaborating-to-inform-arv-path-forward/>.

threat input. This adaptability allows for next-generation systems the time to mature before implementation on the end product.

In the air, the US Army UAS Center of Excellence defines the mid-term timeframe of UAS upgrades as 2016-2025. By that period the Army expects to field, “the future-armed aerial scout aircraft whether manned, unmanned, or a combination of both.”⁷³ Like the aims of several pacing threat capabilities, the combination of reconnaissance and attack roles into a single airframe furthers the goals of counter-reconnaissance and reducing the time between target identification and engagement. While these capabilities exist at a US Army division level through a combat aviation brigade, the ability to apply that capability to individual maneuver brigades assists the shaping of low echelon maneuver in the exploit phase of MDO.

With evolving capabilities like the ARV or mid-term UAS upgrades, a robust and sophisticated intelligence network which operates in space and cyberspace is needed to link sensors to the right shooters. The Tactical Intelligence Targeting Access Node (TITAN) intends to, “serve as a ground-based intelligence system designed to rapidly process data and disseminate targetable intelligence directly to tactical weapon systems.”⁷⁴ The TITAN system is capable of integration with other cyberspace systems like the Terrestrial Layer System (TLS). By linking disparate shooters from across extended battlefields, it generates options for battlefield commanders on how best to shape access into the 25-kilometer lethal area throughout each phase of the MDO sequence.

⁷³ US Department of the Army, US Army UAS Center of Excellence, “*Eyes of the Army*” *US Army Roadmap for Unmanned Systems 2010-2035*, (Washington DC: Government Publishing Office), 2010, 50.

⁷⁴ Nishawn S. Smagh, *Intelligence, Surveillance, and Reconnaissance Design for Great Power Competition*, Congressional Research Service Report Number R46389, June 4, 2020, 23.

Unlike the pacing threats of China and Russia, US capabilities to fix enemy elements revolve around the use of artillery. Specific to fixing enemy elements around the 25-kilometer lethal area, the Long-Range Precision Fires (LRPF) effort to modernize the M109A7 Paladin is the most realistic expectation of capability fielding by 2030. When leading the LRPF CFT, Brigadier General Stephen Maranian highlighted three efforts for the upgrade: increasing range, increasing lethality, and increasing volume of fires in terms of round and at echelon.⁷⁵ To that end the LRPF program projects the use of the XM1113 rocket assisted projectile, an extended 58-caliber cannon tube which enables hypersonic velocity, and an autoloader. Massed artillery to finish an adversary formation requires a lengthy and robust logistics effort, which may not be available when US forces are expeditionary. The planned Paladin upgrades reflect MDO's application of shaping by continual attrition of enemy mid and long-range fires in concealed locations in an expeditionary operation.

In the cyberspace domain, the US Army is beginning to form Cyber Warfare Battalions and Intelligence, Information, Cyber, Electronic Warfare, and Space (I2CEWS) detachments. In an effort to explore the targeting of adversary networks, these units leverage capabilities to, "conduct offensive operations through radio-frequency-enabled cyber effects," and, "demonstrated ability to conduct over-the-air operations targeting Wi-Fi nodes."⁷⁶ Infiltrating and disrupting an adversary's network-centric warfare architecture is an attempt to inflict paralysis in decision making cycles. A cognitively isolated (or fixed)

⁷⁵ Jen Judson, "US Army to Demo Precision Strike, Hypersonics, Ramjet Capabilities In Just a Few Years", Defense News, Last modified March 20, 2018, accessed November 17, 2020, <https://www.defensenews.com/land/2018/03/20/army-to-demonstrate-precision-strike-hypersonics-and-ramjet-capabilities-in-just-a-few-years/>.

⁷⁶ Mark Pomerleau, "Here's How the US Army is Planning Tactical Cyber Operations", C4ISRNET, Last modified October 9, 2020, accessed November 17, 2020, <https://www.c4isrnet.com/cyber/2020/10/09/heres-how-the-us-army-is-planning-tactical-cyber-operations/>.

adversary attempting to influence the 25-kilometer lethal area is easier to maneuver around and defeat.

The actual ability to functionally defeat or finish an enemy in the 25-kilometer lethal area will likely still materialize via ground maneuver forces. While fires capabilities are vital to reducing adversary strengths, ground maneuver forces represent the US Army physical ability to render them ineffective through offensive and defensive operations. As the NGCV portfolio does not currently project a successor to the Abrams Main Battle Tank, upgrades to the platform stretch its lifespan well into 2030. The M1A2C (M1A2 SEPv3) and M1A2D (M1A2 SEPv4) are planned successive variants of the tank which allocate for MDO upgradability. “This program began early enough to on-board any technology the Army deems critical to the future battlefield to include artificial intelligence, autonomy, APS (Active Protection System) or advanced sensors.”⁷⁷ The Abrams program represents a good case study of adaptability over time through a system of systems approach.

The Soldier Lethality CFT attempts to further maneuver force mobility. In the near to mid-term the CFT hopes that, “Given the rapid development of technology innovations, robotic and autonomous systems (RAS) will provide critical capabilities to infantry rifle companies that will enhance the companies’ ability to accomplish their combat mission.”⁷⁸ One of the primary goals of RAS in maneuver forces is to reduce the load burden on the individual soldier. This ability could enable ground forces to rapidly infiltrate through

⁷⁷ “Abrams Tank Upgrade,” United States Army Acquisition Support Center, Last modified 2021, accessed November 17, 2020, <https://asc.army.mil/web/portfolio-item/gcs-m1-abrams-main-battle-tank/>.

⁷⁸ John J. Bastone, 2019, "Focus Modernization Efforts on Rifle Companies" Army 69, no. 2: 9-10, accessed October 2020, <https://lumen.cgsccarl.com/login?url=https://www-proquest.com.lumen.cgsccarl.com/trade-journals/focus-modernization-efforts-on-rifle-companies/docview/2193091880/se-2?accountid=28992>., 9.

heavily restricted terrain, either bypassing the 25-kilometer lethal area or using the restricted terrain itself as cover.

One of the US military's greatest strengths to defeat combined arms forces is its ability to provide fires from the air. The AH-64 represents one of the primary means of destruction in the US Army's inventory. However, the standoff of the 25-kilometer lethal distance limits the ability to implement Hellfire Longbow fires through semi-active laser guidance. The Future Vertical Lift (FVL) program continues upgrades to current platforms to address this issue. In the summer of 2020, FVL fired the Israeli SPIKE NLOS ATGM from the Apache. The 25-kilometer ranged SPIKE NLOS, "could provide an interim solution that exceeds the range of currently fielded systems."⁷⁹ The missile system is designed to provide long-range and accurate precision strikes against heavily armored targets, even behind terrain coverage.

Even though MDO provides substantial conditions setting through the penetration and dis-integration stages, US Army forces still must protect themselves as they cross through the 25-kilometer lethal area. Active Protection Systems (APS) like Trophy and Iron Fist are good examples of this effort. The intent behind APS is to defeat incoming precision munitions with mutually supporting modular components. The Trophy APS currently being fielded on the Abrams tanks is a hard-kill system. These APS implementations detect incoming (non-kinetic) munitions through radar and defeats them via an explosive interception projectile. A soft-kill system attempts to defeat the guidance of a precision munition through electro-optical or infra-red countermeasures as it approaches the target. Currently, only hard-kill systems are fielded which protect US combat platforms.

⁷⁹ Argie Sarantinos, "SPIKE missile tested, leveraging Foreign Comparative Testing program," Army.mil News, Last modified June 1, 2020, Accessed November 17, 2020, https://www.army.mil/article/236110/spike_missile_tested_leveraging_foreign_comparative_testing_program.

As US capabilities evolve into artificial intelligence, robotics, and (semi) autonomous systems, the networks in cyberspace and space that support them must also be protected. The I2CEWS detachments conducts cyber defense via “defensive kits provided to Cyber Command’s cyber protection teams. These include deployable defensive cyber systems and tactical defensive cyber infrastructure.”⁸⁰ New satellite constellations under the direction of the US Space Force will be designed to provide a protected linkage between space and operating components on the ground. The Evolved Strategic Satellite (ESS) will be designed to have “enhanced resilience and cyberspace capabilities.”⁸¹ The ability to protect the nodes and linkages of US systems from active jamming is crucial in MDO.

By discovering the intent and meaning behind all-domain operations through US service branches, it is possible to deduce a general understanding of all-domain implementation around the 25-kilometer lethal area. Observing near and mid-term cross-domain capability trends allows for a practical look at what assets enable penetration, disintegration, and exploitation. The next derives an evaluation of US and pacing threat all-domain warfare concepts through the use of military theory.

Apply Military Theory

In order to evaluate all-domain system effects into the 25-kilometer lethal distance, it is necessary to introduce applicable military theory as a guide. As theories themselves are conceptualizations of a particular phenomena, they are highly subjective in nature. The following paragraphs introduce select military theories of John Boyd and Robert Leonhard. The component

⁸⁰ Mark Pomerleau, “Here’s How the US Army is Planning Tactical Cyber Operations,” accessed October 2020, <https://www.c4isrnet.com/cyber/2020/10/09/heres-how-the-us-army-is-planning-tactical-cyber-operations/>.

⁸¹ Nathan Strout, “US Space Force awards third contract for anti-jamming SATCOM prototypes,” C4ISRNET, Last modified November 12, 2020, accessed November 17, 2020, <https://www.c4isrnet.com/battlefieldtech/space/2020/11/12/space-force-awards-third-contract-for-anti-jamming-satcom-prototypes/>.

concepts of those theories are then synthesized with the findings of threat and US all-domain systems and supporting capabilities. From that synthesis we can create a new understanding of how all-domain systems and capabilities can help US Army forces cross the 25-kilometer lethal distance.

Patterns of Conflict is Colonel John Boyd's attempt to describe, "the nature of moral-mental-physical conflict," and, "discern a pattern for successful operations."⁸² One of the first analogies Boyd draws is with fighter pilot's desire to get in and out of engagements quickly. This idea of fast transients suggests that friendly forces should, "operate at a faster tempo or rhythm" than our adversaries. This is the departure point for "getting inside" an adversary's observation-orientation-decision-action loop.⁸³ Boyd argues that achieving that fast-transient allows us to choose the time and place of engagements.

Selecting the right operations and weapons that enable fast-transients is then key to success. Boyd argues that one should, "Generate a rapidly changing environment" through the use of operations and capabilities that allow for quick observations, enable decisions, facilitate fast-tempo and transient maneuvers, and affect quick kills.⁸⁴ Once a combatant is able to generate these effects it may disrupt an adversary's adaptation to the new environment, which in turn impedes their decisions and actions.

Boyd continues theorizing about successful military operations by attempting to categorize historical conflicts as either those of attrition warfare, maneuver conflict, and moral conflict. Boyd reminds his viewers that these are not "exhaustive" examples and that historical practitioners like Napoleon or Ulysses S. Grant could apply each category at the tactical,

⁸² John R. Boyd, "Discourse on Winning and Losing," Transcript of "Patterns of Conflict" presentation to USMC Command and Staff College, Marine Corps University, MCB Quantico, VA, 25 April and 2-3 May 1989, 7-8.

⁸³ John R. Boyd, "Patterns of Conflict," 5.

⁸⁴ *Ibid.*, 7.

operational, or strategic level of war.⁸⁵ Attrition warfare and maneuver conflict are of most interest given the subject of this monograph.

Attrition, as defined by Boyd, is the creation and exploitation of destructive force, protection, and mobility to compel an enemy to sue for peace. Destructive force is generated through weapons that kill, maim, and enable widespread destruction.⁸⁶ Protection is the ability to minimize the expression of destructive force through cover, dispersion, and obscurity.⁸⁷ Mobility denotes an ability to rapidly focus destructive force, or likewise move away from an enemy's destructive force.⁸⁸ Boyd posits that this attrition via widespread destruction breaks an enemy's will to resist and enables friendly forces to seize and hold terrain objectives.⁸⁹ The combination of these physical effects compels an enemy to surrender and sue for peace.

To Boyd, maneuver conflict is different from attrition in that the means of defeat stems from the mental state of an adversary, not the physical condition. The aim of maneuver conflict is to, "Generate many non-cooperative centers of gravity, as well as disorient, disrupt, or overload those that adversary depends upon, in order to magnify friction, shatter cohesion, produce paralysis, and bring about his collapse."⁹⁰ Boyd's translation of center of gravity is not only a "source of power" as doctrine suggests, but also, "those things that permit an organic whole to stay together."⁹¹ Breaking down the connections between those parts of the whole is achieved by creating ambiguity, deception, novelty, fast-transient maneuvers, and focused effort.⁹² These

⁸⁵ John R. Boyd, "Discourse on Winning and Losing," 131.

⁸⁶ John R. Boyd, "Patterns of Conflict," 113.

⁸⁷ Ibid.

⁸⁸ Ibid.

⁸⁹ Ibid.

⁹⁰ Ibid., 117.

⁹¹ US Department of the Army, Army Doctrinal Publication (ADP) 3-0, *Operations*, (Washington DC: Government Publishing Office, July 2019), 2-27, and John R. Boyd, "Discourse on Winning and Losing," 68.

⁹² John R. Boyd, "Patterns of Conflict," 118.

actions in turn cause an enemy to become disoriented, disrupted, surprised, shocked, or overloaded.⁹³ The ultimate result of which pulls an adversary apart so that its isolated elements are vulnerable.

Retired US Army Colonel Robert Leonhard is also a modern military theorist who conceptualizes the nature of maneuver conflict and future warfare. In his book *The Art of Maneuver*, Leonhard postulates three means of defeat which are achievable through maneuver. The first means is preemption, which “relates to seizing an opportunity before the enemy does.”⁹⁴ The operating principle of preemption is an appreciation for time and the value of immediate boldness to gain quick success. Preemption requires, “an exhaustion of all resources (except time)” to gain a clear understanding of the enemy’s situation.⁹⁵ This exhaustion implies a massive investment in intelligence collection.

The second means of defeat is dislocation. Rather than fight a hostile force on its terms, dislocation implies that, “the friendly force avoids any combat in which the enemy can bring his might to bear.”⁹⁶ Leonhard points out there are two types of dislocation, positional and functional. Positional dislocation is the physical removal of an enemy from a decisive point or vice versa.⁹⁷ Functional dislocation causes an enemy’s strength “to be neutralized or inappropriate.”⁹⁸ In the case of all-domain operations, an analogy could be the use of air power to destroy ground-based artillery.

The final means of defeat Leonhard suggests is disruption, which, “is the practice of defeating the enemy by attacking his center of gravity.”⁹⁹ In this context Leonhard would indeed

⁹³ Ibid., 117.

⁹⁴ Robert R. Leonhard, *The Art of Maneuver: Maneuver-Warfare Theory and AirLand Battle*, 62.

⁹⁵ Ibid., 66.

⁹⁶ Ibid., 67.

⁹⁷ Ibid.

⁹⁸ Ibid., 68.

⁹⁹ Ibid., 73.

view the center of gravity as a source of strength. However, like Boyd, Leonhard posits that disruption through maneuver warfare capitalizes on psychology, moral, surprise and fear.¹⁰⁰ Further, “disruption insists that an army is beaten not when its weapons are destroyed or its armor pierced, but rather when its will to continue the struggle is sapped.”¹⁰¹ This conceptualization of disruption and its ability to cause defeat mirrors Boyd’s version of non-cooperative centers of gravity.

Leonhard also wrote theories about future war in *The Principles of War for the Information Age*. After discussing current principles of war and their mutation over time, Leonhard proposes additional principles to add given the changing characteristics of war. At the heart of the new principles is the concept of knowledge and ignorance. Knowledge concerns the information that a combatant has or intends to receive about themselves, the enemy, or the environment.¹⁰² Ignorance is naturally the opposite end of the spectrum, dealing in what is not known. Leonhard suggests that the capabilities of recent years “adjusted the balance (of war) toward knowledge.”¹⁰³ Further, in the event that an army can-not take advantage of the following principles, they become ignorant and resort to mass industrial age warfare.

The first category of principles Leonhard suggests is that of aggression. In this context aggression means what a combatant intends to do to an enemy to accomplish their goals.¹⁰⁴ The means by which aggression is achieved is through dislocation, confrontation, concentration, and distribution. Leonhard already described the principles of positional and functional dislocation, but added moral and temporal dislocation. Moral dislocation causes the strength of an enemy irrelevant due to lack of will, while temporal dislocation renders strength irrelevant through

¹⁰⁰ Ibid., 74.

¹⁰¹ Ibid.

¹⁰² Robert R. Leonhard, *The Principles of War for the Information Age*, 251.

¹⁰³ Ibid.

¹⁰⁴ Ibid., 255.

manipulation of time or attacking an enemy whilst unready.¹⁰⁵ Confrontation, being highly subjective, is to immobilize, delay, and attrit an enemy's strength primarily through symmetrical engagement.¹⁰⁶ In his book *Fighting By Minutes*, Leonhard calls this the protective phase of a fight.¹⁰⁷ Concentration and distribution deal in the allocation of forces in an area. Leonhard reminds the reader that distribution can be defined through physical spatial separation or temporal accordant to velocity and acceleration.¹⁰⁸ A proper balance between concentration, special and temporal distribution leads to success.¹⁰⁹

Leonhard categorizes the next principle as those of interaction. Interaction addresses the interplay between a friendly and enemy force.¹¹⁰ This interplay is spurred by activity and security actions as well as activities through opportunity and reaction. Leonhard posits that activity is defined as all action of an army that advances the commander's plan, however security is an action only to protect the friendly force from enemy activity.¹¹¹ In this context, security does nothing to advance the plan. The effects of activity and security then provide the two conceptualizations of opportunity and reaction. When an army in conflict obtains knowledge, opportunity allows the freedom to act.¹¹² When that army is ignorant, reactive warfare is the norm in an attempt to destroy an enemy's opportunistic actions.¹¹³

The final principle which Leonhard suggests is that of control, or the management of friendly forces. Leonhard views control as a spectrum based upon the amount of knowledge or

¹⁰⁵ Ibid., 256.

¹⁰⁶ Ibid.

¹⁰⁷ Robert R. Leonhard, *Fighting by Minutes: Time and the Art of War*, 2nd ed., 42.

¹⁰⁸ Robert R. Leonhard, *The Principles of War for the Information Age*, 256.

¹⁰⁹ Ibid., 257.

¹¹⁰ Ibid., 258.

¹¹¹ Ibid.

¹¹² Ibid., 258-259.

¹¹³ Ibid.

ignorance in a force. Leonard proposes two methods in which to provide a friendly force purpose and direction. First, option acceleration seeks to delay the decision concerning a desired end state of a conflict, then capitalizes on that flexibility to use combat power to rapidly create battlefield options at a rate which overturn an enemy's plan and reactions.¹¹⁴ The second method is objective. Objective seeks to make an early decision concerning the desired end state of a conflict, then capitalizes on that decision through a rapid and focused campaign.¹¹⁵ Option acceleration and objective both have strengths and weaknesses, but the primary differentiation is flexibility. Leonard suggests that an army with great knowledge can utilize option acceleration, but if an army demonstrates ignorance it must rely on the unifying message that objective provides.¹¹⁶ Further, the principles of command and anarchy also flow along the same spectrum of knowledge and ignorance. Command, or the ability to affect unity of effort through authoritative direction, is much easier and effective when an army is knowledgeable and dangerous when applied with ignorance.¹¹⁷ Likewise, it is possible to experience success through anarchy by the orchestration of disparate elements which integrate their effects, but it must be done with knowledge.¹¹⁸ Ignorance, when applied to either command or anarchy cause a disruption in the control of a force in combat.

Synthesis

Now that there is an understanding of systems and capabilities that factor into the future 25-kilometer lethal area, it is possible to view those discoveries through the lens of the military theory. Synthesizing the learning of potential warfighting methods and capabilities with the ideas

¹¹⁴ Ibid., 259.

¹¹⁵ Ibid.

¹¹⁶ Ibid., 260.

¹¹⁷ Ibid.

¹¹⁸ Ibid., 250.

of Boyd and Leonhard could lead to a new understanding of what it takes to cross the 25-kilometer lethal area.

If it were possible to define all-domain operations, systems confrontation, and ISR-Strike as a category of conflict, would they be indicative of attrition, maneuver, or both? With current capability trends, it is conceivable that the warfighting concepts and their supporting systems of capabilities leverage an ability to switch between attrition and maneuver in time and space (Figure 4). A belligerent could use maneuver conflict, which attacks the mental state of an adversary, should they have great knowledge as Leonhard points out. Each future war concept studied exhibits a necessary task, the obtainment of information with which to become knowledgeable. Belligerents utilize a network of all-domain sensors (TITAN, Strelets) to gather information about their adversary, themselves, and terrain. At the same time, systems of jammers, ASAT missiles, and conventional counter-reconnaissance platforms attempt to create an environment of ambiguity and deception, all of which is focused on a specific part of the 25-kilometer lethal distance. That denial of information would create a novel situation to an enemy combatant, as operating in that cloud of ignorance places them in a reactionary position. Then using mobile platforms, like upgraded Abrams or 2S35 artillery, concentrate their combat power to affect a link or node in the enemy's combat system (intelligence and firepower-strike for instance) which turns them into Boyd's concept of non-cooperative centers of gravity. As the non-cooperative centers of gravity multiply, an adversary's physical, mental, and moral ability to resist fades.

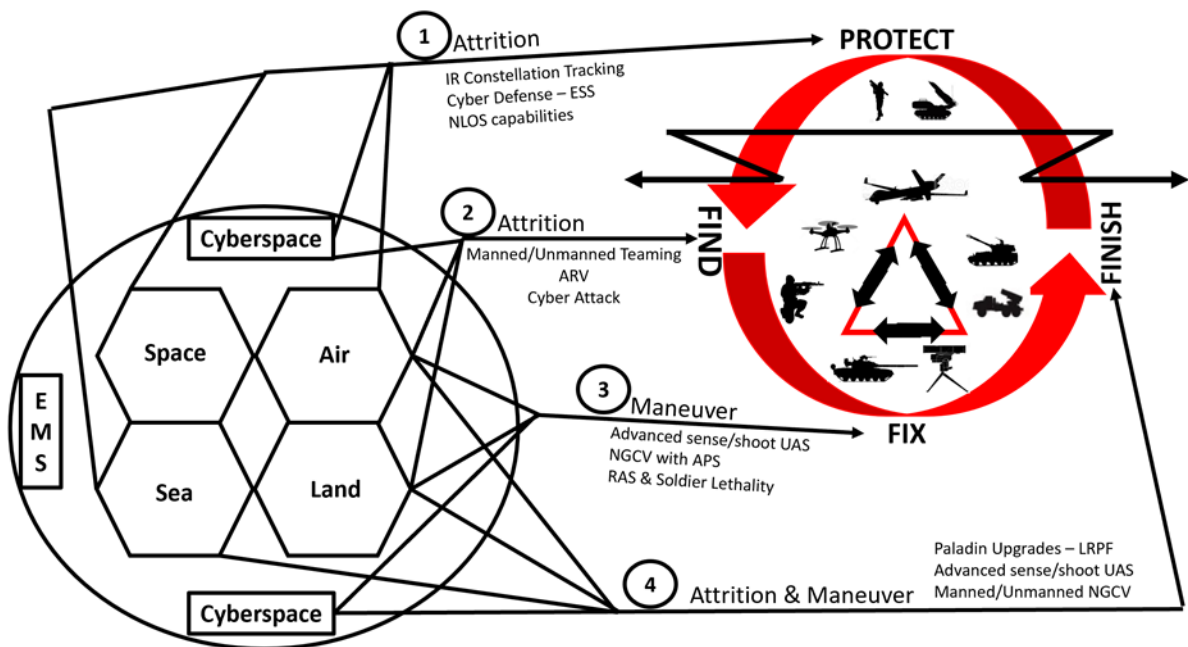


Figure 4. Leveraging Attrition and Maneuver in MDO. Created by author.

The inverse of this situation would be one in which a combatant must operate in that field of ignorance. As information seems to be the common thread between all-domain operations, systems confrontation, and ISR-Strike there would be a desire to return to maneuver conflict as soon as possible. Yet until knowledge is gained, attrition warfare becomes the best possible choice to affect a positive outcome. Unlike wars of the past century, the ability of all-domain sensors to detect forces is seeming persistent and far reaching though the 25-kilometer lethal distance. This implies fighting systems and their capabilities cannot remain hidden indefinitely. Using mobility and multi-functional capabilities, like armed UAVs, a combatant using attrition can protect their forces through spatial distribution while simultaneously exerting destructive power on key enemy capabilities. This precludes the need to close with an adversary. Take, for example, Russian ISR-Strike in relation to their direct fire capabilities. In this context, advanced ATGMs like the Kornet-EM are not used to affect destruction, but keep adversarial maneuver forces at bay until an indirect strike can affect their destruction. As capabilities evolve (APS) an

adversary also adapts their own capability (salvo fire) to account for potential changes that would inhibit their method of war (Figure 5).

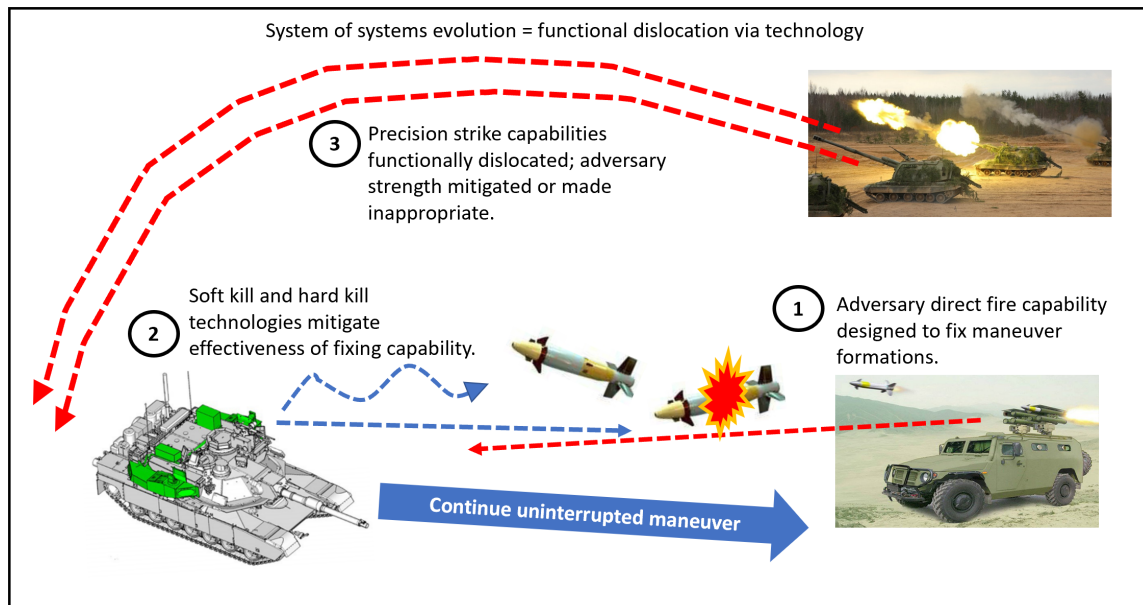


Figure 5. Functional Dislocation via Technology. Created by author.

In support of that suggestion, Leonhard's theories on the possible means of defeat could shed further understanding on the basis of Chinese systems confrontation or Russian ISR-Strike. China's military policy of active defense could classify as a type of broad disruption. Upon observing US actions and the collapse of Iraqi military resistance in the 1991 Gulf War, China conceptualized that command and control of combat forces is a vital center of gravity that must be attacked. Through TCW the Chinese approach this in two different ways. The first is a physical approach in which all-domain reconnaissance and precision weapon systems (sometimes combined into one like Wing Loong or CH-5) enact the physical destruction of command posts or identifiable communications infrastructure. The second approach is virtual in which focused cyberspace and space capabilities, all the way up to ASAT launches, inhibit or destroy the system linkages between maneuver, fires, intelligence, command and control. This could lead one to conclude that China, using active defense and systems confrontation, is relying on attrition over longer periods of time.

Russia's use of ISR-Strike could indicate a level of preemption. The guiding rule of thumb for preemptive action to work in the 25-kilometer lethal area is to avoid direct-fire contact. Russian armed forces use every available sensor throughout each domain to develop a valid picture of extended battlefields. Simultaneously, Russian forces deny an adversary the ability to gain a clear understanding of the close and deep maneuver areas through counter-ISR, ambiguity, and deception, otherwise known as *maskirovka*. Upon identification of concentrating adversary forces, Russia uses mobile direct and indirect strike assets like ATGM equipped vehicles and 2S35 self-propelled artillery to fix and finish those elements. Ideally, Russian forces do not need to enter into a 25-kilometer lethal distance in order to seize an opportunity.

Conversely, the methodology and capabilities behind US all-domain operations through the service branches implies an application of functional dislocation. Setting conditions through a methodical application of various systems and capabilities to reduce an adversary's centers of gravity through time (Figure 6). Ideally, before forces enter into the 25-kilometer lethal area an adversary's strengths are either neutralized or no longer applicable to the tactical or operational situation. Like preemption and disruption, dislocation necessitates a firm and shared understanding of adversary strengths in the 25-kilometer lethal area. During the penetration and dis-integration stages of MDO, Army forces alongside Joint partners utilize deep sensing and strike assets like those of the Paladin upgrades to reduce the potential effects of enemy elements into the 25-kilometer lethal area. Naturally, at some point friendly forces will enter the 25-kilometer area. Capabilities such as counter-reconnaissance ARVs and vehicle protection kits like APS could potentially remove an element of an adversary's warfighting system. In the context of the capabilities mentioned above the elements removed are intelligence/information collection of systems confrontation and the fixing element of ISR-Strike.

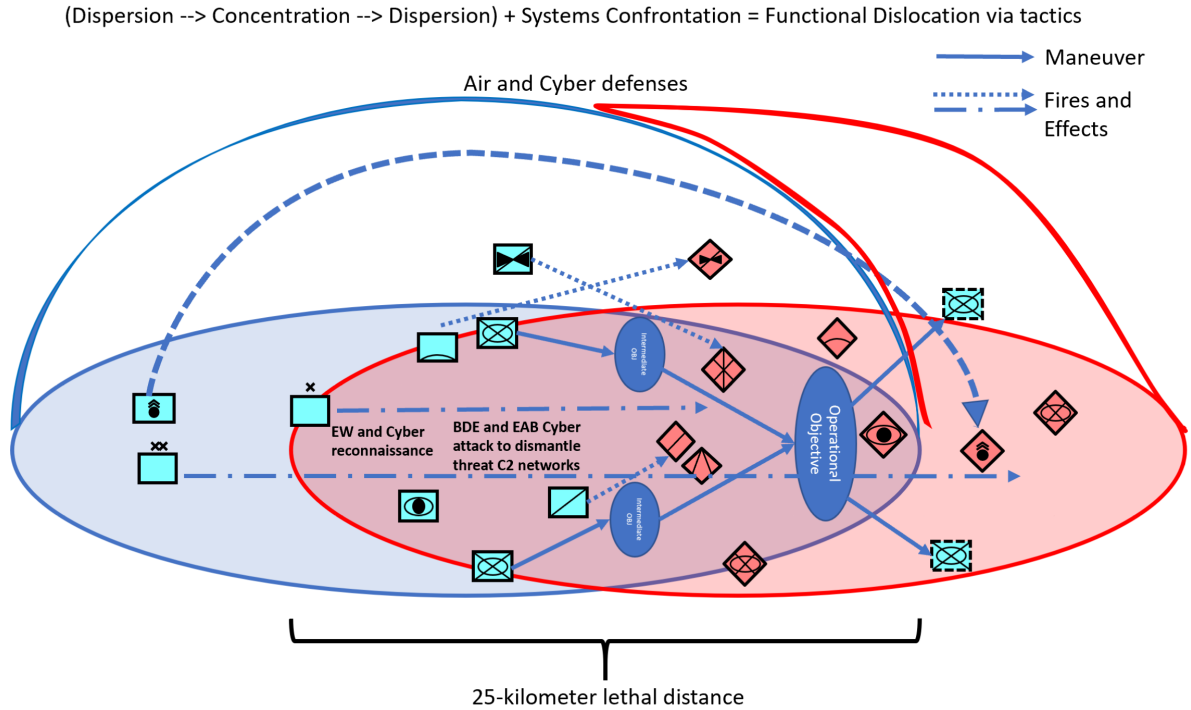


Figure 6. Functional Dislocation via Technology and Tactics. Created by author.

As military forces progress towards 2030, Leonhard’s principles of warfare in the information age could also serve as a guide in crossing the 25-kilometer lethal area. Schemes of maneuver centered around the principle of knowledge and ignorance are decisive to the concepts of future war. The capabilities addressed in the monograph seem focused on collecting information for friendly forces and denying it to an adversary. These capabilities reduce the levels of uncertainty which allow forces to choose the time and place of their engagements. This furthers efforts to apply more aggression and exert activity instead of being reactive.

That aggression and activity sews further ambiguity and novelty in an adversary’s method of war. The orchestrated application of dislocation, confrontation, dispersion, and concentration erode the strengths of an adversarial system and its capabilities (Figure 6). This action could induce a negative feedback loop which continually erodes a combatant’s physical-mental-moral capacities to resist. From an understanding of potential near-term capabilities, this is possible through attrition or maneuver, even a combination of both.

Finally, when military forces apply knowledge/ignorance and aggression into their schemes, they could exert control specifically into a 25-kilometer lethal area. This enables option acceleration in which multiple courses of action could be used to act upon opportunity or react to unforeseen circumstances. Such control also implies an effortless application of fast-transients, as changes in the 25-kilometer lethal area are planned for and even expected.

Now that potential operating environments are explored through theoretical application, it is possible to encapsulate the ideas into recommendations.

Recommendations and Conclusion

Based on presented observations and the creation of new understanding, it is now possible to make recommendations into which actions help Army forces in crossing the 25-kilometer lethal area. Naturally, the recommendations must be feasible, suitable, and acceptable within the next ten years. Also, it is important to remember that time as the basis for technology maturation or military personnel turnover might constrict applicable options. It should be reasonable to assume that there is not a single-factor approach into crossing the 25-kilometer lethal area. In fact, multiple approaches pursued by connected stakeholders increase the chances of viability.

Leader Development and Education

Knowledge is power, especially in the context of information warfare. This requires a certain level of leader broadening. According to ADP 6-22, developing military-technical expertise is the foundation of competence, which in turn serves as a significant basis of professional trust in teams.¹¹⁹ The land domain, especially for the 25-kilometer distance, will serve as a point of convergence not only for US forces, but for those of an adversary as well. It is necessary to send leaders to education opportunities and jobs that are outside of their traditional

¹¹⁹ US Department of the Army, Army Doctrinal Publication (ADP) 6-22, *Army Leadership and the Profession* (Washington DC: Government Publishing Office, July 2019), 1-5.

career path, but still connected to their chosen occupation. Ideally, a leader involved in such broadening gains a more holistic view of distributed battle and increases the knowledge of potential options that could apply to crossing the 25-kilometer lethal distance. For example, there are many positions in the military intelligence community in which combat arms leaders could contribute such as threat analysis. In turn, this increases the knowledge and specialization of adversary systems and ingrains a sense of joint applicability to the officer.

A byproduct of sending more leaders to broadening opportunities outside of their career paths is that they become more adaptable and flexible. Adaptability for a team is having a variety of skills within that team and knowing when or how to use them.¹²⁰ Adversaries use all-domain capabilities on Army forces to create ambiguity. That level of uncertainty creates paralysis and fixes elements inside a 25-kilometer lethal area. To mitigate the chance of paralysis, leaders at the junior level must be taught to experiment and accept risk to gain opportunity. Most leaders today understand risk from the perspective of hazards, this thinking must change. FM 6-22 states the need to create a culture where there is freedom to fail.¹²¹ Yet as units prepare to deploy to combat training centers or rotational employment, the leadership that would actually cross a 25-kilometer lethal area are certified through a pass/fail standard in which risk taking for potential gain is shunned or even punished. During these train-ups and certifications, leaders at all levels should be allowed to wrestle with undefined problems without fear of job loss. The application of new measures of performance could allow units the time and maneuver space to enable experimental failure and eventual long-term success.

Doctrine

Considerations for all-domain concepts and estimated threat or friendly capabilities must be incorporated into current doctrine as soon as possible. This builds familiarity and specificity

¹²⁰ Ibid., 5-7.

¹²¹ US Department of the Army, Army Field Manual (FM) 6-22, *Leader Development* (Washington DC: Government Publishing Office, June 2015), 5-8.

with current trends, which translate into how units train. For example, FM 3-90-1 provides guidance for the warfighting functions in the offense. Nowhere in the text do the considerations identify the nature of a constantly observed 25-kilometer lethal area through the domains. Additionally, considerations for all warfighting functions would need adjustment to reflect the nature of actions during the exploitation phase of MDO. All battlefield functions must understand and emulate the dispersion, concentration for attack, then immediate dispersion after actions on objective. This is general guidance that units can take out to the field and practice with now.

As a doctrinal extension of training, the Combined Arms Task List (CATS) is often used as an evaluative tool for training. CATS should reflect changes in the operational environment and capability capacity. Certain tasks like 'React to Direct Fire' or 'React to Indirect Fire' might not reflect the nature of advanced precision munitions. For example, take long range ATGMs and APS. As such a task or sub-task that includes 'React to Guided Weapons Fire' could account for the stand-off long range direct weapons provide or actions to take should the APS engage an incoming munition. This is only one example and working groups could potentially establish more task for more units should they be provided the contextual information to do so.

Material

The ever-evolving operational environment is often reflected through the capability developments of friendly forces and competitors. As such CFT efforts should continually consider material capabilities which are cross-domain, cross-functional, and modular in nature. Cross-domain and cross-functional capabilities like armed UAVs cut down on the lag time between the identification of critical targets and their neutralization. In addition, the condensed time frame also reduces the risk of becoming decisively engaged. Continuing to promote manned and un-manned teaming should continue. It allows multiple task options to the forces that are tasked to cross the 25-kilometer lethal distance. Take the ARV for instance. If there were a modality for the vehicle to conduct autonomous sentry missions, it could serve as a reconnaissance node while their dismounted soldiers could actively conduct counter-

reconnaissance roles. Additionally, real-time command and control software connected into the combat platforms of movement and maneuver could assist removing uncertainty from the battlefield. A potential application of this would be the integration of mission command software with combat platform optics. This could provide formations the level of knowledge needed to exploit opportunities in real time.

Modularity enables the adaptability of material platforms over time. A good example of this are the APS implementations onto combat vehicles. Eventually, the system should account for both hard-kill and soft-kill technology. The APS would then be able to defeat a multitude of different incoming munitions simultaneously. This singular effect of capability adaptation, could disrupt a recon-strike execution by allowing friendly capabilities continued freedom of maneuver in the face of fixing effects. Protection via air defense should also expand to the lowest echelons. Competitor's capacity to field large and small UAVs highlights the need to innovate material capabilities that can offset each type of threat. The adaptability to intercept each size of target further inhibits an adversary's ability to collect information in which to act upon. Further, expanding the capabilities of units like the 915th Cyber Warfare Battalion into the lowest maneuver elements enable friendly forces to attack, disrupt, and mitigate an adversary's network-enabled operating system.

To cross the lethal distance of future battlefields, Army forces must design and orchestrate their all-domain system capabilities to functionally dislocate adversarial system strengths. To validate this claim, the monograph provided an understanding of competitor methods and capabilities into why the 25-kilometer lethal distance is indeed lethal. Further, discovery learning into what US all-domain methods and capabilities already exist deepened an understanding of potential operating environments. With the help of theoretical application, the monograph articulated the nature of future operating concepts and their supporting capabilities. Its evaluation creates a new understanding of what systems of capabilities are designed to do, and their potential effect on the 25-kilometer lethal area.

This monograph is only a snapshot in time of what it might take to dislocate an adversary's strengths from the 25-kilometer lethal area. Continued further study is necessary to continually update the assumptions behind the understanding of all-domain operations in the close and deep maneuver areas. The recommendations and options provided are only surface level and would need further research to make applicable. For instance, given force billet constraints, what is the best methodology to enable leader broadening? How prescriptive does future doctrine need to be now that battlefields are becoming more complex, using specialized cross-domain capabilities? Which level of autonomous or semi-autonomous technology works best to enable cross-domain and cross-functional capability application? These are just a few of the questions that could provide further clarification on the fluid requirements for crossing the 25-kilometer lethal distance. Ultimately, a force which can best understand the various methods and capabilities of all-domain systems through theoretical comparison sets itself in a favorable position to adapt to the ever-changing climate of war.

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