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Closer Than You Think: The Implications of the Third Offset Strategy for the U.S. Army

Samuel R. White

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FOREWORD

The U.S. Department of Defense (DoD) is moving forward with a broad set of innovation initiatives designed to effectively posture the U.S. military for the coming decades. One sub-set of initiatives, the Third Offset, is focused on leap-ahead technologies and capabilities that may offset competitor parity in critical domains.

In support of the Army's examination of the Third Offset, the U.S. Army War College conducted a 6-month project employing faculty and student researchers to study the potential impact of the DoD's Third Offset Strategy on the Army. The study team examined the Third Offset Strategy from a strategic perspective. Ultimately, the study is designed to help the Army understand the influence of the Third Offset capabilities on the character of warfare and the implications of these capabilities for the Army and Landpower. This understanding may then help inform decisions in research and development, as well as leader development, training, and organizations.

According to the study team, the development of hyper-advanced capabilities and technologies will have implications for the Army in the institutional, leader development, and moral or ethical spaces, and the study team urges the Army to begin preparing now to meet the challenges. The study team's consistent finding throughout their work is the inevitability of advanced Third Offset capabilities, particularly in the areas of artificial intelligence (AI) and autonomous systems. The team contends that the potential for enormous profits will drive industry to push the envelope in these areas. Eventually, these advanced (civilian) technologies will find their way into the military space as game-changing systems. The team warns that adversaries are less constrained than the United States is in the militarization of AI and autonomous systems and are aggressively pursuing these capabilities. They predict that the advantage of being first is significant and potentially disruptive.

This study will prove useful in helping the Army identify and understand the implications of breakthrough innovations in future military operations. It provides insights and recommendations that go beyond the technology and capture the second and third order effects on many Army systems. The researchers' assertion that a change in the fundamental character of warfare could be an outcome only adds urgency to the importance of this work.

DOUGLAS C. LOVELACE, JR.
Director
Strategic Studies Institute and
U.S. Army War College Press

SUMMARY

Samuel R. White, Jr.
Editor

"I believe we are on the cusp of a fundamental change in the character of war."

—General Mark Milley,
Chief of Staff of the U.S. Army, October 1, 2016.

The Defense Innovation Initiative (DII), begun in November 2014 by former Secretary of Defense Chuck Hagel, is intended to ensure U.S. military superiority throughout the 21st century. The DII seeks broad-based innovation across the spectrum of concepts, research and development, capabilities, leader development, wargaming, and business practices. An essential component of the DII is the Third Offset Strategy—a plan for overcoming (offsetting) adversary parity or advantage, reduced military force structure, and declining technological superiority in an era of great power competition.

The Third Offset Strategy is in the beginning phases of development. The Department of Defense (DoD) will embark on a multi-year effort to assess the technologies and systems that should undergo research and development. To date, investment has been modest, but will likely increase over the next 4 years. The majority of effort will be grouped into six broad portfolios:

1. Anti-access and area denial;
2. Guided munitions;
3. Undersea warfare;
4. Cyber and electronic warfare;
5. Human-machine teaming; and,
6. Wargaming and concepts development.

The Third Offset Strategy is still being formed—at this point, it is more concept than strategy—but the ends, ways, and means will soon begin to crystalize.

It is important for the Army to study what the Third Offset Strategy means for Landpower and the land domain. Ground warfare has unique operating conditions; the breakthrough capabilities needed for the Army may likely differ from those required by the Navy or Air Force. The Army, therefore, should help shape the Third Offset Strategy to ensure it accommodates the needs of land forces. In particular, it must identify the implications of the breakthrough capabilities on Landpower.

This study explored the implications of innovations and breakthrough capabilities for the operating environment of 2035-2050. It focused less on debating the merits or feasibility of individual technologies and more on understanding the implications—the second and third order effects on the Army that must be anticipated ahead of the breakthrough. Four broad implication areas were chosen for study, not because they were exclusive to the Third Offset, but because accounting for them requires a long-term enterprise effort. The four areas are:

1. Implications for Army and Joint Capabilities;

The Research Team

This study was prepared by students and faculty from the U.S. Army War College's (USAWC) Future Seminar—a program loosely based on the Army After Next study project of the 1990s. Since 2014, Future Seminar students and faculty have collaborated to explore the Army of the Future. As with previous years, the seminar focused on the requirements for an Army of the future. They studied, debated, researched, and wrote.

In addition to this report on the Third Offset, a compendium of their other papers will be published to add to the discussion on the question, "What kind of Army does the nation need in 2035 and beyond?"

2. Implications for Army Institutions;
3. Implications for Army Leader Development; and,
4. Implications for Moral and Ethical Decision-Making.

A SUMMARY OF THE RESEARCH OBSERVATIONS

The Military Exploitation of Artificial Intelligence (AI) and Autonomous Systems Is Inevitable

Commercial development of highly advanced technologies is already well underway. IBM's Watson, Google's Deepmind and Google Brain, and the Facebook AI Research Project are a few of the leaders in the intensely competitive space of machine or deep learning. Even the Commonwealth of Virginia has established an Autonomous Systems Center of Excellence (CoE) in Herndon.

As with past seismic shifts in the commercial space (e.g., industrialization, motorization, the information age) the competition is so severe because these are likely to be what Clayton Christensen terms disruptive innovations—ideas and technologies that disrupt current markets and displace current market leaders. The potential rewards are staggering and billions (trillions?) are at stake.

These new technologies will follow a logical progression to military applications. There is a natural symbiosis between military and civilian innovation that, in the end, is driven by a need to solve problems and gain advantage. The challenges and realities of big data, complex networks and systems, uncertain environments, ubiquitous technology, and intense peer competition are drivers in both the commercial and military spaces and steer each toward a common set of solutions. The separation between self-driving automobiles and autonomous military air and ground systems is thin—and will grow thinner as deep and machine learning increasingly blur the separation between civilian or military applications. Once advanced AI is achieved, it will quickly spiral into almost every area of the commercial, governmental, and military domains.

Early Adoption of Third Offset Capabilities Is Critical Because Potential Adversaries Will Develop and Field Capabilities without Constraint

The allure of science fiction-like capabilities will be a strong incentive for states and nonstates to pursue Third Offset technologies. These leap-ahead capabilities could be so game changing that the difference between finishing first and finishing next could mean years of decisive advantage in every meaningful area of warfare.

The United States is rightfully concerned about the implications of many of the Third Offset technologies—but current policies and priorities are not reflective of the rapidly evolving technologies or the operational environment. As a result, the United States risks falling dangerously behind potential adversaries who are investing heavily in advanced technologies—and are doing so without self-imposed constraints which limit capabilities and fail to allow full exploitation of these technologies.

The DoD Directive 3000.09, *Autonomy in Weapons Systems*, establishes requirements and parameters for development and use of autonomous weapons systems (AWS). In short, Directive 3000.09 seeks to minimize the risk of unintended lethal engagements by requiring positive human interface for all semi-autonomous and AWS, and prohibiting autonomous lethal force against human targets. While this caution is understandable, the policy is out of step with the evolving battlefield.

Placing a "human in the loop" requirement on the development and employment of future weapons systems may inadvertently induce vulnerability into the system. Swarm technology has already exceeded the capability for any meaningful human control of individual agents and, as the technologies advance, swarms of tens or hundreds of thousands of individual agents will make human control—or even human understanding—of the actions and behaviors of the swarms impossible. In the future vague and uncertain environment, the decision to engage or not engage—to kill or not kill—may not be best made by a human.

It is important that the U.S. Army deliberately develop and embark on a campaign to develop and exploit Third Offset capabilities. The battlefield of the next 30 years will likely evolve far differently (and much faster) than over the past 30 years. The legacy "big five" combat systems, even with version improvements and upgrades, may well be rendered outmatched and ineffective by AI-enabled unmanned autonomous systems, cyber dominance, and swarms. Continued incremental upgrades to current systems may address current readiness challenges, but could leave the Army ill-prepared to contend on a far different battlefield in the future.

Significant Acquisition, Budget, and Cultural Inertia Exists Which Could Impact the Army's Ability to Gain Advantages with Third Offset Technologies

Erosion of U.S. military superiority will continue if the DoD does not think critically and creatively about the modernization challenges faced today and the operational challenges to be confronted in the future. This requires leaders to focus on limiting constraints to innovation and providing a vision of the future force and a path for developing the optimal future force. The Army operating concepts of 2035-2050 must be informed by Third Offset capabilities and not tied to current organizations, doctrine, or weapons systems. Facing tomorrow's threats with today's thinking and systems will not be successful.

The Army (and the DoD) currently takes a risk adverse approach to acquisition and requirements—waiting for technologies to mature before prototyping and experimentation. In order for the U.S. Army to become an innovative organization, it must promote an innovative culture, accept risk, and leverage new ideas, while collaborating and partnering on experiments to enhance creativity. The Army must be an early adopter of potentially disruptive technologies and embrace incremental integration of technologies as they mature.

The Army should exercise honest intellectual rigor in envisioning and developing the future force. The Training and Doctrine Command's (TRADOC) *Force 2025 and Beyond* maneuvers are a sound roadmap and process, but caution must be given to avoid describing the future force by solving today's problems with today's forces—equipped with tomorrow's technology. This thinking will lead us to search for a better howitzer or tank, rather than ask the questions, “What is better than a howitzer?” or “Do we still need tanks?”

Leader Development for a Third Offset Environment Must Begin Now

The current Army Leadership Requirements Model addresses leader development focused on human-human relationships, but the future will challenge leaders with more human-machine relationships. The Army should adapt leader and team development strategies, underpinned by mission command philosophy (centered on trust), leadership attributes (character, presence, intellect), and core leadership competencies (leads, develops, achieves), to enable our leaders to aptly trust and lead organizations increasingly comprised of human and AI.

Highlighting agile and adaptive leaders and mission command philosophy only superficially addresses the emerging leadership skills required to lead human-machine collaboration. Deeply embedded attributes need a distinct, deliberate approach beginning with developing a leader’s propensity to trust and methods to influence and train autonomous systems. The Army has an opportunity to increase its competitive advantage over adversaries by acting now to develop leaders who are skilled at maximizing the best of humans and machines.

The Moral Considerations of Third Offset Capabilities Should be Addressed Before the Technology Matures

Moral conflict will always be a part of war because acceptable conduct in war will always conflict with norms accepted in civilian life. This conflict creates a moral dissonance that can overwhelm a soldier's sense of right and wrong, good and bad, and can cause moral and psychological injury.

Third Offset capabilities increasingly remove the soldier from the conflict—introducing a video game-like effect into ethical decision-making that often leads to moral disengagement. These game ethics override personal or organizational ethics because the technology removes the human-to-human contact necessary to form a proper moral framework. Conflict and the use of force (killing) become dehumanized and, once the soldier has the opportunity for moral reflection, the potential for moral injury is significant.

Widespread military use of AI-enabled decision support and weapons systems is inevitable. The Army must begin to mitigate the potential harmful impacts of these technologies now. The Army should provide training at all levels that reinforces ethical standards in light of an increasingly virtualized battlefield. Operators of unmanned and semi-autonomous systems must understand how the AI processes moral dilemmas, the potential ethical shortcomings of these decisions, and how to ensure ethical decisions are made. The Army should educate leaders in the responsible employment of unmanned and AI systems, particularly in the method the systems use to integrate ethical principles into the decision-making process.

The Third Offset May Create Unintended Risks by Lowering Risk Thresholds, Subsidizing Foreign Modernization Efforts, and Increasing the Risk of Nuclear War

The Third Offset technologies increase the effectiveness of weapons and, as a byproduct, remove the human warfighters from the battlefield, or limit their exposure to direct action. By distancing the human from conflict, the technology lowers not only the costs and risks associated with war, but the political bar to initiating hostilities as well. As a result, the deterrent quality desired in the Third Offset could actually increase the likelihood that the United States would use force and ultimately decrease global stability.

The DoD is openly soliciting and urging commercial entities to work on technologies that will be used to offset the capabilities of U.S. military competitors. This unconcealed approach, which is markedly different from previous offsets, raises the likelihood that American investments in defense modernization will inadvertently subsidize similar foreign efforts through espionage and foreign exploitation of U.S. technological designs. The openness of the Third Offset could fuel the proliferation of these technologies and provide paths leading to intellectual property loss and corruption of the technology.

Conversely, it would be unwise to assume that a U.S. decision to pursue a third technological offset will necessarily induce all adversaries to pursue in kind. Faced with the near impossible costs of attempting to keep pace in a Third Offset capabilities-race, many actors will have an incentive to pursue a more affordable and credible deterrent to U.S. multi-domain superiority. Coupled with the increasing availability of fissile material, proliferation of nuclear expertise and infrastructure, and modern technologies, it is likely that the next 20 years will bring about an expansion of nuclear powers and global nuclear arsenals. The United States must pursue Third Offset capabilities with the understanding that our actions will drive and incentivize continued proliferation of nuclear weapons.

CONCLUSION

Posturing the Army to dominate in 2035 and beyond will require broad and innovative thinking. The Army should continue to broaden its thinking about the character of the future force. Simply projecting a variant of the current force into the future and outfitting it with new equipment is not intellectually rigorous enough to fully explore how the future force must operate—nor will it ensure the future force is prepared for the challenges of the future operational environment.

If the traditional notions of superiority and supremacy in the physical domains have changed, then new attributes must be described for the future force because how it operates must change as well. Legacy attributes of the Army such as flexibility, mobility, and expeditionary skills may be replaced by new attributes such as predictive, continuously learning, unknowable, decentralized, and compelling. This new set of attributes will be enabled by Third Offset capabilities.

The implications of the Third Offset for the Army should not be dismissed. These technologies have the potential to change the character of conflict and they require deliberateness. They are coming, and in many cases are already here—it is inevitable. How the Army approaches the Third Offset over the upcoming few years will set the stage for the next 30 years.

PART I:
THE THIRD OFFSET

CHAPTER 1

THE FUTURE OPERATING ENVIRONMENT AND THE THIRD OFFSET

Adam J. Boyd
Michael Kimball
Researchers

> No one gains competitive advantage from letting technology lead strategic visioning. This is the short road to parity.[1]

Describing the future environment is an inexact and imprecise science—a fool's errand to many. As the Danish politician Karl Kristian Steincke wrote, "It's tough to make predictions, especially about the future."[2] Closer to home, U.S. Army Military History Institute Director Dr. Conrad Crane asserts that the maximum effective range of a future prediction is 20 years or less.[3] It is highly likely that we will get it wrong and fail to adequately mitigate risk, because it is tempting to paint the future environment as simply an enhanced version of today with more variables; such as greater population, more inter-connectedness, more urbanization, and greater stressors. The strategic environment is often described as volatile, uncertain, complex, and ambiguous (VUCA).[4] In the near to mid-term future, certainly the strategic environment will be more volatile, uncertain, complex, and ambiguous. We will be more connected than we are now, causing news and events to propagate at an even faster rate. The abundance of information will significantly increase complexity and ambiguity, which will likely result in a lack of focus in both decision-making and prediction.

The U.S. Army Training and Doctrine Command (TRADOC) Intelligence Staff Section (G2) compiled data from a variety of sources, both civilian and military, to develop a possible future operational environment. In this view, all domains are widely contested by a diverse array of adversaries that appear suddenly and employ peer or near-peer capabilities—though sometimes only in narrowly focused areas.

> The future operational environment will be characterized by a high potential for instability driven by the diffusion of power and technologies among rising regional states, non-state actors, and increasingly empowered individuals. Threats, including traditional militaries, irregular forces, criminal enterprises, groups employing terrorist tactics, and empowered individuals will employ hybrid strategies. These strategies will combine technology, diverse organizations, improvised weapons, and weapons of mass destruction to deny the initiative to the U.S. military, increasingly contesting the U.S. in the air, land, sea, space, and cyberspace domains.[5]

The operational environment of 2035 and beyond will include faster, cheaper, and ubiquitous advanced technologies that shape geography, affect global populations, and enhance the strategic reach of state and nonstate actors. This increase of globalization and interconnectedness will drastically change the strategic landscape and challenge accepted norms. The future environment, conflict, and warfare itself will be shaped by factors that roughly follow six trend lines: speed of human interaction, demographics and urbanization, economic disparity, resource competition, science and technology, and strategic posture.[6]

The global effects of climate change can be interpolated by analyzing the effects of climate change on the continent of Africa; it is the canary in the coalmine. The Africa Center for Strategic Studies notes:

> Rising sea levels are expected to inundate coastal cities including Cape Town, Maputo, and Dar es Salaam. By 2030, Tanzania's coastal areas could lose more than 7,600 km^2 of land, and 1.6 million people will experience annual flooding.[7]

The warming seas are also triggering a decline in fish populations, such that by 2050 fish catches along the West African coast are likely to drop a staggering 50 percent from 2016. A 30-year drought in the Sahel, the worst drought in 50 years in Southern Africa, and the loss of 82 percent of the Mt. Kilimanjaro icecap have already caused famine and regional migration across the entirety of the continent.[8]

Climate change will present already strained states and systems with further sources of friction from which they might not recover. Migration and competition for very scarce resources will exacerbate border conflict and cause tremendous social and cultural upheaval. Humanitarian disasters may well become the norm and governments and civil institutions (even those traditionally considered to be strong and stable) will be under unrelenting pressure to provide basic services or risk massive civil unrest—or worse.

Global population will significantly increase over the coming decades—some estimate as high as 9 billion by 2035—an increase of 25 percent in less than 20 years.[9] This explosion will further strain already scarce resources thus amplifying friction between the haves and have-nots. An increasing percentage of the population will migrate to urban areas, which will cause a staggering expansion of current metropolitan complexes. Demographic shifts are likely as diverse populations and communities are drawn to urban areas because the combination of environmental changes and the commercialization along with automation in agriculture have reduced rural opportunities. This demographic melting pot, coupled with the near-instantaneous interaction enabled by the internet and social media, will amplify and accelerate interaction and conflict between peoples, governments, militaries, and threats.[10]

In his most recent book, *Physics of the Future*, physicist, scientist, and predictor Michio Kaku uses the fundamental laws of nature as a filter and then predicts the future using current technology or prototypes that are being used today. Kaku then extrapolates to predict the future environment in the near future (present-2030), mid-century (2030-2070), and far future (2070-2100).[11]

Some examples of near future technology include: eyeglasses that will connect to the internet, even contact lenses that might do the same; advances in gene mapping, and the use of handheld medical scanning devices; and the emergence of new energy-based economies, through solar or hydrogen energy. Mid-century examples range from “shape shifting” (using Nano technology to change the shape of organic and inorganic materials), the use of fusion power to overcome global warming trends, and possibly even a manned mission to Mars in an effort to begin terraforming that planet.[12]

New technologies have the potential for revolutionary impact on warfighting, enhancing situational understanding, increasing lethality and reducing (or radically changing) logistics and support requirements. Many meaningful technologies will be commercially available making it possible for potential adversaries to gain peer-level capabilities at a fraction of the developmental cost and time required. Though many will be unable to achieve parity across all domains and technology sectors, they likely will be able to surge and become hyper-capable in a focused area(s) that provide high impact capabilities in their particular environment and operations—such as offensive cyber, cheap swarms of autonomous lethal agents (vehicles/craft), or sophisticated biological or genomic agents. Given that the future environment will likely highlight pressured U.S. defense budgets, our adversaries' easier access to a range of technologies will complicate the Army's concept of overmatch when developing the future force.

Former Secretary of Defense Chuck Hagel introduced the Defense Innovation Initiative (DII) at the Reagan National Defense Forum in 2014. He offered the expectation that the initiative would eventually "develop into a game-changing third 'offset' strategy."[13] Specifically, Secretary Hagel indicated that the initiative would maintain U.S. military dominance by sustaining its competitive edge in power projection capabilities, balancing technological innovation with fiscal reality. Simultaneous with developing new technologies, the military would develop new operational concepts and new approaches to warfighting to capitalize on these technologies.[14] Once realized, the DII would set the conditions to facilitate a strategy in total, the Third Offset Strategy, focused on deterrence.

The First Offset Strategy began as President Eisenhower's New Look Strategy in 1953, when the number of Soviet divisions outnumbered the U.S. divisions 175 to 92.[15] This First Offset capitalized on the technological advances in the U.S. nuclear arsenal to offset the Soviet conventional overmatch, allowing the United States to reduce its conventional military size and footprint.[16]

The strategy of nuclear capability and deterrence continued throughout the Cold War, but began to wane in the late 1970s.

> As Soviet capabilities in both areas increased through the late 1960s and 1970s, Soviet leaders seemingly had two advantages to the West's sole nuclear threat, their own nuclear forces and the massive red Army.[17]

The Soviet Union reached nuclear parity, and the United States realized that it lacked a sufficient, non-nuclear conventional capability. As a result, U.S. defense planners began a large conventional-force modernization program in the late 1970s and early 1980s. In support, the Carter administration fashioned a strategy to place greater emphasis on conventional defense capabilities.[18]

The Second Offset Strategy was originally conceived in 1977 by then Secretary of Defense Harold Brown, as well as Andrew Marshall and William J. Perry.[19] Secretary Brown and his team looked to improve U.S. military capabilities through the careful combination of technology and the right systems. William Perry stated that there was:

> the false assumption that [the strategy's] primary objective was to use "high technology" to build better weapon systems than those of the Soviet Union. . . . The offset strategy was based instead on the premise that it was necessary to give these weapons a significant competitive advantage over their opposing counterparts by supporting them on the battlefield with newly developed equipment that multiplied their combat effectiveness.[20]

In other words, the Second Offset Strategy was based on the premise that the combination of technologies provided the strategic benefit, rather than each technology individually.

This combination of how the technologies could best be used together would eventually be known as the AirLand Battle doctrine, demonstrated to great effect in 1991 during Operation Desert Storm. In fact, the U.S.-led coalition success in Desert Storm served as its own form of conventional deterrence, displaying the capability and effectiveness of the U.S. military to other world adversaries.

The Vice Chairman of the Joint Chiefs of Staff, Air Force General Paul J. Selva offered a more pragmatic description of the Second Offset Strategy in his comments during the March 2016 Defense Programs Conference. General Selva suggested that the Second Offset was really about trading firepower for precision.[21] More specifically, General Selva stated that during the escalation of the First Offset, the Russians focused on building a nuclear capability centered on numbers of missiles, thereby having mass in firepower. The United States realized that it could not keep pace with the Russians in terms of building warheads and turned to developing precision in targeting. Coupled with a robust command and control (C2) architecture, the precision capabilities of the U.S. military, offset the sheer numbers of the Russians.

In describing the Third Offset, General Selva has reflected that we have been reliant on the benefits of the doctrine of the Second Offset for the better part of almost 30 years, and that it is time for us to expend some due diligence on building something for the future.[22] General Selva suggests that we must innovate in technologies, as well as the integration of the technologies into operations, formations, and even doctrine, in order to truly create a Third Offset Strategy.

The objectives of the Third Offset Strategy are anchored in a single, core objective: deterrence. According to Deputy Secretary of Defense Robert Work, the focus of the Third Offset Strategy is deterrence directed at the two primary, near-peer adversaries of the United States—Russia and China.[23] In a discussion of the Third Offset, Deputy Secretary Work highlighted five initial vectors which direct research and development:

- Autonomous Learning Systems
- Human-Machine Collaborative Decision-Making
- Assisted Human Operations
- Advanced Manned-Unmanned System Operations
- Network-Enabled, Cyber and EW Hardened, Autonomous Weapons And High-Speed Weapons[24]

Each of these technologies has the potential for significant impacts. However, as the United States develops new capabilities, its adversaries are trying to keep pace. Given the continually shortened development timelines, any technological advantages (never mind overmatch) will likely be short-lived. In some cases, adversary capabilities may already outmatch U.S. capabilities and an increase in U.S. capability may only achieve parity. In order to effectively realize the value of offset technological overmatch, it will be important for the Army's Multi-Domain Battle concept to be informed by Third Offset possibilities so that the technology is nested with a concept; it will not suffice to simply develop the new technologies as capabilities.

ENDNOTES - CHAPTER 1

1. John G. Singer, "What Strategy is Not," *MIT Sloan Management Review*, Vol. 49, No. 2, Winter 2008, available from *https://search.proquest.com/docview/224967850?accountid=4444*, accessed March 24, 2017, p. 96.

2. Karl Kristian Steincke, *Farvel Og Tak* (*Goodbye and Thanks*), Volume 4, Copenhagen, Denmark: Fremad, 1948, p. 227.

3. Conrad Crane, "Note to Futurists: The Maximum Effective Range of a Prediction is 20 Years," War on the Rocks, October 3, 2016, available from *https://warontherocks.com/2016/10/note-to-futurists-dont-get-more-than-20-years-ahead/*, accessed February 3, 2017.

4. Murf Clark, "The Strategic Leadership Environment," in Stephen J. Gerras, ed., *Strategic Leadership Primer*, 3rd Ed., Carlisle PA: Department of Command, Leadership and Management, U.S. Army War College, 2010, p. 11.

5. Jerry Leverich, "The Future Operational Environment," information paper for U.S. Army, Training and Doctrine Command (TRADOC) G2, Fort Eustis, VA, November 25, 2016.

6. Thomas Pappas, "Future Operational Environment & Threats: The World in 2030 and Beyond," lecture to Futures Working Group, U.S. Army War College, Carlisle Barracks, PA, January 20, 2017.

7. See the infographic, Africa Center for Strategic Studies, "Selected Effects of Climate Change on Africa," November 17, 2016, available from *http://africacenter.org/spotlight/selected-effects-climate-change-africa/*, accessed July 31, 2017.

8. Ibid.

9. U.S. Joint Chiefs of Staff, *Joint Operational Environment 2035: The Joint Force in a Contested and Disordered World*, Washington, DC: U.S. Department of Defense, July 14, 2016, p. 10.

10. U.S. Army TRADOC, *The U.S. Army Operating Concept: Win in A Complex World*, TRADOC Pamphlet 525-3-1, Fort

Eustis, VA: U.S. Training and Doctrine Command, October 31, 2014, p. 11.

11. Ibid., pp. 27, 42, 58.

12. Ibid., pp. 226-227, 313.

13. Secretary Chuck Hagel, "A Game-Changing Third Offset Strategy," War on the Rocks, November 17, 2014, *https://warontherocks.com/2014/11/a-game-changing-third-offset-strategy/*, accessed February 10, 2017.

14. Ibid.

15. Bob Work, "The Third U.S. Offset Strategy and its Implications for Partners and Allies," speech, Willard Hotel, Washington, DC, January 28, 2015, available from *https://www.defense.gov/News/Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies*, accessed February 13, 2017.

16. Ibid.

17. Robert R. Tomes, *US Defence Strategy from Vietnam to Operation Iraqi Freedom: Military innovation and the new American way of war, 1973-2003*, New York: Rutledge, 2007, p. 44.

18. Ibid., p. 57.

19. William A. Owens and Edward Offley, *Lifting the Fog of War*, New York: Farrar, Straus and Giroux, 2000, p. 81.

20. Ibid., p. 82.

21. General Paul J. Selva, "FY2017 Defense Programs Conference," Washington, DC, March 10, 2016, video file, in, Amaani Lyle, "Vice Chairman Discusses Defense Deterrence Strategy," *DoD News*, March 10, 2016, available from *https://www.defense.gov/News/Article/Article/692212/vice-chairman-discuses-defense-deterrence-strategy*, accessed January 10, 2017.

22. Ibid.

23. Ibid.

24. Department of Defense, "Third Offset Strategy Overview," slide presented by Deputy Secretary of Defense Robert Work, "Assessing the Third Offset Strategy: Progress and Prospects for Defense Innovation," October 28, 2016, Center for Strategic & International Studies Headquarters, Washington DC, "Part I: Defining the Offset Strategy," video file, at 13:34, available from *https://www.csis.org/events/assessing-third-offset-strategy*, accessed February 27, 2017.

CHAPTER 2

THE URGENCY OF THE THIRD OFFSET

Samuel R. White, Jr.

> We live in a dynamic world, an era of contradictory trends shaped by two great forces, one strategic, the other technical—the advent of the Information Age. The scale and pace of recent change have made traditional means of defining future military operations inadequate. Change will continue, requiring our Army to recognize it as the only real constant.[1]

Twenty-three years ago, the authors of Training and Doctrine Command (TRADOC) Pamphlet 525-2 visualized the operational environment of the first quarter of the 21st century. Even with the information age in its infancy, there was a premonition that something big was on the horizon. Technological innovations, they said, "will revolutionize—and indeed have begun to revolutionize—how nations, organizations, and people interact."[2] "Information technology," they continued, "is expected to make a thousandfold advance over the next 20 years [1995-2015]."[3] The implications to military operations would be both evolutionary and revolutionary. Surprisingly, the authors may have undershot the mark.

Futurist, author, and computer scientist Ray Kurzweil estimates that between 2000 and 2007, technology advanced 1 million times – and predicts by his "Law of Accelerating Returns" it will advance a billion times over the next 30 years.[4] Advances will occur exponentially faster as time passes. Progress is accelerating. During the 21st century, Kurzweil theorizes that we will experience 20,000 years of progress in only 100 years (based upon innovation rates of the past). Kurzweil predicts that by 2020, $1,000 will buy a computer capable of 10 quadrillion calculations per second—roughly equivalent to the power of a human brain. In 2030, $1,000 will buy a computer that is a thousand times more powerful than the human brain; by 2045, that same $1,000 will buy a processor a billion times more intelligent than every human combined.[5]

The Internet of Things is real and growing and everywhere. In December 1995, there were 16 million Internet users in the entire world. In June 2017, there were about 3.8 billion—and growing every day. In only 21 years, half the world's population became connected.[6]

The proliferation of technology into everything will radically change the future military and operational environment. In 2035-2050, the battlespace will be elongated, deepened, and hyper-connected. Engagements will occur at home station military bases through ports of debarkation to tactical assembly areas all the way to the adversary's motor pool. From space to the ocean floor; from military to non-military; from governmental to nongovernmental; from state to non-state; from physical to virtual. The operational area will be wherever effects are generated—and the array of stimuli that will generate effects is staggering. The interconnected and global nature of everything will produce physical and virtual effects that have tremendous range, saturation, and immediacy—along with daunting complexity and stealth.

More than ever before, the tactical fight will be influenced less by the tactical fighter and more by actors or organizations either unknown to the warfighters, or beyond their ability to affect. A hacked and corrupted computer server in the Defense Logistics Agency will have a disproportionally greater impact on a brigade's combat readiness than the security of supply routes.

Increased adversary reach and the ubiquitous battlespace in the future will mean U.S. freedom of action in all domains will be heavily contested and both sides will take asymmetric cross-domain approaches to offset overmatch. An advantage in fighter aircraft quantity and quality will be offset by adversary interdiction of airfields, radar spoofing, and cyber-paralysis of air command and control (C2). Overmatch in ground combat systems will be offset by multi-domain deception, cyber-corrupted logistics networks, and swarms of autonomous lethal and non-lethal weapons. An advantage in strategic mobility will be offset by formidable anti-access capabilities, sophisticated information campaigns, and contested deployment that extend into service members' homes, families and private lives.

Adversaries and potential adversaries are investing heavily in capabilities that offset U.S. legacy systems and processes. In 1999, 8 years after end of the Cold War, the U.S. Army Command and General Staff College's correlation of forces calculators gave an M1A2 tank battalion a 63 percent force equivalent (FE) advantage over a T80 tank battalion; an M2 infantry battalion a 30 percent FE advantage over a *Boevaya Mashina Pehoty* (BMP-3 [Infantry Combat Vehicle]) battalion; and, a multiple launch rocket system (MLRS) battalion a 31 percent advantage over a BM-22 multiple rocket launcher (MRL) battalion (see Table 2-1).[7] The 2017 version of the calculator, updated to reflect current equipment and capabilities, reflects almost FE parity (+/- 5 percent) between a U.S. armored brigade combat team (ABCT) and a Russian tank brigade equipped with T-90 tanks and BMP-3s. The MLRS battalion now has 40 percent less FE compared to a Russian BM-30 Smerch-M MRL battalion and 37 percent less compared to a Chinese WM-80 MRL battalion (see Table 2-2).[8]

U.S. FORCES		ADVERSARY FORCES		U.S. ADVANTAGE PERCENTAGE
Type	FE	Type	FE	
Infantry Battalion (M2)	1.00	Infantry Battalion (BMP-3)	0.77	30
Armored Battalion (M1A2)	1.21	Tank Battalion (MIB 40xT80)	0.77	57
155(SP) Battalion (M109A6)	1.20	2S3 Battalion	0.85	41
MLRS Battalion	4.60	BM 22 Battalion	3.5	31

Table 2-1. 1999 Force Equivalent (FE) Comparison.[9]

U.S. FORCES		ADVERSARY FORCES		U.S. ADVANTAGE PERCENTAGE
Type	FE	Type	FE	
Infantry Combined Arms Battalion (M1A2)	37.69	Infantry Battalion (BMP-3)	41.12	-9
Armored Combined Arms Battal-ion (M1A2)	37.24	Tank Battalion (T-90)	28.01	33
Field Artillery Battalion (MLRS)	13.08	Field Artillery Battalion (Smerch-M/ BM-30)	18.29	-40
		Field Artillery Battalion (WM-80)	17.95	-37
ABCT (M1A2)	248.99	Tank Brigade (T-90/BMP-3)	230.49	8

Table 2-2. 2017 Force Equivalent (FE).[10]

While not designed to drive requirements or force structure planning (or to compare dissimilar organizations), FE calculations are a useful tool to get a snapshot of relative advantage—and by extrapolation—trends in relative overmatch. Moreover, though comparing FE for U.S. and adversary armor, infantry, and artillery units over a period of 17 years is not clean, it does support an assertion that U.S. advantage has been eroded. Increasing readiness may bring a short-term benefit, but as long as the modernization gap continues to widen, the U.S. Army will find itself overmatched in legacy systems by its traditional competitors—and counter-matched in emerging asymmetric areas by a growing number of nontraditional ones.

The absence of sustained overmatch in previously uncontested physical domains will place U.S. forces in an unfamiliar position. Supremacy and superiority in the physical domain will be temporary at best and unlikely at worst. In the future, the concept of decisive point may well be different. In fact, a decisive point may not exist at all—or may have to be created. Lethality and adversary reach will make offensive action less decisive in some domains. Maneuvering to positions of advantage may be impossible and the future principles of war (particularly offensive, mass, and maneuver) may not apply—or will be fundamentally different.

Future conflict will likely find adversaries fighting to create a narrow window of advantage, taking action, and then fighting to regain the advantage once lost (or to gain a different advantage). Each side will be continually challenged to identify which advantages to seek, and most importantly, to recognize when the advantage is gained (and when it is lost). The opportunities for action will be sudden, fleeting, and will change sides.

The decline of the U.S. Army's advantage will continue unless the Army and the Department of Defense (DoD) are creative and innovative in future modernization. They should exercise honest intellectual rigor in envisioning and developing the future force and avoid building a future force optimized to solve today's problems with today's organizations—equipped with tomorrow's technology. This path will lead to a search for a better howitzer or tank, rather than to ask the questions, "What is better than a howitzer?" or "Do we still need tanks?"

Mark Cuban's caution about artificial intelligence (AI) during an interview at the March 2017 South by Southwest (SXSW) Conference and Festivals highlights the urgency and impact of Third Offset capabilities and indeed Third Offset **thinking**:

> Whatever you are studying right now if you are not getting up to speed on deep learning, neural networks, etc., you lose.[11]

America's first multi-millionaires made their fortunes in the industrial revolution (e.g., Andrew Carnegie, Cornelius Vanderbilt, George Westinghouse, and Éleuthère Irénée du Pont); the billionaires in mechanization and mobilization (e.g., Henry Ford, John D. Rockefeller, J. Paul Getty, Howard R. Hughes, Jr.); and the mega-multi-billionaires in information technologies and global connectedness (e.g., Bill Gates, Carlos Slim, Larry Ellison, Jeff Bezos, Mark Zuckerberg). The world's first trillionaires, says Cuban, "are going to come from somebody who masters AI and all its derivatives and applies it in ways we never thought of."[12]

The race to develop and **apply** meaningful and break-through AI is already at full-throttle, and the prize for finishing first is significant. The tech industry giants are investing tens of billions of dollars in their own AI research and development, and venture capitalists are funding an equal amount for new startup companies.

This headlong rush has prompted some of the world's great minds to acknowledge the inevitability of advanced AI and go so far as to warn against possible catastrophe. Physicist Dr. Stephen Hawking has warned that unbridled AI development "could spell the end of the human race."[13] As recently as July 2017, tech innovator Elon Musk rattled the nation's governors at the summer National Governor's Association meeting when he offered that AI is "a fundamental risk to the existence of civilization."[14] Since January 2017, over 4,600 of the top experts in the AI, robotics, and scientific fields, to include Google's DeepMind founder Demis Hassabis, IMB Watson Chief Scientist Grady Booch, Elon Musk, and Stephen Hawking signed an open letter as part of the Future of Life Institute's Asilomar *AI Principles*. The letter and principles acknowledge the potential of AI and advocate a framework that guides its beneficial development.[15]

Pragmatically, these warnings and frameworks will do little to prevent the militarization of AI. The rewards are too great and the risk of being second too severe. Just as industrialization and mechanization changed the fundamental character of both civilization and warfare, and they gave an overwhelming advantage to the side that was first, break-through AI could have a similar (if not exponentially greater) effect. Five-time Hugo Award winning author, mathematician, and futurist Vernor Vinge cautioned in 1993, if technological achievement of a "singularity" is possible—that point at which greater-than-human intelligence drives runaway progress and models are discarded and a new reality rules—then that singularity will certainly happen.

> Even if all the governments of the world were to understand the 'threat' and be in deadly fear of it, progress toward the goal would continue. . . . In fact, the competitive advantage—economic, military, even artistic—of every advance in automation is so compelling that passing laws, or having customs, that forbid such things merely assures that someone else will get them first.[16]

It is not a matter of if the development of AI will occur, but when—and what form it will take.

AI—and human-computer interfaces that Vinge terms intelligence amplification (IA)—offers the Army opportunities for leap-ahead offset over potential competitors. While advantages in the physical domains may be brief and few, sustainable decisive advantage could be gained in the cognitive domain—the boundary-free area of the battlefield that involves knowing, predicting, and deciding. However, while not a domain in the strictest doctrinal sense, the cognitive dimension of human (and artificial or amplified) intelligence and organizational perception is a ripe arena for future conflict. In the future, individuals, teams, units, and the entire force could operate far more cognitively connected than today— almost as a single cognitive organism. There is great potential for common understanding, collective decision-making, and unified anticipatory action. Unlike the physical domains, dominance in the cognitive domain is less vulnerable to asymmetric offset. Adversaries may attempt to prevent each other from gaining knowledge, but offsetting the advantage once it is achieved is difficult. Knowledge is not fungible—something is either known or it is not.

Advantages in the cognitive domain could be deep and long lasting. In future conflict, ambiguity will increase despite interconnectedness. The velocity and scale of activity will make it difficult to discern the important from the unimportant and what is real from what is fake. Adversary spoofing, deception, and data manipulation and corruption will create a common operational picture that is part-fact, part-fiction. This murky situational awareness will feed decision cycles that will be compressed by pervasive data and near-instantaneous communications.

Decision events will increase in frequency and speed. The "observe, orient, decide, and act" (OODA) loop decision cycle—must be compressed in the short-term to "recognize, decide, act" (RDA). Observation and orientation as discrete actions will be a luxury that the future battlefield will not allow. Superiority will be predicated on further evolving the decision cycle to "predict, decide, and act" (PDA)—with the goal of reducing (or ultimately eliminating) the time to decide—or "predict and act" (PA)—through automation, AI, and IA.

Predicting will be more important than understanding. In fact, AI/IA could make it possible to reliably predict without understanding. Accurately predicting changes to the environment and adversary actions make it possible to be anticipatory and preemptive—gaining supremacy over the adversary by eliminating the majority of their options—and then focusing on countering the option(s) that remain. Limiting adversary options controls outcomes and denies the adversary the initiative (at a minimum the range of possible choices are controlled). Conversely, AI/IA can help retain friendly freedom of action (options). Increased cognitive reliability and the resultant ability to act appropriately (time and action) can markedly decrease friendly uncertainty and increase the operational tempo—to a point, adversaries are orders of magnitude behind in decision cycles and have no counteraction available.

The pace of advances in AI and IA create an urgency for the Army. They are areas of intense competition and development by industry as well as by potential competitors and will be the first-principles in building a sustainable advantage in the future. If the future operational environment is markedly different from today, then the attributes of the Army should be different. Legacy attributes such as mobility and versatility are focused on the physical domains, where any advantage is fleeting and is met with asymmetric counters. Using these legacy attributes solely to describe the future force belies appreciation of the future operational environment and the evolving character of warfare and does not fully account for the probability that AI and IA will make things radically different. Beyond fielding a force that simply competes in the physical domains, the Army of 2035 and beyond must be designed to dominate and achieve overmatch in the cognitive domain; for the greatest potential for superiority or supremacy lies here.

ENDNOTES - CHAPTER 2

1. Training and Doctrine Command (TRADOC), *FORCE XXI OPERATIONS*, TRADOC Pamphlet 525-5, Fort Monroe, VA: Headquarters, Department of the Army, U.S. Army Training and Doctrine Command, August 1, 1994, p. 1-1.

2. Ibid., p. 1-5.

3. Ibid.

4. Ray Kurzweil, "The Law of Accelerating Returns," Kurzweil, Accelerating Intelligence, Essays, March 7, 2001, available from *http://www.kurzweilai.net/the-law-of-accelerating-returns*, accessed July 31, 2017.

5. Ray Kurzweil, "Singularity Q&A," Kurzweil, Accelerating Intelligence, Essays, December 9, 2011, available from *http://www.kurzweilai.net/singularity-q-a*, accessed August 3, 2016.

6. "World Internet Usage and Population Statistics June 30, 2017—Update," Internet World Stats: Usage and Population Statistics, June 30, 2017, available from *www.internetworldstats.com/stats.htm*.

7. Jim Craig, contrib., "Force Ratio Calculator," The S2 Company, January 10, 1999, available from *www.*

s2company.com/index.php?fid=141&filter=allname&file_count=0&uid=FC141&sortby=name_asc.

8. Dennis K. Clark and Jeffrey Holcomb, "Relative Combat Power," v9, milBook, blog of MilSuite, Department of Defense - PEO C3T, July 17, 2017, available from *https://www.milsuite.mil/book/docs/DOC-33456*, accessed August 24, 2017. The Relative Combat Power Calculator is developed and maintained by the Department of Army Tactics at the U.S. Army Command and General Staff College. It is posted for use on milSuite (milBook).

9. Craig.

10. Clark and Holcomb.

11. See the interview by Michele Skelding of Mark Cuban and Adam Lyons, "Mark Cuban & Tech Execs: Is Govt Disrupting Disruption? — SXSW 2017," YouTube, SXSW (channel), May 2, 2017, at 20 min. 54 sec., available from *https://www.youtube.com/watch?v=ekYd-s-QL7o*, accessed March 14, 2017.

12. Ibid.

13. Rory Cellan-Jones, "Stephen Hawking warns artificial intelligence could end mankind," BBC News, December 2, 2014, *http://www.bbc.com/news/technology-30290540*, accessed March 6, 2017.

14. Interview of Elon Musk by Governor Brian Sandoval, in "National Governor's Association 2017 Summer Meeting—Closing Plenary," Providence, Rhode Island, July 13-16, 2017, at 26 min. 35 sec., available from *https://www.nga.org/cms/video/2017/sm/closing-plenary*, accessed July 16, 2017. Elon Musk warned the same thing in October 2014 at the Massachusetts Institute of Technology Aeronautics and Astronautics Department's Centennial Symposium. Musk cautioned, "With Artificial Intelligence we are 'summoning the demon'." See Interview of Elon Musk by Jaime Peraire, "One-on-One with Elon Musk" YouTube, AeroAstroMIT (channel), October 31, 2014, at 1 hr. 1 min. 20 sec., available from *https://www.youtube.com/watch?v=PULkWGHeIQQ&list=PLsJnBOe4esTYVKhyconcb4qK915ensFMC&index=1*, accessed August 18, 2017.

15. The complete list of principles as well as all signatories to the document can be found on the Future of Life Institute's site, "Asilomar AI Principles," Future of Life Institute, n.d., available from *https://futureoflife.org/ai-principles/*, accessed January 15, 2017.

16. Vernor Vinge, "The Coming Technological Singularity: How to Survive in the Post-Human Era," article for "VISION-21 Symposium," March 30-31, 1993, available from *http://edoras.sdsu.edu/~vinge/misc/singularity.html*, accessed December 14, 2016.

PART II:
IMPLICATIONS FOR ARMY AND JOINT CAPABILITIES

CHAPTER 3

GO AND ARTIFICIAL INTELLIGENCE: POTENTIAL FOR STRATEGIC DECISION-MAKING

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Go is the world's oldest board game.[1] Played on a square game board with a grid of 19x19 lines, two players take turns placing black or white stone pieces. To surround an opposing player's stones, results in the capture of those stones. At the end of the game, the player who surrounds the most space on the board and has the least captured stones is the winner.[2] The overall goal of the game of *Go* is to apply initiative in order to maximize one's own strengths while exploiting an opponent's weaknesses to achieve strategic and tactical encirclement. Short of that, it leads to a situation characterized by stability and balance.

While seemingly simple, *Go* is amazingly complicated. It is a game of initiative, maneuver, balance, and a clash of human wills to control the game board geography. *Go* is essentially a 2,500-year old "abstract war simulation."[3] Because of this, several prominent political thinkers have suggested that *Go* is a viable model for understanding geopolitics and strategy.[4] Still, few know how to apply it to their own decision-making. They can see *Go* as illustrative, informative, and even eye-opening, but are unable or unwilling to take the next steps and learn what *Go* teaches in order to apply it to their own strategic thinking. Teaming humans and computerized artificial intelligence (AI) is a potential solution that will allow a human to act like an expert at *Go* or similar decision-making processes, without the experience or in-depth study otherwise required. Recent developments in AI show this is now possible.

In 2016, a computer program resoundingly defeated two of the world's best *Go* players. The program was AlphaGo, written by computer scientists at Deepmind, a Google-owned AI research company.[5] AlphaGo did this, not through pre-programmed expert knowledge of the game, but by learning from the games played by expert human players and improving through self-play.[6] This approach is both revolutionary and wide reaching. While AI will be useful in many places, its application to the ancient strategy game of *Go* shows how it can help improve foreign and security policy decision-making. Combining the strategic lessons of *Go* with AI has the potential to make those lessons more broadly applicable and improve decision-making without requiring a cultural background or expertise in the game. It will allow human decision-makers to focus on their strengths and overcome their cognitive weaknesses. By creating a model of the world based on a *Go* framework, an AI algorithm like AlphaGo can become an expert in that world, understand a given situation, and then look far into the future, across many possible courses of action (COA), to help human decision makers determine which next move will best meet their objectives. By teaming with human decision makers to think faster, deeper, and more accurately, this type of AI can provide a decisive strategic advantage to those most willing to use it.[7]

MAN-MACHINE TEAMING FOR DECISION-MAKING

Moravec's Paradox states that what humans do effortlessly can be very difficult for computers.[8] This is especially true with basic tasks like motor skills and visual or audio recognition. The converse is also true, especially when it comes to human cognitive thinking. A complex strategic environment can be (too) difficult for the human mind to accurately process. There can be too much information, too much complexity, and too rapid a change in a situation. However, this is the exact environment in which strategic decision makers must operate. They cannot afford to make mistakes or succumb to the weaknesses inherent in human decision-making. This is what makes man-machine teaming complementary. Teaming an AI computer mind with the human mind combines human strengths with AI strengths to offset the weaknesses of both.

Where AI may struggle is when it encounters a situation beyond its learned experience or model. It may have difficulty thinking creatively beyond its database or programming. It may not be able to think ethically, especially in situations where the most ethical solution may not be the most efficient or effective solution. In addition, AI needs a goal to work toward (AI does not day-dream). This is where the human part of the man-machine team comes in. In this model of man-machine teaming, humans will provide objectives, creativity, and ethical thinking, while AI will provide self-taught experience, intuition, and forecasting abilities. An algorithm with these elements was key to the breakthrough that enabled AlphaGo to outthink the world's best *Go* player.

ALPHAGO, AN ARTIFICIAL INTELLIGENCE BREAKTHROUGH

AlphaGo is an AI breakthrough, different from many other attempts at game AI. Previous game AI like International Business Machine's (IBM) Deep Blue, a computer that first beat a world chess champion, did so with very specialized software and hardware.[9] It had large libraries of pre-programmed expert knowledge that it applied using computational brute force.[10] However, *Go* is estimated to be 300 times more complicated than Chess.[11] The techniques used by Deep Blue are impractical for a computer playing *Go*.

Since pre-programmed expert game knowledge is impractical for *Go*, the AlphaGo programmers took a different route.[12] Using deep learning and reinforcement learning artificial with neural networks coupled to a Monte Carlo Tree Search, AlphaGo was essentially self-taught.[13] Using a deep learning artificial neural network, it studied expert human games and then used that knowledge to improve itself through self-play. It developed its own experience, formed a type of intuition, and used that intuition to focus its forecasts in order to evaluate a sequence of likely best moves.[14] The algorithm then chose the move with the highest probability of winning the match.[15] In doing so, it made better game decisions than world's best *Go* players. This was a revolutionary achievement.

The self-learning decision-making algorithm used by AlphaGo is noteworthy because it does not just apply to *Go*—it can extend to other types of decision-making.[16] The elements required are a historical library of data for study and a basic model applicable to that data for improvement through self-play. Given relevant data and an applicable model, this process can be extrapolated from the abstract game of *Go* to real-world strategic decision-making. Then, as computer scientists have noted, "Deep learning has the property that if you feed it more data, it gets better and better."[17]

GO AND STRATEGIC DECISION-MAKING

The same thinking process that makes a mind (human or AI) successful in a strategic war simulation like *Go* will make that mind successful in geopolitical strategy. This implies that any strategic leader would benefit from learning *Go* and incorporating the way of thinking that *Go* stimulates into his or her decision-making framework. Even if unable to learn the intricacies of the game itself, a basic level of understanding and appreciation for its concepts will enhance decision-making. Additionally, if the *Go* way of thinking is integrated into the programming of an AI-assisted decision-making process, one need not be an expert to play like an expert. This is the key benefit of man-machine teaming through AI-assisted decision-making.

Go may apply directly in some cases and may serve as a useful analogy in others. Placing pieces on a *Go* board may provide direct insight on where to place equivalent pieces in the real world. Figure 3-1 shows an example for Europe and the Middle East.

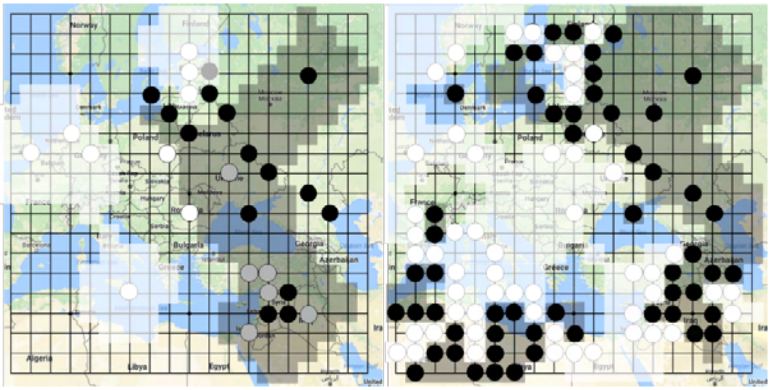

Figure 3-1. ***Go*** **Game Overlaid on Europe and Middle East Map.**[18]

The left map shows a constructed position based on a notional map of relative influence in Europe and the Middle East. White represents the United States and the North Atlantic Treaty Organization (NATO), black Russia and Russian allies. The map on the right shows the results of a relatively simple *Go* computer program, much less sophisticated than AlphaGo, playing both black and white positions through computer self-play. While this very basic *Go* model has several limitations, computer self-play does imply strategic benefits to Russia by applying additional influence activity in the Middle East, North Africa, and Northern Europe. It also highlights that the United States and NATO should strengthen their own influence throughout Europe and into the Middle East. This simple experiment illustrates the promise and applicability of *Go* as a basis for understanding and making decisions in a strategic environment.

STRATEGIC DECISION-MAKING THROUGH ARTIFICIAL INTELLIGENCE

Like AlphaGo, a decision-making AI tool would be composed of three minds. The first is the experience mind, based on an artificial neural network trained by history, doctrine, and examples from human strategists, able to recognize expert moves in a given area. The second is an intuition mind, formed by an artificial neural network trained through reinforcement learning, based on a relevant game model, and able to tell a winning position from a losing one, using a reward function based on a human-specified goal or objective. The third, a forecasting mind, would use the experience and intuition minds to narrow down possible options, forecast multiple possible future sequences of events, and make recommendations to meet given objectives.

The first two minds would always be learning. The experience mind would receive continuous updates of news, intelligence, and other relevant information. The intuition mind would continue to improve through reinforcement learning self-play and reward criteria that could update as objectives change. The forecasting mind would continue to run simulations and update probabilities of success as a situation develops. It would continuously extend the decision tree to cover more actions that are possible and improve the fidelity of previous estimates. Much like human strategic decision-making, the overall concept is a continuous cycle of evaluation and improvement.[19]

APPLICATIONS FOR AI-ASSISTED DECISION-MAKING

The basic approach for any application would be to create a simulation (game model) for the situation, to define success criteria, and then build and train a neural network for that simulation. AI-assisted decision-making could help leaders at all levels rapidly design, plan, and evaluate operations. Planners could test multiple operational approaches against a realistic AI-based adversary. Through a continuous deliberative planning process, the AI could update and evaluate the plans against the operational environment. The AI would continuously monitor the environment and warn planners when assumptions are no longer valid or if there is an opportunity to improve the plans.

Another application would be an AI-assisted common operating picture (COP).[20] It would catalog and display a disposition of friendly and enemy forces, automatically built and updated through a big data approach. Despite incomplete intelligence, an AI-supported COP could tell where an enemy should be with a corresponding level of confidence. In real-time, the AI would continuously interpret the situation, explore multiple lines of effort, and determine which is most likely to meet the given success criteria.

Based on this, the COP would recommend next actions and predict likely enemy responses. A commander could rapidly explore the situation and various COA, choosing hypothetical actions to see what the AI thinks would be a likely enemy response. In a complicated, multi-domain, anti-access area-denial future operating environment, this type of AI would find and predict "windows of superiority" for friendly forces to exploit.[21] It would show threat avoidance routing and recommend an optimized multi-domain fires tasking order. Essentially, this is a real-time situational awareness tool coupled to a forecasting, real-time, and AI-driven war game.

RECOMMENDATIONS

As part of the Third Offset Strategy, the Department of Defense (DoD) should fund research and development that will enable AI-supported human-machine teaming for strategic decision-making. Additional efforts should experiment with integrating AI into decision-making processes at all echelons. These efforts should be incremental, demonstrating basic capabilities before attempting more complicated ones.

The DoD and military services should begin a rapid prototyping effort to determine which aspects of AI can achieve the most near-term success. They should fund groups of programmers, strategists, and war-gaming experts to explore what is possible with this AI-assisted decision-making approach. Research into man-machine teaming processes should determine the best way to integrate, train with, and scale these AI tools. Organizations that would use these AI tools should apply change management principles to incorporate them into their processes and culture.

The true power of AI will be in the teaming of the human mind with the AI mind. This type of man-machine teaming will combine human strengths of goal-setting, creativity, and ethical thinking with AI strengths of rational thought through self-taught experience, intuition, and deep forecasting. A decision-making process that incorporates man-machine teaming through self-learning AI will overcome the weaknesses inherent in human decision-making and give those who use it a unique and decisive advantage over those who do not. This could be used to create a real-time, forecasting COP that could advise a decision maker on the next best move, while predicting the likely moves of an adversary. It could help strategists at all levels rapidly plan operations and quickly update those plans as facts change. In the end, by teaming with human decision makers to think faster, deeper, and more accurately, this type of AI will provide a decisive strategic advantage to those most willing to use it.

ENDNOTES - CHAPTER 3

1. David Lai, *Learning From the Stones: A Go Approach to Mastering China's Strategic Concept, Shi*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2004, p. 6, available from *http://ssi.armywarcollege.edu/pubs/display.cfm?pubID=378*, accessed August 1, 2017.

2. For a more detailed explanation of the rules of *Go*, see "Learn To Play," American *Go* Association, n.d., available from *http://www.usgo.org/learn-play*, accessed Mar 13, 2017.

3. Christopher Moyer, "How Google's AlphaGo Beat a Go World Champion," *The Atlantic*, March 28, 2016, available from *http://www.theatlantic.com/technology/archive/2016/03/the-invisible-opponent/475611/*, accessed November 30, 2016.

4. Scott A. Boorman, *The Protracted Game: A Wei Chi Interpretation of Maoist Revolutionary Strategy*, London, UK: Oxford University Press, 1969, is the seminal work in this regard. However, these ideas languished until 2002, when the following work was written, David Lai and Gary W. Hamby, "East Meets West: An Ancient Game Sheds New Light on US-Asian Strategic Relations," *Korean Journal of Defense Analysis*, Vol. 14, Iss. 1, Spring 2002. With later works like Lai, *Learning from the Stones* in 2004, and subsequent publications and presentations, Dr. Lai brought *Go* to the attention of U.S. diplomatic and defense circles. He continues to apply this game to examine U.S.-China and U.S.-Asia interactions in the Western Pacific. Dr. Henry Kissinger learned about *Go* from Dr. Lai's work and subsequently used these ideas to put U.S.-China relations in a new perspective in, Henry Kissinger, *On China*, New York: The Penguin Press, 2011. See the following,

Boorman; Lai and Hamby; Lai, *Learning From the Stones*; David Lai, "China's Strategic Moves and Counter-Moves," *Parameters*, Vol. 44, No. 4, Winter 2014-15; Kissinger, p. 201.

5. Google acquired Deepmind in 2014 for $650M, see, Samuel Gibbs, "Google buys UK artificial intelligence startup Deepmind for £400m," *The Guardian*, January 27, 2014, available from *https://www.theguardian.com/technology/2014/jan/27/google-acquires-uk-artificial-intelligence-startup-deepmind*, accessed December 18, 2016.

6. David Silver, Aja Huang, Chris J. Maddison, Arthur Guez, Laurent Sifre, George van den Driessche, Julian Schrittwieser, Ioannis Antonoglou, Veda Panneershelvam, Marc Lanctot, Sander Dieleman, Dominik Grewe1, John Nham, Nal Kalchbrenner, Ilya Sutskever, Timothy Lillicrap, Madeleine Leach, Koray Kavukcuoglu, Thore Graepel, and Demis Hassabis, "Mastering the game of Go with deep neural networks and tree search," *Nature*, Vol. 529, January 28, 2016, p. 484, available from *https://storage.googleapis.com/deepmind-media/alphago/AlphaGoNaturePaper.pdf*, accessed December 19, 2016.

7. See, Kareem Ayoub and Kenneth Payne, "Strategy in the Age of Artificial Intelligence," *Journal of Strategic Studies*, Vol. 39, Iss. 5-6, pub. online November 23, 2015, pp. 805-806, available from *http://dx.doi.org/10.1080/01402390.2015.1088838*, accessed November 28, 2016.

> In many of these respects a domain specific AI [artificial intelligence] could radically shift military power towards the side that develops it to maturity. Domain-specific AI will be transformative of conflict, and like previous transformations in military capability, it has the potential to be profoundly disruptive of the strategic balance.

8. As highlighted in, Garry Kasparov, "The Chess Master and the Computer," *The New York Review of Books*, February 11, 2010, available from *http://www.nybooks.com/articles/2010/02/11/the-chess-master-and-the-computer/*, accessed December 19, 2016; and, Hans Moravec, *Mind Children, The Future of Robot and Human Intelligence*, Cambridge, MA: Harvard University Press, 1988, p. 9.

9. Feng-hsiung Hsu, *Behind Deep Blue: Building the Computer That Defeated the World Chess Champion*, Princeton, NJ: Princeton

University Press, 2002, pp. 172, 257, available from *https://archive.org/details/Behind_Deep_Blue_gnv64*, accessed December 19, 2016.

10. From the International Business Machine (IBM) Deep Blue information page: "There is no psychology at work" in Deep Blue, says IBM research scientist Murray Campbell. Nor does Deep Blue "learn" its opponent as it plays. Instead, it operates much like a turbocharged "expert system," drawing on vast resources of stored information (for example, a database of opening games played by grandmasters over the last 100 years) and then calculates the most appropriate response to an opponent's move. See, "Frequently Asked Questions: Deep Blue," IBM Research, n.d., available from *https://www.research.ibm.com/deepblue/meet/html/d.3.3a.html*, accessed December 19, 2016. Deep Blue and its difference from AlphaGo are further described here, Christof Koch, "How the Computer Beat the Go Master," *Scientific American*, March 19, 2016, available from *https://www.scientificamerican.com/article/how-the-computer-beat-the-go-master/*, accessed December 21, 2016.

11. Danielle Muoio, "Why Go is so much harder for AI to beat than chess," *Business Insider*, March 10, 2016, available from *http://www.businessinsider.com/why-google-ai-game-go-is-harder-than-chess-2016-3*, accessed on December 19, 2016.

12. Silver et al., p. 489.

13. Ibid., p. 484.

14. The idea of AlphaGo and intuition came from the following article, Christopher Burger, "Google DeepMind's AlphaGo: How it works," TasteHit, March 16, 2016, available from *https://www.tastehit.com/blog/google-deepmind-alphago-how-it-works/*.

15. Silver et al., p. 489.

16. Ibid.

17. Nicola Jones, "The Learning Machines," Nature, Vol. 505, January 4, 2014, p. 148, available from *http://www.nature.com/polopoly_fs/1.14481!/menu/main/topColumns/topLeftColumn/pdf/505146a.pdf*, accessed December 24, 2016.

18. Images created by the author, using computer self-play from app, see Patrick Näf Moser, designer, "Little Go," Version 1.3.1, updated January 19, 2017, available from *https://itunes.apple.com/us/app/little-go/id490753989?mt=8*; influence map from the computer program "Leela," available from *https://sjeng.org/leela.html*.

19. "Appendix I: Guidelines for Strategy Formulation," in J. Boone Bartholomees, ed., *The U.S. Army War College Guide to National Security Issues, Volume II: National Security Policy and Strategy*, 5th Ed., Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2012, pp. 417-418, available from *http://ssi.armywarcollege.edu/pubs/display.cfm?pubID=1110*, accessed August 1, 2017.

20. This idea of a Big Data generated Common Operating Picture (COP) is also captured in the Air Force's *Future Operating Concept*, see Headquarters, Department of the Air Force, *Air Force Future Operating Concept: A View of the Air Force in 2035*, Washington, DC: Department of the Air Force, September 2015, p. 9, available from *http://www.af.mil/Portals/1/images/airpower/AFFOC.pdf*, accessed January 8, 2017.

21. Sean Kimmons, "With multi-domain concept, Army aims for 'windows of superiority'," U.S. Army, November 14, 2016, available from *https://www.army.mil/article/178137/with_multi_domain_concept_army_aims_for_windows_of_superiority*, accessed March 14, 2017.

CHAPTER 4

THE ROLE OF NUCLEAR WEAPONS IN THE THIRD OFFSET

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The Department of Defense's (DoD) technology innovation initiative, also known as the Third Offset, seeks to provide a framework for the development of next generation technologies to offset parity achieved by our nearest peer competitors. Named due to its relationship to two previous technological eras, nuclear weapons (1950s) and stealth and precision strike (1970s), the Third Offset is designed to provide the United States assurance of dominance on the future battlefield. Although nuclear weapons have played an enduring role in our national security strategy throughout both of the previous offsets, the role of our nuclear deterrent in the Third Offset remains unclear. Failure to account for this role while developing Third Offset capabilities and constructs that are not properly integrated with our existing nuclear deterrent has potential to result in deterrence shortfalls. The aim of this chapter is to analyze the previous and current roles of our nuclear deterrent, with the goal of assessing the future role of nuclear weapons within the Third Offset construct. In the end, the pursuit of Third Offset technologies, while having potential to politically supplant our existing nuclear stockpile, provides our adversaries significant incentive to pursue their own nuclear weapons capabilities. The United States must consider this fact at all stages going forward.

THE THIRD OFFSET

The Third Offset is both an organizational and operational construct, enabled by key technologies, designed to provide conventional deterrence of great power competitors.[1] While Pentagon leadership has consistently stated that the Third Offset is not about any one technology, they have acknowledged there is a strong technology component.[2]

In 2009, then-President Barack Obama announced that U.S. policy would be to "seek the peace and security of a world without nuclear weapons."[3] This declaration has provided the underpinnings of U.S. nuclear policy in the years since. The *Nuclear Posture Review Report 2010* identified the reduction of the role of nuclear weapons in U.S. national security strategy, largely by increasing conventional deterrence capabilities, as one of five key objectives of U.S. nuclear policy and posture.[4] In this respect, the Third Offset initiative supports these deterrence aims. By emphasizing conventional deterrence in the Third Offset, the United States is signaling their commitment to the Prague initiatives. By creating a construct, or technology, more attractive than nuclear weapons (from a deterrence perspective) it may seem possible to wean the world's great powers from their nuclear requirements. Deputy Secretary Work furthers this notion:

> Our advantage is, and this is an enduring advantage, the thing that I know is that if we force, for example, an adversary who is an authoritarian power to adopt the organizational and operational concepts that this will cause, it will cause changes in their military and ultimately in their society that will make it less likely that we will fight against each other.[5]

Part of the offsetting quality of the Third Offset is the U.S. ability to change and adapt capabilities more rapidly than our adversaries can counter. If successful, the logical course for an adversary would be to mimic this innovation cycle to preempt U.S. advantages. The result of this competition becomes an innovation arms race where victory goes to the side that anticipates and adapts the quickest. Since private industry is key to success in this competition, an adversary must be able to leverage and access private partners. Secretary Work postulates that the only way to support these private institutions would be for adversaries to adopt military and societal reforms similar to the United States under the Third Offset Strategy. His postulate is based on one key premise—that the U.S.-model democratic society is the only type that can support such an innovation cycle.

This theory poses an interesting question for an adversary, who either cannot or is not willing to engage in the innovation arms race. If one assumes that the lack of participation is based upon fiscal resources, then a would-be adversary would be obliged to pursue the most economical means possible to deter perceived or real U.S. aggression. Ironically, nuclear weapons represent a relatively inexpensive, accessible, and proven military deterrent. These weapons are potentially the only means capable of countering dramatically "offset" future U.S. power.

NUCLEAR WEAPONS NOW AND IN THE FUTURE

The U.S. military thinking on nuclear weapons is shaped by both the Cold War "peace dividend" and 15 years of counterterror and counterinsurgency operations. For the previous 8 years, as set out in former President Obama's Prague address, the United States has pursued an approach to nuclear weapons that has been largely based upon addressing the threats of nuclear proliferation, the threat of terror actors obtaining a nuclear device, and the consequences of nuclear mishap or accident.[6] This approach unwittingly requires an assumption that nuclear states are unlikely or unwilling to engage in a nuclear conflict. It also assumes that the world remains unipolar, with a dominant U.S. hegemony engaged in conflict with nonstate actors as it has been for much of the past 2 decades. Overall, the prospect of deliberate nuclear use has been marginalized largely through a U.S. lens that reflects a lack of political willpower to do so.

The role of nuclear weapons in the future operating environment of 2035 has potential to be elevated by the increasing incentives for developing nations to pursue nuclear power. Global concerns over the role of fossil fuels and climate change will likely lead to an increased demand for nuclear power, not only for economic reasons, but also for political status and prestige.[7] Countries with declared intent to develop nuclear power programs by 2035 include: Saudi Arabia, United Arab Emirates, Jordan, Turkey, Algeria, and Egypt.[8] The widespread proliferation of peaceful nuclear power also permits the propagation of knowledge, expertise, and infrastructure capable of supporting a nuclear weapons program as a byproduct, and potentially clandestine, industry. Consider, for example, that under international protocols it is within acceptable statistical error limits for a commercial nuclear fuel plant to lose track of hundreds of pounds of plutonium per year, enough for dozens of nuclear warheads.[9] Efforts to contain illicit weapons development will be further complicated by the dual use nature of the technologies involved. This will require stringent application of non-proliferation protocols in order to contain the spread of weapons-usable material and related technologies. States capable of crossing the threshold from nuclear power to nuclear arms will likely use these weapons as a deterrent to regional aggressors as well as a means to offset the various, and prohibitively expensive, technological advantages of the world's great powers.

The future role of nuclear weapons in the strategies of our near peer competitors is unlikely to decline. In contrast to U.S. efforts to decrease the role of nuclear weapons in its foreign policy, Russia sees its nuclear arsenal as central to retention of its power, prestige, and influence in the world.[10] Over the past 20 years, Russian nuclear use doctrine has shifted away from exclusive use as a deterrent in global and regional conflict to now including applications of tactical nuclear munitions in small conflicts, including local wars, against potentially non-nuclear opponents, including terrorism.[11] Further, the use of tactical nuclear weapons is seen as the primary and only means to counterbalance U.S. advantages in conventional capabilities gained by stealth and precision munition technologies.[12] Russian objections to U.S.-sponsored missile defense capabilities in Eastern Europe are based largely on the fact that these would erode the effectiveness of the critical balance they attempt to achieve with tactical nuclear weapons.[13]

Much less is understood about China's nuclear intent and aspirations. Despite having much smaller nuclear arsenals than either Russia or the United States, the actual size of China's nuclear arsenal is in debate. Most analysts infer that China maintains a stockpile of up to 300 warheads, however, some assess that the number may be nearly 6 times greater due, in part, to estimated production quantities of uranium and plutonium.[14] These assessments are further obscured by China's construction of nearly 3,000 miles of tunnels used to protect and conceal its nuclear arsenal.[15] China openly claims a no-first-use policy; however, it has repeatedly indicated that it would consider use of nuclear weapons in the event of U.S. conventional intervention in a conflict with Taiwan.[16] In this scenario, China's policy of escalation with regard to regional conflicts is similar to Russia's policy.

India and Pakistan use their nuclear capabilities to offset each other in their regional conflicts. Israel maintains an ambiguous capability to ensure survival from an existential threat. North Korea leverages a portfolio of weapons of mass destruction, including a fledgling nuclear capability, to deter and complicate U.S. military action aimed to overthrow a dictatorial regime. Iranian pursuit of nuclear weapons was presumably based on the demonstrated successes of Russian and North Korean programs in deterring U.S. military action. It remains uncertain when, or if, Iran will decide to resume work on their nuclear weapons program. Given current world nuclear-posturing, it seems improbable that pursuit of a U.S. Third Offset would alter the security calculations of these nuclear weapons states.

NUCLEAR IMPLICATIONS OF THE THIRD OFFSET

In light of the United States pursuit of a Third Offset Strategy, Russia in particular is faced with the proposition of a widening conventional capability gap. In response, Russia is anticipated to pursue a policy of "countering the Third Offset Strategy with the First Offset Strategy."[17] These efforts include expansive modernization efforts that include a variety of delivery platforms designed, in part, to ensure the resiliency of the Russian nuclear force. Thus, an unintended consequence of U.S. conventional capability growth under the Third Offset is the expanded reliance on nuclear weapons of a near peer competitor that uses it to hedge its bet in the race for offsetting technology.

As the United States moves toward the Third Offset, we must acknowledge our own reluctance to maintain a robust nuclear deterrent and the inherent predisposition toward developing conventional alternatives to their use. This phenomenon is rooted in the evolution of a "nuclear taboo" over the past 70 years that has driven U.S. political will to form a distaste for all things nuclear.[18] The causes of this taboo are rooted in "domestic public opinion, world opinion . . . and personal conviction informed by beliefs about American values and conceptions of the appropriate behavior of civilized nations."[19] As a result, we deliberately describe the Third Offset as a conventional endeavor thus concretely reinforcing the status of this taboo and signaling U.S. desire to remove the nuclear equation from the future of warfare. This taboo serves to incentivize the development of conventional capabilities in the form of a Third Offset. The U.S. reluctance to maintain nuclear dominance in favor of a conventional approach creates an opportunity for adversaries to redouble efforts to obtain nuclear power status in an attempt to fill the vacuum created by the U.S. departure from the nuclear arena.

As the United States launches on its Third Offset journey, we must consider potential adversary actions in response to our offset pursuits. One response could be to copy or counter our new capabilities. This would likely be part of the approach of great power peer-competitors with access to technologies and the capital required to engage in such an arms race. Following too fast, however, generates risk of large sunk financial costs into risky technologies that may fail to provide an offset or real deterrent. A prudent adversary will seek to hedge these pursuits with a proven and fiscally obtainable deterrent. Despite efforts to modernize its conventional forces, it is unlikely that Russia will abandon or ignore its nuclear arsenal and both the political and military power it provides. Additionally, while the Third Offset focuses on offsetting a peer adversary, the United States cannot ignore the impact on smaller and emerging threat actors and states. Faced with the near impossible costs of attempting to keep pace in a Third Offset, these actor nations will have incentive to pursue an affordable and credible deterrent to U.S. multi-domain superiority. Coupled with the increasing availability of fissile material, proliferation of nuclear expertise and infrastructure, and modern technologies, it is likely that the next 20 years will bring about continued expansion of global nuclear arsenals.

It would be irresponsible to assume that a U.S. decision to pursue a third technological offset will necessarily induce an adversary to pursue in kind. Likewise, it is equally unwise to assume that an adversary will continue to pursue Second Offset technologies while watching the United States gain overwhelming advantages in emerging Third Offset capabilities. In this analysis, it is most logical that an adversary pursues the best offset that it can afford—one that delivers the greatest and most proven (or perceived) deterrence. Thus, the First Offset remains an integral, and potentially the most significant, part of an adversary's deterrent to U.S. aggression. It is likely that the pursuit of Third Offset technologies, while having potential to supplant our existing nuclear stockpile, provides our adversaries significant incentive to pursue nuclear weapons capabilities, a fact that U.S. leadership must consider at all stages going forward. As such, the United States must pursue the Third Offset armed with the understanding that our actions will drive and incentivize continued proliferation of nuclear weapons.

ENDNOTES - CHAPTER 4

1. Deputy Secretary of Defense Bob Work, "Reagan Defense Forum: The Third Offset Strategy," public speech, Ronald Reagan Presidential Library, Simi Valley, CA, November 7, 2015, available from *https://www.defense.gov/News/Speeches/Speech-View/Article/628246/reagan-defense-forum-the-third-offset-strategy*, accessed January 11, 2017.

2. Cheryl Pellerin, "Deputy Secretary Discusses Third Offset, First Organizational Construct," U.S. Department of Defense News, September 21, 2016, available from *https://www.defense.gov/News/Article/Article/951689/deputy-secretary-discusses-third-offset-first-organizational-construct*, accessed January 13, 2017.

3. President Barack Obama, "Remarks by President Barack Obama In Prague As Delivered," public speech, Hradcany Square, Prague, Czech Republic, April 5, 2009, available from *https://obamawhitehouse.archives.gov/video/The-President-in-Prague#transcript*, accessed August 2, 2017.

4. Secretary of Defense Robert M. Gates, *Nuclear Posture Review Report 2010*, Washington, DC: U.S. Department of Defense, April 2010.

5. Work.

6. Obama.

7. Mathew J. Burrows, *Global Risks 2035: The Search for a New Normal*, Washington DC: The Atlantic Council, September 2016, p. 41.

8. Henry D. Sokolski, *Underestimated: Our Not So Peaceful Nuclear Future*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2016, p. 60.

9. Ibid., p. 61.

10. Daniel Goure, "Moscow's Visions of Future War: So Many Conflict Scenarios So Little Time, Money and Forces," *The Journal of Slavic Military Studies*, Vol. 27, No. 1, March 10, 2014, p. 75.

11. Marcel Van Herpen, "Russia's Embrace of Tactical Nuclear Weapons: Its Negative Impact on U.S. Proposals for Nuclear Arms Reductions," *Cicero Foundation Great Debate Paper*, No. 11/04, Paris, France and Maastricht, The Netherlands: The Cicero Foundation, September 2011, pp. 15-16.

12. Goure, pp. 81-82.

13. Ibid., pp. 81-84.

14. Sokolski, pp. 44-45.

15. Ibid., p. 47.

16. Ibid., pp. 45-46.

17. Vasily Kashin and Michael Raska, *Countering the U.S. Third Offset Strategy: Russian Perspectives, Responses and Challenges*, Singapore: Rajaratnam School of International Studies, January 2017, p. 14.

18. Nina Tannenwald, "The Nuclear Taboo: The United States and the Normative Basis of Nuclear Non-Use," *International Organization*, Vol. 53, No. 3, Summer 1999, pp. 433–468.

19. Ibid., p. 462.

CHAPTER 5

SWARMS IN THE THIRD OFFSET

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BACKGROUND

During the 2017 Super Bowl 51 half-time performance, Intel demonstrated the control of 300 drones; a few months earlier Intel had set a new record with 500 drones controlled by a single operator. Just a year earlier, the Advanced Robotic Systems Engineering Laboratory at the Naval Postgraduate School in Monterey, California, held the record with 50 simultaneous airborne unmanned aerial vehicles (UAVs) controlled by a single operator. In October of 2016, the U.S. military conducted the largest deployment ever of micro-swarms. Dubbed the Perdix micro drone, these small, inexpensive, battery-powered, propeller-driven air vehicles were launched by three F/A-18 Super Hornets. Given the pace of advance, 500 drones will quickly increase to 1,000 and 10,000 agents in just a few short years while being scalable, adaptable, distributed, and collective.

The Third Offset advances the enabling capabilities of swarm behavior that could be wholly adopted in the future force. This chapter will provide an overview of swarms and explore three major areas relevant to understanding the degree to which the Department of Defense (DoD) should pursue research, development, and procurement of swarm capable intelligence, surveillance, and reconnaissance (ISR) and low-cost, numerous, unmanned, and fast weapon systems. The first area includes swarm initiatives that could allow the DoD to transition away from expensive, heavy, and human-centric weapons platforms such as legacy tanks, manned fighters, and submarines. Second, the advent of self-driving vehicles, automated logistics, and aerial drones in the commercial sector could translate to autonomous supply trains, reduced soldier fatigue and error, and targeting missions in the military. Third, adversaries from both state and nonstate actors are pursuing swarm capabilities and autonomous weapons. While swarms offer many potential advantages and the potential to achieve overmatch with future adversaries, there is significant risk with a rapid adoption of unproven technologies and the many legal and ethical issues associated with autonomous weapons.

SWARMS

A swarm is a collection of agents (either homogeneous or heterogeneous) that can coordinate and adapt its activity to achieve an overall goal or direction.[1] Nature has many examples of swarming behavior—e.g., ant colonies, beehives, and termite nests. Typically, swarms in nature involve homogenous groups where single agents outside of the group cannot attempt to accomplish the same task as the whole. Further, the direction or collective task of the swarm is not orchestrated by a centralized leader but rather by simple rules followed by all of the individual agents. Elements within the swarm have little to no knowledge or ability to communicate with other elements that are not its immediate neighbor.[2]

In contrast, robotic swarms could involve centralized control, distributed control, or at a minimum overall task knowledge in the event that the human operator loses communications with any of the agents.[3] These swarms can have near-perfect knowledge of their neighbors through the use of wireless communications (uncontested frequency spectrum) or on-board sensors such as vision and ranging payloads in a contested spectrum. Processing power and sensor packages should continue to increase in capabilities such that a swarm will be able to execute mission objectives even if there is no communication with the human operator or within elements of the swarm itself. Swarm agents that are within line of sight may still be able to sense neighbors if communications are jammed or unavailable.

Robotic swarms do have similarities with nature in that they leverage autonomy and favor quantity with the typical sacrifice in quality.[4] Unmanned systems can have reduced weight, size, and design complexity that may in turn reduce their overall cost. Countering a swarm may prove difficult for any adversary, including the United States. Swarm agents that can react to enemy defenses faster and in a distributed manner may saturate adversary capabilities. Perhaps the most significant benefit to a swarm mentality is the focus on small size, which can be more deployable and easier to logistically sustain.

SWARM INITIATIVES

Future warfare will include operations that occur in large, densely populated, costal megacities. Over half of the world's population currently resides in urban areas and that percentage will likely increase drastically over the next 25 years. The DoD recognizes that the rise of megacities increases the likelihood that future battles are urban. Therefore, the DoD swarm initiatives across all services are integrating the technology with man-unmanned teaming mechanisms to allow soldiers the ability to control swarm systems. One recent example is the Defense Advanced Research Projects Agency's Offensive Swarm-Enabled Tactics (OFFSET) program that seeks to overcome the difficulties in managing and interacting with hundreds of swarm agents.[5] Focused on urban environments, OFFSET involves swarm tactic implementation using combinations of unmanned air and ground robots. In its early stages, OFFSET aims to bring swarm system integrators (akin to an end-to-end operating system like iOS or Android) and swarm tactic sprinters (application developers) together to realize 100, 150, and 250 agent swarms together with an intuitive user interface for squad-sized elements on the ground. The services are all heavily invested in swarm research and development.

The field of aerial swarms has seen great advances just in the past few years with movement from out of the laboratory environment to outdoor experiments with tens to hundreds of vehicles. Society is in the infancy in swarm development. This technology will have a profound impact on the global economy, commerce, transportation, safety, and efficiency. Two industries that are changing the landscape are self-driving automobiles and commercial unmanned aerial systems (UAS). It is likely that the self-driving car industry will provide much of the underlying technological advances in swarm autonomy and capability. Advances in collision avoidance, parking assistance, and congestion detection and re-routing are already improving safety and efficiency. In commercial UAVs, the factors that allow almost anyone to build a quad-copter for under $100 could enable thousands and tens of thousands of small to medium sized drones simultaneously controlled by a single operator in the next 5 to 10 years. The commercial sector is already poised to leverage these technologies.

Low-cost, asymmetric threats have proven dangerous for U.S. military forces and homeland security. The proliferation of improvised explosive devices of all types in the Iraqi and Afghan theaters has demonstrated that inexpensive, commercial off-the-shelf technology, and some electronics knowledge can be combined to significantly impact high tech operations. Autonomous Global Positioning System (GPS)-guided and semi-autonomous UAVs are changing the paradigm in their employment now and in the future. While a single attack might be insignificant, a swarm of robotic devices could prove a credible threat. Wired magazine reported that the Department of Homeland Security pitted $5,000 worth of drones against a convoy of armored vehicles, and the drones won.[6] In addition to state actors developing swarm capabilities, nonstate actors, such as the Islamic State, are doing the same.

THE RISK OF AUTONOMOUS WEAPONS SYSTEMS (AWS) AND SWARMS

Swarms and autonomous weapons systems (AWS) offer potential advantages in future warfare but also present many legal and ethical challenges in addition to the inherent risk in turning over decision-making to machines. The literature contains many examples of legal and ethical considerations with AWS.[7] There are also many petitions from individuals, states, and nongovernmental organizations supporting an international ban on "killer robots."[8] The level of risk and probability of unexpected or errant behavior (collateral damage or the inability to control the AWS once enabled) is perhaps the greatest concern. If an AWS engages and kills civilians, then who is responsible? What role does the military perform in making ethical decisions if machines and algorithms are executing them? Autonomous agents in close proximity to adversarial agents could quickly escalate a conflict without a human involved in the decision. The current debate within the DoD is the "Terminator Conundrum" and given the potentials risks of AWS, the DoD should not develop them.[9] However, U.S. adversaries do not have the same hesitations with AWS and could achieve a decisive advantage in the future. Therefore, the debate does not necessarily lie with whether or not to develop AWS as much as deciding what aspects of warfare to automate and those to leave in control by humans. Many of these decisions will involve a scenario where there is a loss of communications with the AWS and how much autonomy is provided to engage targets of opportunity and the ability and authority of the AWS to defend itself if attacked.

RECOMMENDATIONS

First, the Army should adopt a "swarm mindset." This change would largely be seen in the movement away from the single, exquisite weapons platforms to those that are small, cheap, unmanned, expendable, and fast. There are many operational advantages of swarms in terms of autonomy, quantity, and speed. Unmanned systems can take greater risk by reducing survivability while maintaining lethality and increasing deployability. A swarm mindset could lead to reduced costs and could potentially avoid extensive research, development, and long acquisition cycles as with current weapons platforms.

Second, DoD Directive 3000.09 should be re-evaluated and relaxed. In almost every case, the technology far outpaces the policy. Swarms do not allow for any meaningful human control over individual agents. These agents will make targeting decisions once they are deployed. While the "Terminator Conundrum" continues to be debated in the Pentagon, it is already apparent that our adversaries are developing, improving, and integrating autonomous weapons into their doctrine and force structure.[10] The DoD should continue to monitor AWS development by Russia, China, violent extremist organizations, and others. Swarm-capable systems will not realistically allow control at the agent level and policy should be adapted to account for this reality.

Finally, the Army should increase research and development spending on swarm capable systems, sensing, and command and control (C2) mechanisms. Acquisition programs should be tailored to rapidly develop and field these devices. The Army should continue to leverage academia and commercial innovations in self-driving cars and commercial UAS among other private sector initiatives.

ENDNOTES - CHAPTER 5

1. Paul Scharre, "Unleash the Swarm: The Future of Warfare," War on the Rocks, March 4, 2015, available from *https://warontherocks.com/2015/03/unleash-the-swarm-the-future-of-warfare/*, accessed January 7, 2017.

2. Paul Scharre, *Robotics on the Battlefield Part II: The Coming Swarm*, Washington, DC: Center for a New American Security, October 2014, available from *https://www.cnas.org/publications/reports/robotics-on-the-battlefield-part-ii-the-coming-swarm*, accessed January 10, 2017.

3. Doug Wise, "Future Warfare Will Not Allow Meaningful Human Control," The Cipher Brief, January 15, 2017, available from *https://www.thecipherbrief.com/article/tech/future-warfare-will-not-allow-meaningful-human-control*, accessed February 14, 2017.

4. Paul Scharre, "Robots at War and the Quality of Quantity," War on the Rocks, February 26, 2015, available from *https://warontherocks.com/2015/02/robots-at-war-and-the-quality-of-quantity/*, accessed January 8, 2017.

5. "OFFSET Envisions Swarm Capabilities for Small Urban Ground Units," Defense Advanced Research Projects Agency (DARPA), December 7, 2017, available from *http://www.darpa.mil/news-events/2016-12-07*, accessed January 5, 2017.

6. "Threat Report 2017: New Dangers and the American Tech to Beat Them," *Popular Mechanics*, February 6, 2017, available from *http://www.popularmechanics.com/military/weapons/a25062/threat-report-russia-china/*, accessed February 15, 2017.

7. Jeffrey Caton, *Autonomous Weapon Systems: A Brief Survey of Developmental, Operational, Legal, and Ethical Issues*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2015, available from *http://ssi.armywarcollege.edu/pubs/display.cfm?pubID=1309*, accessed August 2, 2017.

8. See official website of the international coalition "Campaign to Stop Killer Robots," available from *https://www.stopkillerrobots.org/*, accessed March 15, 2017.

9. Matthew Rosenberg and John Markoff, "The Pentagon's 'Terminator Conundrum': Robots That Could Kill on Their Own," *The New York Times*, October 25, 2016, available from *https://www.nytimes.com/2016/10/26/us/pentagon-artificial-intelligence-terminator.html?_r=0*, accessed January 11, 2017.

10. Dan Rassler, "Remotely Piloted Innovation: Terrorism, Drones, and Supportive Technology," West Point, NY: Combating Terrorism Center, October 20, 2016, available from *https://www.ctc.usma.edu/posts/remotely-piloted-innovation-terrorism-drones-and-supportive-technology*, accessed March 12, 2017.

CHAPTER 6

GAME OF DRONES: STRATEGIC UNMANNED AERIAL SYSTEMS (UAS) COMMAND AND CONTROL (C2)

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Unmanned aerial systems (UAS), while not a new capability, have increased in importance during the operations since 2001 due to their great persistence and ability to change from an intelligence, surveillance, and reconnaissance (ISR) platform to a precise kinetic asset in a matter of seconds. The military operations tempo over the past 16 years has been unrelenting, and there has been little opportunity to institutionally change how UAS are employed. Emerging Third Offset capabilities and innovative new procedures can innovate how strategic UAS can better serve all of the geographic combatant commanders (GCC).

Discussion in this section is limited to the strategic UAS, specifically the MQ-1 Predator, MQ-1C Gray Eagle, MQ-9 Reaper, and follow-on aircraft that share their attributes. These three UAS have similar capabilities as beyond line of sight, persistent attack platforms that are optimized for high fidelity ISR, but are also able to be switched to an attack role when needed.

Since their inception 20 years ago, the Air Force MQ-1 and later the MQ-9 have experienced tremendous growth. From 1 combat air patrol (CAP) in 2001 to 12 in 2006, the growth still was not enough to supply the combatant commander's (CCDR) demand for more ISR.[1] In 2011, the Air Force fielded 50 CAPs and was directed by Secretary of Defense Robert Gates to increase to 65 by the end of 2013, commenting, "more remains to be done." In the same memorandum, Gates also suggested 65 CAPs is a "temporary plateau in progress toward an even greater enduring requirement."[2] As capacity continues to increase, the demand is already present. At a Pentagon press briefing in 2016, Air Force Chief of Staff, General Mark Welsh told reporters the Air Force would reach 70 CAPs within a year and a half.[3] Furthermore, the Department of Defense (DoD) will increase to a total of 90 CAPs by 2019.[4] That total is represented by Air Force, Army, and contractor operated aircraft. It is clear that the services are increasing capacity by increasing means. In conjunction with increasing quantities, the opportunity is ripe to examine and adjust how the UAS are controlled and utilized by the services.

Command and control (C2) of airpower is a relatively straightforward concept. A GCC is allocated air domain assets to accomplish the mission. The CCDR designates a joint force air component commander (JFACC) to conduct joint air operations in the theater. The JFACC is critical to unity of command and unity of effort of air assets in a given area of responsibility (AOR).[5] The JFACC tasks subordinate commanders through an air tasking order, which integrates air assets to fulfill CCDR intent. Through decentralized execution, the subordinate commanders determine the details of specifically how to accomplish the tasking. This construct allows airpower "to cope with the uncertainty, disorder, and fluidity of combat."[6] According to Joint Publication 3-30, "UASs should be treated similarly to manned systems with regard to the established doctrinal warfighting principles."[7] However, should they?

Strategic UAS have grown tremendously since their early stages of use in 2001, but the concept of operations is largely unchanged; it is simply bigger. MQ-1s and MQ-9s have flown over 3 million hours, of which, 2.8 million hours has been combat. The construct has worked because the preponderance of assets has been allocated to one combatant command—Central Command (CENTCOM).[8] As Chairman of the Joint Chiefs of Staff, General Joseph Dunford pointed out, "Conflicts are very quickly going to spread across multiple combatant commanders [CCDRs], geographic boundaries, and functions."[9] Does the current C2 architecture of allocating UAS to an individual CCDR leverage the key advantages UAS provide? General Dunford suggests not. "We have grown ISR [by] 1,200 percent since 2001, we have grown it 600 percent since 2008. We are currently meeting 35 percent of the stated demand. We cannot buy our way out of this problem."[10]

The current C2 system makes sense with traditional weapons systems. Once an asset is physically in an AOR, it is not feasible to move it to regularly task to another AOR. The inherent agility of strategic UAS is limited by the rigidity of the legacy C2 construct. "Any future conflict will be transregional and multifunctional," according to General Dunford.[11] The current organization does not recognize key differences between a weapons system that must be in a theater in its entirety versus a weapons system that can be distributed amongst all theaters every day. As situations arise around the world, our organizational construct hampers UAS innate capabilities as a global force multiplier.

The strategic UAS offer many advantages in today's complex fight. They give our civilian leaders options for limited warfare with negligible risk to U.S. troops.

For the CCDRs, they present invaluable real-time intelligence akin to watching high definition television and sensors that collect a wide range of signals intelligence. They also offer persistence of the target area and multirole flexibility to strike if the rules of engagement allow. These traits created an evolution in U.S. warfare in a permissive environment, allowing tracking of high-value targets and finishing with a precision strike upon meeting defined criteria. Granted there are numerous vulnerabilities, such as the inability to operate in a contested environment, potential susceptibility to cyber and electronic warfare attack, and manpower and frequency spectrum intensity to name a few. However, the real game-changing technology is not in development, it is one the U.S. Armed Forces utilize but are simply not taking full advantage. That technology is called remote split operations (RSO).

RSO allows the unmanned aircraft to be launched and recovered by a small footprint of personnel and equipment where the aircraft is forward-based. The aircraft is then "passed" (via satellite or other over the horizon communication) to an aircrew located in sanctuary. The mission aircrew flies the aircraft for the duration of the tactical mission, accomplishing all mission tasks until it returns the aircraft and "passes" it back to the forward-based aircrew for landing.[12] This description of RSO, while technologically impressive, serves more to minimize U.S. footprint and political complications across the globe. The game-changing characteristic of RSO involves the flexibility of the mission cockpit to be located anywhere. A single cockpit can control any strategic UAS, anywhere in the world, any time. Even with today's technology, the possibilities are staggering. For example, a cockpit tasked to fly a UAS in support of the CENTCOM AOR may be re-tasked to support a higher priority mission in the

Africa Command (AFRICOM) AOR. Assuming there is an aircraft available to fly; the same cockpit can take control of the AFRICOM aircraft. This example is illustrative, that no "iron" needs to move because of the inherent distributed nature of the strategic UAS. The possibilities are endless when technological growth in capabilities such as auto land, vertical takeoff and land, and carrier launch and recovery are factored in.

In addition, the services associated with the strategic UAS, the Army, and the Air Force utilize them differently. Largely, the organizational construct previously described applies to the Air Force, which bases the majority of its unmanned aircraft overseas with a small contingent of forward-based rotational aircrew and maintenance personnel. The missions are exclusively controlled via RSO and are flown in support of a GCC. In stark contrast, the majority of the Army's Gray Eagles operate organically to support the brigade combat teams. The Army UAS support the ground commander and provide assured support to the maneuver commander.[13] The UAS are generally controlled by cockpits in the theater in which they are flown.

The Army operates differently from the Air Force for logical reason. Unity of command and effort and the associated synergy are more easily achieved when the UAS are assigned to the ground commander. Integration is simpler and effective when the unit trains, deploys, and redeploys together. It is a fundamental difference in Army and Air Force culture and doctrine. The Army historically invested more in small, tactical UAS, controlled via remote control to provide overwatch and scout for the ground unit.[14] These aircraft fit well into the Army organic paradigm. They are inexpensive, expendable, and fly below theater coordinating altitudes. Later, when much larger, more capable

Gray Eagles were acquired, the same concept of operations was applied. Of equal importance to integration is surety. By assigning all UAS organically, regardless of capability, the fear of not receiving support from the strategic UAS is alleviated. The majority of operations are in the CENTCOM AOR, and the tempo has been such that the relatively small numbers of Gray Eagles have been well-employed. However, as demand for persistent ISR grows globally, the Army structure is limiting and unnecessarily constrains their inherently distributed systems.

At the operational level, strategic UAS platforms operate with agility. They provide the commander with all the attributes of agility through persistence and multirole capability. The UAS can loiter in a theater for nearly a full day and have the range to be re-tasked great distances while airborne to cover a wide variety of missions. They deliver options with minimal risk of life. However, at the strategic level, the command function fails to provide agility to the CCDRs as a whole and also fails to capitalize on the advantages RSO offers. Responsiveness is severely lacking at the strategic level, the technology gives the opportunity for global response within hours, but the command structure is not responsive enough to take advantage of global windows of opportunity.

Tactically, strategic UAS share much in common with fighter aircraft. They are both equipped with sensors capable of providing battlefield awareness to the joint air operations center (JAOC) with the ability to employ kinetic effects if needed. However, at the strategic level, UAS share more in common with the global mobility enterprise's aircraft (airlift and tanker) than fighters do. While not intuitive because of the UAS tactical capabilities, the inherent limits of capacity to global demand and their range bear greater resemblance to air mobility assets.

Strategic UAS would flourish in a similar system of operations under a functional CCDR, where forward-based aircraft, equipment, and personnel can be strategically positioned at forward operating bases along the seams of the geographic boundaries of the GCCs. Conceivably, a small number of these aircraft could reach almost anywhere in the world if positioned correctly. Strategic UAS can have the effect of being everywhere at once with RSO; a single cockpit at one location can essentially take control of any strategic UAS in the world. Strategic UAS require a system that takes advantage of their global agility, effectively balances the global demand, and has clearly defined C2 relationships. A functional command would bring unity of effort and garner lessons learned with the ability to adapt and improve to any situation worldwide. The structure would give the appearance that aircraft are everywhere simultaneously, when in reality it would be a highly choreographed, agile C2 system.

Now is the time to implement changes to the strategic UAS community. The technology was rapidly fielded to answer an urgent operational need. The systems have grown from one CAP to over 60 CAPs in just over 15 years, going from niche to a staple in the CCDR's plans. The call for innovation through the Third Offset Strategy is ideal to reform a disjointed enterprise with vast potential. In April 2008, Secretary of Defense Robert Gates frustratingly observed, "Because people were stuck in old ways of doing business, it's been like pulling teeth," with respect to increasing ISR assets in CENTCOM.[15] Nine years later, a means-based solution of increased inventories remains the solution in attempting to satiate all the GCCs' requirements. The DoD is demanding innovation to maintain asymmetric advantage over our adversaries through the Third Offset Strategy. The strategic UAS enterprise can benefit immensely by changing the ways of C2, to synchronize efforts across the globe in the present, and be postured for future technological innovation.

ENDNOTES - CHAPTER 6

1. U.S. Senate, Subcommittee on Airland, Committee on Armed Services, "Hearing to Receive Testimony on Army Unmanned Aircraft Vehicle and Air Force Remotely Piloted Aircraft Enterprises in Review of the Defense Authorization Request for Fiscal Year 2017 and the Future Years Defense Program," 114th Cong., 2nd sess., Washington, DC, March 16, 2016, transcript, Washington, DC: Alderson Court Reporting, March 16, 2016, p. 3, available from *www.armed-services.senate.gov/imo/media/doc/16-32_3-16-16.pdf.*

2. U.S. Secretary of Defense Robert M. Gates, "Continued Growth of Unmanned Aircraft Systems (UASs)," memorandum for Secretary of the Air Force, Washington, DC, June 29, 2011.

3. Phillip Swarts, "Air Force Expanding Flights, Training and Bases for Drones, Top General says," *Air Force Times*, March 7, 2016, available from *https://www.airforcetimes.com/story/military/2016/03/07/rpa-flights-increase-70-day-training-and-bases-grow-too-welsh-says/81454190/*, accessed December 10, 2016.

4. Brian W. Everstine, "DOD Plans 50 Percent Increase in RPA CAPs by 2019," *Air Force Magazine*, August 18, 2015, available from *http://www.airforcemag.com/DRArchive/Pages/2015/August%202015/August%2018%202015/DOD-Plans-50-Percent-Increase-in-RPA-CAPs-by-2019-.aspx*, accessed December 10, 2016.

5. U.S. Joint Chiefs of Staff, *Command and Control of Joint Air Operations*, Washington, DC: U.S. Joint Chiefs of Staff, February 10, 2014, p. II-2.

6. Ibid., p. I-3.

7. Ibid., p. III-29.

8. David A. Deptula, *Revisiting the Roles and Missions of the Armed Forces: Statement before the Senate Armed Services Committee*, 114th Cong., 1st sess., Washington, DC, November 5, 2015, p. 18.

9. Joseph F. Dunford, "Meeting Today's Global Security Challenges," Washington, DC, Center for Strategic and International Studies, March 29, 2016, video file, at 17 min. 20 sec., available from *https://www.csis.org/events/meeting-todays-global-security-challenges%C2%A0-general-joseph-f-dunford*, accessed January 20, 2017.

10. Ibid., at 29 min. 08 sec.

11. Ibid., at 16 min. 53 sec.

12. U.S. Department of the Air Force, *United States Air Force RPA Vector: Vision and Enabling Concepts 2013-2038*, Washington, DC: U.S. Department of the Air Force, February 17, 2014, pp. 20-21.

13. U.S. Senate, p. 13.

14. Michael P. Kreuzer, *Remotely Piloted Aircraft: Evolution, Diffusion, and the Future of Air Warfare*, Ann Arbor, MI: University of Michigan, 2014, p. 71.

15. U.S. Senate, p. 4.

CHAPTER 7

INTEGRATING ARTIFICIAL INTELLIGENCE (AI) INTO MILITARY OPERATIONS: A BOYD CYCLE FRAMEWORK

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The U.S. military has been a leader in implementing emerging and revolutionary technologies. The ever-growing use of autonomous vehicles is an obvious example. These systems have given U.S. forces unprecedented situational awareness and operational abilities. However, there are indicators that the adoption of these maturing information age technologies have yet to reach their full potential. Currently, the use of autonomous systems paradoxically relies extensively on human capital to maintain the systems and process the data generated by those systems.

As the information age matures, the ability to process and distil information may be its new defining feature. The ability to fully integrate information collection, communication, storage, and processing into timely and decisive action may result in new technologically and conceptual advantages. These technologies, embodied in artificial intelligence (AI) and the development of autonomous systems, may cumulatively result in what may be called the Third Offset. However, achieving a Third Offset is not a foregone conclusion.

Exploiting the advantages of AI and autonomous systems will require fuller integration into the decision process (the loop) and an increased trust in their ability to act without human intervention. To examine their integration into decision loops, the relative simplicity of the Boyd loop, also known as the observe, orient, decide, and act (OODA) loop, is an ideal tool to explore AI systems. Its intuitive four steps are easily understood and closely align to the first four principle elements of AI—perceive, understand, predict, and manipulate (as well as learn).[1] The OODA loop provides a clear and obvious framework to explore the implications of integrating AI systems across the spectrum of competitive military environments.

ANALYSIS

Increasingly, success in the battlespace has become about collecting information, evaluating that information, and then making quick, decisive decisions. Network centric warfare with its advanced command and control (C2) concepts demonstrated this concept during the emerging phases of information age warfare. Winning in the decision space is winning in the battle space.[2] Yet, the defining feature of information age warfare, the ability to gather, store, and communicate data, has begun to exceed human processing capabilities.[3] Thus maintaining a competitive advantage in the information age will require a new way of integrating an ever-increasing volume of data into a decision cycle.

Future AI systems offer the potential to continue maximizing the advantages of information superiority, while overcoming limits in human cognitive abilities. AI systems, with their near endless and faultless memory, lack of emotional investment, and potentially unbiased analyses, may continue to complement future military leaders with competitive cognitive advantages. However, these advantages may only emerge if

AI systems are understood, properly utilized, and integrated seamlessly into a decision process.

The potential implications of future AI systems will be explored through the remainder of this discussion using the OODA loop as the overarching framework. This framework will provide a methodical approach to explore: 1) how future autonomous AI systems may participate in the various elements of decision cycles; 2) what aspects of military operations may need to change to accommodate future AI systems; and, 3) how implementation of AI and its varying degrees of autonomy may create a competitive decision space.[4] The examination of potential implications of AI on internal military operations will also use the doctrine, organization, training, materiel, leadership, education, personnel, and facilities (DOTMLPF) framework.

OBSERVE

This analysis begins with the first element of the OODA loop, observe. Observation is more than simply seeing. Observation implies two distinct but entwined activities. The first activity is scanning the environment and the second is recognizing potentially meaningful events. It is the combination of these activities that forms the basis for a sentient observation. The automation of observation can be performed using AI systems, either solely as an automated observation, or as part of a broader integrated decision loop. The degree of autonomy for the two activities of observation may vary. High autonomous AI systems may be allowed to select or alter scan patterns, boundary conditions, and numerous other parameters; potentially including the selection of the scanning platforms and sensor packages. While at the other end of the autonomy spectrum, low autonomous AI systems might be precluded from altering pattern recognition parameters or thresholds for flagging an event as potentially significant. In this domain, AI systems could perform potentially complex analyses, but with limited ability to assess or reassess the potential significance of an event. Fundamentally, the output from the observe activity is the observation of data and the signaling that further analysis is necessary. A military example of this would be the development of field reports that annotate the observation of hostile adversaries. The report developed by a field unit is reflexively developed and passed up a chain of command. Moreover, organizationally, no significant analysis is performed until some command or staff element decides to take further action.

Extrapolating from this, it is not difficult to infer that when AI systems operate as autonomous observation systems they could easily be integrated into existing doctrine, organizations, and training. Issues may however arise when we consider manned and unmanned mixed teams. For example, sentry outpost locations and configurations described in existing doctrine may need to be revised to address additional considerations for AI systems, such as safety, degrees of autonomy, communication, and physical capabilities, and dimensions, and integration issues with human forces.

ORIENT

Orient is the processes and analyses that establish the relative significance of an observation. The orientation occurs when the observation is placed in the context of previous experiences, organizational, cultural, or historic frameworks; and other observations. From this, the observation's significance and priority are assessed.

The degree of priority given to an observation then determines how resources will be committed to incorporate the observation into an operational picture. If the priority is low, further analysis may not occur. If the priority is moderate, perhaps the observation is aggregated with other observations for later analyses, or rudimentary analysis. Moreover, if the priority is high, the observation may be evaluated in detail. Thus, in a data rich environment, with limited analytical resources, large fractions of observations may not be evaluated in detail or brought into the operational picture.

The emergence of AI systems capable of contextualizing data has the potential to address this issue. The International Business Machine (IBM) Corporation has already fielded advanced cognitive systems capable of performing near human level complex analyses.[5] Moreover, it is expected this trend will continue and these types of AI systems will continue to displace humans performing many staff officer, "white collar," activities.[6] Autonomy issues associated with AI systems orientating data and developing operational pictures are complex. AI systems operating with a high autonomy may independently prioritize data; add or remove data from an operational picture; possibly deconflict contradictory data streams; change informational lenses; and set priorities and hierarchies. High autonomous AI systems could also ensure the operational picture is the best reflection of the current information. The tradeoff to this most accurate operational picture might however be a rapidly evolving operational picture with little continuity that could possibly confound and confuse system users.

At the other end of the spectrum, low autonomous AI systems might not explore alternative interpretations of data. These systems may use only prescribed informational lenses and data priorities established by system users or developers. The tradeoff for a stable and consistent operational picture might be one that is biased by the applied informational lenses and data applications. This type of AI system may just show users what they want and expect to see.

The use of AI systems for the consolidation, prioritization, and framing of data may require a review of how military doctrine and policy guides the use of information. Similar to the development of rules of engagement, doctrine and policy present interesting challenges to developing rules of information framing. For example, doctrine or policy development could potentially prescribe or restrict the use of informational lenses. While applying a lens to organize information is not without precedent, under a paradigm where AI systems could implement doctrine and policy without question or moderation, the consequences of a policy change might create a host of unanticipated consequences.

DECIDE

Decide is the process used to develop, and then select a course of action. As a rational action, a decision is the selection of a course of action that is forecasted to improve a situation or achieve a specified goal. Prior to selecting a course of action, the military decision-making process generally requires the development of multiple courses of action (COA) and consideration of their likely outcomes. These COAs are compared (based on criteria), and the COA with the preferred outcome is selected. The methods for developing COAs and choosing among them can be categorized as rules based, or values based, decisions.

Rules based decisions explore ends, ways, and means, through the lenses of feasibility and suitability, but do not actively address questions of acceptability or risk. Further, rules based decisions are prescriptive with the decision space closed. A good example of rules based decision-making is a cashier dispensing correct change. There are multiple COAs or solutions to the problem; provide change in using largest bills and coins available and appropriate, or use the smallest bill and coins available and appropriate. These COAs are bounded and well quantified. Yet because the rules for providing change were absolute, there were no considerations of acceptability or risk in COA development or selection.

In this example of providing correct change, legal and ethical values are intrinsic to the process of providing correct change. However, when applied as a rule, provide correct change contains no consideration (by a cashier) about the acceptability or risks of not providing correct change. The only consideration is compliance with the rule.

In this sense, if an AI system is using a rules based decision process, there is inherently a human-in-the-loop, regardless of the level of the AI autonomy. This is because human value judgments are inherently contained within the rule development process. From this perspective, when considering the concept of human in or on-the-loop, it would be worthwhile to include additional qualifiers of active or embedded human participation. Active human-in-the-loop implies an operator or external agent is assuming some responsibility for the value judgments. However, an AI system with an embedded human-in-the-loop implies an engineered value judgment, thus anchoring responsibilities for the value judgments to the engineers of the AI system.

Value based decisions explore ends, ways, and means, through the lenses of feasibility and suitability, while also potentially addressing issues of acceptability and risk. Value based decisions are generally associated with subjective value assessments, greater dimensionality, and generally contain some legal, moral, or ethical qualities. The generation of COAs and their selection may involve substantially more nuanced judgments. Autonomy for AI systems involved in the decision process can be divided into the two parts of the decide step, the development of COAs (and their predicted outcomes) and the selection of a preferred COA. The division of decide into two distinct activities may result in a mix in levels of autonomy used in the decision process. High levels of autonomy may be granted for the development of COAs, while medium or low autonomy may be granted for the selection of a preferred COA. Alternatively, other combinations of high or low autonomy could be used.

The employment of value based or rules based decisions tends to vary according to the operational environmental and the level of operation. Tactical applications often tend toward rules based decisions, while operational and strategic applications tend toward values based decisions. Clarifying doctrine, training, and policies on rules based and values based decisions could be an essential element of ensuring that autonomous decision-making AI systems are effectively understood, trusted, and utilized.

During the acquisition of AI systems, AI decision process categories (such as rules-based, values-based, emulation-based, or other processes) should be understood and standardized. Thus, creating clear categories of AI systems may improve the system acceptance and the expectations by human operators and engineers. This could also aid in clarifying responsibilities for AI decisions between operators, systems, and engineers.

ACT

The last element of the OODA loop is act. For AI systems, this ability to manipulate the environment may take several forms. The first form may be indirect, where an AI system concludes its manipulation step by notifying an operator of its recommendations. The second form may be through direct manipulation, in either or both the cyber and physical domains. Within the OODA framework, once the decision has been made, the act is reflexive. For advanced AI systems, there is the potential for feedback to be provided and integrated as an action is taken. If the systems supporting the decision operate as expected, and events unfold as predicted, the importance of the degree of autonomy for the AI system (to act) may be trivial. However, if events unfold unexpectedly, the autonomy of an AI system to respond could be of great significance.

Consider a scenario where an observation point (OP) is being established. The decision to set up the OP was supported by many details. Among these concerns were the path taken to set up the OP, the optimal location of the OP, the expected weather conditions, and the exact time the OP would be operational. Under a strict interpretation, if any of the real world details differed, even slightly, from those supporting the original decision, they would all be viewed as adjustments to the decision, and the decision would be voided. While under a less restrictive interpretation, if the details closely matched the expected conditions, they would be viewed as adjustments to the approved decision, and the decision would still be valid.

High autonomous AI systems could be allowed to make adjustments to the act. Allowing adjustments to the act would preclude a complete OODA cycle reiteration. By avoiding a reiteration of the OODA cycle, an AI system might outperform low autonomous AI elements (and human oversight) and provide an advantage to the high autonomous system. Low autonomous AI systems following strict interpretation would be required to reinitiate a new decision cycle every time the real world did not exactly match expected conditions. While the extreme case may cause a perpetual initiation of OODA cycles, some adjustments could be made to the AI system to mitigate some of these concerns. The challenge still remains to determine the level of change that is significant enough to restart the OODA loop. Ultimately, designers of the system would need to consider how to resolve this issue.

Humans often employ assumptions when assigning or performing an action. There is a natural assumption that real world conditions will differ from those used in the planning and authorization process. When those differences appear large, a decision is reevaluated. However, when the differences appear small, a new decision is not sought, and some risk is accepted. The amount of risk is often intuitively assessed, and dependent upon personal preferences, the action will continue or it is stopped. However, because of the more literal nature of computational systems, autonomous systems may not have the ability to assess and accept personal risks. As a result military doctrine addressing command and leadership philosophies, such as mission command and decentralize operations, should be reviewed, and if necessary updated, to determine their applicability to operations in the information age.[7]

CONCLUSION

This section examined how AI systems might perform four principle functions: perceive, understand, predict (and choose), and manipulate (act). These functions were then examined in respect to OODA decision loop. The OODA loop, with its four principle steps: observe, orient, decide, and act, closely aligned with the aforementioned four elements of AI systems and provided an approach to consider future AI systems for military operations.

Through this lens, it was demonstrated that the integration of future AI systems has the potential to permeate the entirety of military operations, from acquisition philosophies to human-AI team collaborations. Key issues identified in this study include a potential need to develop clear categories of AI systems and applications. These categories should be aligned along axes of trust, with rules-based and values-based decision processes clearly demarcated. This study also established a coherent framework for future discussions about the integration of AI systems in future military operations.

ENDNOTES - CHAPTER 7

1. Tim Grant and Bas Kooter, "Comparing OODA and Other Models as Operational View C2 Architecture," paper presented at the 10th International Command and Control Research and Technology Symposium, *The Future of Command and Control*, Virginia Beach, VA, October 4-6, 2005, available from *http://www.dodccrp.org/events/10th_ICCRTS/CD/papers/196.pdf*, accessed August 3,

2017; Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, Englewood Cliffs, NJ: Prentice-Hall, 1995.

2. Roger N. McDermott, *Russian Perspective on Network-Centric Warfare: The Key Aim of Serdyukov's Reform*, Fort Leavenworth KS: Foreign Military Studies Office, U.S. Army, 2011.

3. Ang Yang, Hussein A. Abbass, and Sarker Ruhul, "Evolving agents for network centric warfare," in *GECCO '05 Proceedings of the 7th annual workshop on Genetic and evolutionary computation*, New York: Association for Computing Machinery, 2005, pp. 193-195.

4. Decision space is the range of options that military leaders explore in response to adversarial activities. Competitiveness in the decision space is based on abilities to develop more options that are effective and to develop and execute them more quickly. Numerous approaches to managing decision space exist. Network-centric warfare is an approach that emphasizes information rich communications and a high degree of decentralized decisions to generate options and self-synchronized activities.

5. The International Business Machine (IBM) Corporation, specifically IBM Watson Analytics, has been employing cognitive analytics and natural language dialogue to perform big data analyses. IBM Watson Analytics has been employed in the medical, financial, and insurance fields to perform human level analytics. These activities include reading medical journals to develop medical diagnosis and treatment plans; performing actuary reviews for insurance claims; and recommending financial customer engagement and personalized investment strategies.

6. Aaron Smith and Janna Anderson, "AI, Robotics, and the Future of Jobs," Pew Research Center, August 6, 2014, available from *http://www.pewinternet.org/2014/08/06/future-of-jobs/*, accessed March 5, 2017; Executive Office of the President, *Artificial Intelligence, Automation, and the Economy*, Washington, DC: Executive Office of the President, December 2016, available from *https://obamawhitehouse.archives.gov/sites/whitehouse.gov/files/documents/Artificial-Intelligence-Automation-Economy.PDF*, accessed March 5, 2017.

7. Jim Storr, "A Command Philosophy for the Information Age: The Continuing Relevance of Mission Command," *Defence Studies*, Vol. 3, No. 3, Autumn 2003, pp. 119-129.

PART III:
IMPLICATIONS FOR ARMY INSTITUTIONS

CHAPTER 8

INFLUENCING THE RATE OF INNOVATION

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> We are entering an era where American dominance in key warfighting domains is eroding, and we must find new and creative ways to sustain, and in some areas expand, our advantage even as we deal with more limited resources. This will require a focus on new capabilities and becoming more efficient in their development and fielding.[1]

STRATEGIC ALIGNMENT

Erosion of U.S. military superiority will continue if the Department of Defense (DoD) does not think critically and creatively about the modernization challenges faced today and the operational challenges to be confronted in the future. This requires our strategic leaders to focus on limiting the DoD constraints to innovation and providing a vision of the future force and a path for developing the optimal future force.

In order for the U.S. Army to become an innovative organization, it will be necessary to organize appropriately. Army organizations must promote an innovative culture, accept risk, and leverage new ideas while collaborating and partnering on experiments to enhance creativity. Collaboration is essential to successful innovation and includes partnerships between acquisition, requirements, the defense industry, research and development community, Soldiers and units. The future Army depends on the ability to think clearly about the future character of warfare and apply processes that will foster creative thought about achieving strategic overmatch through an agile acquisition framework. The acquisition framework adopts commercial business concepts for innovation while tailoring to support the bureaucracy of the DoD business process.

THE INNOVATIVE FRAMEWORK

The 23 Army Warfighting Challenges (AWFC) are the enduring first-order problems the Army must solve to improve the combat effectiveness of the current and future force. The fourth AWFC is to, "Adapt the Institutional Army and Innovate."[2] In order to accomplish this, the Army should develop an innovative framework that evolves the Army to not only be innovative, but also accelerate innovation and improve combat effectiveness for the current and future force. The innovative framework can use existing ideas and processes in the DoD and refine, tailor, and improve them for a specific project outcome and (as applicable) integrate them with industry best practices. The framework supports continuous and regular collaboration with industry to assist in various strategic approaches to force modernization. These strategic approaches range from technology maturity, feasibility studies, and to assistance in requirements development or mentorship programs of small innovative business.

The innovative framework accomplishes the following. First, the framework incorporates innovative organizations with innovative cultures. Second, it emphasizes partnering and collaboration with industry and the operational force. Third, it leverages opportunities to experiment, learn, and develop ideas in a collaborative environment for both industry and military. Fourth, it facilitates an innovative process that links operators and engineers in the field that enables innovation and optimizes information exchange while fostering creativity. At the lowest level, the framework aligns developers with the users resulting in enhanced learning and accelerating the rate of innovation.

COMMERCIAL BEST PRACTICES

A review of the flourishing innovation in the corporate world is a DoD necessity. The DoD must adopt best practices that are applicable to the DoD business model of operation. Six best commercial practices emerge from various commercial sources that should be incorporated in the acquisition innovative framework.

- First, align to a vision, strategy, and culture.[3] Strategic leaders should create the vision and establish the priorities for future force modernization. The culture of the organization needs to believe in the vision and strategy and to understand their role in contributing to its success.
- Second, "divergence" functions of creative thinking and organizations. The collaborative design process can assist with breaking down typical thought processes and solutions to problems. Outside resources can bring new ideas, different perspectives, and spur creative thinking. For example, design the multi-domain battle concept into the development process upfront and early.
- Third, processes for innovation management.[4] Innovation management is evolving into a mainstream management discipline much like

behavior management of the 1990s. Successful innovative companies have presented a predictable, repeatable innovation process.

- Fourth, "evolve ideas" as an innovative framework tenet applicable to best practices.[5] This best practice focuses on evolving ideas based on a collaborative effort among a diverse group, maturing concepts to further explore their validity. Conducting prototype experiments to test and validate ideas or concepts is the foundation to either build upon or dismiss the idea. The value of early experimentation is the efficient use of time and schedule; early failure saves resources for more rewarding ideas.
- Fifth, evaluate and rate concepts or ideas, which are essentially grading the product based on its merit.[6] The Army Warfighting Assessment (AWA) is an opportunity for capabilities to be evaluated and rated by Soldiers; this data and information is shared as necessary for evolutionary improvement. This is an essential step in the process that must be performed by subject matter experts who understand the product and how it will be deployed.
- Sixth, continuously scan the future environment. Innovative organizations continuously evaluate the evolving changing environment. Developing concepts and capabilities today for future risk is essential in developing for the future.

ARMY CAPABILITIES INTEGRATION CENTER (ARCIC) INNOVATION DIRECTORATE (ID)

The ARCIC ID is a proposed acquisition-centric directorate within ARCIC. The ID is the organizational foundation of the innovative framework. The ID will emphasize the innovative culture and lead the Army in its pursuit to innovative ways to sustain Army and Joint strategic capabilities for the 21st century. ID aligns with the other three directorates in ARCIC, but perform duties that align force modernization with the Defense Innovation Unit Experimental, defense industry, the acquisition community, science and technology, and service components. This directorate will promote the innovative culture in order to unharness the energy and creativity of industry and soldiers. Leveraging the associational thinking of innovative industry and soldiers is an area of opportunity that can assist in improving capabilities. Soldiers have a vested interest in what equipment they use in combat, increasing their stake and value in contributing to the product and its development. Ideally, we want our operators to be part of the process engaging in creative behavioral skills to improve their ability to fight and win. The ID would be an acquisition organization within ARCIC that provides the appropriate diversity of skill sets that understand the institutional Army, governmental bureaucracy, and aligns with the requirements community to facilitate efficient material development in support of operational requirements, timelines, and the Third Offset priorities.

General Mark A. Milley, Chief of Staff of the U.S. Army, stated, "Aligning responsibilities with authorities only improves the acquisition process."[7] The ID recommendation includes leadership of an acquisition brigadier general with acquisition officers and civilian supervisors as team leads throughout the organization. The 0-7 grade aligns with the other directorates in ARCIC and is necessary to influence modernization decisions across the strategic level of stakeholders involved in force modernization, requirements, and program executive offices. Success hinges on maximum traction to change, overcome institutional barriers, and rapidly integrate necessary stakeholders.

The ID would be ineffective as an innovative organization if it did not have the resources to support its mission. Resources include the acquisition personnel and funding to implement focus assessments, experiments, and evaluations based on Army priorities. The implied task with resources includes the management of a budget and submission of a Program Objective Memorandum across the Fiscal Year Defense Program. The bill payer for the ID positions requires further analysis from the Training and Doctrine Command (TRADOC), Army Contracting Command, and the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics.

THE INNOVATIVE CONCEPT

The primary responsibility for the ID would be to provide the integration between requirements, acquisition, and the face to industry. Therefore, all material development requirements will be assisted by the ID. This responsibility includes supporting the ARCIC learning demands relevant to material capability solutions and working closely with TRADOC directorates, Brigade Modernization Command, Force 2025 maneuvers, Army Warfare Group, Rapid Equipping Force, Defense Advanced Research Projects Agency, and the science and technology community. The ID would apply the learning demands to lines of effort and the priorities established by the U.S. Army and the Third Offset. This concept keeps the acquisition community engaged in their area of expertise (material development) while further integrating requirements development and the acquisition process. Accuracy of the required capability is fundamentally the most important part of the acquisition process. One of the primary objectives of the innovative concept is to improve on the integration of the acquisition and requirements processes.

In addition, the concept supports an ARCIC single face to industry to assist with the partnering and collaboration with DoD industry partners. Leveraging input from industry is crucial to the creative innovative process and necessary to the discovery and generation of new and valuable capabilities. This can be accomplished by adopting the U.S. Special Operations Command's Technology Integration Liaison Office concept into ARCIC via the ID. The ID would lead the "face to industry" for the Army, and coordinate and manage industry briefs and updates for innovative projects and ideas from industry. The management of industry is important to the innovative concept; it is critical that acquisition professionals include acquisition lawyers to lead this effort. The safeguarding of proprietary technology, intellectual property, information, and data—to include cost data—are paramount in this effort.

INNOVATE FORCE 2025 MANEUVERS (F2025M)

Thomas Edison developed the concept of the industrial research and development laboratory when he built what was really an idea factory at Menlo Park, New Jersey. Menlo Park had no manufacturing facilities—only research and prototype construction was performed there.[8]

F2025M are exercises and experiments designed to incorporate, assess, test, evaluate, and validate *Force 2025 and Beyond* ideas and capabilities.[9] The F2025M can comprise of almost any venue that can evaluate, assess or provide feedback to the developer, company, engineering team, soldiers, program manager or requirements writer to either improve, inform or terminate a product or concept.

The F2025M concept is the experimentation opportunity for any organization to collect information or data on a developing capability or concept. The ID will facilitate its own experiments—called focused assessments—based on developing capabilities prioritized by Centers of Excellence (CoE) and ARCIC. In addition, the AWA will continue to be one of the premier F2025M venues to experiment, evaluate, and collect information for new up-and-coming capabilities. Properly funding and empowering the CoE battle labs to lead the experimentation effort based on CoE concepts and priorities is a first order task. Solving problems and refining requirements upfront and early at the proponent level is essential. The ID would champion and advocate experimentation results and concepts to ARCIC and all associate stakeholders. The ID as described would influence the acceleration of Army priorities aligned with the Third Offset.

CONCLUSION

General Milley stated, "Our adversaries are rapidly leveraging available technology; our acquisition process must be agile enough to keep pace."[10] Based on this caution, the Army should consider the following recommendations. First, implement the proposed organization and staffing of the ID within the ranks of the ARCIC team. Integrate the proposed acquisition framework and maximize its traction across the Army, TRADOC, and the Acquisition community. The proposed acquisition framework aligns with the Chief of Staff of the Army and ARCIC priorities linked to Force 2025 and the ARCIC mission. Analyze—examine solutions to AWFC, specifically answering the fourth AWFC, "Adapt the Institutional Army and Innovate."[11] In addition, the Army should examine learning, demand answers, and apply that knowledge to material development priorities associated with the Army's Big 6 +1 funding priorities and the Third Offset priorities. Implement solutions to increase the rate of innovation, collaborate with industry, requirement community, program executive offices, and the entire force modernization team on experiments, focused assessments, F2025M on concepts, ideas and capabilities that have learning demands and require analysis and assessments for future force opportunities.[12] The Army should leverage best practices from successful innovative commercial companies and new DoD innovative initiatives like the Defense Innovation Unit Experimental approach and Better Buying Power 3.0. These efforts coupled with the proposed acquisition framework will accelerate the rate of innovation within the Army.

ENDNOTES - CHAPTER 8

1. U.S. Secretary of Defense Chuck Hagel, "The Defense Innovation Initiative," memorandum for Deputy Secretary of Defense and Secretaries of the Military Departments, Washington, DC, November 15, 2014, p. 1.

2. Army Capabilities Integration Center (ARCIC), "Army Warfighting Challenges," ARCIC Flyer, Fort Eustis, VA: Army Capabilities Integration Center, as of January 31, 2017, available

from *www.arcic.army.mil/App_Documents/AWFC-Current.pdf*, accessed February 7, 2017.

3. Howard Brock and Loubna Erraji, "Commercial Model Makeover: Six Best Practices for Innovative Commercial Model Design," *White Paper*, New York: Campbell Alliance, January 2013, available from *consulting.inventivhealth.com/articles/Campbell%20 Alliance%20-%20Commercial%20Model%20Makeover%20-%20 January%202013.pdf*, accessed March 6, 2017.

4. Microsoft Corporation, "Best Practices for Innovation: Microsoft's Innovation Management Framework," *White Paper*, Redmond, WA: Microsoft Corporation, June 2013, p. 6.

5. Ibid., p. 8.

6. Ibid., p. 9.

7. Chief of Staff of the Army General Mark A. Milley, "2017 Posture statement of the U.S. Army," U.S. Army, February 24, 2016, available from *https://www.army.mil/article/163561/2017_ Posture_statement_of_the_U_S__Army/*, accessed March 3, 2017.

8. Thomas F. Hanson, *Engineering Creativity*, 2nd ed., Newhall, CA: University of Virginia, 1997, p. 31

9. ARCIC, "Force 2025 & Beyond Maneuvers and Army Warfighting Assessments," ARCIC Flyer, Fort Eustis, VA: Army Capabilities Integration Center, n.d., available from *www.arcic.army. mil/App_Documents/AWA.pdf*, accessed February 7, 2017.

10. Milley.

11. Ibid.

12. Ibid.

CHAPTER 9

IMPLICATIONS TO ARMY ACQUISITION

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The Army acquisition process is designed to reduce risk to the Army enterprise to the maximum extent possible. As a result, the process is complex and convoluted, which results in long development, production and fielding cycles. In order to realize the potential of the Third Offset, the Army must identify areas within the acquisition process to make more efficient or significantly modify. Failure to adapt to the emerging environment will widen current capability gaps and create new gaps between the Army and its potential adversaries.

The velocity at which technology emerges creates two critical implications for the Army—the need to emphasize program schedule over cost and to reform its requirements process. Additionally, the rise of peer competitors creates a budgetary balancing act—supporting readiness and maintaining current capability while also addressing the requirement to invest in the future force. However, no implication is greater than the cultural changes required to implement Third Offset capabilities.

The Army's challenge will only worsen as the speed at which technology becomes available or adoptable continues to increase.[1] The Army can no longer fail to be an early adopter of new and disruptive technologies. Simply, the first actor or nation to adopt the emerging technology will gain a competitive advantage over its rivals. For example, should a near peer develop and procure fully autonomous weapons prior to the United States that near peer would gain a temporal advantage relative to U.S. capabilities.

The importance of rapidly providing technology to the Army, or what industry describes as "time to market," was highlighted by two leading industry thinkers, John Kovach and Artie Mabbet, who posit:

> looking at adversary cycle times we see that their agility and focus allows them to be inside of our production loop, often fielding counters to our capabilities as our systems are introduced . . . creating gaps and forcing reactionary responses.[2]

However, Kovach and Mabbet offer that, "If that equation can be flipped, where . . . [we] can introduce advanced capabilities at a faster pace, it will put our adversaries in a more reactionary mode."[3]

Requirements are the most significant activity for program to meet its cost and schedule target. A 2008 Government Accountability Office (GAO) report found that "programs with requirement changes experienced cost increases of 72%, while costs grew by 11% among those programs that did not change requirements."[4] Further, a 2011 GAO report stated that "programs with changes to performance requirements experienced roughly four times more growth in research and development costs and three to five times greater schedule delays."[5]

There are fundamental areas that the Army needs to consider vis-à-vis requirements, as it pertains to the Third Offset to avoid previous painful acquisition misses. The Army must articulate a concept for the conflicts of 2035-2050 that is informed by the potential Third Offset capabilities. The Army must then proceed on a much broader series of experiments and battle lab effort to allow the Army to introduce a specific campaign plan for a tiered set of priority requirements based on gaps identified during the wargames and experiments.

The Army must also open an honest and candid feedback loop with industry. Raytheon's chief executive officer, Thomas Kennedy, offered that critical to the success of the Third Offset "will be close collaboration among industry, academia and government to rapidly innovate and integrate the next-generation."[6] Furthermore, analysis of recent Israeli acquisitions provides another insightful notion that partnership with industry, not competition, "enables shorter timelines by matching current needs" and increases system effectiveness.[7] For example, the Army should identify core research and development capabilities to maintain within its research laboratories that would provide industry an understanding of other areas for it to invest. This practice would eliminate duplicity of effort and resources by ensuring the Army and industry are not solving the same technical problem. Likewise, rapid prototyping provides early assessments of capabilities and reduces resource risk and opportunity costs.

Finally, the Army should review how requirements are crafted. Early adoption necessitates an incremental process that allows the technology or capability to be integrated over time as it continues to mature. A similar notion was recently provided by Dr. Will Roper, in what he sees as the perils of how requirements are defined. He suggested that there is far too much specificity in requirements that prohibit architecture or systems engineering trades.[8] All of the aforementioned requirement recommendations affect both resourcing and culture.

Similar to the challenge of rapidly adopting technology, the Army is also confronted by the lack of fiscal resources. The Third Offset will intensify internal pressures on the Army's Research, Development, and Acquisition account because of the funding required to mature the technologies. Further, once the technologies are matured, a dichotomy will emerge between funding the current, fielded systems versus the emerging, next generation systems, all while maintaining readiness. Lieutenant General (Retired) David Barno and Nora Bensahel described this as a "strategic crossroad" because:

> the Army has to contend with a 'pernicious combination of a shrinking force, declining resources, increasing global commitments, and the renewed possibility of major power conflict.'[9]

Furthermore, Barno and Bensahel posit, "Leaders face 'inevitable tradeoffs between the need to fight today's wars while preparing for the possible wars of the future—and the need to pay for both.'"[10]

Additionally, parochial, interservice power struggles that occur every budget cycle will be exacerbated. Not only is interservice budget competition likely, but so are non-intraservice budget competitions as different proponents continue to argue to maintain established Programs of Record funding levels. Because the funding process is a zero sum game, in order to fund emerging Third Offset programs, the Services and the Office of the Secretary of Defense will stay within the Army's Research, Development, and Acquisition account for bill payers.[11]

This overarching budget challenge calls for "imagination, creative solutions, and unrestrained thinking."[12] Some possible options to consider are tiered forces, not only in readiness levels that are currently under consideration, but also tiered capability. This proposal, while creating the budget room, creates contentious issues. This will cause sustainment impacts to maintain essentially two or more armies. In addition, this could create training issues caused by personnel turnover from one tier to the next. Lastly, this construct could create a counterproductive environment of haves and have nots.

Arguably, the most efficient and best practice to adopt is a regimented enterprise and a project-portfolio management framework. This framework would advocate and encourage cross portfolio trades and establish analytical underpinnings to resource allocation decisions causing resource managers to think of the enterprise during Program Objective Memorandum development.

The Army must evaluate the use of Third Offset capabilities within the acquisition process. For example, leveraging big data—deep learning and artificial intelligence (AI)—to assist in resource allocation, program schedule optimization, and even within the context of identification of programs with the highest probability of success.

The previous challenges notwithstanding, the most important endeavor the Army must address is its acquisition culture.

> The process in place currently emphasizes low-risk solutions and approaches; however, technically and programmatically there are times where significant gains can be made by taking calculated risk.[13]

This overemphasis on reducing risk exposure results in a culture that "rewards individuals and programs for 'not messing up' rather than incentivizing success."[14]

Therefore, the Army must thoroughly review how it views risk. The Army is firmly grounded in risk aversion, which stymies innovation. Reducing nearly all programmatic risk requires time and funding and there are measurable opportunity cost associated with extreme risk aversion.[15] This approach is seen in the acquisition process where there is a "traditional hierarchy . . . [that] has numerous levels of leadership involved in decision-making based on the type and impact of the decision."[16] In order to both streamline the process and to take full advantage of opportunities "Senior leadership needs to be able to rely on their teams to take calculated risks" and "Key decisions need to occur on the timeline of the technology and progress of a program rather than based on the process" all of which implies a degree of empowerment.[17]

The need to innovate and adopt (field) quickly, makes teaming a critical component for the Army's future acquisition success. To fully achieve unity of effort, the Army should realign the Development and Engineering Centers out of Army Materiel Command (AMC) to the Office of the U.S. Assistant Secretary of the Army for Acquisition, Logistics, and Technology. Since AMC's core capability is sustainment, this is a sensible realignment with the potential to create greater effectiveness and efficiency.

In conclusion, the emergence of the Third Offset provides the Army an opportunity to optimize acquisition initiatives and efforts. This provides a compelling narrative to drive the necessary changes to become more efficient and effective. The one characteristic that remains constant during the next 20 to 30 years is the velocity of change and speed of innovation. The Army must recognize this, adapt to it, and take advantage of this trend, or risk being left behind.

ENDNOTES - CHAPTER 9

1. "50 Years of Moore's Law: Fueling Innovation We Love and Depend On," Intel Corporation, n.d., available from *http://www.intel.com/content/www/us/en/silicon-innovations/moores-law-technology.html*, accessed March 29, 2017. Moore's Law states for computers that either or both, processor speeds and processing power will double every 2 years.

2. Artie Mabbett and John Kovach, "'Third Offset' Strategy Calls for Fresh Thinking," *National Defense*, January 10, 2017, available from *http://www.nationaldefensemagazine.org/articles/2017/1/10/third-offset-strategy-calls-for-fresh-thinking*, accessed August 7, 2017.

3. Ibid.

4. Government Accountability Office (GAO), *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-08-467SP, Washington, DC: Government Accountability Office, July 2, 2008, p. 8.

5. GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-11-233SP, Washington, DC: Government Accountability Office, March 29, 2011, pp. 14-15.

6. Thomas A. Kennedy, "Raytheon's CEO: The DoD's Third Offset Strategy Remains Critical to National Security," *Defense News*, December 5, 2016, available from *https://www.defensenews.com/outlook/2016/12/05/raytheon-s-ceo-the-dods-third-offset-strategy-remains-critical-to-national-security/*, accessed August 7, 2017.

7. Nir N. Brueller, David R. King, and Rojan Robotham, "Competition in Defense Acquisition: A Comparison of Perspectives," paper presented at The Limits of Competition in Defense Acquisition, Defense Acquisition University Research Symposium, Fort Belvoir, VA, September 18-19, 2012, available from *http://dau.DODlive.mil/2015/06/30/competition-in-defense-acquisition-a-comparison-of-perspectives/*, accessed March 15, 2017.

8. William Roper, "Creative Disruption: Harnessing Innovation for Strategic Effect," Center for Strategic & International Studies International Security Program Forum, Washington, DC, July 13, 2016, video file, available from *https://www.csis.org/events/*

creative-disruption-harnessing-innovation-strategic-effect, accessed January 12, 2017.

9. David Barno and Nora Bensahel quoted in Sandra I. Erwin, "Army Looks to Change the Conversation with Defense Industry," *National Defense*, January 9, 2017, available from *http://www.nationaldefensemagazine.org/articles/2017/1/9/army-looks-to-change-the-conversation-with-defense-industry*, accessed July 28, 2017.

10. Ibid.

11. Timothy A. Walton, "Securing the Third Offset Strategy: Priorities for the Next Secretary of Defense," *Joint Force Quarterly*, Iss. 82, 3rd Qtr. 2016, pp. 6-15.

12. Ibid., p. 15.

13. Mabbett and Kovach.

14. Ibid.

15. Ibid.

16. Ibid.

17. Ibid.

PART IV:
IMPLICATIONS FOR ARMY LEADER DEVELOPMENT

CHAPTER 10

HUMAN-MACHINE DECISION-MAKING AND TRUST

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> We have to place the big bets . . ., every assumption we hold . . . must be challenged. War, war tends to slaughter the sacred cows of tradition. . . . Those of us . . . that stubbornly cling to the past will lose . . . in a big way.[1]

For 2050 and beyond, the Department of Defense (DoD) Third Offset Strategy leverages technology across warfighting capabilities with new operational and organization constructs to enable DoD to wage multi-domain battle.[2] Human-machine collaborative decision-making is a future capability that teams the best characteristics of human leaders with opportunities derived from artificial intelligence (AI) including autonomous systems and machine learning. The U.S. Army is people-centric, vice weapons platform-centric, so the Army needs to be aggressive in developing leaders to maximize human-machine decision-making effectiveness in a multi-domain operational environment.[3]

The current Army Leadership Requirements Model addresses attributes and competencies of leaders that centers on human-human relationships, but the future trends will challenge leaders with more human-machine relationships.[4] The Army should adapt leader and team development strategies, underpinned by mission command philosophy (centered on trust), leadership attributes (character, presence, intellect), and core leadership competencies (leads, develops, achieves), to enable our leaders to aptly trust and lead increasingly capable levels within a broad category of AI. This aligns with (but is currently absent from) several Army Warfighting Challenges (AWFC): 1) Situational Understanding; 9) Improve Soldier, Leader and Team Performance; 10) Develop Agile and Adaptive Leaders; and, 19) Exercise Mission Command.[5]

The Third Offset implications to Army leadership development will be formed in three areas: 1) expected maturity of AI capabilities; 2) interpersonal and autonomous systems trust; and, 3) implications on leader influence.

AUTONOMOUS SYSTEMS CAPABILITY

"Artificial intelligence (AI) is the capability of computer systems to perform tasks that normally require human intelligence such as . . . decision-making."[6] Within AI, automation is:

> The level of human intervention required by a system to execute a given task(s) in a given environment. The highest level of automation (full) is no immediate human intervention.[7]

Autonomy, different from automation, is the "level of independence that humans grant a system. . . . to achieve an assigned mission . . . [with] planning, and decision-making."[8] Looking at human-machine decision-making, experts from industry and the DoD foresee AI capability maturity in 2050 at a level where machines have functional autonomy (machine learning and improving within a specific role), otherwise known as narrow AI. This does not reduce the prominence of the human element.

The Army expects to be challenged by a global military peer power where all domains (land, air, maritime, space, and cyberspace) are contested. The speed of recognition, speed of decision, and speed of action will strain human abilities, so more human tasks will be aided by autonomous systems.[9] The Army's Chief Information Officer/G6, in the Army Network Strategy, envisions that:

> augmented humans, autonomous processes and automated decision making, will permeate the battlefield. The speed at which data are dispersed will create an information-rich environment . . . [where] extraction of mission-relevant content may be challenging.[10]

The Army's robotic and autonomous systems (RAS) strategy also emphasizes that machines will improve decision-making, but might also overwhelm human decision management ability.[11] A human-machine team, collaborating in the operations process, can be exceedingly responsive to changes in the fast-paced, complex, and adaptive future operating environment while maintaining the human dimension. As with any relationship, a level of trust is required to be dependent on another teammate and still be effective.

TRUST

Trust is "assured reliance on the character, ability, strength, or truth of someone or something."[12] Prudent trust is a competitive advantage that increases efficiency and effectiveness of teams and organizations. There are many components of trust that are relevant to man-machine interaction—trust between individual humans as trustee and trustor, between humans and computer automation, and between cultures in order to analyze the implications of trust on human-machine collaborative decision-making.

Trust between two entities, the trustee and the trustor, is a dynamic at the personal level. Trustee variables include integrity, intent, abilities, and results. The absolute value of these variables is not important, but rather how the trustor perceives the value of these variables in the trustee. A trustor's propensity to trust is based on their biases, beliefs, and experiences—and is the lens through which they view trustworthiness.[13] Trust studies by Stephen H. R. Covey compare high trust and low trust factors in relationships. High trust builds confidence, resulting in faster decisions and lower resultant costs, whereas low trust causes suspicion and negative effects.[14] A "no trust" leader loses opportunities and opens windows for adversaries to exploit friendly vulnerabilities due to indecision. An "absolute trust" leader appears to be effective, but simply relinquishes their leader role by excessive trust. A "prudent trust" leader sensibly balances trust relationships to leverage dividends from trust. The propensity to trust generates synergy without relinquishing leadership.

Research on human interaction with automation and robots provides similar results in the human-machine trustor-trustee relationship. People trust automation to a level commensurate with their confidence in the machine—and its ability to complete the task at least as well as they could on their own. This is tempered by how well they feel they can control the machine system.[15] In general, the trustor gives trust when they perceive it will result in a beneficial outcome.[16]

Another meaningful study involved analyzing automation trust across cultures.[17] The study grouped cultures into dignity, face, and honor culture groups.

Dignity cultures emphasize individual self-worth and are more prevalent in Western Europe and North America where laws are important aspects that govern interpersonal transactions. Face cultures, primarily in East Asia, centered on stable social hierarchies and norms that cherish other's views of them with high trust for in-group and lower trust for out-groups. Honor cultures, primarily in Middle East and Latin America, have more unstable social hierarchies that require significantly longer experience to develop trust.[18] The research suggests that interpersonal trust within these cultures translates into trust in automation also. Dignity cultures have the highest relative trust of automation and AI while honor cultures have the lowest relative trust of automation, with face cultures in between. Operators in honor cultures required more extensive training with the automation than operators from dignity and face cultures to develop an equal degree of trust in automation.[19] This suggests that, at least culturally, the United States has an advantage in adopting autonomous systems with human-machine relationships. The caveat is that individuals may exhibit traits of other cultures based on their personal beliefs, biases, and experiences.

A 2016 Defense Science Board study described barriers to trust in autonomous systems that emphasized inputs, processing, and outputs. Human inputs, especially sensory functions, are not easily replicated for machines, but machines do have the potential for a much higher number of more varied input types. In decision-making, this input variance can create differences between how either the human or machine understands the environment or defines the problem. During processing, even if both humans and machines receive exactly the same inputs, each may assign different degrees of relevance to each of those inputs, resulting in differences in the underlying reasoning. Moreover, even if those same inputs are weighed with the same value, machine learning, with deeper and more rapid cycles, may lead to different results than a human—who might weigh a single significant life experience very highly when he or she makes decisions. A machine may lack other contextual learning that humans gain from more broad experiences. The output barriers may be ineffective human-machine computer interfaces (keyboard, mouse, screen, etc.) that slow communications in situations requiring speed. While enhanced language processing and visual interfaces may make the experience richer, it could still paralyze the human with overwhelming amounts of complex information. Human-machine trust barriers, including cognitive disparity or even resentment, have the potential to be significant as machines learn and retain information much faster, broader, (and better?) than human teammates. There are not only great opportunities to leverage autonomous system capabilities, but also challenges in fielding capabilities to leaders who do not trust the full capability.

IMPLICATIONS ON LEADER INFLUENCE

The Army is a leader-centric organization in which the leader must have trust and is responsible to establish trust with others. *Army Leadership*, Army Doctrine Reference Publication (ADRP) 6-22, specifically emphasizes that leaders need "the courage to trust."[20] In order to realize the military potential of human-machine collaborative decision-making and teaming, it is useful to acknowledge there will be a need for leaders to prudently place their trust in machines and

AI. There is, however, considerable ground to cover. Despite the inexorable proliferation of "smart" decision tools and semi-autonomous systems— and the tacit understanding that AI (or at least some degree of artificial learning) will play a bigger role in future military operations—the current Army Leadership Requirements Model does not address the shift to more human-machine relationships. In order to prepare leaders for the future, the Army should update this model to meet the challenges of the multi-domain battle environment, enabled by human-machine teaming. While the leader attributes (character, presence, intellect) and competencies (leads, develops, achieves) may remain the same, they will likely need to transform as Third Offset AI and autonomous capabilities become fielded systems.

Machines will increasingly develop as a cognitive aid to humans, placing greater importance on leaders' ability to leverage the information processing, storage capability, and innovation capacity of the machine. This will stress the sound judgment component of the current leader attribute, intellect, since the machine reasoning processes may not be obvious to the human leader. With some Third Offset capabilities, the leader will not be the best, smartest, or most expert in many tasks and functions. Leaders must develop mindsets that collaborative decision-making and performance stems from both humans and machines gaining experience together. This will be a game changer. The develops competency skill (from the Army Leadership Requirements Model) will need to include developing the human-machine team, vice exclusively a human team.

Adjustments in the Army Leadership Requirements Model, early in autonomous system development, could minimize barriers to effective human-machine teaming. There are at least three areas of influencing autonomous systems that should be taken into account for future leader development: 1) educating leaders to define and communicate behavioral constraints for machines—such as an ethical framework and shared mental models for operational approach to decision-making; 2) identifying and correcting divergent machine behavior; and, 3) responding to the possibility that machines may (rightly) identify divergent (or less than optimal) human behavior—even in the leader. This will take a new approach within the leadership development strategy.

CONCLUSION

On the future multi-domain battlefield, humans will likely face significant challenges in the cycle of conflict recognition, decision, and action. Machines are expected to have functional autonomy by 2050 to enable human-machine collaborative decision-making. Understanding trust relationships and the associated impacts in the human-machine relationship are key to unlocking the competitive advantage of the human-machine team. Beyond the trust element, the implications on how leaders influence the autonomous system are grounded in the attributes and competencies of the Army Leadership Requirements Model—but they need modernized. This is particularly highlighted by the intellect attribute and the develops competency.

The Army has an opportunity to address the implications on Army leadership development in the environment of the Third Offset Strategy with these initial thoughts: 1) replicate human-human visual, verbal, and tactile dialogue capabilities in human-machine interface to reduce barriers to trust; 2) conduct RAS essential element analysis within the AWFCs, especially AWFC numbers 1, 9, 10, and 19 to create common understanding, team development, and autonomous systems leaders; and, 3) establish a credentials standard for autonomous systems for initial validation with recurring auditing of machine learning to identify divergent behavior.

Highlighting agile and adaptive leaders and mission command philosophy only superficially addresses the rising information velocity requiring human-machine collaboration. Deeply embedded attributes need a distinct, deliberate approach beginning with developing a leader's propensity to trust and methods to influence autonomous systems. The Army has an opportunity to increase its competitive advantage over adversaries by maximizing the best of humans and machines.

ENDNOTES - CHAPTER 10

1. Mark A. Milley, "GEN Mark A. Milley, Chief of Staff United States Army, Remarks at AUSA 2016 – Dwight David Eisenhower Luncheon," October 4, 2016, Defense Video Imagery Distribution System, video file, at 1 hr. 5 min. to 1 hr. 8 min., available from *https://www.dvidshub.net/video/485996/ausa-2016-dwight-david-eisenhower-luncheon*, accessed December 21, 2016.

2. This chapter is an abbreviated version of Eric Van Den Bosch, "Third Offset Strategy: Army Leadership Development Implications," Strategic Research Paper, Carlisle, PA: U.S. Army War College, March 31, 2017.

3. Patrick J. Murphy and General Mark A. Milley, *Army Posture Statement 2016*, Statement on the Posture of the U.S. Army 2016 Submitted to the Committees and Subcommittees of the U.S. Senate and the U.S. House of Representatives, 2nd Sess., 114th Con., March-April 2016, available from *https://www.army.mil/e2/rv5_downloads/aps/aps_2016.pdf*, accessed December 12, 2016, p. 6.

4. U.S. Department of the Army, *Army Leadership*, Army Doctrine Reference Publication (ADRP) 6-22, C1, Washington, DC: Headquarters, Department of the Army, September 10, 2012, p. 5, available from *http://www.apd.army.mil/epubs/DR_pubs/DR_a/pdf/web/adp6_22.pdf*, accessed August 7, 2017.

5. Army Capabilities Integration Center (ARCIC), "Army Warfighting Challenges," ARCIC Flyer, Fort Eustis, VA: Army Capabilities Integration Center, as of January 31, 2017, available from *www.arcic.army.mil/App_Documents/AWFC-Current.pdf*, accessed February 15, 2017.

6. U.S. Army Training and Doctrine Command (TRADOC), *The U.S. Army Robotic and Autonomous Systems Strategy*, Fort Eustis, VA: Maneuver, Aviation, and Soldier Division of Army Capabilities Integration Center, March 2017, p. 3, available from *http://www.tradoc.army.mil/FrontPageContent/Docs/RAS_Strategy.pdf*, accessed on March 20, 2017.

7. Ibid. p. 23.

8. Ibid.

9. U.S. Department of the Army, "The Army Way Ahead," Draft Copy, Washington, DC: Headquarters, Department of the Army, December 2016, p. 3.

10. U.S. Army Chief Information Officer/G6, *Shaping the Army Network 2025-2040*, Washington, DC: Architecture, Operations, Network, and Space Directorate, March 2016, p. 9, available from *http://ciog6.army.mil/Portals/1/Home/Tabs/Strategy/Shaping%20the%20Army%20Network%202025-2040.pdf*, accessed July 28, 2017.

11. U.S. Army TRADOC, p. 3.

12. "Trust," Merriam-Webster.com, n.d., available from *https://www.merriam-webster.com/dictionary/trust*, accessed April 30, 2017.

13. U.S. Army Combined Arms Center, "Building Mutual Trust between Soldiers and Leaders," White Paper, Fort Leavenworth, KS: Human Dimension Capabilities Development Task Force, Capabilities Development Integration Directorate, Mission

Command Center of Excellence (CoE), October 6, 2014, pp. 13, 22-23, available from *http://usacac.army.mil/pubs/Force-2025-and-Beyond-Human-Dimension*, accessed December 30, 2016.

14. Stephen M. R. Covey and Rebecca Merrill, *The Speed of Trust: The One Thing that Changes Everything*, New York: Free Press, 2006, p. 43.

15. Hamed Saeidi, "Trust-Based Control of (Semi)Autonomous Mobile Robotic Systems," Dissertation, Clemson, SC: Graduate School of Clemson University, August 2016, available from *http://tigerprints.clemson.edu/all_dissertations/1703/*, accessed November 30, 2016.

16. U.S. Army Combined Arms Center, p. 13.

17. Shih-Yi Chien, Michael Lewis, Katia Sycara, Jyi-Shane Liu, and Asiye Kumru, "Influence of Cultural Factors in Dynamic Trust in Automation," presented at the Systems, Man, and Cybernetics (SMC) 2016 Conference, Budapest, Hungary, October 9-12, 2016, p. 1, available from *www.ri.cmu.edu/pub_files/2016/10/smc2016_ShihyiChien.pdf*, accessed December 16, 2016.

18. Ibid., pp. 1-2.

19. Ibid., Fig. 8.

20. U.S. Department of the Army, *Army Leadership*, pp. 1-3.

CHAPTER 11

LEADER DEVELOPMENT AND THE THIRD OFFSET

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The technology explosion in the future will require a multifaceted approach to management—particularly when discussing leadership in an environment with ubiquitous autonomous systems and artificial intelligence (AI). Indeed, leadership will be the key competent at managing such a complex environment. The Chief of Staff of the U.S. Army, General Mark A. Milley envisions the Army destroying enemy sensors, air defenses, and land-based anti-ship missiles to open paths for the rest of the joint force. "Land-based forces now are going to have to penetrate denied areas to facilitate air and naval forces," Milley said. "This is exact opposite of what we have done for the last 70 years, where air and naval forces have enabled ground forces."[1] The U.S. military's technology and leadership is evolving and so should the leadership strategy. Landpower ultimately provides decision makers the capability for human-to-human interaction, the best and most precise tool to influence and compel on land. However, the ever-changing environment hints that the United States will have to use new elements of strategy when it comes to facing new threats from adversities. As we look to the future, it will require a new 21st-century approach.

The Army Capabilities Integration Center (ARCIC) considers that in order to set the Army's future with robots, it must focus on three main areas, autonomy, AI, and command and control (C2). This means the robots employed by the force need to get better at "functioning independently from the user and think for itself through the right sensor technology while working on the battlefield with a multitude of other systems."[2] It is essential that the military develop the correct doctrine and training to connect man and machine, and ultimately establish authorities and permissions for AI and autonomous systems. The technology and capabilities that have evolved into robotic systems are increasingly becoming more intuitive, lethal, and advanced. The concern with this trajectory is defining the moral and ethical concerns when mixing man with robots.

Chess Grandmaster Garry Kasparov wrote about human-computer chess collaboration, "Human strategic guidance combined with the tactical acuity of a computer was overwhelming."[3] Tesla and SpaceX's chief executive officer, Elon Musk, believes that man must merge with machines or become irrelevant in the AI age. Musk stated:

> computers can communicate at a trillion bits per second, while humans, whose main communication method is typing with their fingers via a mobile device, can do about 10 bits per second.[4]

A 2004 survey of military officers on the future of robots in warfare revealed:

> the officers identified developing a strategy and doctrine as the third least important aspect to figure out (only ahead of solving inter-service rivalry and allaying allies' concerns). Meanwhile, the capabilities of these robotic systems continue to advance both in intelligence and lethality.[5]

There are a number of studies that examine the required attributes and characteristics of military and corporate leaders. Discussions center on what personal qualities are required to be a successful military leader in the 21st century. The current doctrine that focuses on leadership, Army Doctrine Reference Publication (ADRP) 6-22, aims at the human-to-human relationships. The current *Army Leader Development Strategy 2013* contains a model that basically consists of three domains of development—operational (training), institutional (education), and self-developmental (experience).[6] The Army must begin the discussion on how it will train AI-enabled systems to be smarter and more capable. By its nature, AI learns and gets better with experience—just as humans do. In order to best develop and prepare our force—both human and machine—the Army should begin curricular and pedagogical experimentation that teaches leader development across a range of human to machine interaction.

The military can gain valuable insight from the recommendations of Accenture's AI Institute for High Performance. They recommend training intelligent machines in context because they typically arrive with very general capabilities. From a defense strategic management perspective, there would need to be a comprehensive training program that outlines a framework for military commanders to train AI systems. In addition to guidance that will govern how these systems are trained, the Army leaders selected to perform the training would need to have specific attributes that align with The Army Leadership Requirements Model.[7]

According to Accenture's AI Institute for High Performance, the willingness to trust AI-generated advice hinges on a manager's understanding at all levels.

Involving managers in AI training fosters a sense of ownership in the learning process and provides managers' familiarity with such systems. The result could be a shared belief that AI extends, not eliminates, human potential and a greater willingness to embrace the technology.[8]

CONCLUSION

The Department of Defense's (DoD) responsibilities are to be prepared to address a broad range of contingencies and unpredictable crises well into the future. It is imperative that we link the Army leadership competencies and attributes between humans and machines. Creating a connection between leadership development and machine development will ensure that the human element remains tied to capabilities in the Third Offset Strategy. The military will have to ensure that leadership is:

> willing to experiment in an effort to identify AI uses that make the most sense for their organization and teams. A great way to implement efforts is to create structured experiments with AI to help zero in on the most promising opportunities, including the use of intelligent machines to accelerate human learning.[9]

This may enable leaders to establish trust, character, values, and warrior ethos between man and machine.

ENDNOTES - CHAPTER 11

1. Sydney J. Freedberg, Jr., "Miserable, Disobedient & Victorious: Gen. Milley's Future US Soldier," Breaking Defense, October 5, 2016, available from *http://breakingdefense.com/2016/10/miserable-disobedient-victorious-gen-milleys-future-us-soldier/*, accessed December 25, 2016.

2. Jen Judson, "Army Details Draft Robotics and Autonomous Systems Strategy At AUSA," *Defense News*, October 4, 2016, available from *http://www.defensenews.com/articles/army-details-draft-robotics-and-autonomous-systems-strategy-at-ausa*, accessed February 1, 2017.

3. Diego Rasskin-Gutman, *Chess Metaphors: Artificial Intelligence and the Human Mind*, trans. by Deborah Klosky, Cambridge, MA: The MIT Press, 2009.

4. Arjun Kharpal, "Elon Musk: Humans must merge with machines or become irrelevant in AI age," CNBC News, February 13, 2017, available from *http://www.cnbc.com/2017/02/13/elon-musk-humans-merge-machines-cyborg-artificial-intelligence-robots.html*, accessed February 14, 2017.

5. Ibid.

6. U.S. Department of the Army, *Army Leader Development Strategy 2013*, Washington, DC: U.S. Department of the Army, 2013, p. 8.

7. Ibid., pp. 6-8.

8. Ryan Shanks, Sunit Sinha, and Robert J. Thomas, "Managers and machines unite! Three things managers must do to make the most of cognitive computing," Accenture Strategy Paper, n.p.: Accenture Institute for High Performance, January 10, 2017, available from *https://www.accenture.com/us-en/insight-promise-artificial-intelligence*, accessed February 20, 2017.

9. Ibid.

PART V:
IMPLICATIONS FOR MORAL AND ETHICAL DECISION-MAKING

CHAPTER 12

MORE THAN A GAME: THIRD OFFSET AND IMPLICATIONS FOR MORAL INJURY

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Perhaps the most useful technology coming out of artificial intelligence (AI) research is computerized decision support systems (DSS). DSS advances the use of computers from simply managing data, to using data to provide courses of action (COA). Some soldiers liken the use of DSS to playing a computer or video game.[1] The adversary is an icon, and COA are graphics. Research indicates that gamers use a different set of ethical rules in a game than they would use in the real world.[2] Since the DSS environment emulates a game, soldiers may end up using game ethics in place of their personal ethics, delaying moral reflection, and potentially leading to moral injury.

GAME WORLD ETHICS

For many gamers, the characters in the game do not represent reality; instead, they are seen as simply obstacles to overcome in order to reach an objective.[3] Research shows that gamers who choose to kill adversaries "argued that the most effective mechanism for moral disengagement is that it is only a game."[4] This response is likened to soldiers who dehumanize their enemy in order to justify their actions in war.

This tendency to morally disengage may place "digital natives"[5] at an ethical disadvantage. In the virtual world, gamers have taught themselves to accept the game's ludonarrative dissonance, where the mechanics of the game, i.e., killing hundreds of characters, is antithetical to the concept of being the hero.[6] People do things in a virtual world that they would never do in the real world. This disengagement has the potential to take all emotion out of the act of killing and dehumanize the process – already some involved with unmanned systems compare coordinating unmanned airstrikes to playing a video game.[7]

As the process for decision-making becomes more game-like, there is the possibility that soldiers using a DSS will accept inappropriate violence. This could result in the soldiers using a game-set of rules for decision-making, approving COA that they would not approve under normal conditions leaving them susceptible to feelings of guilt and shame. One way to understand the potential psychological danger is to examine how performance in battle (reality) that closely mimics training (game-like environment) has resulted in moral injury.

MORAL INJURY

Nancy Sherman, professor of Philosophy at Georgetown University defines moral injury as "experiences of serious inner conflict arising from what one takes to be grievous moral transgressions that can overwhelm one's sense of goodness and humanity."[8] Moral injury is experienced as an intense inner conflict or incongruence resulting from the violation of deeply held moral beliefs. Combat is often so severe that it alters the soldier's view of life and an inadequate moral or religious base leads to moral injury.[9] An inadequate understanding of God only exacerbates the soldier's internal turmoil compounding the effects of the trauma. When a soldier's morals are loosely based in a mix of civil religion and culture rather than firmly fixed and based on belief in a higher ideal, deep incongruence can develop leading to moral injury.

Incongruence between the internal moral code of decision-makers and the realization of how their action resulted in transgressions of that code could arise with the use of DSS. There is the possibility that decision-makers using DSS will fail to realize the situations presented by the DSS are real. Since decision-makers using DSS will be trained using situations they know are not real, they may create a default set of game rules during training, and default to these rules in battle. This use of game rules for actual combat has the potential to result in a deep and abiding incongruence between their actions and their moral code. In battle, soldiers might react the same way they do in training, i.e., not processing their actions as real in the moment, leaving them open to moral injury as they reflect on the aftermath of their actions.

Military training produces soldiers who automatically respond to their environment, a process called muscle memory, by habituating the application of violence through repetitive exercises. The result is that soldiers learn to simply react to their environment rather than to observe, process, and then engage. For example, to improve the reflexive nature of engaging the enemy, in the 1960s Army marksmanship training changed from firing at a stationary circular target to engaging human silhouettes that moved and were arrayed at different ranges. This new system was designed to mimic the act of killing on the battlefield and taught soldiers to reflexively react to movement in a morally benign setting that, in many ways, was like a game. This behavior was reinforced by marksmanship badges and other rewards.

The result of reflexive training was an impressive increase in small arms efficiency, but not without a cost. At the end of World War II, S. L. A. Marshall found that only 15 to 20 percent of U.S. soldiers engaged the enemy with their personal weapon.[10] This is compared to a study of American soldiers who served in Vietnam where an estimated 90 to 95 percent of soldiers in Vietnam engaged an enemy combatant with their personal weapon.[11] Sergeant Scott Galentine, who was involved in the 1993 battle of Mogadishu, described killing the enemy as "just like target practice, only cooler."[12] His reaction to the battle was echoed by Private First Class Jason Moore who said:

> it seemed to me it was just like a moving target range, and you could just hit the target and watch it fall and hit the target and watch it fall, and it wasn't real. . . . That upsets me more than anything else, how easy it was to pull the trigger over and over again.[13]

Moore's reaction is akin to gamers using game ethics instead of their ethical code. During the battle, he was simply reacting to his environment without first working through the moral and ethical implications of his actions—the battle seemed like a game. Once the "game" was over and Moore had time to consider what he had done, he found that his actions had violated his moral and ethical standards. If training can habituate violence without moral consideration on the battlefield, the use of DSS may make moral disengagement even easier by using icons and other avatar-like symbology to dehumanize the enemy.

COMPUTER ENHANCED DECISION-MAKING

Contemporary U.S. military command centers give leaders access to a staggering amount of information. However, there is a point at which too much data is detrimental to decision-making, reduces situational awareness, and lowers trust.[14] To compensate, over the past 2 decades the Army has explored DSS to shorten the observe, orient, decide, and act (OODA) loop.[15] In 2002, the Army pitted the Course of Action Display and Evaluation Tool (CADET) against a team of field grade officers. CADET produced a battle plan in about 2 minutes while it took the officers about 16 hours. "The results demonstrated very little difference between CADET's and human performance" except that the CADET DSS reduced the OODA loop by more than 15 hours per plan and reduced the staffing to one reviewer.[16]

The advantages of DSS may obscure a potential down side. A Korean study indicated that decision makers might feel compelled to rely on a DSS. Three primary factors were significant for the DSS to be accepted and used; institutional pressure, top management support, and the maturity of the host technology. It is surprising that the quality of the information provided by the DSS was the least important.[17] This indicates it is difficult for the operator to evaluate the quality and accuracy of the data. The results may be that operators will accept the output without moral or ethical review because they are not capable of fully assessing DSS recommendations. Research also indicates that individuals will take unjustified risks with DSS based on overconfidence. A study examining DSS enabled investment decisions indicated that overconfidence resulted from two errors—the illusion of knowledge and the illusion of control. The study showed that the more familiar the individual was with the system, the riskier their behavior became.[18] Researchers noted that, "Insufficient sensemaking may result in unethical behavior regardless of an individual's personal level of moral development."[19]

MAKING ARTIFICIAL INTELLIGENCE (AI) MORAL

DSS clearly have some advantages over humans. Computers process more information and reach decisions at speeds that dwarf human efforts. Computers are not susceptible to psychological and physical factors like fatigue, pride, revenge, anger, social pressures, and biases. Computers do not become more risk-adverse or risk-loving based on emotion. A computer does not employ "mind-guards" to isolate dissenting opinion; and does not deploy spurious analogies of past events without systematically considering parallels.[20] However, computer systems do not innately have a moral center either.

The emerging machine ethics field is attempting to capture ethics in computer code—based on "principles, parameters and procedures."[21] Machine ethics incorporates logic models in a computer subroutine designed to evaluate a course of action against ethical standards. A recent study considered the efficacy of the relative ethical violation (REV) model for use with a military DSS. The study involved pitting the REV model against the survey results of one thousand military members and humanities experts. The REV model "turned out to be rather accurate, its effectiveness deriving from the proper choice of principles and weights."[22] This study shows that integrating an ethical model into DSS and AI is possible; however, the process of developing "ethical weighting" may limit its effectiveness. First, the developers of the system must define a comprehensive set of ethical standards and properly weight each one. Second, the system must be protected from manipulation of the weights to obtain a certain COA.[23] A critical limitation of DSS and AI is the fact that they must rely on data inputs in order to make decisions. Therefore, the quality of their decisions relies on the quality of the data.[24] Perhaps the worst-case scenario is not total failure, but a sub-system failure leading to the production of sub-optimal and potentially unethical COA.

RECOMMENDATIONS

Moral conflict will always be a part of war because acceptable conduct in war will always conflict with norms accepted in civilian life. This conflict creates a moral dissonance and places a burden on the military to do everything in its power to prevent psychological and moral injuries when employing DSS.

The following recommendations will help prevent psychological and moral injury resulting from the use of DSS:

1. **Training**. The Army should provide training at all levels that reinforces ethical standards and includes exploration of each soldier's personal religious or spiritual center, to develop competent ethical decision-makers. Operators must understand how DSS processes moral dilemmas, the potential ethical shortcomings of these decisions, and how to ensure ethical decisions are made.
2. **System Design**. Programmers must design systems that produce COA that are morally

defendable. Since no system can be created that is 100 percent reliable, a soldier who is trained to recognize morally questionable decisions must always remain in or on the loop.

3. **System Education**. The Army should educate leaders in the responsible employment of DSS and AI systems, particularly in the method the system uses to integrate ethical principles into the decision-making process. In addition, the Army should provide a feedback loop that allows decision-makers to provide input to the programmers to enhance the effectiveness of the system's ethical model.
4. **Moral Review after DSS Training**. The Army should include after-action reviews assessing the moral and ethical implications of the decisions made during training events for all training involving the use of DSS and AI. This will help counter the default position of "it's only a game" and reinforce the need for all soldiers to morally evaluate their actions both in training and in battle.

Widespread military use of AI enabled DSS is inevitable. It is incumbent on the Army to mitigate the potential negative impacts of using these technologies. Anything less could lead to an increased number of Soldiers suffering from psychological or moral injury. Those who work with these systems must understand the potential consequences; they must understand that using these systems is more than a game.

ENDNOTES - CHAPTER 12

1. Peter W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, New York: The Penguin Press, 2009, p. 395.

2. See Mia Consalvo, Thorsten Busch, and Carolyn Jong, "Playing a Better Me: How Players Rehearse Their Ethos via Moral Choices," *Games and Culture*, first published November 17, 2016, available from *journals.sagepub.com/doi/abs/10.1177/1555412016677449*, accessed January 10, 2017; Louise Perrson, "To Kill or Not to Kill: The Moral and Dramatic Potential of Expendable Adversaries in Role-playing Video Game Narratives," Bachelor of Arts Project, Skövde, Sweden: University of Skövde, 2016; Tilo Hartmann and Peter Voderer, "It's Okay to Shoot a Character: Moral Disengagement in Violent Video Games," *Journal of Communication*, Vol. 60, No. 1, March 2010.

3. Hartmann and Voderer, p. 113.

4. Perrson, p. 32.

5. A digital native is a person who was raised with digital technology as an integral part of everyday life.

6. Perrson, p. 4.

7. Singer, p. 395.

8. Nancy Sherman, *Afterwar: Healing the Moral Wounds of Our Soldiers*, New York: Oxford University Press, 2015, p. 8.

9. William P. Mahedy, "Some Theological Perspective on PTSD," *National Center for PTSD Clinical Quarterly*, Vol. 5, No. 1, Winter 1995, p. 7.

10. Dave Grossman, *On Killing: The Psychological Cost of Learning to Kill in War and Society*, Boston, MA: Little, Brown and Company, 1995, p. 3.

11. Ibid., p. 35.

12. Peter Kilner, "Military Leaders' Obligation to Justify Killing in War," *Military Review*, Vol. 82, No. 2, March-April 2002, p. 22. With a secondary quote from Mark Bowden, *Black Hawk Down*, New York: Atlantic Monthly Press, 1999, p. 64.

13. Jason Moore, "Ambush in Mogadishu, Interview of Specialist Jason Moore," Frontline, available from *www.pbs.org/wgbh/*

pages/frontline/shows/ambush/rangers/moore.html, accessed January 17, 2017.

14. Laura R. Marusich, Jonathon Z. Bakdash, Emrah Onal, Michael S. Yu, James Schaffer, John O'Donovan, Tobias Höllerer, Norou Buchler, and Cleotilde Gonzalez, "Effects of Information Availability on Command-and-Control Decision Making: Performance, Trust, and Situational Awareness," *Human Factors*, Vol. 58, No. 2, March 2016, pp. 315-316.

15. Colonel John Boyd, U.S. Air Force, coined the term observe, orient, decide, and act (OODA) in the 1950s to describe the process of reacting to a stimulus. In combat, the adversary with the shortest OODA loop has the advantage.

16. Larry Ground, Alexander Kott, and Ray Budd, "Coalition-based Planning of Military Operations: Adversarial Reasoning Algorithms in an Integrated Decision Aid," Computing Research Repository, arXiv.org, submitted January 22, 2016, p. 8, available from *https://arxiv.org/abs/1601.06069*, accessed January 17, 2017.

17. Hyun-Ku Lee and Hangjung Zo, "Assimilation of Military Group Decision Support Systems in Korea: The Mediating Role of Structural Appropriation," *Information Development*, Vol. 33, Iss. 1, January 2017, p. 23.

18. Chi-Wen Chen and Marios Koufaris, "The Impact of Decision Support System Features on User Overconfidence and Risky Behavior," *European Journal of Information Systems*, Vol. 24, No. 6, November 2015, pp. 607-623.

19. Miriam C. de Graaff, Ellen Giebels, Dominique J. W. Meijer, and Desiree E. M. Verweij, "Sensemaking in Military Critical Incidents: The Impact of Moral Intensity," *Business & Society*, November 30, 2016, p. 2, available from *journals. sagepub.com/doi/abs/10.1177/0007650316680996*, accessed January 10, 2017.

20. Kareem Ayoub and Kenneth Payne, "Strategy in the Age of Artificial Intelligence," *The Journal of Strategic Studies*, Vol. 39, No. 5-6, 2016, p. 799.

21. Gregory S. Reed, Mikel D. Petty, Nicholaos J. Jones, Anthony W. Morris, John P. Ballenger, and Harry S. Delugach, "A principles-based model of ethical considerations in military decision making," *Journal of Defense Modeling and Simulation: Applications, Methodology, Technology*, Vol. 13, Iss. 2, April 2016, p. 195.

22. Ibid., p. 208.

23. Ibid., p. 209.

24. Mary L. Cummings, "Artificial Intelligence and the Future of Warfare," Research paper, London: Chatham House, the Royal Institute of International Affairs, January 26, 2017, p. 8, available from *https://www.chathamhouse.org/publication/artificial-intelligence-and-future-warfare*, accessed January 23, 2017.

CHAPTER 13

THE THIRD OFFSET, REMOTELY PILOTED SYSTEMS (RPS), AND MORAL HAZARDS

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The Third Offset's technical focus and developmental approach may engender two distinct, yet compounding, moral hazards, which occur in situations where "greater risks are taken by individuals who are able to avoid shouldering the cost associated with these risks."[1]

The first moral hazard originates from the Third Offset's technical focus. The Third Offset aims to reduce risks by increasing the effectiveness of weapons that remove the human warfighter from the battlefield. By distancing the human from conflict, this technology lowers not only the costs and risks associated with fighting, but the political bar to initiating hostilities as well. As a result, the U.S. Government could inadvertently set conditions for an increase in international conflict. Moreover, these offset technologies are derivatives from mature, commercial technologies and as such can be readily militarized and proliferated by other powers.

The second moral hazard results from the overt nature of the Third Offset's development. The unconcealed approach and design of the Third Offset, which distinguishes itself from previous offsets, raises the likelihood that American investments in defense modernization will inadvertently subsidize similar foreign efforts through espionage and foreign material exploitation of U.S. technological designs. These moral hazards, taken together, could create a situation where U.S. defense efforts will inadvertently decrease global stability and national security.

THE SLIPPERY SLOPE OF A REMOTELY PILOTED SYSTEM (RPS)

Today, service members located safely at locations, such as Creech Air Force Base in Nevada, are piloting armed Reaper aircraft that are flying in Africa, Europe, and the Middle East.[2] While remotely piloted systems (RPSs) that operate in the air domain are in the public eye, there are also RPSs that operate in the maritime and land domains. In 2015, the Navy publicly announced its first operational use of an unmanned undersea vehicle (UUV).[3] Over the past decade, the Army invested in "more than 7,000" RPSs that assist with tasks such as explosive ordinance disposal and reconnaissance.[4] However, the Army's designs and missions for RPSs are evolving to include target acquisition with lethal and non-lethal effects.

Not surprisingly, this evolution of RPSs capabilities conforms to the Department of Defense's (DoD) vision for unmanned systems. As found in the DoD *Unmanned Systems Integrated Roadmap FY2011-2036*:

> The Department of Defense's vision for unmanned systems is the seamless integration of diverse unmanned capabilities that provide flexible options for Joint Warfighters while exploiting the inherent advantages of unmanned technologies, including persistence, size, speed, maneuverability, and reduced risk to human life. DoD envisions unmanned systems seamlessly operating with manned systems while gradually reducing the degree of human control and decision making required for the unmanned portion of the force structure.[5]

To get a sense of the financial costs associated with achieving that vision, the DoD requested over $2.3 billion for the acquisition of the top three remotely piloted aircraft (RPA) in 2016. That request did not include funding for any of the other RPSs or for their associated research and development. This resource request highlights both the importance that the DoD is placing on RPSs and the level of financial risks placed upon potentially fleeting technological superiority.

Regardless of the level of artificial intelligence (AI) or automation that unmanned platforms of the future may use, the physical distance between the service members and the area of conflict will increase. Given the reality of RPSs operating half a world away, it is not hard to imagine a future in which significant portions of the services' foreign combat missions are controlled by members that are safely protected in the homeland or other sanctuary. The reduced risk to service members may increase U.S. proclivity to use force.

In August 1998, there were two near simultaneous bombings of the U.S. embassies in Kenya and Tanzania, which intelligence quickly linked to Osama bin Laden.[6] Former President Bill Clinton wanted to send a strong signal to bin Laden and retaliate with military force. However, there was hesitation by the senior military leadership to use ground forces.[7] Committing aircraft to drop bombs would have required coordination with surrounding countries for both targets, complicating the operations and increasing risks to the pilots. However, the military had Tomahawk land attack missiles in its arsenal.

The use of Tomahawks allowed former President Clinton to retaliate without putting U.S. service members at risk. While not an RPS, these pre-programmed missiles can fly under radar systems, have a range of

700-1,350 nautical miles, and can deliver a 1,000-pound bomb with an accuracy of 30 feet.[8] Less than 2 weeks after the embassy bombings, the United States launched 79 Tomahawks at sites in Sudan and Afghanistan.[9] Had unmanned military options not been available, it is doubtful that the President would have authorized the use of conventional forces given the potential risks and the narrow scope of the objectives. This increased use of Tomahawks by the U.S. political and military leadership is an illustrative surrogate for the potential future growth of weaponized RPSs.

Since the United States' first combat strike by an armed RPA in 2001, the use of armed RPAs has continued to rise.[10] While there is not a public database of all U.S. RPA strikes, on July 1, 2016, then-President Barack Obama issued an executive order that requires the Director of National Intelligence to report the "number of strikes undertaken by the U.S. Government against terrorist targets outside areas of active hostilities from January 1, 2016, through December 31, 2016," and to provide a yearly update thereafter.[11] In accordance with this executive order, the director released his findings in "Summary of Information Regarding U.S. Counterterrorism Strikes Outside Areas of Active Hostilities," which included data from January 20, 2009 to December 31, 2015. It listed 473 strikes, which resulted in an estimated 2,372-2,581 combatant deaths and 64-116 non-combatant deaths.[12] While these figures do not explicitly state that they were all RPA strikes, there is a high probability that the United States conducted them with RPA since they exclude strikes inside the controlled airspaces of Afghanistan, Iraq, and Syria. Consider that prior to the use of RPA, a nation would have to risk the consequences of sending its military personnel to a foreign country to conduct 473 operations and kill over 2,000 foreign combatants. U.S. political and military leadership clearly appreciate the reduction in operational risks that RPSs capabilities provide.

Recent surveys of the U.S. civilian population also reflected this desire to reduce operational risks to service members. The Pew Research Center survey found that 58 percent of the U.S. public approved of the United States conducting RPA strikes in countries such as Pakistan, Yemen, and Somalia.[13] The authors James Walsh and Marcus Schulzke surveyed over 3,000 participants to quantify the propensity to support the use of force when using a low risk platform such as a RPA.[14] One of their findings was that "participants were more likely to support wars that posed lower levels of risk to American soldiers."[15] Jacquelyn Schneider and Julia Macdonald surveyed 2,148 U.S. citizens and found when "given a scenario with a high risk to air crew, 58 percent chose unmanned aircraft, while only 23 percent chose unmanned aircraft in the scenario specifying low risk to air crew."[16] These findings confirm that "casualty aversion" influences "when and how wars are waged in democratic societies."[17] The public support for RPA strikes makes them the more politically viable option. The lower the risk, the more likely countries will engage in conflict through armed RPSs.

As the United States continues to rely on armed RPSs, the international community has taken notice. The reduced risks to the operators, the relative low cost to procure, and the minimal infrastructure to employ them makes RPSs an appealing military tool. Worldwide sales of RPA have become a big business, with an estimated growth potential of over $11 billion in 2026, up from $6 billion in 2016.[18] The countries profiting the most from RPA sales include the United States, Israel, China, Iran, and Russia.[19] With this worldwide growth in mind, the U.S. Department of State has started taking steps to address the proliferation of RPA.

In October 2016, the Department of State issued a *Joint Declaration for the Export and Subsequent Use of Armed or Strike-Enabled Unmanned Aerial Vehicles (UAVs)* with 51 other countries.[20] This declaration states, "the international community must take appropriate transparency measures to ensure the responsible export and subsequent use of these [UAVs] systems."[21] These measures should be taken by the international community because UAV strikes "could fuel conflict and instability."[22] As with every competitive market, the products, such as RPA or any of the other RPSs, will continue to evolve. One way to acquire the evolving technology is to leverage the research and development costs borne by others. Given the public nature of the Third Offset, other countries may view the United States as a target of opportunity to obtain advanced technology with minimal investment.

LOSING THE OFFSET

Unlike the classified nature of the First and Second Offsets, former Secretary Hagel took a different approach and advocated for the Third Offset technological advances in a much more open manner. Openly soliciting and urging commercial entities to work on technologies that will be used to offset the capabilities of U.S. military competitors risks the very nature of the investment of the offset. The openness of the Third Offset could fuel the proliferation of advanced armed RPSs and provide pathways leading to intellectual property loss and corruption of the technology, putting the tax dollars in the DoD's modernization efforts at risk. As the U.S. Government and private entities invest billions of dollars in the research and development of the technologies that will support the Third Offset, foreign nations will attempt to obtain those advances through less expensive means such as computer network attacks, corporate mergers, or reverse engineering.

On March 23, 2016, a Chinese national pled guilty to conspiracy for hacking U.S. defense contractors' systems in order to steal sensitive data for China. This conspiracy lasted from 2008 to 2014 and targeted information on the "C-17 strategic transport aircraft and certain fighter jets produced for the U.S. military."[23] From the design and the technological leap forward, it is widely assumed that the China's stealth fighter, J-20, is based upon the stolen technology. Stealing advanced technology is but one way to get it. Another way to obtain a technical edge without the research and development costs is through corporate mergers and acquisitions.

China recently announced its "Made in China 2025" vision, which shifts its mergers and acquisitions from the resource sectors to advanced technologies.[24] While this could be viewed as a natural evolution of its economy, it is possible that the announcement of the Third Offset influenced their targeted sectors.[25] Many of these targeted sectors have duel commercial and military associated technologies. A recent example of China's focus on a crossover company was its desire to obtain the German company Aixtron. Aixtron is a leader in producing advanced gallium nitride epitaxial wafers, which are extremely useful in military applications due to their heat and radiation tolerance.[26]

Sales or transfers of military technology to other counties also increase the risk of technological loss. Despite formal agreements that restrict further resale or access to these technologies by third countries, the United States has identified partner nations as sources of technology proliferation. Even with trusted partners, it is impossible to ensure the non-proliferation of shared technology.

The final way to lose a technological edge is to lose physical control of the technology. When countries obtain access to foreign technology such as advanced weapons, platforms, or devices, they normally study them in order to replicate or defeat them. While maintaining physical control is an issue with any advanced military technology, RPSs are unique. By their very design, they function at some distance from their operator. Additionally, the military will use RPSs more frequently and outside of traditional combat areas due to their lower operational risks. These unique factors make RPSs more vulnerable for physical loss and possible exploitation by foreign countries than manned military platforms.

The current path of the Third Offset as an open partnership with industry, coupled with the long development timelines, allows for strategic positioning by a foreign nation to influence the supply chain of the offset technologies. This increases the ability of a competitor to insert counterfeit material into the supply chain or malicious code in order to disrupt that RPA. Security of the supply chain is vital for the economy of the United States as a whole, and it is critical for the U.S. military

CONCLUSION

The rationale for the DoD *Unmanned Systems Integrated Roadmap FY2011-2036* and the technologies associated with the Third Offset is to reduce risks to U.S.

forces by developing and enhancing armed RPSs that operate effectively in the air, sea, and land domains. However, this path is not without its own risks to larger national security concerns: increased international conflict, proliferation of armed RPSs, and international efforts to purloin the Third Offset technologies. The United States can take steps now that will help mitigate these risks, which include reassessing the long-term impact of using armed RPSs outside of combat zones, strengthening international agreements on the use and proliferation of armed RPSs, and enhancing the protection of the U.S.'s Third Offset investments. If the United States fails to consider the long-term consequences of using armed RPSs or fails to protect the technology, it will find itself continuing to face these moral hazards and risks the very purpose of the Third Offset Strategy.

ENDNOTES - CHAPTER 13

1. John Kaag and Sarah Kreps, "The Moral Hazard of Drones," Opinionator, blog of *The New York Times*, July 22, 2012, available from *https://opinionator.blogs.nytimes.com/2012/07/22/the-moral-hazard-of-drones/?_r=0*, accessed March 25, 2017.

2. Brian Everstine, "Inside the Air Force's drone operations," *Air Force Times*, June 22, 2015, available from *https://www.airforcetimes.com/articles/inside-the-air-forces-drone-operations*, accessed January 7, 2016.

3. Michael Melia, "Submarine launches undersea drone in a 1st for Navy," *Military Times*, July 20, 2015, available from *www.militarytimes.com/story/military/tech/2015/07/20/submarine-launches-undersea-drone-in-a-1st-for-navy/30442323/*, accessed January 7, 2016.

4. David Vergun, "More ground robots to serve alongside Soldiers soon," U.S. Army News, April 8, 2015, available from *https://www.army.mil/article/146061/*

More_ground_robots_to_serve_alongside_Soldiers_soon, accessed January 8, 2017.

5. James A. Winnefeld, Jr., and Frank Kendall, *Unmanned Systems Integrated Roadmap FY2011-2036*, Washington, DC: U.S. Department of Defense, available from *www.acq.osd.mil/sts/docs/Unmanned%20Systems%20Integrated%20Roadmap%20FY2011-2036.pdf*, accessed September 16, 2016.

6. Michael Barletta, "Chemical Weapons in the Sudan: Allegations and Evidence," *The Nonproliferation Review*, Vol. 6, No. 1, Fall 1998, p. 116, available from *www.nonproliferation.org/wp-content/uploads/npr/barlet61.pdf*, accessed January 9, 2017.

7. National Commission on Terrorist Attacks Upon the United States, Thomas H. Kean, chair, and Lee Hamilton, vice chair, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States*, Washington, DC: The Government Printing Office, July 22, 2004, p. 136, available from *govinfo.library.unt.edu/911/report/911Report.pdf*, accessed on March 3, 2017.

8. U.S. Navy, "*Tomahawk* Cruise Missile," U.S. Navy Fact File, last updated April 10, 2017, available from *www.navy.mil/navydata/fact_display.asp?cid=2200&tid=1300&ct=2*, accessed August 9, 2017; Tony DiGiulian, "United States of America, Tomahawk BGM-109 Cruise Missile," NavWeaps: Naval Weapons, Naval Technology and Naval Reunions, last updated May 8, 2016, available from *www.navweaps.com/Weapons/WMUS_Tomahawk.php*, accessed January 10, 2017.

9. Tom Vanden Brook, "Cruise missiles are accurate but are they effective?" *USA Today*, August 28, 2013, available from *www.usatoday.com/story/nation/2013/08/28/syria-cruise-missiles-chemical-weapons-bashar-assad/2720959/*, accessed January 10, 2017.

10. Chris Woods, "The Story of America's Very First Drone Strike," *The Atlantic*, May 30, 2015, available from *www.theatlantic.com/international/archive/2015/05/america-first-drone-strike-afghanistan/394463/*, accessed January 10, 2017.

11. Barack Obama, "Executive Order—United States Policy on Pre- and Post-Strike Measures to Address Civilian Casualties

in U.S. Operations Involving the Use of Force," Washington, DC: The White House, July 1, 2016, Sec. 3.

12. James R. Clapper, "Summary of Information Regarding U.S. Counterterrorism Strikes Outside Areas of Active Hostilities," Washington DC: Director of National Intelligence, July 1, 2016, p. 1, available from *https://www.dni.gov/files/documents/Newsroom/Press%20Releases/DNI+Release+on+CT+Strikes+Outside+Areas+of+Active+Hostilities.PDF*, accessed January 10, 2017.

13. Pew Research Center, "Public Continues to Back U.S. Drone Attacks," Washington, DC: Pew Research Center, May 28, 2015, p. 1, available from *www.people-press.org/files/2015/05/5-28-15-Foreign-Policy-release.pdf*, accessed March 5, 2017.

14. James Igoe Walsh and Marcus Schulzke, *The Ethics of Drone Strikes: Does Reducing the Cost of Conflict Encourage War?* Carlisle, PA: Strategic Studies Institute, U.S. Army War College, September 2015, p. 2.

15. Ibid., p. 3.

16. Jacquelyn Schneider and Julia Macdonald, *U.S. Public Support for Drone Strikes: When do Americans Prefer Unmanned over Manned Platforms?* Washington, DC: Center for a New American Security, September 20, 2016, p. 4, available from *https://s3.amazonaws.com/files.cnas.org/documents/CNAS-Report-DronesandPublicSupport-Final2.pdf*, accessed March 5, 2017.

17. Walsh and Schulzke, p. vii.

18. Katy Barnato, "'Growing global tension' to drive drone sales, seen doubling by 2025: Research," CNBC News, September 11, 2016, available from *www.cnbc.com/2016/09/11/growing-global-tension-to-drive-drone-sales-seen-doubling-by-2025-research.html*, accessed March 7, 2017.

19. Robert Farley, "The Five Most Deadly Drone Powers in the World," *The National Interest*, February 16, 2015, available from *nationalinterest.org/feature/the-five-most-deadly-drone-powers-the-world-12255?page=show*, accessed March 5, 2017.

20. The Joint Declaration signatories were Albania, Argentina, Australia, Austria, Belgium, Bulgaria, Canada, Chile, Colombia, Czech Republic, Denmark, Estonia, Finland, Georgia, Germany, Greece, Hungary, Iraq, Ireland, Italy, Japan, Jordan, Kosovo, Latvia, Lithuania, Luxembourg, Malawi, Malta, Mexico, Montenegro, Netherlands, New Zealand, Nigeria, Norway, Paraguay, Philippines, Poland, Portugal, Republic of Korea, Romania, Serbia, Seychelles, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Ukraine, United Kingdom, United States, and Uruguay. See U.S. Department of State, "Joint Declaration for the Export and Subsequent Use of Armed or Strike-Enabled Unmanned Aerial Vehicles (UAVs)," Washington, DC: U.S. Department of State, Office of the Spokesperson, October 28, 2016, available from *https://2009-2017.state.gov/r/pa/prs/ps/2016/10/262811.htm*, accessed March 7, 2017.

21. Ibid.

22. Ibid.

23. U.S. Department of Justice, "Chinese National Pleads Guilty to Conspiring to Hack into U.S. Defense Contractors' Systems to Steal Sensitive Military Information," Washington, DC: Office of Public Affairs, U.S. Department of Justice, March 23, 2016, available from *https://www.justice.gov/opa/pr/chinese-national-pleads-guilty-conspiring-hack-us-defense-contractors-systems-steal-sensitive*, accessed January 16, 2017.

24. Scott Kennedy, "Made in China 2025," June 1, 2015, Center for Strategic and International Studies, available from *https://www.csis.org/analysis/made-china-2025*, accessed January 16, 2017.

25. For information on the "Made in China 2025" initiative, see The State Council, The People's Republic of China, "Made in China 2025," english.gov.cn, n.d., available from *english.gov.cn/2016special/madeinchina2025/*, accessed January 16, 2017; "Made in China 2025," China-Britain Business Council, 2016, available from *www.cbbc.org/mic2025/*, accessed January 16, 2017.

26. Judy Lin, "Obama Blocks Grand Chip Investment Acquisition of Aixtron," LEDinside, December 7, 2016, available from *www.ledinside.com/news/2016/12/obama_blocks_grand_chip_investment_acquisition_of_aixtron*, accessed March 18, 2017; Paul

Mozur, "Showdown Looms as U.S. Questions Chinese Deal for German Chip Designer," *The New York Times*, November 19, 2016 *https://www.nytimes.com/2016/11/20/business/dealbook/china-germany-aixtron-cfius.html?_r=0*, accessed March 18, 2017.

CHAPTER 14

THE ETHICAL IMPLICATIONS OF ENHANCING SOLDIERS

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> Our suits give us better eyes, better ears, stronger backs . . . better legs, more intelligence . . . more firepower, greater endurance, less vulnerability. You look like a big steel gorilla, armed with gorilla-sized weapons.[1]

In 1959, when Robert Heinlein first wrote these words in his book, *Starship Troopers*, publishers rightly categorized the book as science fiction. However, what was considered science fiction 58 years ago is plausible today due to stunning technological advances. The nexus of technology with the vision of how the U.S. Army will fight in the future will drive requirements to better protect Soldiers and make them more effective. Currently available technology can produce suits like Heinlein's, which work through sensors and physical controls. However, by 2050, similar suits could integrate Soldier and suit through neural connectivity, enabling the suit to provide immediate feedback to the Soldier and respond instantaneously as an extension of the Soldier's body. These technological enhancements create ethical concerns for Soldiers and society. Because of these concerns, U.S. Army and congressional leaders should carefully examine ethical principles to address moral considerations before the technology matures.

The Greenwall Report, which examines ethical implications of Soldier enhancement, defines enhancement as "a medical or biological intervention to the body designed 'to improve performance, appearance, or capability besides what is necessary to achieve, sustain, or restore health'."[2] This definition narrows the consideration of what qualifies as an enhancement, and enables a focused discussion of the ethical concerns of temporary and permanent enhancements. A temporary enhancement is a medical or biological intervention that increases performance and is reversible. For example, pilots on long combat flights are given amphetamines to remain alert and focused.[3] Pilots' use of the amphetamines provides ability beyond what is necessary for normal health and thus qualifies as an enhancement. A permanent enhancement is a medical or biological intervention that increases performance and is irreversible. Using neural implants to permanently link a Soldier to an exoskeleton battle suit, similar to Heinlein's mobile infantry suit, serves as an example of a permanent enhancement.

These enhancements create moral concerns for society and the individual Soldiers who receive them. In 1979, *The Belmont Report* established the common rule for medical research and proposed a model to judge an enhancement to be ethical from the perspective of the individual.[4] However, militarization of enhancement technology may also represent a potential benefit to society. Hence, further consideration of ethical guidance beyond the individual is necessary. A public health model argues enhancements are ethical when they serve the greater good.[5] In a military context, winning the war provides a benefit to society, but creates a tension with the moral interests and rights of the individual. The doctrine of double effect proposes that acts with both good and bad effects may be morally permissible. Considering enhancements morally permissible provides a starting point for further exploration of the ethical implications of enhancements.

The aforementioned models present six moral principles: necessity, proportionality, informed consent, individual dignity, societal risk, and the doctrine of double effect. These principles provide a framework to begin to examine the moral implications of enhancing Soldiers.[6] These principles also apply to both temporary and permanent enhancements. However, because permanent enhancements are irreversible, this section will apply the framework of moral principles to consider the ethical implications of Soldier enhancements as a permanent enhancement.

In this hypothetical example, the United States is at war with an adversary that possesses advanced weapons and that poses an existential threat to the nation. The U.S. Army elected to enhance Soldiers in response to the adversary's capabilities in order to protect the United States. For this enhancement, the military adopted a mobile infantry suit, similar to Heinlein's; however, this U.S. Army suit links to Soldiers through a neural connection. Soldiers receive this neural connection through an operation to emplace a cerebral implant that allows them to synchronize thoughts with the suit's onboard computer. The suit increases a Soldier's strength and stamina, affords protection from the adversary's advanced weapons, and enables the Soldiers to carry a large amount of ammunition for the suit's advanced weapons. To handle the increased data flow between the suit and Soldier, the cerebral implant increases the Soldiers' mental cognition and ability to synthesize information. Because of the threat to society, the U.S. Army screens Soldiers when they enlist and directs some to enhancement programs. The cerebral implant leaves a clearly visible plate on the

Soldiers' head, where the suit connects to the implants, but Soldiers view this as a mark of distinction. Soldiers also retain their enhanced cognition from the implant. Many in society view this plate as unsightly, and former enhanced Soldiers find it difficult to establish relationships with unenhanced people due to differences in cognitive ability. While some people may shun the enhanced Soldiers, corporations seek them out, and hire them over unenhanced humans. To remain competitive in the marketplace, some members of society also seek cerebral enhancements, and further the discord between unenhanced and enhanced humans. Furthermore, the cerebral implants deteriorate over time and are known to cause Alzheimer symptoms in enhanced humans over time resulting in a shortened lifespan.

NECESSITY

Using the principle of necessity, one could argue that the described future battlefield makes this enhancement necessary to effectively wage war. If the U.S. military is at a disadvantage and cannot win the war without the suit, the enhancement is necessary. The suit is not necessary if it just makes winning the war easier. Additionally, it is important to note that if the adversary did not pose an existential threat to the United States, then the enhancement would not be necessary.

PROPORTIONALITY

This scenario presents a case where moral goods outweigh moral harms for both the Soldiers and society. For example, the benefits of added protection, lethality, and enhanced cognition make the Soldiers better able to survive in combat. These benefits outweigh the moral harms of decreased lifespan and inability to form lasting relationships. Consider that without human enhancements, the Soldiers will have a much shorter lifespan in combat because they would be inferior to their adversary. Likewise, the security interests of the United States outweigh the potential societal risks the enhancements may create if the United States faces an existential threat. One could argue that society would cease to exist if the nation ceases to exist.

INFORMED CONSENT

Even if Soldiers receive information, comprehend the information provided to them, and choose to receive the enhancement, the coercive nature of offering the suit to some Soldiers provides ethical concerns. When Soldiers consider the information provided to them, the most pressing information is the suit makes them more likely to survive in combat. Not accepting the enhancement almost guarantees they will die in combat. Making the Soldier choose between certain death and capabilities provided by the enhancement is coercive, and no reasonable person would choose not to accept the enhancement regardless of the suit's negative side effects, making selection of the enhancement a non-choice. Coupling this non-choice with Soldiers' internal desires to serve their country, be part of a team, and be successful, offering the suit creates significant perceptions of taking away the Soldiers' individual autonomy. Likewise, withholding suits from some Soldiers also affects their individual autonomy by removing their ability to choose the enhancement, which condemns unenhanced Soldiers to almost certain death.

INDIVIDUAL DIGNITY

In this scenario, the enhancement causes several violations to an individual's dignity. The perception of the chain of command ordering Soldiers to accept enhancements and withholding the choice of the enhancement from other Soldiers removes their ability to choose, violating their autonomy and individual dignity. Society's view of the metal plate also affects the individual dignity of a Soldier. Corporations seeking enhanced Soldiers for jobs and the Soldiers' belief that the metal plates are a mark of distinction mitigate the negative societal impressions. However, corporations choosing enhanced Soldiers over their non-enhanced humans for jobs would disadvantage the unenhanced members of society and creates social conflict.

SOCIETAL RISK

The societal risk presented in this scenario builds from corporations desiring to hire enhanced Soldiers. As unenhanced individuals seek to remain competitive in business, they begin seeking their own enhancements. As the population of enhanced persons increases, so too does the dichotomy between enhanced and unenhanced persons. This dichotomy increases societal discontent between those who can afford enhancements and those who cannot. The dichotomy also affects the individual dignity of unenhanced people. Rationalizing the division between moral harms and goods leads to the next principle, double effect.

DOCTRINE OF DOUBLE EFFECT

In this scenario, the enhancement fails to pass all of the elements from the medical and public health models. While it passes necessity and proportionality, it lacks informed consent and harms individual dignity. This point is where the doctrine of double effect can provide some guidance. The act of providing the enhancement provides a moral good to both Soldiers and society in that it prevents the adversary from destroying the United States, making the enhancement morally permissible. In enhancing Soldiers, the government intends to provide Soldiers and society, better protection and more lethality. Even though the cerebral implant deteriorates, the negative effect is an unintended harm to the Soldier, and the enhancement is morally permissible. The bad effects caused by the deteriorating implants do not make Soldiers more lethal or provide them more protection so the enhancement remains permissible. Determining the proportionality of this enhancement requires consideration of the harm and benefits to Soldiers and society. In this scenario, it is hard to know the amount of harm or benefit caused by the enhancement to society and Soldiers. Without concrete numbers, determining proportionality is difficult. However, in looking at proportionality, one might consider whether or not the adversary represents an existential threat to America; how significantly enhancements change societal values; how quickly the values change; and, how severely the enhancements negatively affect Soldiers? Answering these proportionality questions could determine if the enhancement was permissible under the doctrine of double effect.

Technology makes possible what was science fiction when Heinlein wrote *Starship Troopers*. Current technology makes plausible a shift from improving Soldiers' tools to enhancing the Soldier. However, these enhancements create moral concerns for Soldiers and society. Before these enhancement technologies mature, military, government, and civilian leaders need to examine the ethical concerns surrounding enhancements.

Examining enhancements through the lens of several ethical models enables one to scope the ethical concerns involved with military enhancements. A medical research model accounts for individual interests. The benefits militarization of technology represents to society are accounted for using a public health model. When the interests of the individual do not align with the interests to society, the doctrine of double effect can help determine if the act is morally permissible.

The ethical principles of necessity, proportionality, informed consent, individual dignity, societal risk, and double effect provide a basic framework through which one can examine ethical concerns of both temporary and permanent enhancements. U.S. Army and congressional leader discussions should consider the ethical implications of enhancing Soldiers before the technology matures.

ENDNOTES - CHAPTER 14

1. Robert A. Heinlein, *Starship Troopers*, New York: The Berkley Publishing Group, 1987, pp. 99-100.

2. Eric Juengst quoted in Patrick Lin, Maxwell J. Mehlman, and Keith Abney, "Enhanced Warfighters: Risk, Ethics, and Policy," Report prepared for the Greenwall Foundation, ver. 1.0.2, January 1, 2013, available from *http://ethics.calpoly.edu/Greenwall_report.pdf*, accessed March 16, 2017, p. 17.

3. Lianne Hart, "Use of 'Go Pills' a Matter of 'Life and Death,' Air Force Avows," *Los Angeles Times*, January 17, 2003, available from *http://articles.latimes.com/2003/jan/17/nation/na-friendly17*, accessed February 21, 2017.

4. Office of the Secretary Ethical Principles and Guidelines for the Protection of Human Subjects of Research and The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, *The Belmont Report*, Washington, DC: Department of Health, Education, and Welfare, April 18, 1979, available from *https://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/*, accessed March 13, 2017.

5. James F. Childress, Ruth R. Faden, Ruth D. Gaare, Lawrence O. Gostin, Jeffrey Kahn, Richard J. Bonnie, Nancy E. Kass, Anna C. Mastroianni, Jonathan D. Moreno, and Phillip Nieburg, "Public Health Ethics: Mapping the Terrain," *The Journal of Law, Medicine & Ethics*, Vol. 30, Iss. 2, June 2002, p. 173.

6. Brian Orend, *The Morality of War*, Ontario, Canada: Broadview Press, 2006, p. 115:

> The DDE [doctrine of double effect] stipulates that an agent A may perform an action X, even though A foresees that X will result in both good (G) and bad (B) effects, provided all of the following criteria are met: 1) X is an otherwise morally permissible act; 2) A only intends G and not B; 3) B is not a means to G; and 4) the goodness of G is worth, or is proportionately greater than, the badness of B.

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