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FOREWORD

In 1994 the Army embarked on the Army After Next (AAN) study plan to explore new concepts and think innovatively about how the Army would fight in the future. Envisioned as way to develop the Army after Force XXI (thought to be the Army of 2025), the AAN project was chartered by the Chief of Staff of the Army and grew to involve a wide range of participants. Think tanks, scientists, federal laboratories, and organizations across the Army undertook study projects and thought deeply about what "could be."

The Army War College also contributed to the AAN effort through strategic wargames, experimentation and student and faculty research. One of the initiatives was the AAN Seminar – a special program in Academic Year 1997 – composed of students who were interested in contributing to the development of the future Army. The students studied, debated, researched and wrote about the AAN. A compendium of their papers was published to inform senior leaders on a range of issues regarding the Army's future.

In 2014 the Army War College established the Futures Seminar – a seminar loosely modeled on the AAN Seminar. As with the AAN seminar, Future Seminar students and faculty collaborate to explore the Army of the Future…in this case, the Army of 2035 and beyond. As with previous years, the seminar focused on the requirements for an Army of the future – and sought to explore the question:

"What kind of Army does the nation need in 2035 and beyond?"

This 5th annual compendium is the result of the student requirement to write a paper addressing this question. In Academic Year 2018 the Futures Seminar students and faculty, in collaboration with the Army Capabilities Integration Center (ARCIC) and the Defense Advanced Research

Project Agency (DARPA), examined a proposed new unit that was small in size and equipped with advanced technological capabilities. This unique opportunity allowed the students to consider all aspects of organizational design and operational capabilities for this unit to meet its mission requirements. The students learned about future concepts and technologies from expert speakers, engaging other futures personnel in the Department of Defense and academia, and participating in the Army's Deep Future Wargame – Unified Quest – where they "fought" the proposed unit against a potential adversary.

These students contributed greatly to the Army-DARPA project and to the overall dialogue on the requirements of the future Army.

Samuel R. White, Jr
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PART I:

FUTURE SOLDIER REQUIREMENTS

SUPERMEN AND CYBORGS: HUMAN PERFORMANCE ENHANCEMENT IN THE MILITARY

LTC Linn K. Desaulniers, U.S. Army

The genre of Science Fiction is an excellent place to look toward future capabilities, best summed up by paraphrasing a known quote, “at some point, all technology was science fiction.” From the Montgolfier brothers and their hot air balloon to Apollo 11, to have said these feats were possible a decade prior, one would probably receive sideways looks. Yet to really examine the next evolutionary steps, one can look no further than *Iron Man* (bio-implant supplemented with exoskeleton), *Aliens* (space marines monitored via bio-sensors and real time video feed), and *Captain America (*pharmaceutically/genetically altered to increase human performance).

In order to mitigate future human resource gaps and ensure soldiers can accomplish their missions, the Army must continue forward with both Human Performance Optimization (HPO) and Human Performance Enhancement (HPE). The goal of augmenting human systems is not to create a human computer, but to assist humans in keeping up with the increasing speed of warfare. The United States’ current and future adversaries are no doubt working toward HPE with fewer moral and ethical restrictions. Developing our own augmentation to understand what can be done, how to counter a threat, and improve U.S. soldier capabilities is crucial. At this time science is working toward many possibilities but it is still speculation as to what is in the realm of the achievable.

What exactly is Human Performance Enhancement and Human Performance Optimization? For the purposes of this paper, they are anything that augments or assists a soldier, through non-materiel and materiel solutions, in the performance of duties, especially as it relates to combat. A more

specific categorization is put forth by Kenneth Ford and Clark Glymore who describe it as a, "genetic or computational-mechanical alteration of the human body; physiological monitoring and tighter coupling between man and machine; pharmaceuticals; and nutrition and supplementation."[1]

Colonel David Brown offers a more military focused definition, "HPO – ensures efficient use of limited human resources in military systems through the process of human systems integration; HPE – enables the human to operate beyond established and sustainable performance thresholds, achieved primarily through science and technology."[2]

In many ways the military and the civilian sector have been working towards some version of HPO/HPE for decades. Reading glasses, Lasik, cochlear implants, hip replacements, pacemakers, and prosthetic limbs are all widely accepted in society to "enhance normal functioning."[3]

Science is now on the brink of breakthroughs in biotechnology. As computers continue to become more powerful, allowing for rapid genome sequencing, tools like Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/Cas9 provide the opportunity to "modify the DNA sequence of an organism without relying upon and intermediate mechanism, for example a virus or radiation, to induce genetic changes."[4] This ability could be revolutionary

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1. Kenneth Ford and Clark Glymour, "The Enhanced Warfighter," *Bulletin of the Atomic Scientists* 70, no. 1 (January 2014): 43, Http://bos.sagepub.com/content/70/1/43 (accessed May 15, 2018).

2. Colonel David Lex Brown, MD, "Doctrine and Organization for Determining the Ethics of Human Performance Enhancement," Paper for the symposium on Human Performance Enhancement for NATO Military Operations (Science, Technology and Ethics) Sofia, Bulgaria from 5 through 7 October 2009, 22-2.

3. Kevin Warwick, "Cyborg morals, cyborg values, cyborg ethics," *Ethics and Information Technology* 5, no. 3 (October 2003): 131, http://mysite.du.edu/~lavita/dmst_2901_w12/docs/warwick_cyborg_ethics.pdf (accessed May 15, 2018).

4. LTC Douglas R. Lewis, PhD, "Biotechnology: An Era of Hopes and Fears," *Strategic Studies Quarterly* 10, no. 3 (Fall 2016): 30, http://www.airuniversity.af.mil/Portals/10/SSQ/documents/Volume-10_Issue-3/Lewis.pdf (accessed May 15 2018).

for military formations. Imagine a soldier made resistant to chemical or biological weapons, or at least the technology to rapidly identify and neutralize the threat agent using "DNA synthesis to directly program [an] immune system."[5]

As early as the 1980s, the US Army sought to tap into human biology to improve soldier training and neuro-cognitive skills. From neuro-linguistic programming to guided imagery and meditation thru the use of endorphins to maintain a "runners high," all saw experimentation with the intent to improve soldier performance.[6] These concepts, however, should not be placed in the same bin with the CIA's Cold War experiments in telepathy and Extrasensory Perception (ESP), as they are all rooted in real science. Neuroplasticity, according to research, has shown to increase overall cognitive capacity, increase focus and processing speed and improve visual processing.[7] Specifically the Defense Advanced Research Projects Agency (DARPA) has demonstrated that enhanced marksmanship accuracy is possible using a neurofeedback program.[8] The next step in this evolution is a man-machine interface using Artificial Intelligence (AI) to augment the human brain.

Chess champion Garry Kasparov has written about this pairing. After his loss to IBM's Deep Blue, he developed "Centaur" competitions that pair humans with computers on

5. Kettner Griswold, Jr., "Engineering Warfighter Resilience Against Biothreats," slide presentation for Bio Convergence and Soldier 2050 Conference, Menlo Park, CA, March 8, 2018, https://community.apan.org/wg/tradoc-g2/mad-scientist/m/bio-convergence-and-the-changing-character-of-war/225215 (accessed May 15, 2018).

6. Sally Squires, "The Pentagon's Twilight Zone," *The Washington Post*, April 17, 1988, https://www.washingtonpost.com/archive/opinions/1988/04/17/the-pentagons-twilight-zone/7677a8f2-366b-49a9-a20f-e167cf6f7dde/?utm_term=.4a03edaa1b26 (accessed May 15, 2018).

7. Amy A. Kruse, PhD, "Human 2.0: Upgrading Human Performance," slide presentation for the Bio Convergence and Soldier 2050 Conference, Menlo Park, CA, March 8, 2018, https://community.apan.org/wg/tradoc-g2/mad-scientist/m/bio-convergence-and-the-changing-character-of-war/225185 (accessed May 15, 2018).

8. Ibid.

one team to "create the highest level of chess ever played."[9] The results show the man-machine pairing will win against just a machine in all demonstrated iterations. The key here is the interface. Chess is simply based on what task is required. As the complexity moves higher on a scale, how will information need to be presented to assist humans with battlefield decisions? The next step could be some type of hardwired neuro-implant.

Implantable sensors are not that far away and the Army is seeking to leverage this technology. LTG Nadja West, the Army's surgeon general, recently discussed the possibilities. She said, "Commanders can use this kind of technology to decide who to send on the next mission…just imagine a commander having that information, where that person is and how they're doing…are they deployable or not…if you had a pilot getting into a cockpit, wouldn't you want to know if they're sleepy or not?"[10] The *Aliens* reference in the intro does not seem so much Science Fiction as it does science when you hear a senior officer discussing the possibilities.

Soldiers that are at less than optimal performance could then be given any number of pharmaceutical products. The Air Force has been supplying its pilots with a cocktail of drugs to facilitate long duration sorties for years.[11] The Army Special Forces also use amphetamines for certain mission profiles. The military has, in general, been the recipient of "anti-depressants, narcotics, sedatives, anti-psychotics, or anti-anxiety drugs."[12] The scientific community and pharmaceutical companies continue to develop so-called

9. Garry Kasparov with Mig Greengard, *Deep Thinking: Where Machine Intelligence Ends and Human Creativity Begins* (New York, NY: PublicAffairs, 2017), 3.

10. Kathleen Curthoys, "Soldiers may soon have implantable health monitors and robotic surgeries done remotely," *The Army Times Online*, May 18, 2018, https://www.armytimes.com/news/your-army/2018/05/18/soldiers-may-soon-have-implantable-health-monitors-and-robotic-surgeries-done-remotely/ (accessed May 23, 2018).

11. Brown, "Doctrine and Organization," 22-2.

12. Ford and Glymour, "The Enhanced Warfighter," 48.

"Nootropics" that enhance cognitive ability and will be useful in a military environment. It may be soon that every student will take a "smart shake" prior to a test, just as a soldier may take one prior to a patrol. The culture of using drugs to regulate and manipulate human personalities and performance exists today, and one can expect that to continue to evolve.

The "sense" technology discussed by LTG West will develop into more of an interface platform versus a feedback device. DARPA has already made advances in brain-machine interfaces that allows modular prosthetic limbs to respond to wearer's thoughts. While this type of interface normally requires a surgical implant, scientists are confident that a wearable sensor package is a near term possibility.[13]

In the end the question surrounding all of this science is why is it important? As Ford and Glymour state, "not *all* is fair in war, but *a lot* of unfairness is wanted."[14] The United States wants every advantage for its soldiers. It spends inordinate amounts of resources to train and equip the military so that it is the best in the world. If adversaries are possibly taking advantage of HPE/HPO, is there not an obligation to find an overmatch in similar capabilities?

This paper will not examine the specific ethics of any of the HPE/HPO technologies. However, even if it is decided that we as a society do not want to utilize all possibilities, we must still research and understand what they are capable of providing to a military force. The single reason to pursue these solutions - adversaries of the United States are attempting to use them all. China, for example, is making advances in AI-assisted command decision-making, brain computer interfaces, military exoskeletons and CRISPR.

13. Michael P. McLoughlin and Emelia S. Probasco, "Brain-Machine Interfaces: Realm of the Possible," *Strategic Studies Quarterly* 10, no.3 (Fall 2016), 15-20, http://www.airuniversity.af.mil/Portals/10/SSQ/documents/Volume-10_Issue-3/McLoughlin.pdf (accessed May 15, 2018).

14. Ford and Glymour, "The Enhanced Warfighter," 45.

China also has the advantage of leveraging its dual-use laboratories and government/private industry to focus technologies on military aspects.[15] They have already shown the capability to "increase muscle mass and hair production in dogs and goats and alter the neurological development in monkeys.[16] This is just what the West can see in published work, it is not difficult to speculate they are doing the same things in humans at this time. In order to counter or defeat technology, the United States must continue to explore all aspects and applications.

Given the benefits that can be seen to assist combat wounded, both physically and mentally (after a traumatic brain injury for instance), do we not want to develop "a next-generation memory-enhancing brain prosthesis?"[17] The medical technology alone may be able to keep soldiers on active duty, whereas now they are medically retired. As discussed at the outset, as the recruiting pool continues to shrink, it is well within the possible to see HPO/HPE providing the capability to fill gaps within the ranks, or just bringing the ranks up to a higher level of performance.

It is comforting to know that organizations like DARPA and its Biological Technologies Office are working on these needed future capabilities. It will, however, take the full weight of civilian and research agencies in partnership with private companies to ensure that the United States retains the advantage against its adversaries. It has been disheartening to see companies like Google having internal strife over involvement in Project Maven.[18] While not necessarily

15. Elsa B. Kania, "PLA Human-Machine Integration," slide presentation for the Bio-Convergence and Soldier 2050 Conference, Menlo Park, CA, March 8, 2018, https://community.apan.org/wg/tradoc-g2/mad-scientist/m/bio-convergence-and-the-changing-character-of-war/225234 (accessed May 15, 2018).

16. Lewis, "Biotechnology," 30.

17. Eve Harold, *Beyond Human: How Cutting-Edge Science is Extending Our Lives* (New York, NY: St, Martin's Press, 2016), 133-134.

18. Tom Simonite, "Pentagon will expand AI project prompting protests at Google," *Wired*, May 29, 2018, https://www.wired.com/story/

directly tied to HPO/HPE, there is a dangerous undercurrent that might find the military struggling to gain the technological edge. In the future, the United States does not want to play "catch up" to its rivals like it has done in every war prior to the Gulf War. The conflicts of tomorrow will not allow for the time.

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googles-contentious-pentagon-project-is-likely-to-expand/ (accessed May 29, 2018).

THE HUMAN DIMENSION IN THE ARMY OF 2035 AND BEYOND

LTC Russell J. Wolf, U.S. Army National Guard

The traditional expectation of American service members was the possession and demonstration of qualities such as discipline, fitness, leadership, loyalty, and patriotism. These remain important qualities, however other characteristics continue emerge as the character of war continues to change with the implementation of new technologies to prosecute war. This paper will discuss some of the requisite traits service members must possess in the Army of 2035 and beyond. Specifically intellect/cognitive abilities, physical considerations and leadership characteristics.

The men and women who served in World War II (WWII) were a mix of volunteers swept up in a wave of patriotism after the attack on Pearl Harbor as well as career regular Army soldiers and officers. They were Midwest farmers, intercity teens, and blue collar factory workers. They endured eight weeks of basic training, and then shipped out to fight in the European or Pacific theaters where they typically fought as a large conventional force facing off on open ground. The service members' education, fitness level, and job preference had very little weight when factored into the equation.

The force fielded to fight in Korea and Vietnam consisted primarily of draftees who lacked the patriotic enthusiasm of their WWII predecessors. They faced extreme physical challenges posed by extreme cold in Korea to sweltering heat and humidity in Vietnam; mountainous, jungle terrain, as well as mental challenges presented by the lack of support for the wars. Television and movies portray soldiers of this era as courageous and competent, but laid-back, and at times, insolent. The Army professionalized following the war in Vietnam. Army Doctrine Reference Publication (ADRP) No. 1 states,

> "The all-volunteer Army began thorough professional development of all uniformed cohorts. It developed a codified body of expert military knowledge in land warfare doctrine, instituted formal programs of career-long military education in professional schools, and cultivated a unique military culture grounded in the Army Ethic of honorable service to the Nation."[19]

As the U.S. military professionalized, additional characteristics became important such as education, expertise, moral/ethical character, and taking responsibility for one's actions.

During the most recent conflicts in Iraq and Afghanistan, warriors are required not only to know how to fight, but how to deal with the local civilian leaders, how to cooperate with partners and allies, as well as civilian and government interagency organizations. This requires a broad range of experience, cooperativeness, open-mindedness, innovation.[20]

The future operating environment will be more complex and ambiguous. Soldiers performing military operations in 2035 and beyond will face increased cognitive demands in order to target an enemy's will.[21] A changing operating environment requires soldiers who have the skills and competencies to match. Soldier intellect, cognitive capacity, and

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19. U.S. Department of the Army, The Army Profession, Army Doctrine Reference Publication 1 (Washington, DC: U.S. Department of the Army, June 14, 2015), 1-3 http://data.cape.army.mil/web/repository/doctrine/adrp1.pdf (accessed May 19, 2018).

20. Australian Defence Science and Technology Organisation, The Network Centric Warrior: The Human Dimension of Network Centric Warfare, (Edinburgh South Australia, July 2004), Executive Summary https://pdfs.semanticscholar.org/c138/d60292a0447c20b5e54efa5395b017877f89.pdf?_ga=2.121784523.1589339662.1564508131-24580079.1564508131 (accessed April 16, 2018).

21. U.S. Joint Chiefs of Staff, *The Joint Force in a Contested and Disordered World,* Joint Operating Environment (JOE) 2035, (Washington, DC: U.S. Joint Chiefs of Staff, July 15, 2016), 18 http://www.airuniversity.af.mil/Portals/10/

character will be vital. In its publication *Strategic Trends Programme, Future Operating Environment 2035*, the United Kingdom Ministry of Defence Development, Concepts and Doctrine Centre noted that "Young people and therefore future soldiers will be increasingly 'tech savvy' as users, but they may not have the technical skills to design or maintain these systems. The training requirements to keep pace with technology will be considerable… Our challenge will be to recruit and develop people who are comfortable with change and can adapt as necessary."[22]

The Defence Science and Technology Organisation of the Australian Department of Defence list some of the most important cognitive qualities future Soldiers must have as:[23]

- versatility, adaptability, flexibility
- confidence, independence, initiative
- intercultural competence
- system thinking
- relationship management
- emotional intelligence
- ability to cope with uncertainty and ambiguity
- the ability to innovate and to improvise

In other words, soldiers must have innovation, creativity, and problem solving abilities. It is essential they have the

CMSA/documents/Required_Reading/Joint%20Operating%20Environment%202035%20The%20Joint%20Force%20in%20a%20Contested%20and%20Disordered%20World.pdf (accessed February 12, 2018).

22. United Kingdom Ministry of Defence, *Strategic Trends Programme, Future Operating Environment 2035,* (UK Ministry of Defence, November 30, 2014), 35, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/646821/20151203-FOE_35_final_v29_web.pdf (accessed on October 25, 2017)..

23. Australian Defence Science and Technology Organisation, The Network Centric Warrior, 60.

ability to learn, think about, and apply large quantities of information and the ability to interpret and make decisions on incomplete or conflicting data. They must have a good understanding of what their systems can do and the initiative to apply them properly in order to get optimum effects.[24]

Alliances, partnerships, and conducting operations within international organizations are likely to remain the preferred method of military engagement.[25] The importance of such partnerships will grow, as they do they are likely to become more complex and ambiguous. Soldiers must have the knowledge, language ability, and finesse to work comfortably in multi-cultural environments.

A strong character can assist future soldiers cope with the increased amount of complexity and uncertainty. The United States Army Training and Doctrine Command (TRADOC) publication titled *The U.S. Army Study of the Human Dimension in the Future 2015-2024* states, "Character develops through learning and experience."[26] It also describes character as, "built on values and beliefs serves as a moral compass that helps individuals make sound moral judgments in the midst of chaos, ambiguity, fear, and violence."[27] Given the complex and ambiguous environment in which future generations will operate, a well-developed character is the best defense against the temptation to make immoral choices and poor decisions without sacrificing honor or integrity.

A soldier's physical fitness is another key component to fighting future wars. The TRADOC Human Dimension

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24. Ibid., 13.

25. United Kingdom Ministry of Defence, *Strategic Trends Programme, Future Operating Environment 2035*, 12.

26. United States Army Training and Doctrine Command, The U.S. Army Study of the Human Dimension in the Future 2015-2024, TRADOC Pamphlet 525-3-7-01, (Washington, DC: U.S. Department of the Army, April 1, 2008), 54 https://apps.dtic.mil/dtic/tr/fulltext/u2/a489116.pdf (accessed on April 7, 2018).

27. Ibid., 53.

publications identifies the most important physical fitness requirements as aerobic capacity, strength, endurance, flexibility, and coordination.[28] Persistent conflict in a multitude of environments will place extreme physical demands on Soldiers. The U.S. Army Study of the Human Dimension in the Future 2015-2024 offers this scenario,

> "Soldiers stationed in the Arctic climate of Alaska on one day deploying the next day to a desert or jungle environment. With no time to acclimate, Soldiers must be in top physical condition to be able to function in such extreme conditions. Temperatures topping 125 degrees Fahrenheit in Iraq are common and Soldiers outfitted in full body armor cannot escape the heat.[29]

Army leaders must address this consideration now. The soldiers of the future are the children of today. There is no shortage of articles and information on America's current obesity dilemma. A study conducted by *Child Trends Data Bank* found that from 1980 to 2000, the number of overweight children in the U.S. tripled from five percent to 15 percent. In 2003, almost two thirds of high school students were not physically active during physical education.[30] This trend poses a significant challenge to the future force.

The leaders who will guide the future force must be adaptable, critical thinkers who possess a wide range of tactical, technical, and interpersonal expertise. They will function throughout the range of military operations. The rapid advances in technology will require continuous changes in tactics. The figure below presents the envisioned required

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28. Ibid., 87.
29. Ibid., 88.
30. Child Trends. (2017). *Overweight children and youth*. retrieved from https://www.childtrends.org/indicators/overweight-children-and-youth (accessed April 8, 2018).

attributes of the future multi-skilled leader according to TRADOC.[31]

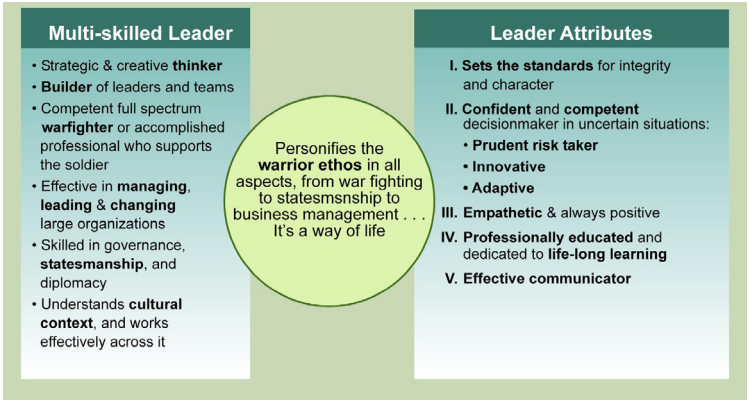

Figure 1. Attributes of the Multi-skilled Leader[32]

General Milley, The Army Chief of Staff, provides his vision of the qualities of future leaders,

> "Our leaders then are going to have to be self-starters. They are going to have to have maximum amounts of initiative. They are going to have to have critical thinking skills well beyond what we normally think of today in our operations. They are going to have to have huge amounts of character so that they make the right moral and ethical choices with the absence of supervision under the intense pressure of combat. They are going to have to have a level of mental and organizational agility that is not necessarily current in any army really,"[33]

The human dimension in the Army of 2035 and beyond will require soldiers and leaders to boast advanced technical competence, along with superior cognitive capacity,

31. United States Army Training and Doctrine Command, TRADOC Pamphlet 525-3-7-01, 106.

32. Ibid.

33. Scott Maucione, "This is the Army's future soldier," *Federal News Radio*, October, 3, 2016, https://federalnewsradio.com/army/2016/10/

exceptional physical endurance and strength, and extraordinary moral character. Technological advances and artificial intelligence will assist in many ways to lessen the burden placed on humans, the paradox however is they will also add complexity to the calculus of what future soldiers should "look like."

Lieutenant Colonel Russ Wolf is an Engineer officer in the North Dakota Army National Guard who recently commanded an Engineer Battalion in North Dakota. He currently serves as the Deputy Director for Strategic Plans, Policy, and Communications for the North Dakota National Guard. His Strategy Research Paper (SRP) examines the use of the Electromagnetic Spectrum to support the future force.

armys-future-soldier/ (accessed April 6, 2018).

PART II:

FUTURE STRUCTURES

UNITED STATES DIGITAL RESERVE

LTC Geoffrey J. Jeram, U.S. Army Reserve

People embody the raison d'être of their government and the fundamental strength of their military. Today, a civilian-military gap widens within the United States while its adversaries' technological gaps narrow. A *Digital Reserve* of remote combatants wielding semi-autonomous weaponry will provide the offset strategy to counter the aggression of major power adversaries. It will exploit the convergence of existing technologies and social trends, work around demographic constrains, and avoid the ethical and technological pitfalls of fully autonomous weapon systems. The last two decades have seen parallel maturation of robotic weaponry, socialization of serious collaborative online gaming, and mastery of telecommunications and information technology. When these technologies converge, the Digital Reserve offers an effective offset for the U.S. force-ratio disadvantage of its close fight combatants.

Analytical Context

A strategic research project exploring the long-term tendencies of warfare across three socio-technical dimensions of the twenty-first century revealed a potential solution for a "Digital Reserve." These dimensions included centralization of decision authority, distance separating the combatant and his weapon, and the level of machine autonomy. The study revealed a fertile solution space described by decentralized decision authority, remote controlled weaponry, and limited machine autonomy. The project outlined the potential for a force of remote combatants fighting with semi-autonomous weapon systems which this paper explores in detail.[34]

34. Geoffrey Jeram, *Citizen Soldier Sensor Swarm*, Strategy Research Project (Carlisle Barracks, PA: U.S. Army War College, March 28, 2018), 21.

Social, Technological, and Martial Developments

With the end of conscription in the United States, the portion of the Americans with personal service in the military began to drop, and the vicarious experience provided to the general population dropped with it. Before the U.S. ended the draft in 1973, a member of the President's Commission on an All-Volunteer Armed Force predicted that U.S. armed forces could not be voluntary in a major conflict. Thirty years later, the prediction had not been realized, but recruiting remained an active concern. A RAND study in 2006 maintained that financial resources to attract high quality volunteers remained the essential remedy.[35] Yet by then, the American labor force with military experience had dropped from 30% at the end of the draft to 10% in 2004. Meanwhile, force cuts and base closures isolated military populations, leaving Americans with few opportunities to encounter members of their armed forces in daily life.[36] On a broader scale with a different metric, the percentage of the total U.S. population in the armed forces dropped from 9% at the peak of the Second World War to about 2% at the peak of the Vietnam War to settle at 0.5% in 2011 a decade into the Global War on Terror. By then, even Admiral Mullen, the Chairman of the Joint Chiefs of Staff, feared that the nation's civilians did not know their own military.[37] These measures reflect a growing civilian-military gap, the most severe than any since the 1940s when the U.S. stepped away from isolationism at the start of the Second World War.

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35. Rostker, Bernard, *I want you!: The evolution of the All-Volunteer Force* (Santa Monica, California: Rand Corporation, 2006), 3 (accessed May 20, 2018). Rostker quotes Crawford Greenewalt as the source of the prediction.

36. Casey Wardynski, "Informing Popular Culture, The America's Army Game Concept," in *America's Army PC Game—Vision and Realization*, ed. Margaret Davis (San Francisco: United States Army and the MOVES Institute, 2004), 6, http://www.movesinstitute.org/%7Ezyda/pubs/YerbaBuenaAABooklet2004.pdf (accessed May 20, 2018).

37. Pew Social and Demographic Trends, *The Military-Civilian Gap, War and Sacrifice in the Post-9/11 Era* (Washington, DC: Pew Research Center, October 5, 2011), 8 and preface page, http://assets.pewresearch.org/wp-content/uploads/sites/3/2011/10/veterans-report.pdf (accessed May 20, 2018).

As the US population grew distant from its military, it also grew obese. Data sourced from the Center for Disease Control revealed that "in 1990, no state had an obesity rate higher than 15%. By 2006, only 6 states had obesity rates less than 20%." And by 2004, obesity reached 32% of the total U.S. population and 17.1% of adolescents.[38] A decade later, those adolescents had grown into the prime age bracket for military service and 2017 Pentagon data revealed that 71% of Americans ages 17-24 would not qualify for military service.[39] Those disqualified due to health problems other than weight amount to 32% and those due to physical fitness amount to 27%.[40] Not only did the population lack first- or second-hand knowledge of its military, but most Americans lacked the qualifications to serve regardless of their inclinations.

Recognizing the widening civilian-military gap, in 2002 the U.S. Army debuted *America's Army*, a first-person shooter, role-playing, personal computer game that demonstrated the interplay between soldiering and Army values. Registered users grew to over 2.4 million users and became "the Army's most effective medium for reaching young Americans."[41] The game proved itself a versatile platform for strategic communication with the public, accessible down to mobile platforms, and effective as combat training for real soldiers.[42] Since 2015, the game reached its

38. Charles Menifield, Nicole Doty, and Audwin Fletcher, "Obesity in America," *The Official Journal of the Association of Black Nursing Faculty in Higher Education* 19, no. 3 (Summer 2008): 83, in ProQuest https://search.proquest.com/docview/218860194?accountid=4444 (accessed May 29, 2018).

39. Thomas Spoehr, Bridget Handy, "The Looming National Security Crisis: Young Americans Unable to Serve in the Military," *Backgrounder*, No.3282, February 13, 2018, 1, https://www.heritage.org/sites/default/files/2018-02/BG3282.pdf (accessed March 25, 2018).

40. Ibid., 3.

41. Wardynski, "Informing Popular Culture", 7.

42. Ibid.; Tom Bramwell, "America's Army launches mobile offensive," March 17, 2007, https://www.gamesindustry.biz/articles/americas-army-launches-mobile-offensive (accessed March 29, 2018); Jean, Grace, "Game Branches Out Into Real Combat Training," February 2006, https://web.archive.org/

fourth version in America's Army Proving Grounds, now a multi-player, squad-level, first person shooter game on the Stream distribution platform.[43] *America's Army* became the quintessence of a "Serious Game," whose definition might read as "a mental contest played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives."[44] In practical effect, this and other multiplayer games with first-person perspectives using lean client interfaces, had prototyped and matured useful functionality for the human partition of what could become an online army.

The computer gaming industry shares a common interest and investment with the military in its funding for research, development, and testing. In 1997, the National Research Council identified research areas of common interest. These areas included technologies for immersion, networked simulation, standards for interoperability, computer generated characters, and tools for creating simulated environments.[45] In 2009, U.S. gamers spent about $3.8 billion on Massively Multiplayer Online Games (MMOGs).[46] The size of the 2014 MMO and Multiplayer Online Battle Arena (MOBA) gaming market reached $24.4 billion while forecasts for its 2017

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web/20081001005713/http://www.nationaldefensemagazine.org/archive/2006/February/Pages/games_brance3042.aspx (accessed May 29, 2018).

43. Valve Corporation, "America's Army: Proving Grounds," 2018, https://store.steampowered.com/app/203290/Americas_Army_Proving_Grounds (accessed May 29, 2018).

44. Michael Zyda, "From visual simulation to virtual reality to games," *Computer* 38, no. 9 (2005): 25, https://pdfs.semanticscholar.org/1ff5/0dd498d5805941ca6bb720d425f625b5c56d.pdf (accessed May 29, 2018).

45. National Research Council, *Modeling and Simulation: Linking Entertainment and Defense*, (Washington DC: National Academies Press, 1997), 2, https://www.nap.edu/catalog/5830/modeling-and-simulation-linking-entertainment-and-defense (accessed May 29, 2018).

46. MMOhuts, "US Gamers spent $3.8 billion on MMO Gaming in 2009," March 11, 2010, https://mmohuts.com/news/us-gamers-spent-3-8-billion-on-mmo-gaming-in-2009 (accessed May 29, 2018).

market reached $31 billion.[47] Another estimate places the 2019 gaming industry at $19.6B by 2019.[48] The economic success of MMOG and Multiplayer Online Battle Arena games demonstrates the popularity and viability of gaming technology for martial interests. Moreover, it demonstrates practical success in fields of technology and development of value for national defense.

The technology of remote weaponry matured during the Global War on Terror and the capabilities of autonomous weapon systems improved. The trend since the end of the U.S. draft continued, as capital investments in a variety of helpful robots offset practical and political limits to the number of "boots on the ground." The backpack-sized Packbot proved versatile as a mobile chemical sensor and showed potential for casualty extraction and urban navigation, relieving the need for U.S. troops to perform such dirty and dangerous missions.[49] Unmanned Aerial Systems had been used for long-duration surveillance for years before the U.S. Central Intelligence Agency exercised an armed Predator drone to make the first targeted killing on February 4, 2002.[50] The U.S. Air Force regularly operated the MQ-1 Predator and MQ-9 Reaper both domestically and abroad and by 2014 the Air National Guard remotely piloted 48 of these aircraft from ground stations in the U.S. and abroad.[51]

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47. Steve Fuller, "MMO gaming – Statistics & Facts," https://www.statista.com/topics/2290/mmo-gaming (accessed May 29, 2018).

48. Dean Takahashi, "U.S. games industry forecast to grow 30 percent to $19.6B by 2019," June 2, 2015, https://venturebeat.com/2015/06/02/u-s-games-industry-forecast-to-grow-30-to-19-6b-by-2019 (accessed May 29, 2018).

49. Brian Yamauchi, "PackBot: A versatile platform for military robotics," *Unmanned Ground Vehicle Technology* VI 5422 (2004): 228, https://webpages.uncc.edu/~jmconrad/ECGR6185-2008-01/notes/packbot.pdf (accessed May 29, 2018).

50. John Sifton, "A Brief History of Drones," The Nation, February 7, 2012, 1, https://www.thenation.com/article/brief-history-drones (accessed May 29, 2019).

51. Stephen Guerra, Michael McNerney, *Air National Guard Remotely Piloted Aircraft and Domestic Missions: Opportunities and Challenges* (Santa Monica, CA: RAND National Defense Research Institute, 2005), 15 http://www.dtic.mil/get-tr-doc/pdf?AD=ADA617774 (accessed June 1, 2018).

The Army demonstrated battlefield operation of remotely controlled semi-autonomous ground robots, while the Air Force demonstrated the same for aerial vehicles. Robotic weapons systems proliferated and the world took notice.

Literature in both technical and ethical fields exploded with research and analysis exploring the feasibility and acceptability of remotely operated Autonomous Weapon Systems (AWS). This analysis does not explore the full depth and breadth of the ethical reasoning regarding AWS but acknowledges that significant ethical and legal reservations exist regarding machines with the liberty to decide whether and how to kill humans. These ethical and legal reservations touch upon international humanitarian law, distinctions between combatants and non-combatants, proportionality, military necessity, the Laws of War and Rules of Engagement generally, the Martens Clause, moral hazard, accountability, and more.[52] These topics remain moot while technological barriers prevent the fielding of effective AWS.

The U.S. military has well-established and combat-proven means of telecommunication between operators and their remote weapons. The small tactical ground robots, such as the PackBot, may use wired or radio communication for short distance (hundreds of meters) remote operation.[53] Aerial robots, such as the MQ-1 and MQ-9, rely on line of sight radio and satellite communications.[54] Human Machine Interfaces (HMI) have evolved from truck-sized ground control stations, to laptop computers with joysticks, and now to computer tablets and other handheld systems. The automation that reduces operator workload makes the

52. Bonnie Docherty, "Losing Humanity: The case against killer robots," *Human Rights Watch* (New York: 2012), iv https://www.hrw.org/sites/default/files/reports/arms1112_ForUpload.pdf (accessed February 11, 2018).

53. Endeavor Robotics, 2018, http://www.endeavorrobotics.com/products (accessed May 31, 2018).

54. Maj William Bierbaum, "UAVs," https://www.airuniversity.af.edu/Portals/10/ASPJ/journals/Chronicles/uav.pdf (accessed May 31, 2018).

leaner HMI possible.[55] Yet this reliance on the electromagnetic spectrum for telecommunication makes the remote weapon systems vulnerable to interference and disruption from electronic warfare systems. Anti-satellite weapons could destroy the Global Positioning Systems that many remote systems need for navigation. Destruction or jamming of military communications satellites or line of sight radio links between stateside pilots and their remote aerial systems could leading to the loss of the assets.[56] While the technology of telecommunication systems and networks are mature and battle tested, they have vulnerabilities in great power conflicts with militaries capable of advanced electronic warfare.

From the late 1990s, the U.S. telecommunications industry experienced a boom and bust period of disruptive innovation. The Telecommunications Act of 1996 brought competition to the local and regional levels and opened long distance networks to regional telecom companies.[57] The act arrived coincident "with advances in fiber-optic technology that dramatically increased the capacity for data transmission and with more efficient use of the spectrum available for wireless communication" and "during a time of rapidly increasing Internet use." Intense competition for all of a family's or firm's telecommunication needs ensued and the industry faced extraordinary uncertainty. The industry overinvested in its infrastructure, particularly in long-distance

55. Courtney Howard, "UAV command, control & communications," Military & Aerospace Electronics, July 11, 2013, https://www.militaryaerospace.com/articles/print/volume-24/issue-7/special-report/uav-command-control-communications.html (accessed May 31, 2018); Endeavor Robotics, 2018.

56. Dan Lamothe, "Predator drone crashed in New Mexico after losing communications link," *The Washington Post*, June 26, 2014, https://www.washingtonpost.com/news/checkpoint/wp/2014/06/26/predator-drone-crashed-in-new-mexico-after-losing-communications-link/?utm_term=.223ae02269f4 (accessed may 31, 2018).

57. Telecommunications Act of 1996, Public Law 104-104, 104th Cong., 2nd sess. (February 8, 1996), 110 STAT. 56, https://www.fcc.gov/general/telecommunications-act-1996 (accessed May 31, 2018).

fiber optic cable.[58] In the five years between 1998 and 2003, the price index for the two digital telecommunications services dropped precipitously. Mobile telephone service dropped 32% and that for long distance service dropped 25%.[59] Since 2003, the industry stabilized and U.S. internet usage grew geometrically from 234 monthly petabytes in 2003 to 31,352 monthly petabytes in 2016.[60] Although the years shortly after 1996 brought turmoil to many telecommunication businesses, the investments and competition expedited widespread public access to digital voice and data networks with high bandwidths, low prices, and global reach.

Convergence to a Digital Reserve

Put simply, a "Digital Reserve is a people's army wielding remote weaponry in decentralized operations."[61] More generally, it could encompass aerial, maritime, subterranean, and space domains and may allow centralized command in permissive environments. It emerges at the convergence of four well developed fields: massively multiplayer online games, information technology, telecommunications, and autonomous weapon systems. The architecture of a Digital Reserve involves four functional elements: 1) the individual human combatant who makes the lethal decisions; 2) an information system that makes battlefield sensor information coherent and useable for the combatant and other stakeholders; 3) the telecommunication network that disseminates information among the combatant, the remote

58. Elise Couper, John Hejkal, and Alexander Wolman, "Boom and Bust in Telecommunications," *Federal Reserve Bank of Richmond Economic Quarterly* 89, no. 4 (Fall 2003): 2, https://www.richmondfed.org/~/media/richmondfedorg/publications/research/economic_quarterly/2003/fall/pdf/wolman.pdf (accessed June 1, 2018).

59. Ibid., 9.

60. *Cisco Visual Networking Index and US Telecom Analysis*, quoted in US Telecom Broadband Association, "Estimated U.S. Internet Protocol Traffic 1990-2016," 2016, https://ustelecom.org/wp-content/uploads/2018/12/Internet-Usage-Historical-Data.pdf (accessed June 1, 2018).

61. Geoffrey Jeram, *Citizen Soldier Sensor Swarm*, 22.

weapon system, combat support systems, and command stakeholders; and 4) the semi-autonomous weapon system on the battlefield that applies force.

The digital reservist fights with semi-autonomous weapon systems through a remote interface and differs from the traditional guardsman or reservist who is subject to physical deployment into close combat. The aforementioned Air National Guardsmen who remotely pilot Predator and Reaper aircraft offer a close precedent. But the digital reservist, as a combatant, fights remote weapon systems in close proximity to comrades, enemies, and non-combatants. In a MMOG, such as *America's Army*, the user maneuvers as virtual player and weapon system. He communicates through a personal computer and collaborates, typically via Voice over Internet Protocol (VOIP), with other remote teammates to engage and defeat virtual adversaries in a simulation of a notional combat environment. In the Digital Reserve, instead of a notional environment with a fictional adversary, the human combatant experiences a near real-time simulation assembled from a variety of data and sensor signals of an actual battlefield. And instead of actuating a virtual soldier or weapon with no physical substance, the combatant actuates a physical weapon system on the distant battlefield. In other words, the Digital Reserve combatant has a telepresence as a robotic combatant on the battlefield.

If the physical fitness requirements for the Digital Reserve adopt the functional fitness aspiration of today's armed forces, the medical and physical fitness requirements for the Digital Reserve will differ from the rest of the army.[62] Because the physical function of the digital reservist

62. Meghann Myers, "As the Army turns to functional fitness testing, is the end of gender standards near?" *Army Times*, March 26, 2018, https://www.armytimes.com/news/your-army/2018/03/26/as-the-army-turns-to-functional-fitness-testing-is-the-end-of-gender-standards-near (accessed May 30, 2018).

does not demand the heavy physical labor of a soldier in the field, the remote combatant need not attain the same level of physical fitness. If the fundamental demand on the remote combatant is the ability to teleoperate a robot combatant, then even a motor-disabled person could serve in the Digital Reserve if technology allowed them to teleoperate a robot, as one study finds.[63] Mental acuity rather than physical athleticism may be the primary concern for teleoperators. Appropriate physical standards could open the service to a broader pool of manpower, including retired and disabled veterans still willing to serve.

A primary legal and ethical concern regarding autonomous and remote weapon systems emphasizes the difficulty of ensuring their use "in accordance the law of war, applicable treaties, weapon system safety rules, and applicable rules of engagement."[64] The executor of the weapon system must discriminate between combatants, non-combatants and protected persons. No AWS or artificial intelligence system has the requisite sensing and reasoning capability to do this.[65] Therefore, remote combatants must be as fully trained and knowledgeable in the law of war and rules of engagement as any other member of the armed forces. Their teleoperated semi-AWS systems must have high sensory acuity. And until fully autonomous systems prove consistent and reliable compliance with ethical and

63. Luca Tonin, Tom Carlson, Robert Leeb, and José del Millán, "Brain-controlled telepresence robot by motor-disabled people," *Engineering in Medicine and Biology Society, 2011 Annual International Conference of the IEEE*, 4227-4230, https://infoscience.epfl.ch/record/168292/files/millan_embc11.pdf (accessed May 31, 2018).

64. Human Rights Watch, "Review of the 2012 US Policy on Autonomy in Weapons Systems," April 15, 2013, https://www.hrw.org/news/2013/04/15/review-2012-us-policy-autonomy-weapons-systems (accessed February 11, 2018); Ashton Carter, *Department of Defense Directive 3000.09 May 2017 Autonomy in Weapon Systems*, 7, http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/300009p.pdf (accessed February 10, 2018).

65. Noel Sharkey, "Moral and Legal Aspects of Military Robots," in *Ethica Themen: Ethical and Legal Aspects of Unmanned Systems, Interviews*, ed. Gerhard Dabringer (Vienna: Institute for Religion and Peace, 2010), 45.

legal requirements, U.S. policy will not permit them to autonomously target humans with lethal force.[66]

Beyond sensory and reasoning capacities, the combatant must have situational, contextual, and cultural awareness during combat to discriminate combatants and apply appropriate, proportional force. Such deep cognitive capabilities in combat may remain beyond artificial intelligence for decades. But if remote combatants limit their span of control to about one semi-AWS each, they will have the highest situational awareness and effectiveness on the battlefield.[67] Fully-AWS remain unacceptable and lack the situational awareness to fight effectively on the battlefield, but a Digital Reserve teleoperating semi-AWS with adequate sensor acuity can comply with ethical and legal requirements and fight effectively.

The Digital Reserve will understand, shape, and exploit the evolving character of war. The remote combatant's telepresence on a real battlefield evolves from a MMOG that provided a virtual presence on a simulated battlefield. The architecture of a Digital Reserve will retain and exploit its capacity for simulation to enable experimentation with equipment, tactics, and teammates. Designers model real-world adversaries and environments as accurately as possible and test the Digital Reserve against the threat in a live, interactive simulation, much like a MMOG with digital reservists using their own HMI. These virtual wargames allow the digital reservists to study the adversary; self-organize into combat teams; build their semi-autonomous weapon systems from a limited suite of modular chassis, sensors, protection, weapons, communication and camouflage; fight

66. Ashton Carter, *DoDD 3000.09*, 3.

67. Jennifer Riley, Laura Strater, Sharyl Chappel, Erik Connors, and Mica Endsley, "Situation Awareness in Human-Robot Interaction: Challenges and User Interface Requirements," in *Human-Robot Interactions in Future Military Operations*, eds. Florian Jentsch, Michael Barnes (Burlington VT: Ashgate Publishing Company, 2010) 176.

the virtual adversary; learn; and iterate their approach to combat. Through virtual wargaming, the Digital Reserve improves its warfighting capability by exercising its warfighting system as a multi-player simulation.

The program of record for the Digital Reserve acquires the four major subsystems of the Digital Reserve architecture. The HMI subsystem offers a combination of general issue and commercial off the shelf components, such as computers, tablets, virtual reality headsets, and so on. Options for remotely commanded semi-autonomous weapon systems span a range from birdlike and expendable to carlike and affordable. These systems offer a limited number of standardized interfaces and attachment points for modular sensors, weapons, protection, etc. A forward deployable armory, about the size of a tractor trailer, has an automated assembly system to build (or repair) a modular semi-AWS according to the reservist's specifications. The Digital Reserve's program delivers AWS with tailorable capabilities and facilitates reality-based training that resembles a MMOG.

The Digital Reserve relies on a telecommunication network appropriate for the combat environment. As mentioned above, the communication link is the primary vulnerability of a teleoperated weapon system in a contested electromagnetic environment. In urban environments, the mobile phone networks may supersede line-of-sight radio, satellite communication, and GPS to support the weapon systems' communication and geolocation. The uncertainty of telecommunication in a contested environment favors decentralized command and control and may necessitate the forward deployment of digital reservists to operate in closer proximity to the semi-autonomous weapon systems they command. The high velocity of information enables rapid fire and maneuver in a remote combatant facing a

mobile adversary.[68] For these reasons, the Digital Reserve operates most effectively in defense when it can exploit a friendly, secure, and fast wireless network. This could be the case when defending an ally who controls its mobile communications infrastructure. Considering the importance of situational awareness, the U.S. may find the Digital Reserve architecture more effective in the defense of allies when the remote combatants are sourced from the host country population where the close proximity to the battlefield improves the velocity of information.[69]

The Digital Reserve architecture allows non-combatants to safely visit contested environments. Non-governmental organizations and journalists could explore the battlefield through their telepresence in a robotic autonomous system. Their reports from the battlefield can debunk an adversary's propaganda with timely information.[70]

Conclusion

The Digital Reserve "is a people's army wielding remote weaponry in decentralized operations." And the digital reservist fights as a robotic telepresence on the battlefield. The digital reservist commands a semi-autonomous weapon system and makes the ultimate decision whether to kill because fully autonomous weapon systems lack the situational awareness to distinguish combatants and make such decisions within legal and ethical bounds.

The design of the Digital Reserve exploits the convergence of the advances in telecommunications, information technology, massive multi-player online games, and remote autonomous weapon systems since the 1990s. Because it fights through human-machine interfaces where mental acuity supersedes physical athleticism, the Digital Reserve

68. Geoffrey Jeram, Citizen Soldier Sensor Swarm, 21.
69. Ibid., 23.
70. Ibid., 24.

draws from a broader pool of manpower than do the most of the armed forces. Having evolved from the simulation technology of games, it retains the capacity for human experimentation and learning through wargames, which allows it to explore, shape, and exploit the character of war.

Because the Digital Reserve is vulnerable to telecommunication disruption in times of electronic warfare, it operates best in the defense and in urban environments where it can rely on the secure and fast mobile networks of the friendly governments it defends. It offers novel means for nongovernmental organizations and journalists to explore the battlefield and communicate truth that counters adversarial propaganda.

The Digital Reserve relies on mature technologies and broad pools of manpower instead of fully autonomous weapon systems and artificial intelligence systems. Its great advantages are the creativity, intelligence, and teamwork of the people.

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INFORMATION SUPPORT BRIGADES TO SUPPORT FUTURE REQUIREMENTS

LTC John S. Perrine, U.S. Army

The operating environment for U.S. military forces is rapidly changing. Urbanization, rapid changes in information technology, global commodities and scarce resources, climate change, and small conflicts around the world create an environment that is complex and challenging. Competition between great powers and small regional powers can escalate towards conflict and the Army needs to be ready to support the Geographic Combatant Commander's requirements to support operations. The adversary's understanding of the limits of U.S. Power and the ability to manage coalitions, allow them to continue conflict that is just below the threshold of major war. This warfare now extends into the information environment, including the cyber and space domains, exposing the joint force's vulnerability to information and electronic warfare.[71] This type of warfare will proliferate in the future, demanding specialization within the joint force to plan, operate, compete and fight in the information environment with various information capabilities to further the Commander's objectives.

Due to the expanding role of information and the information environment (IE), the future Army requires a readily available formation that specializes in information capabilities and information warfare. This unit ensures multiple information capabilities, along with regional expertise are available to the Combatant Commanders to effectively synchronize plans and effects in support of national interest during both competition and conflict operations. An Army

71. Marine Corps Gazette Staff, "The Future Starts Now, Marine Corps Force 2025 implementation and information warfare capabilities," Marine Corps Gazette, Vol. 101, no. 8. Quantico, VA. in Proquest https://search.proquest.com/docview/2025652678/fulltext/794AECC8AE56493FPQ/1?accountid=4444 (accessed May 20, 2018).

Information Support Brigade, composed of Component (Compo) 1, 2, and 3 (Active, National Guard and Reserve respectively) personnel from various occupational specialties and functions, can meet this operational need of the regional Combatant Commanders. This paper examines the future regional Combatant Commander requirements for information support, the concept of an information brigade and what it would include, and employment options for this formation.

As contests against adversaries became more frequent, the Defense Department recognized the importance of codifying and understanding how U.S. forces use information and the IE. In the fall of 2017, Secretary of Defense Mattis endorsed the Chairman of the Joint Chiefs of Staff out-of-cycle change, introducing Information as the seventh joint function. Mattis states that this movement "signals a fundamental appreciation for the military role of information at the strategic, operational, and tactical levels within today's complex operating environment."[72] Joint doctrine is changing to reflect information as a joint function. The rational for these changes include that "the contemporary IE can be characterized by its unprecedented breadth, depth and complexity; but also, by its ubiquity, hyper-connectivity, and exponential growth."[73]

According to the Joint Operating Environment 2035, IE technologies will be widely available around the world and adversaries will incorporate them into their military operations looking for asymmetric advantages. This includes all manner of handheld or worn wireless or even brain-interfaced devices with advanced levels of connectivity through

72. James Mattis, U.S. Secretary of Defense, "Information as a Joint Function" memorandum, (Washington DC: Office of the Secretary of Defense, September 15, 2017)

73. Chairman of the Joint Chiefs of Staff Information Paper regarding Joint Function Approval, (Washington, DC, May 22, 2017).

the electro-magnetic spectrum.[74] Developing states will construct comprehensive national information infrastructures, moving past current technologies. This access to more affordable technology will allow geospatial and geophysical data that once cost billions of dollars and was only available to the wealthy and developed nations, to now be available to most everyone.[75] The cost of entry to effectively use the information environment for any number of purposes will continue to become less and less, thus allowing for greater access. As the cost of effectively operating in the IE becomes less, we can project that no one nation will maintain an overwhelming technological advantage over rival nations or groups. Even as a group or government finds an advantage, it will be fleeting as rivals will quickly adapt.[76]

The Department of Defense (DoD) recognizes that the world changed with an expanded IE, but also the adversary's ability to operate within this environment changed. Adversaries can now easily disseminate information and propaganda, truthful or otherwise, using the IE, reaching global audiences to gain support or sustain their operations. They can attack the Army's access to the IE, restricting and disrupting our use of networks and precision guided munitions.[77] The National Defense Strategy identifies China and Russia as threats that have developed new tactics, procedures, and technology to conduct "Informationized Warfare" (sic) as a central element to their warfighting strategy, attacking the electromagnetic spectrum with EW and

74. U.S. Joint Chiefs of Staff, *Joint Operating Environment (JOE 2035)*, (Washington, DC: U.S. Joint Chiefs of Staff, July 14, 2016), 18, http://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/joe_2035_july16.pdf?ver=2017-12-28-162059-917 (accessed September 27, 2017).

75. Ibid.

76. U.S. Department of the Army, *The Operational Environment and the Changing Character of Future Warfare*, (Fort Eustis, VA, Training and Doctrine Command G-2, May 31, 2017), 18 http://www.arcic.army.mil/App_Documents/The-Operational-Environment-and-the-Changing-Character-of-Future-Warfare.pdf (accessed October 18, 2017).

77. Ibid.

cyber capabilities, as well as the cognitive realm with propaganda, strategic messaging, and deception.[78] Russian doctrine states that information warfare is fundamental to operational success, and that gaining information superiority is a "necessary precondition for achieving all other warfighting objectives."[79] The Combatant Commander currently has several disparate elements and units that help mitigate these threats, and a small information staff that helps to incorporate information into the overall operational and strategic plans. However, in the future, information will become even more prominent, in many different and various forms. This will require units that specialize in planning and conducting operations in the IE and integrating information assets directly into the Commander's operations.

The future joint force will need to respond to the Combatant Commander's requirements. To fill the gap of required expertise and ability to compete and fight in the information environment, the Army should develop Information Support Brigades. It would contain expertise in various information functions and capabilities, with the ability to plan and conduct operations and Information Warfare in the Land, Air, Cyber and Space Domains. These new formations would expand on current Army formation infrastructure, creating specialized units and teams that can rapidly deploy to support operations.

Currently, the Army maintains five Information Operations formations: the active duty 1st Information Operations Command (1st IOC), and four Theater Information Operations Groups (TIOG) supported by the Army Reserves

78. Mark Gunzinger et al., Force Planning for the Era of Great Power Competition (Washington, DC: CSBA, October 2, 2017), 14 http://csbaonline.org/research/publications/force-planning-for-the-era-of-great-power-competition/publication (accessed February 21, 2018).

79. Ibid., 14-15.

and Army National Guard.[80] These units contain primarily Information Operations Forces and Field Support Teams, with limited Cyber, Military Information Support Operations (MISO), Operational Security (OPSEC) and deception planning. They currently support Special Forces and Conventional Forces throughout the world. With the expansion of the IE and the need to support the Commander's operational requirement for information warfare, these current brigades need to expand, incorporating even more information capabilities with habitual synchronization under a unified command.

Each of these five brigades should change its force structure to include Compo 1, 2, and 3 forces, creating the Information Support Brigade, and remaining flexible to meet the future Army requirements. The brigade will incorporate specialties in Information Operations, MISO, Cyber, Space, Public Affairs, Electronic Warfare, OPSEC, deception, Civil Affairs and especially Intelligence personnel. Four of the five brigades will focus regionally, supporting a specific Combatant Command and Army Service Component Command (ASCC). This will allow for regional expertise to develop amongst the soldiers and officers within each brigade. The remaining brigade will provide operational and strategic flexibility in a General Support role to reinforce the Geographic Combatant Commands or provide support to the Functional Combatant Commanders as needed. Each of these brigades allow development of expertise in combined information warfare and a structure to rapidly and readily support the Commander's needs.

The force structure to support this new formation will come from the current TIOGs, 1st IOC, and the Reserve and National Guard MISO and Civil Affairs Groups. Cyber billets would expand under the total Army Cyber Mission

80. U.S. Army Civil Affairs and Psychological Operations Command, Home Page. http://www.usar.army.mil/USACAPOC/ (accessed May 22, 2018).

Force structure and would be readily available to support Cyber requirements for both the Combatant Commander and US Cyber Command. United States Army, Civil Affairs and Psychological Operations Command, at Fort Bragg, will maintain General Officer oversight of these expanded formations. The active duty Civil Affairs and Psychological Operations Brigades at Fort Bragg would continue to support Special Forces requirements around the world. However, these new Information Support Brigades provide an outlet for career development, broadening opportunities, and movement within those specialties.

Employment of the brigades will focus on specific regions, developing cultural understanding of the human environment and IE throughout their supported area. The Geographic Combatant Command areas supported will include Pacific Command, European Command, Africa Command, and Southern Command. This will expand to working with the interagency and their counterparts in the various departments that focus upon their regions. They will develop habitual relationships with the Army Service Component Command, supporting conventional force deployments to the region and participating in exercises and partnership activities. Small teams will also support embassy activities, working with interagency partners and developing deeper understanding of the operational environments within the region.

Information Support Brigade soldiers will be well versed in understanding the IE in their specific region. They will follow advances in in technologies, changes in politics and demographics that cause conflict and disruption. They will understand the political and human decision making occurring throughout the region to better tailor their information effects. They must also seamlessly combine the different information capabilities into combined effects that support the Commander's objectives in the area. The combined,

multi-functional nature of the Information Support Brigade allows for this interaction and convergence of different information functions.

Conventional Army forces can also request Information Support Brigade support to their exercises and deployments. By using Compo 1, 2, and 3 Soldiers, the brigade retains the flexibility to rapidly support most requests for forces. The Information Support Brigade concept also reduces the requirement of organic information related MOS's within a conventional formation, instead deploying to support that formation with a team specifically tailored to meet the demands of the mission. These forces can deploy in support of plans and operations, integrating information warfare capabilities into their operations, and meeting the Commander's operational and strategic objectives. Deployed teams would also have reach-back capability to home station to help with analysis and regional expertise.

The rapidly changing world needs formations that can help the Commander in an uncertain future. A specialized brigade of information experts, regionally trained, and able to synchronize and integrate multiple information functions to achieve effects, fills the Combatant Commander's need to conduct information warfare. The complexity of the operating environment continues to increase, and adversaries now conduct conflict within the IE and all domains to attain their objectives. Commander's need a ready way within the joint force to meet and defeat the threat within the information space. The Army can meet that need with the Information Support Brigade and its many capabilities. This organization also provides the organization necessary to develop professional and regional expertise amongst the various soldiers and officers, further supporting the Combatant Commander and the Army as a whole. Army leaders must make the decisions on future force composition soon to have a ready force that can meet the necessary threats and provide the capabilities needed in the future.

Lieutenant Colonel John Perrine is an Information Operations officer who recently served as the Information Operations officer for the 10th Mountain Division. He is currently deployed in support of Operation Inherent Resolve. His Strategy Research Paper (SRP) examines the Army's adaptation to the role of the Information Environment in future conflict.

BACK TO THE FUTURE: WHY THE ARMY NEEDS U.S. SPACE COMMAND

LtCol Bradley W. Phillips, U.S. Marine Corps

Space is rapidly becoming a contested domain no longer reserved for First World countries. New threats to U.S. commercial and military space users are quickly emerging. Proliferation of space threats from China and Russia, such as China's 2015 test of the DN-3 exo-atmospheric vehicle, designed to destroy U.S. satellites is evidence that the United States' adversaries are advancing strategies designed to test, intimidate, degrade, and disable the United States space capabilities.[81] The U.S. is strategically vulnerable in the space domain, because of its reliance on space for national security, military, economic, societal services, and infrastructure services.[82] The Army through the Secretary of Defense, Congress, Combatant Commands, the Joint Staff, and other military services must form a consensus for the re-establishment of U.S. Space Command as a Unified Combatant Command or it will not be ready to face a near peer competitor and dominate the ultimate high ground in the future. This paper examines why the Army needs U.S. Space Command re-established, highlights potential barriers to its re-establishment, identifies recent government proposals regarding U.S. space forces, and broadly outlines an approach for the Army to re-establish U.S. Space Command.

The Army is the largest user of space and space-enabled capabilities in the Department of Defense (DoD). The Commanding General, U.S. Army Space and Missile Defense

81. Harsh Vasani, "How China Is Weaponizing Outer Space," *The Diplomat,* January 19, 2017, https://thediplomat.com/2017/01/how-china-is-weaponizing-outer-space/ (accessed online April 30, 2018).

82. George Popp, *Strategic Risk in the Space Domain*, A Virtual Think Tank Report, NSI, February 2018, 3, http://nsiteam.com/social/wp-content/uploads/2018/02/NSI_Space_ViTTa_Q16_Strategic-Risk-in-the-Space-Domain_FINAL.pdf (accessed May 2, 2018).

Command / Army Forces Strategic Command (USASMDC/ ARSTRAT), Lieutenant General James Dickinson stated at a space symposium in April 2018, that the Army "relies on space to communicate, navigate and deliver precision fires." He went on to say that a typical Army Brigade relies on more than "2,500 devices for positioning, navigation and timing, and more than 250 satellite communication-enabled devices" as well as the ability to operate when soldiers are in degraded, denied, or disrupted environments.[83] The Army, as the primary land force and user of space-based capability in the DoD, should have more weight amongst the services in shaping the space domain for the DoD. It appears, however, that the Army is ceding its role in the space domain to the Air Force.

There is a divergence amongst the services as to which service should lead the DoD in the space domain. The Air Force is responsible for 90 percent of the nation's unclassified space assets. It also receives 90 percent of DoD's space funding. The Navy and Army own the remaining 10 percent of DoD space assets.[84] The Navy contends that space operations resemble operations at sea.[85] The Army's efforts in the space domain have principally been aimed at the Multi-Domain Battle Concept, a coordinated Army and Marine Corps approach for ground combat operations against a peer enemy. This concept has gained wide favor throughout the Joint services. As the Army, however, focuses on the Multi-Domain Battle Concept, working

83. Lira Frye, "Space capabilities crucial to Army readiness," *USASMDC/ ARSTRAT Public Affairs*, April 30, 2018, http://www.peterson.af.mil/News/Article/1507088/space-capabilities-crucial-to-army-readiness/ (accessed May 7, 2018).

84. Steven T. Corneliussen, "Debating the creation of a US space corps," *Physics Today,* January 11, 2018, http://physicstoday.scitation.org/do/10.1063/PT.6.3.20180111a/full/ (accessed May 7, 2018).

85. Andrew Follett, "Congress And The Air Force Are Feuding Over Who Will Manage War In Space," *The Daily Caller,* July 2, 2017, http://dailycaller.com/2017/07/02/congress-and-the-air-force-are-feuding-over-who-will-manage-war-in-space/ (accessed February 25, 2018).

though cross-functional teams to address its six modernization priorities, and conducts echelon level field drills simulating GPS outages, the Air Force is shaping the DoD's priorities and resources in the space domain.

The Air Force's primacy amongst the services in the space domain was codified in December of 2017 when Air Force Space Command was designated the Joint Force Space Component Commander (JFSCC) for U.S. Strategic Command. This designation gave Air Force Space Command dual responsibilities; (1) organizing, training and equipping of Air Force space forces, and (2) executing operational command and control of joint space forces as the JFSCC.[86] Air Force Space Command's elevated status places the Army's proponent for space, USASMDC/ARSTRAT, at a disadvantage for advocating the Army's strategies regarding space situational awareness, force enhancement, support, control, force application – space mission areas. Outside of Integrated Missile Defense – the Army's Title 10 responsibility, the Army must rely primarily on its service headquarters and U.S. Strategic Command via Air Force Space Command/JFSCC for advancing Army priorities in space mission areas.

As the largest user of space-based capabilities, the Army should have a more direct channel besides its service headquarters and the Air Force JFSCC to champion its position regarding how to best support the soldier from the space domain. The re-establishment of U.S. Space Command, serving as the DoD's lead for the space domain would fix this issue. U.S. Space Command, as a unified combatant command, would yield a more efficient and adaptive joint command and control architecture, advance space warfighting

86. "AFSPC commander becomes JFSCC, joint space forces restructure," *Air Force Space Command Public Affairs*, December 3, 2017, http://www.afspc.af.mil/News/Article-Display/Article/1386530/afspc-commander-becomes-jfscc-joint-space-forces-restructure/ (accessed May 7, 2018).

capabilities, refine space leadership development for the joint force, and enable parity amongst the services for establishing strategic priorities in the space domain.

The most significant obstacle to establishing a U.S. Space Command, yet the most important one, is that the space acquisition portfolio across the DoD has many stakeholders, including each of the services. The acquisition of DoD satellite systems is expensive; according to the Government Accountability Office (GAO) costs for DoD satellites can "range from $500 million to over $3 billion, and ground systems can cost as much as $3.5 billion." The GAO determined that the "structure of space system acquisitions and oversight continues to be complicated. It involves a large number of stakeholders, and there is no single individual, office, or entity in place that provides oversight for the overall space program acquisition structure." The lack of a single focal point for space acquisitions has resulted in cost overruns and inefficiencies in the space acquisitions process.

For example, according to the GAO, program costs for the "Advanced Extremely High Frequency (AEHF) satellite program, a protected satellite communications system, that will be utilized by soldiers in air and ground platforms, had grown 116 percent as of our latest review, and its first satellite was launched over 3.5 years late." Also, the GAO identified that "contract costs for the Global Positioning System (GPS) ground system, designed to control on-orbit GPS satellites, had more than doubled and the program had experienced a 4-year delay."[87] According to John Venable, a Senior Research Fellow for Defense Policy, there are "11 different organizations or bodies charged with

87. Cristina T. Chaplain, *Space Acquisitions Challenges Facing DOD as it Changes Approaches to Space Acquisitions*, GAO-16-471T, Statement for the Record to the Subcommittee on Strategic Forces, Committee on Armed Services U.S. Senate (Washington, DC: U.S. Government Accountability Office, March 9, 2016) 233-234, https://www.gao.gov/assets/680/675694.pdf (accessed May 2, 2018).

oversight—none of which is in control, or able to set the direction, map the course, or build the overarching strategy for U.S. space capabilities."[88] These inefficiencies, delays, and cost overruns in space acquisitions directly deplete the Army and DoD procurement and acquisition funding of other programs. Additionally, this misalignment creates stovepipes and service parochialisms in the space defense acquisition system.

The re-alignment of space forces in the DoD has been on the legislative forefront. Congress has recognized that the DoD is at a crossroads in the space domain. Fiscal constraints and threats to U.S. national interests led Congress to commission the GAO to conduct a study identifying major challenges confronting the DoD in the space domain. In July of 2016, the GAO identified approximately 60 stakeholder organizations involved in the DoD space acquisitions. The GAO concluded that the U.S. space requirements, budget, and acquisitions priorities are disconnected.[89] The GAO report highlights the misalignment, lack of unity, and standardization of space forces and assets within the DoD. This lack of alignment and unity across the Department resonates into the Army creating inefficiencies in resourcing, training, and readiness of Army space forces and assets.

The House of Representatives Armed Services Committee (HASC), in its version of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2018 proposed a separate service under the Secretary of the Air Force analogous to the Marine Corps within the Department of the

88. John Venable, "Creating a "Space Corps" Is Not the Solution to U.S. Space Problems," *The Heritage Foundation,* October 10, 2017, https://www.heritage.org/defense/report/creating-space-corps-not-the-solution-us-space-problems (Accessed May 3, 2018).

89. Cristina T. Chaplain, *Defense Space Acquisitions: Too Early to Determine If Recent Changes Will Resolve Persistent Fragmentation in Management and Oversight*, GAO-16-592R, (Washington, DC: U.S. Government Accountability Office, July 27, 2016) 9-10 and 15-16, https://www.gao.gov/assets/680/675694.pdf (accessed April 30, 2018).

Navy.[90] This provision from the HASC did not pass through the Senate Armed Services Committee. The minimal benefits of a separate space force as recommend by the HASC would have been overshadowed by personnel and infrastructure costs. The risk of disrupting space support to the warfighters currently engaged in combat operations and the friction such a restructuring of forces would create outweighs the return.[91]

In the approved FY 2018 NDAA, Congress directed the Deputy Secretary of Defense to recommend an "organizational and management structure for the national security space components of the Department of Defense, including Air Force Space Command."[92] It is clear Congress is not satisfied with the National Security Space Organization, stating that "without significant reorganization of the national security space enterprise, the United States is at serious risk of losing the competitive advantage it has maintained as a result of its use of space for national security."[93] The push from Congress has created an opportunity for the Army to serve as a change agent to transform how the DoD aligns its space forces and how space support is provided to the soldier.

It is at this juncture that the Army should advocate and support the commissioning of a study for the re-establishment of U.S. Space Command that addresses four key areas that Congress wants fixed: (1) organization, (2) funding, (3)

90. Steven T. Corneliussen, "Debating the creation of a US space corps."

91. Russell Berman, "Does the U.S. Military Need a Space Corps?," *The Atlantic,* August 8, 2017, https://www.theatlantic.com/politics/archive/2017/08/military-space-corps/536124/ (accessed May 7, 2018).

92. U.S. Congress, *National Defense Authorization Act for Fiscal Year 2018*, 115th Cong., 1st Sess, January 2, 2017, 438-439, https://www.congress.gov/115/bills/hr2810/BILLS-115hr2810enr.pdf (accessed February 22, 2018).

93. U.S. Congress, House of Representatives, Committee on Armed Services, *Report of National Defense Authorization Act for Fiscal Year 2018, July 6, 2017, 233-234,* https://www.gpo.gov/fdsys/pkg/CRPT-115hrpt200/pdf/CRPT-115hrpt200.pdf (accessed February 22, 2018).

acquisition, and (4) leadership development.[94] The Army in campaigning for the re-establishment of U.S. Space Command through the Secretary of Defense will be in position to influence the strategic narrative of this proposal. This study will enable the Army to inform and garner the required support from Congress regarding the organization, timing, and overall implementation concept of this proposal. This study, addressing congressional concerns and leading a whole of government approach will demonstrate the Army's commitment to the space domain.

The Army while gaining consent from Congress and the rest of the DoD for re-establishing U.S. Space Command, should consider endorsing the model used in FY 2018 for establishing U.S. Cyber Command as a unified combatant command. In this model the National Security Agency's key staff positions were used to form the core staff of U.S. Cyber Command. A similar approach can be used for re-establishing U.S. Space Command where the U.S. Air Force, JFSCC could dual hat and serve as the core for U.S. Space Command's key staff positions. This re-designation of JFSCC to U.S. Space Command using its existing force structure to serve as its core will enable cleaner lines of command and control of space forces and lines of authority across the DoD and enable U.S. Space Command to build capacity. The establishment of U.S. Space Command would also enable it to serve as a voting member of the Joint Requirements Oversight Council regarding space matters. Establishing U.S. Space Command as a combatant command, would open up key billets, to include command billets, for the Army to fill at U.S. Space Command. This opportunity to provide a space cadre from the Army to billets in U.S. Space Command would alleviate service parochialism and enable USASMDC to champion the Army's position in the space domain directly to the commander of U.S. Space Command.

94. John Venable, "Creating a "Space Corps."

The Army's backing of this proposal coupled with the Secretary of Defense's push to re-establish U.S. Space Command, will enable the DoD to create a vision and roadmap, develop a space acquisition strategy and management plan, and set strategic space policy ensuring the United States' dominance in the space domain. The Army must stay ahead of its adversaries in the space domain and not allow itself to be satisfied with the status quo that lacks unity of command and effort and dis-organization in the DoD.

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FORCE STRUCTURE CHANGES FOR THE 2035 CYBER FORCE

LTC John S. Transue, Jr., U.S. Army

In his remarks on the 2018 National Defense Strategy, Secretary Mattis described how "failure to modernize our military risks leaving us with a force that could dominate the last war but be irrelevant to tomorrow's security."[95] The United States Army's cyber forces have quickly formed over the past few years and the cyber forces should consider organization and structure changes over the next decade to better provide resources and support missions. The Army's cyber force can align its brigade formations to rebalance the capabilities, USCYBERCOM can modify the Joint Force Headquarters-Cyber to improve coordination with the Combatant Commands, and the Joint Cyber Mission Force can adjust its structure to streamline resource requirements. From 2013 to 2018, the United States' Cyber force quickly grew capabilities and is now postured to review and adjust the force to prepare for the 2035 operational environment.[96] Although the 2035 Army is 17 years in the future, there are multiple changes that can be conducted within the next five to ten years to prepare the cyber mission force.

Army Brigade level Cyber Mission Force Structure

The Army's current cyber force is primarily structured in two distinct silos partly because of the method used to quickly form the organizations. The offensive cyber force consists of the 780th MI Brigade with the 781st MI BN at Fort Meade, Maryland and the 782nd MI BN at Fort Gordon,

95. James N. Mattis, "Remarks by Secretary Mattis on the National Defense Strategy," Department of Defense Press Operations, January 19, 2018, https://www.defense.gov/News/Transcripts/Transcript-View/Article/1420042/remarks-by-secretary-mattis-on-the-national-defense-strategy/ (accessed February 11, 2018).

96. In 2013, General Alexander, then Commander of USCYBERCOM, described the creation process as "Build, Assess, Build". Quickly build the force then assess the build and make necessary adjustments.

Georgia. The offensive cyber operations 780th MI Brigade is administratively controlled by the Army's Intelligence and Security Command (INSCOM) while operationally controlled by Army Cyber Command. The defensive cyber forces consist of the cyber protection teams within the Cyber Protection Brigade located at Fort Gordon. The Cyber Protection Brigade is administratively controlled by the Army's Network Enterprise Technology Command (NETCOM) while operationally controlled by Army Cyber Command. There are reasons for how the current structure and command relationships were created, but there are other possibilities to re-align the structure.[97]

One possibility is to maintain the current structure as there are advantages to it. The offensive cyber teams are able to leverage existing memorandum of agreements between INSCOM and the NSA to quickly obtain the network, database, and other privileges needed to perform their work role requirements. Other INSCOM units conduct the signal intelligence mission and the current organizational structure maintains those elements along with the offensive cyber teams. Under the current brigade structure, the defensive cyber teams fall under NETCOM, which also has operational control of the signal units that conduct the area defense of the network.

However, the current structure splitting the offensive and defensive forces can hinder the cyber response actions, provide different resource levels, and affects the cyber mission force unity. The cyber response actions are currently coordinated across brigades that align with NETCOM and brigades that align with INSCOM but this could change as

97. INSCOM was able to utilize MI BN force structure changes to make the 780th MI BDE Battalions similar to the other strategic MI BNs. NETCOM utilized 70 authorizations from the merging of the Regional Cyber Center – South with the Regional Cyber Center Western Hemisphere. The Web Based Total Army Authorization Document Systems shows the differences in the structure of the NETCOM and INSCOM administratively controlled cyber force structure.

the understanding grows that the cyber force is a maneuver force within the information environment. A maneuver element would have more capability if they could perform both offensive and defensive missions similar to how an armor or infantry force seamlessly performs movement to contact, deliberate attack, deliberate defense, and other land domain operations within the same formation. Some allied, neutral and adversary cyber forces are structured so that they can perform the full range of cyber operations within the maneuver force, and USCYBERCOM should consider adjusting the structure to provide quicker cyber response actions.

Cyber units within separate administrative commands also affect the level of resources provided to the offensive and defensive cyber mission force. An example of the disparate resource level between INSCOM and NETCOM is observed through the force structure of the offensive cyber operations battalion and the defensive cyber operations battalion. This current structure is the product of the Total Army Analysis (TAA) process where INSCOM and NETCOM utilized different existing force structure to internally exchange to create their respective cyber formations. Training, travel, building and maintenance funding levels are also different between the cyber forces operating under the two commands.

One possibility to adjust the cyber force for 2035 operations is to remove the divide between a unit that conducts the defensive cyber mission and a unit that conducts offensive cyber operations. A catalyst for this change could be if additional units are added to the Army which could also lead to a greater reorganization. Even with the current brigade structure, reorganization could be based on geography with a brigade that has operational control of the offensive and defensive cyber mission forces residing on Fort Meade and the current Cyber Protection Brigade at Fort Gordon expanding the mission to have operational control of the

782nd battalion. This change would also improve the talent management to allow easier movement between the cyber work roles at each location. The transition of cyber soldiers between offensive and defensive work roles must currently be coordinated between the brigades, both INSCOM and NETCOM, and Army Human Resources Command (HRC) because of the move between major commands.

As the cyber mission force matures, the administrative control between the two different commands should also be changed to optimize the resources for the entire force. Rather than two different organizations, the Army Cyber managed Joint Force Headquarters Cyber – Gordon (JFHQ-C) could be expanded to have both operational and administrative control over the cyber forces. This would consolidate the control to one organization that has purview over the cyber force rather than separating the man, train, and equip responsibilities between NETCOM and INSCOM. A potential opportunity and catalyst for this is the future move of Army Cyber Headquarters to Fort Gordon where it will be co-located with the JFHQ-C.

Operational Headquarters Changes

The operational level forces should also adjust structure and align their mission to better support the national, geographical combatant command, and service requirements. The JFHQ-C staff can ensure the separate cyber efforts are synchronized into an effective campaign rather than conducting separate tactical missions. The headquarters could also provide a greater common operating picture of adversary actions throughout the global area of operations. The JFHQ-C managed by the Army has attempted to oversee defensive cyber operations and coordinate those actions with the combatant commands. USCYBERCOM should review the JFHQ-C and Joint Cyber Center (JCC) mission, ensure that the JFHQ-Cs also conduct the mission

command for defensive cyber operations, and provide manning and resources for full spectrum cyber operations.

The JFHQ-Cs should have personnel from each service to make it a true joint headquarters and to increase coordination across the joint cyber mission force.[98] Cyber personnel authorizations need to be increased at the Combatant Command's JCC to increase the capacity for planning and coordination between the combatant command and the tactical cyber teams.

Strategic Organizational Changes

Currently, each Service has a cyber force and conducts the manning, training, and equipping mission separately. In the current structure, the Services compete against each other for cyber recruits, funding, and other resources. In the future, the talent management and resourcing requirements could become greater as the global war for talent continues. The operational mission could be hindered by the Services competing not only against other government agencies and the private sector, but also against each other. Two future structure possibilities are to establish a structure similar to the special operations structure or establishing a Service that manages the responsibility for the cyber domain.

At least for the Army, A key difference in the current special operations community construct and the cyber forces is that the Special Forces soldier is generally recruited from within the Army. An individual can also transfer back to the general Army without needing to do a branch transfer. Currently, the cyber force is recruited from external sources through recruiting and accessions command to a specific assigned skill and branch rather than using the Special Forces model.

98. Each Joint Force Headquarters – Cyber is managed by a service. Army's JFHQ-C is located at Fort Gordon, the Air Force JFHQ-C is at San Antonio and the Navy JFHQ-C is at Pearl Harbor. Currently the JFHQ-Cs are labelled joint, but manned strictly by their respective Service.

Another possibility is establishing a separate service responsible for the cyber force. This has historical precedent where the Army was established for the land domain, the navy for the sea domain, and the marines for the littoral zone. When operations began in the air domain, the air organizations were first part of the Army, but a separate service was established as the operations in the domain matured. Each service also maintains specialized air capability to also function within the air domain. A Cyber Service could consolidate the recruitment so that there are not different recruiting requirements and benefits for the same work role.[99] The tactical structure could be optimized and changed from the current method where the Cyber Mission team (CMT) and Cyber Protection Team (CPT) grade structure are different depending on each Service.[100] The facilities and equipment could be better resourced and standardized rather than each service competing to obtain different amount of resources for their respective cyber forces.

There could potentially be a Cyber Service by 2035, but each Service has a vested interest in maintaining the current method. A change on that scale could be difficult and would require stakeholders at the DOD, congress, and the executive branch. Creating a cyber service that expands the cyber national mission force and the supports the geographic combatant commands while maintaining the current service teams for the specific service requirements would be more likely to succeed. This tiered support is possible as seen by the air domain where there is an air Service for most operations, but the Army has helicopters and air defense assets, the marines have specialized jets, and the navy operates with carrier-based aircraft. If the Services maintain cyber

99. Although each individual conducts the same USCYERCOM work role, there are different service recruiting requirements and benefits between Army, Navy, Marines, and Air Force.

100. Examples include CPT Team Lead being a senior MAJ or LTC in the Army and CPT or Junior MAJ in the Air Force. Air Force has 3 CPTs per “squadron” battalion HQ while Army has 9 CPTs per Battalion. PCS and training requirements also differ by service.

capability, they would be more likely to support the establishment of a cyber force concentrating on national efforts. However, the Services would more likely support a change into a structure like the special operations model where the Service maintains greater control of the resourcing mission.

Recommendations

The current cyber force structure should be evaluated to have the force prepared for 2035. A holistic review from the joint level between the services and at the lower Army tactical unit level must occur so that potential changes are synchronized. The Army cyber forces should be modified to have brigades that can individually conduct all maneuver within the cyber domain like an Army Brigade that conducts multiple land domain missions. The Army should modify the administrative structure to have the cyber force consolidated into one administrative headquarters under Army Cyber Command. The joint force needs to be consolidated with personnel authorizations from each service at every JFHQ-C. The JFHQ-C's mission must also be reviewed and resourced for the defensive cyber mission. Finally, a model like the special operations structure can be used for the cyber national mission force and the combatant command teams. A specific service could be established and would have advantages, but a Special Forces model is likely more palatable to the Services and would be more likely to be supported. These changes would synchronize efforts from the strategic to the tactical level and increase the capability for the 2035 cyber mission force.

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PART III:

INSTITUTIONAL CHANGES

ANTICIPATING FUTURE ENVIRONMENTS

COL J. Michael James, U.S. Army

The Army's Combat Training Centers (CTC) focus a great deal of time and effort on setting conditions for the next fight. Conversations revolve around using the Army's operations process as a framework to direct formations through planning, preparing, and execution; all while constantly assessing the environment to understand how ever-changing conditions might influence current and future operations.[101] Understanding the future environment is essential to planning and preparing, however, accurately predicting a precise future is a tenuous prospect as described by former Secretary of Defense Robert Gates in a speech at West Point. Gates stated, "…when it comes to predicting the nature and location of our next military engagements, since Vietnam, our record has been perfect. We have never once gotten it right."[102]

While Secretary Gates' comment is accurate, reviewing the past and observing the contemporary operating environment should provide insights into determining the characteristics of future conflict and further the discussion on how to best prepare for future operations. In the future, will training, doctrine, and equipment gradually evolve over time or will a new technology cause a revolutionary change in the conduct of war? Will commercial sector or military technological advances drive changes to doctrine and tactics? How do we prepare leaders for future environments? How the Army as an institution answers these question will materially influence the ways we prepare for the future.

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101. U.S. Department of the Army, The Operations Process, ADRP 5-0 (Washington, DC: U.S. Department of the Army, May 17, 2012) 1-1 - 1-5.

102. Robert M. Gates, "United States Military Academy," public speech, United States Military Academy, West Point, NY, February 25, 2011, http://archive.defense.gov/Speeches/speech.aspx?SpeechID=1539 (accessed May, 2018).

In his article *Note to Futurists* Doctor Conrad Crane states, "I propose a working hypothesis for others to consider: The maximum effective range of any future prediction is 20 years or less, and any viable warfighting concept will be supported by developed or emerging technology rather than some figment of someone's imagination."[103] Dr. Crane makes two very good points. First, in the past technology has incrementally improved weapons systems' mobility, lethality, and protection. As this happened corresponding changes to systems' employment evolved slowly. Secondly, Dr. Crane believes that future weapons systems more closely resembled yesterday's systems, than futuristic science fiction systems.

To illustrate his point consider the example of the tank. The Army recognized the importance of incorporating this new technology during the First World War; in November of 1917 Captain George S. Patton received orders to establish a tank school in Langres, France.[104] One hundred years later, advancements in technology have enabled numerous incremental and sustained improvements to the platforms systems. Tanks have vastly improved mobility, lethality, and protection that cumulatively might appear as science fiction to General Patton. However, each individual improvement was only a minor improvement over its immediate predecessor.

Acknowledging the cumulative improvements in technology, with an explanation of the tank's current capabilities General Patton would probably be comfortable employing them on a contemporary battlefield. There are, however,

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103. Conrad C. Crane, "Note to Futurists: The Maximum Effective Range of a Prediction is 20 Years," *War on the Rocks*, October 3, 2016, https://warontherocks.com/2016/10/note-to-futurists-dont-get-more-than-20-years-ahead/ (accessed May, 2018).

104. Dale E. Wilson, *The American Expeditionary Forces Tank Corps in WW I*, Thesis Paper, March 1988, https://apps.dtic.mil/dtic/tr/fulltext/u2/a192722.pdf (accessed May, 2018) p 15.

notable technological advancement in the civilian sector that were rapidly adapted to military use and led to accelerated changes in battlefield tactics. Advancements in commercial technology such as railroads and airplanes were quickly implemented for military use and changed the characteristics of war almost immediately.

These paradigms address an interesting interaction between civilian and military technological innovations and subsequent adaptation. In the period prior to 1914, the commercial sector was primarily responsible for technological advances and the military adapted these new technologies to military applications. Railroads provided the opportunity to move large numbers of troops, equipment, and supplies over great distances at unprecedented speeds decreasing deployment timelines and increasing operational reach. Similarly, the airplane was rapidly adapted to military use as a reconnaissance platform. As military utility became additionally apparent the airplane was then further adapted to a crude bomber, and continued development into a versatile platform use for a myriad of task from Information Collection (IC) platform to strategic lift asset.

Conversely, "…the period from 1914 through 1990, … military organizations became the primary drivers behind revolutionary changes in technology."[105] The Global Positioning System (GPS) technology originally designed for military use, has revolutionized our private lives and improved numerous commercial functions with over one billion receivers supporting applications from cell phones to agricultural utilities. Navigation systems have become commonplace in everyday civilian life. During the same period advancements in precision munitions, unmanned aircraft, and other advanced technologies common across military formations

105. Williamson Murray, "Technology And The Future of War," November 14, 2017, *Hoover Institution*, https://www.hoover.org/research/technology-and-future-war (accessed May, 2018)

have provided the United States military a period of persistent overmatch.

In the current environment the rate of innovation is at the speed of Google, Apple, Tesla, and other private sector companies producing leap-ahead and potentially disruptive technologies that are available and affordable to an expanded group of adversaries. Competitors implementing or adapting these technologies for military use could erode or erase our competitive advantage within weeks.

The rapid advancement in commercial technologies indicates the industrial sector has reclaimed the predominant position in leading technological innovation. The rate of technological change in the commercial sector has been exponential and accelerating at an unprecedented rate. "The doubling of computer processing speed every 18 months, known as Moore's Law, is just one manifestation of the greater trend that all technological change occurs at an exponential rate."[106] Systems such as Google's DeepMind or IBM's Watson are evolving quickly and impacting the commercial sector's approach to data gathering and application. Consider DeepMind's mission statement, "We're on a scientific mission to push the boundaries of AI, developing programs that can learn to solve any complex problem without needing to be taught how."[107]

Commercial and military technological advances will continue to influence tactics and change the character of war. Just as the invention of airplanes or railways changed how we conduct conflict, robotics and artificial intelligence will influence future tactics. Multiple sensors, automated or Artificial Intelligence systems, and long-range precision

106. Big Think Editors, "Big Idea: Technology Grows Exponentially," *Big Think,* http://bigthink.com/think-tank/big-idea-technology-grows-exponentially (accessed January 20, 2018).

107. Google Editors, "Mission Statement", *Google,* https://deepmind.com/about/ (accessed May, 2018)

weapons creating an “Internet of Things” will have the ability to detect, analyze, and deliver lethal effects in seconds. The access to military and commercial spaced base imagery, drones, radar, and personal devices such as smart phones create an abundantly transparent operating environment, and provide persistence surveillance. Near persistent surveillance creates an environment where movement equals detection and defensive operations could become the preferred form of combat. Perceptions of camouflage, concealment, and deception evolve into a series of temporal dilemmas to achieve security and protection. Speed and frequent movements to outpace surveillance/targeting or dormant and digital/electromagnetic blackout to avoid detection may become necessary. Digital/electromagnetic systems will need to balance capability and vulnerability. New and emerging technologies yet to be discovered will impact the battlefield in way we haven’t imagined.

This period of rapid technological growth and lower barriers to entry leaves the US military vulnerable to threats from state, non-state and individuals actors. Rapid advances in technology also present opportunities to create innovative solutions and achieve competitive advantages. The Army traditionally seeks to maintain a balance between mobility, lethality, and protection in weapons systems. Over the past twenty years we have moved away from mass and moved toward creating precision weapons and munitions to increase lethality. Emerging technologies provide an opportunity to increase lethality by achieving both mass through swarming and precision by establishing near persistent surveillance networks linked to multiple precision fires platforms. It also continues the pattern of Army systems increase reliance on technology; moving from technology enabled to technology dependent. Dependence on technology and networks increases the vulnerability to attacks that decrease effectiveness, deny the ability to employ systems, or even

the ability of an adversary to assume control of systems. Network vulnerabilities necessitate the ability to un-plug or close the network to reduce risk and potentially require leaders to operate disconnected for extended period's time. Maintaining balance between technical and complementary tactical solutions will require leaders that understand the implications of new technologies.

If the current trend of commercial driven technology continues, the Army should enable the early adaptation and implementation process by expanding Research and Development (R&D) programs. However, to maintain a competitive advantage over adversaries and remain an effective deterrent force the Army cannot rely solely on commercial sector development of technology for military applications. Creating a cadre of military professionals that understand, can invent, or adapt new technologies rapidly into military formations will ensure the Army remains prepared for future environments.

Predicting the future environment will remain a moving target. Depending on the theater of war and potential adversaries both points of view are probably valid. In many instances the future will look remarkably similar to the past, and in other instances we may find ourselves in a technological arms race. A combined approach to preparing for the future is likely the best course of action. Focusing on fundamentals and core competencies will continue to prepare formations for future conflicts. However, the era of accelerated technological innovation, characterized by revolutionary and potentially disruptive technologies will also require anticipating future requirements and transforming emerging technologies into military innovations. The answer may be to maintain a sufficient general-purpose force prepared to conduct operations for multiple contingencies and to develop special purpose units for limited or specific operations. The Army may be moving in this direction with the creation of

Security Force Assistance Brigades and Cyber units. The development of an Advanced Technology Formation that rapidly adapts emerging technologies and provides "cutting edge" capabilities could provide a competitive advantage and options to the entire force. Whatever the holds, we can safely assume future conflict will be complex, dynamic, unpredictable, ill structured, and will require agile and adaptive leaders capable of executing discipline initiative within the commander's intent. Investing in leader training will ensure the Army remains prepared to conduct operations in future environments.

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STRATEGIC IMPACTS OF TECHNICAL STANDARDS

COL Nickolas T. Kioutas, U.S. Army

The United States' success with the "Big 5" weapons platforms[108] and Second Offset Strategy[109] technologies during the Gulf War represented a significant technical gap between the United States and peer competitors. The technical gap, however, is now diminished. The Army Operating Concept, *Win in a Complex World*, outlines the potential for threat overmatch, technology proliferation, and advanced capabilities, to complicate future armed conflict. To win, the Army must adapt quicker than the threat and remain ahead of their technological decision cycle, thereby presenting them with multiple technical dilemmas. Adaptation of battlefield technology is significantly impacted by the acquisition strategies employed, a general understanding of technology cycles, and most importantly, how the ability to utilize technology is impacted by the technical standards at the nucleus of the enterprise. Adaptation is either facilitated or hindered by the technical standards employed and will become increasingly more important into the future.

Background

The economic growth associated with the industrial revolution, and the exponential rate of technological change on the battlefield, can be attributed to the ease of system integration enabled by technical standards. Shortly after the founding of the United States, Thomas Jefferson promoted, and convinced Congress of the value of interchangeable parts in production of muskets. As methods for specifying and producing interchangeable parts advanced, parts across various armories became interoperable. Technical

108. The Big Five weapon platforms refers to the Abrams Main Battle Tank, Patriot Air Defense Missile System, Blackhawk Utility Helicopter, Apache Attack Helicopter, and the Bradley Fighting Vehicle.

109. The Second Offset Strategy dealt with investing in precision munitions and stealth technologies to offset the capabilities of the Soviet Union.

standards, and manufacturing ability to meet these standards, unleashed the ability to mass produce weapons, conduct field repair, and supply combat power more effectively. Following World War II, a military-industrial complex ensued, creating competitive forces and technical differentiation in constituent corporations. The complex prevailed through the Cold War and up to the Gulf War. Following the Gulf War, a series of consolidations impacted the competitive environment, but the environment was also impacted by the possibility of commercial product use on the battlefield.

Weapon systems, such as the “Big 5,” had been developed by consolidated large scale technology integrators and were expected to provide significant overmatch for decades. Incremental upgrades to these weapon systems, subject to proprietary standards, were limited to in-house development. Much has changed in the technical environment since the Gulf War. Today, personal electronics, and plug-and-play technologies have opened the door to rapid and robust system development to friend and foe alike. Technology cycles, driving rapid technical obsolescence, affect weapon systems overmatch. To maintain overmatch, new systems and system upgrades must be implemented with technologies from across industry. Furthermore, since military contracts are no longer the most lucrative, the government must adapt to an industry hesitant to engage with the complex government procurement process. It is increasingly difficult, costly, and time consuming to dictate military specifications. While the Department of Defense has made significant moves to adopt commercial standards, weapon system development strategies must be in alignment with such an approach. If the technical standards are the means of the acquisition strategy, the ends of maintaining overmatch are achieved through use of the right technical standards.

Issue

Given the total cost of the Army's materiel enterprise, the desire to begin netting systems together into interoperable systems-of-systems, and the timeframe over which weapon system development occurs, the impact of today's decisions will not be realized until after 2030 – the future is shaped by the decisions of today. The acquisition strategies implemented today must consider the dynamic changes that are likely to occur with respect to technology, and perhaps more importantly consider the approach to technical standards. Since the technical standards of the weapon systems the Army develops are "baked-in" to the system, changing acquisition strategies mid-course is either facilitated or inhibited by the technical standards implemented from the beginning of development.

Making the wrong decision with regard to the standards used can lead to significant re-work and ultimately a capability gap on the battlefield. Because the Army is large, the problem is bigger than in smaller units, organizations, and activities, because re-work and switching costs are lower. Perhaps this fact will challenge the Army's longstanding efforts to maintain equipment commonality for logistical and training efficiencies, and lead to unique equipment sets to spread the risk associated by having the entire capability on a common technical standard. This decision will need to be made for each capability by looking at the long-term effects to cost, schedule, and performance rather than a blanket decision applied to all capabilities.

Discussion

One need only to look to industry to understand the various ways to implement technical standards and the impacts of one method over another. There are basically three standard ways, open standards, closed standards, and user-defined standards. Open standards, such as the Universal Se-

rial Bus (USB), internet hyper-text markup language, and android smart phone platform, are standards that allow anyone to develop technologies that integrate together. Closed or proprietary standards, such as the iPhone Operating System (iOS), Microsoft Office, and many defense systems developed by large prime vendors, are standards restricted and subject to intellectual property considerations. User-defined standards, such as Military Specifications (MIL-SPEC), assign specific standards that may or may not be open or obsolete. Each one of these ways of implementing standards has cost, schedule, performance, and risk implications far into the future.

Open standards have proven to be extremely beneficial for advancing technology rapidly, while enhancing scalability and extensibility. They allow anyone to develop technologies that interface with other technologies using the same standards, enhancing specialization in unique technologies. An example of this is the ubiquitous USB peripheral connector which has allowed for countless peripheral devices interoperating together. By opening the aperture on the available options, the crowd develops more advanced capabilities much quicker than those developed through restricted or closed approaches. The problem with open standards is that they also evolve quickly and are often uncontrolled. The standards that become the common ones used by the crowd are selected through free market approaches. One of the more prominent examples of this is the Video Home System (VHS) and Betamax videotape format war, where VHS prevailed against an arguable better Betamax standard. Investments by the Army in weapon systems using open standards are subject to unplanned changes resulting in costly and time-consuming re-work. This unplanned change is easier to deal with when considering personal electronics where the cost barrier is relatively low, such as with power cord interfaces for smart phones, but not as easy

when considering the cost and durability of a missile system, tank, satellite, helicopter, or integrated battle command system.

Proprietary standards tend to be costly over time, however the base capability is usually well integrated to meet capability requirements. To maintain this tight integration, the primary system integrator often develops its own unique solution to technologies which have already been developed by open source vendors, increasing weapon system cost and schedule factors. Adapting rapidly with the latest technologies is difficult when proprietary standards are involved since commercial-off-the-shelf and commercial industry technologies are not easily integrated. Closed standards also make systems more secure because there are less vulnerabilities, and this fact is a significant concern as cyber and electronic warfare become more pervasive. In the commercial world, closed systems, such as the iPhone, go through many generational developments over a short time period. Not everyone has the same version phone, and the products are not expected to last more than a few years, so eventual upgrade is not far off. This allows for backward compatibility of new systems to allow all the systems to interoperate during the wear-out period. The Army has struggled to integrate proprietary systems such as the Army Battle Command Systems (ABCS). To ensure that the ABCS system work together, all systems must conduct upgrades together or risk degraded capability. This complicated process slows the pace of adaptation to the least common denominator and requires additional overhead to manage upgrades, obsolescence, and testing.

User-defined standards, such as Military Specifications (MIL-SPECS), have been vilified over the past two decades for resulting in non-sensical cost and schedule impacts. Specific incidences, such as toilet seats and hammers costing astronomically more than the local hardware store

can provide, led to legislation that requires justification for use of MIL-SPECS. This is certainly justifiable when minor changes to requirements can reduce costs significantly. In fact, the capabilities requirements process developed in the mid-1990's changed the way that requirements were written in favor of vendor ability to meet the need rather than the technical specification. In many cases, this has reduced cost, schedule, and risk factors. It also led to many vendors developing proprietary specifications so that the government would have to pay them for follow on work, spare parts, and repairs. This is known as "vendor lock" where the government is essentially locked into the prime vendor's downstream pricing.

One method that the Army has tried to use to blend the approach to technical standards is by using Interoperability Profiles (IOP). Through IOPs, the Army recognizes the need to control the interface between various standards and codifies what specific standards should be met to adequately interoperate with the overall system. IOPs are generally developed in three different ways. One method is to baseline the open standards that exist and mandate that vendors build to those standards until the baseline is upgraded in line with obsolescence. A second method is to collaborate with various vendors to secure agreement across all vendors that certain standards will be utilized until some agreed upon time where the standards will be reassessed and updated. A third method is for the government to dictate what standards they require, much like a MIL-SPEC; unlike a MIL-SPEC, however, the government can select open standards. The three methods for employing IOPs essentially mirror the three types of standards previously discussed, namely proprietary, open, and user-defined. Using IOPs helps to reduce the immediacy of a need to change standards as technology advances, but it does not abrogate the need to change. Additionally, technical standards baselined

at one level do not always guarantee seamless interoperability because there are often subordinate standards that may vary across the spectrum of standards.

Conclusion

Weapon system acquisition strategies, in support of rapid adaptation, must consider the long-term effects of the technical standards they implement. The standards implemented today can have long lasting impacts to cost, schedule, performance, risk, and ultimately the United States power to influence a rules-based order. There is no single solution answer to the wicked problem of technical standards usage. Potential solutions may change longstanding notions of commonality in training and logistics, or result in procurement of multiple unique equipment sets to meet the total Army's need. Each weapon system, technology, and standard is subject to volatile environmental factors, and the environment become more volatile in an increasingly connected digital age. Additionally, interoperation with other systems, allies, and partners complicates the considerations for maintaining interoperability. Technical standards, seemingly inconsequential and unnoticeable, have strategic impacts.

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INNOVATING ARMY CULTURE FOR THE FUTURE

LTC Mark S. Lent, U.S. Army

The United States Army has a problem with innovation. Or does it? Competitors from across the globe are taking advantage of rapidly spreading technologies to improve their ability to compete against the United States. The vast resources and wealth of the United States has provided a marked advantage in delivering military innovation. Nuclear weapons, stealth technology, and the modernized Abrams Main Battle Tank, Bradley Infantry Fighting Vehicle, Apache helicopter, Blackhawk helicopter, and Patriot Missile Systems are all examples of military innovations that gave the U.S. Army an advantage over competitors. Now, that advantage is being challenged as technology proliferates and other nation states and non-state actors are pushing into new domains and are producing capabilities to neutralize U.S. advantage in all domains. In the *Army Innovation Strategy 2017-2021*, the following declaration is made in the foreword,

> Since the 2014 Defense Innovation Initiative, military and civilian leaders within the Department of Defense have been calling for accelerated innovation, identifying it as a component of the next offset strategy that will put competitive advantage firmly in the hands of American power projection over the coming decades. To this end, the Army will contribute by doing what it has done so well in the past by unleashing the creativity, ingenuity, and adaptability of the uniformed and civilian workforce. Innovation is part of the Army's rich tradition and will be indispensable to meeting our global mission requirements in the future.[110]

110. United States Department of the Army Publication, "Army Innovation Strategy 2017-2021," foreword, https://www.army.mil/e2/c/downloads/493916.pdf (accessed May 1, 2018).

This forecast points to the Army continuing to out-innovate all competitors without much difficulty. However, the global proliferation of several new technologies makes this a challenging proposition. This coupled with the Army's slow-moving, bureaucratic organizational culture make it much easier said than done. For the Army to compete and truly maintain a temporal 'offset' in innovation, it must do two things: first, change its culture to one of risk tolerance and speed, and secondly the Army must recruit, develop and promote diversity in thought in its leadership (officer and non-commissioned officer) ranks.

At a recent Strategic Multi-Layer Assessment Conference, Dr. Ian McCulloh stated there were four components necessary for innovation to thrive. To paraphrase, he suggested that an organization needed: diversity of thought, inclusion of these ideas, a problem on which to orient, and time. He went on to say that the Army possessed ample problems on which to select from but was sorely lacking in the other components that were necessary to enable innovation to occur.[111]

Much attention has been paid to a lack of diversity in the military. In 2010, the Military Leadership Diversity Commission noted, "…minority men are underrepresented in today's senior leadership as a result of low levels of representation among accessions and relatively low promotion rates. For women overall, the results suggest that low representation in today's leadership is due to low representation among accessions and to low promotion."[112] While this study and subsequent analysis is important to better develop an armed

111. Ian McCulloh, paraphrased notes from a panel discussion (Panel #6- "Global Information Systems and Futures: State of the World and Where We Are Headed"), at the 2018 Strategic Multi-Layer Conference, Joint Base Andrews, April 4, 2018.

112. Military Leadership Diversity Commission, "Issue Paper #30," page 4, http://diversity.defense.gov/Portals/51/Documents/Resources/Commission/docs/Issue%20Papers/Paper%2030%20-%20Differences%20in%20Promotion%20and%20Retention%20Rates.pdf (accessed May 1, 2018).

force that is representative of our culture at large, it doesn't get after the specific leadership traits needed to drive innovation. This can only be found in diversity of thought. If it were possible to magically increase gender and racial or ethnic equality, it would likely not dramatically improve the Army's ability to innovate because those that were promoted would likely possess the same experiences and remain on a consistent vector of thought as their majority counterparts. Senior officer leaders are almost always cut from the same cloth- successful Battalion and Brigade Command appears to be the exclusive discriminator for promotion to General officer in the Army. In a 2016 article for the Association of the U.S. Army (AUSA), Retired Lieutenant Colonel Richard Brown wrote,

> If the Army wants to foster a culture of innovation as senior leaders profess and doctrine proclaims, then we must innovate to create that culture. We must break from our current command-centric leader development model to build the military's finest senior staff officers, making strategic-level staff positions sought after and progressive assignments for the best and brightest officers. Staff colonels and the talented teams that support them are the engines of the institutional Army and essential components of an innovation chain converting ideas to competitive advantage for our joint force. In short, staff colonels are key to Army innovation.[113]

In a 2017 School of Advanced Military Studies Monograph, MAJ Valarie Farrara highlighted research limited to the Meyers-Briggs Type Indicator to showcase an Army bias favoring leaders who demonstrated extrovert

113. Richard T. Brown, "Staff Colonels are Army's Innovation Engines," *Association of the United States Army*, November 13, 2016, https://www.ausa.org/articles/staff-colonels-armys-innovation-engines (accessed May 1, 2018).

characteristics. These vocal leaders who thrive answering on-the-spot questions are valued more than introvert leaders who need time to contemplate and reflect on the question before answering. While clearly not represented of the full scope of diversity of thought, this research was interesting in both highlighting the depth of the problem, as well as making recommendations, that if implemented would assist with enabling innovation. She writes,

> Recent studies suggest that extraverted leaders do not always contribute positively to overall group performance, particularly when subordinates are encouraged to be proactive and innovative. Hence, organizations fail to benefit from subordinate contributions where extraverts dominate the discourse. The US Army preference for the extraverted leadership type over less extraverted types should be addressed as both a cultural bias and hindrance to innovation and creativity.[114]

The good news is that the Army recognizes the need to champion diversity of thought. The bad news is that the Army is schizophrenic and unable to chart a clear path ahead. As an example, *The Army Innovation Strategy 2017-2020* articulates that,

> Openness to new ideas, a willingness to experiment and take risks, workforce engagement, and diversity are values most closely correlated with strong performance in innovation. Yet the Army's approaches to recruiting, developing, managing, retaining, and recognizing the uniformed and civilian

114. Valarie C. Ferrara, "US Army Organizational Culture's Effect on Innovation and Creativity," School of Advanced Military Studies Monograph, Fort Leavenworth, KS, 2017, https://apps.dtic.mil/dtic/tr/fulltext/u2/1038982.pdf (accessed May 1, 2018).

> force do not fully support these values. Further, as an enterprise, the Army lacks a systemic approach for the discovery, rapid evaluation, accreditation, integration, and acquisition of promising ideas, technologies and processes that may be realized through collaboration with partners, suppliers, and collaborators internal and external to the Federal Government. [115]

This same strategy document simultaneously struggles with identifying the problems with our current culture, and simultaneously charts a bold vision for the future where none of those same challenges exist, without explaining how this much-needed culture change will be led. Highlighting the continuing challenge of selecting diversity of thought for promotion to higher ranks is the following example from Brown's 2016 article,

> In a review of two officer basic branches with these type of command-equivalent staff assignments, not a single general officer of the 31 presently on active duty exclusively held a command-equivalent staff assignment as a colonel. Each had a brigade-equivalent command even though in doctrine, the Army considers both central select list staff and command positions to be equivalent key developmental assignments. Unfortunately, these practices are reinforced through mirror-imaging by these very general officers and their peers who sit on Army senior promotion boards.[116]

115. Department of the Army, "Army Innovation Strategy 2017-2021," 9.
116. Brown, "Staff Colonels are Army's Innovation Engines".

If the Army is to truly get serious about increasing diversity of thought, it starts with changing the way the Army recruits, develops, and promotes senior leaders.

The Army culture is justifiably steeped in history and has developed multiple layers of bureaucracy to reduce organizational risk. The Army must break through this organizational bureaucracy to forge a new culture where acceptance of prudent risk is actually accepted and encouraged and diversity of thought is rewarded. Technology diffusion across the globe is occurring at an unprecedented rate. Many are forecasting a much more lethal future environment with autonomous weapons systems and multi-domain operations producing a significant change in the character of future warfare. United States Army War College Professor, Dr. Andrew Hill writes,

> Every generation in a military organization develops a unique sense of the courage required in war. What was courageous behavior in a prior conflict may be reckless or futile in a later one. Yet military cultures will try to resist an innovation that upends their principles of honorable warfare before succumbing to the logic of a new weapon… An innovation that alters the calculus of courage also changes the social context of war, and will therefore be resisted by the organization.[117]

Recent steps by Army leadership that indicate steps in the right direction include designation of the Army Futures Command and Cyber Command. Both moves indicate a willingness to change the organization, and hopefully over time, the culture within the organization. Specifically, the Army Futures Command is expected to be charged with

117. Andrew Hill, "Military Innovation and Military Culture," *Parameters,* 45, no. 1 (Spring 2015): 89.

synchronizing innovation and rapid prototyping to bring inexpensive capabilities to the Soldier much faster than we have seen in the plodding bureaucracy of the past. As usual, the verdict on the effectiveness of the command will (rightly) be withheld until we can evaluate if it has delivered in accordance with its chartered mission.

The Army recognizes that the character of warfare is changing, and it also recognizes the need to change its culture to increase the value of innovation. The ability for the United States to produce innovative technologies, processes, and effects faster and at a relatively better quality than competitors is critical to maintaining a future advantage. Fundamentally, the difficult part for the Army will be in action. If the Army can successfully re-wire its organizational culture to where encouraging prudent risk is actually rewarded it has a chance to be successful. A critical waypoint to changing culture is the broadening of diversity of thought in Army leaders. This diversity of thought can lead organizational culture change and simultaneously encourage creative and critical thinking that is of paramount importance to delivering innovation better and faster than our competitors.

Lieutenant Colonel Mark Lent is an Aviation officer who recently served as the Senior Aviation Trainer at the Joint Multinational Readiness Center, Hohenfels, Germany. His next assignment will be as the Command Inspector General to the Maryland National Guard. His Strategy Research Paper (SRP) examines the core attributes required to design a future force.

THE REASON WHY: ADDING A FOURTH LEG TO THE LYKKE STRATEGIC FRAMEWORK MODEL

Mr. Christopher J. Semancik, Department of the Army

Recently the Art Lykke strategy model, more commonly known as the Ends+Ways+Means=Strategy formula, has come under skeptical review and criticism. One author reveals his cause for questioning Lykke's concept by opining that "our strategic performance since widespread adoption (of the formula) has been unremarkable at best."[118] A fair point, strong enough to call for reflection on the model that the critic has characterized as being "too formulaic" [119] for the complexities faced by America in the global landscape of the 21st century.

Along with labeling the formula as a "crutch" for the U.S. defense communities' lack of creative solutions, another critic, Jeffrey Meiser, summarizes his argument that the Lykke formula is "…a simplistic notion of means to create a situation where strategy is reduced to a perfunctory exercise in allocating resources."[120] Meiser's point is that the Lykke model reinforces the American way of waging a war of materiel rather than of unique situational strategies by ensuring that American strategy is "…an exercise in means-based planning…"[121] thus lacking creative spark.

Should the Lykke model be discarded as a relic of the post-Vietnam strategic scene, or like other disciplines of inquiry, now that it has had several trials of testing should the formula be refined? One of the authors even took umbrage to the term "ends" as used to define an objective of strategy

118. M.L. Cavanaugh, "It's Time to End the Tyranny of Ends, Ways, and Means," *Modern Warfare Institute* https://mwi.usma.edu/time-end-tyranny-ends-ways-means/ (accessed May, 25 2018)

119. Ibid.

120. Jeffrey W. Meiser, "Ends+Ways+Means= (Bad) Strategy," *Parameters*, (46, no. 4, Winter 2016-17), 82 https://ssi.armywarcollege.edu/pubs/Parameters/issues/Winter_2016-17/10_Meiser.pdf (accessed May 29, 2018).

121. Ibid., 81

in the Lykke model with an attack on the term stating that strategy does not "end". This level of criticism understandably stems from the frustrations of the practitioners of the long war of the past 15 years.[122] The critics sense that something is lacking and requires investigation.

The concepts embodied in "ends" and "means" have been a part of the strategic lexicon for a long time and should not be quickly discarded.[123] Lykke himself stated that the formula that bears his name was first expressed during a U.S. Army War College lecture by General Maxwell Taylor, the father of strategic flexible response, which can be argued is still an underpinning principle of our American Grand Strategy. Maybe, like any good theory, the Lykke model should be updated to reflect what we have learned through collective experience since its introduction. What does the theory need if to be relevant in a modern strategic concept like Multi-Domain Battle (MDB) or should it be set aside for something new?

During the conclusion of the article "The Strategic Corporal: Leadership in the Three Block War", General Charles C. Krulak's protagonist, Marine Corporal Hernandez makes the right set of decisions aiding in the diffusion of a rapidly escalating situation between a local population, warring factions, and peacekeeping forces that had complex implications. Krulak was prescient in his assessment of the emerging modern battlefield in which widespread U.S. involvement in global affairs, the nature of asymmetric conflict, the impact of the diffusion of advanced technology and information fueled by the immediacy of media reporting brings the actions of all ranks, even the most junior member of our armed forces, into the strategic calculus.[124]

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122. Cavanaugh, "It's Time to End the Tyranny of Ends, Ways, and Means,"1-2

123. John M. Collins, Grand Strategy: Principles and Practices, (Annapolis, Naval Institute Press, 1973) 5-6

124. Charles C. Krulak, "The Strategic Corporal: Leadership in the Three Block War" Marines Magazine, January 1999 http://www.au.af.mil/au/awc/

Krulak observes that his fictional Corporal must be able to "confidently make well-reasoned and independent decisions under extreme stress…"[125] and goes on to describe how values, training, life-long learning regarding leadership and a shift in attitude toward decision making at the lowest level (read mission command) will enable the future Corporal Hernandez to rise to the occasion. But are those subjective qualities enough to provide seamless real-time decision making across multiple domains as will be required by those operating at all levels in the future?

Krulak's narrative implies an understanding that his fictional Corporal had of the mission relating to the situation at hand that enabled him to make those precious well-reasoned decisions in those crucial minutes. The Corporal understood the reason why: the needs of the local population, the interests of the warring factions and the role of the international peacekeeping forces. He understood the motivation of the actors, including himself, as they interacted in the context of the operation and the strategy of the mission. In essence he was able to internalize and act upon the Clausewitzian translation of policy by other means and thus served the interests of the nation.

Krulak was accurate in describing the character and requirements of conflict and the implications of the actions of our armed forces in the 21st century, but his conclusions on how to get each member of the force to act in aligned concert with strategic guidance and policy goals is ambiguous. Again, how do you ensure that young soldiers, senior leaders and policy makers act in harmony under public scrutiny in each disparate mission around the globe?

Nineteen years after the publication of Krulak's article, the emerging concept of MDB evolves the envisioned

awcgate/usmc/strategic_corporal.htm (accessed May 27, 2018)

125. Ibid.

attributes of the modern conflict space and the required decision- making requirements at all levels through the Command and Control (C2) philosophy of Mission Command. Articles that describe MDB envision "converged and integrated capabilities spanning across domains…"[126] that will go beyond land, sea and air to include "space, cyberspace, the electromagnetic spectrum, and the information environment…"[127] to form an "overall operational environment." [128]

Krulak's article dealt with physical actions and how they can be perceived in the information domain. U.S. Army General David G. Perkins, in describing MDB, pushes beyond the physical by stating that MDB will include the "…physical, temporal and cognitive…"[129] dimensions of the battle space. Perkins expounds that

> The temporal aspect introduces the added complexity of wide-ranging time-based variables that affect an operation, requiring commanders to think far beyond just synchronization. Virtual aspects will include activities related to information, cyberspace, and electronic warfare. Finally, the cognitive aspect will relate to understanding the enemy and ourselves and also the perceptions and behaviors of populations. Cognitive considerations will be informed by the physical, temporal, and virtual aspects of the operations framework.[130]

To operationalize the virtual and cognitive environments in strategic concert will require willful and constant evaluation of multiple factors including the motivations of all forces

126. David G. Perkins, "Preparing for the Fight Tonight: Multi-Domain Battle and Field Manual 3-0", *Military Review*, (Fort Leavenworth, Vol. 97, no.5, Sep/Oct 2017), 11 https://search.proquest.com/docview/1949583740?pq-origsite=summon (accessed 25 May, 2018)
127. Ibid.
128. Ibid.
129. Ibid.
130. Ibid.

concerned. This gets to the heart of some of the foundational points espoused by the classical conflict writers such as Sun Tzu's admonition to know yourself[131] and Thucydides' "fear, honor and interest"[132] as causational factors of war which Clausewitz ascribed to the passion of the people in his famous trinity.[133]

From these writers we understand that people enter conflict motivated by their interests. An understanding of these motivations and interests are the key to MDB strategy formulation in order to achieve not just as GEN Perkins noted "synchronization"[134] but true synthesis of the strategy across the domains. To achieve this everyone involved and those observing need to understand the interest/motivations of the strategic situation which would form the basis of any information operation associated with the strategy.

The concept of Mission Command has been offered to achieve this needed synthesis.[135] The foundation of mission command is based on commanders creating a "shared understanding of the situation."[136] In an article entitled "The 'Secret Ingredient' in Multi-Domain Battle" the authors advocate

> …the empowerment of soldiers to take disciplined initiative. In general terms, initiative is the inclination to act purposefully. Disciplined initiative implies that soldiers demonstrate a duty to act in the

131. Sun Tzu, *The Art of War,* Translated by Samuel B. Griffith, (London, Oxford, New York: Oxford University Press, 1971) 84

132. Thucydides, *The Landmark Thucydides*: A Comprehensive Guide to the Peloponnesian War, Edited by Robert B. Strossler (New York: Free Press, 1996)

133. Carl von Clausewitz, *On War*, trans. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1976/1984) 89.

134. Perkins, "Preparing for the Fight Tonight, 13.

135. Ted Thomas, Wes Farmer, Derrick Robinette, "The 'Secret Ingredient' in Multi-Domain Battle", *Army*; (Arlington, VA, 67, no. 5, May 2017) 27 https://search.proquest.com/docview/1904128805?pq-origsite=summon (accessed May 25, 2017)

136. Ibid.

> absence of orders (as when communications are denied, degraded or disrupted), when existing orders no longer fit the situation, or when unforeseen opportunities or threats arise. It is a commitment to find or create windows of opportunity, solve problems, and take action to accomplish the mission.[137]

The shared understanding must be developed as part of the strategy in order to facilitate this type of initiative. Lykke wrote that in developing strategy the guidance from our senior leadership and policy makers "…answers the question of 'why' in the formulation of our military strategy."[138] The "why" speaks directly to the motivation and interests of the nation as expressed in the policy and guidance. As strategy is developed Lykke encouraged that as much of the "why" be included in the formulation of the military strategy as possible.[139] As the domains of the battle space expand so should the variables of the Lykke formula.

In addressing the dissemination of guidance, the great strategic thinker John M. Collins targeted the often missing 'why' component by quoting Sherman Kent who stated that "unless the intelligence organization knows why it is at work, what use its end product is designed to serve, and what sorts of actions are contemplated with what sorts of implements, the analysis and proper formulation of the substantive problem suffer in proportion." [140]

Although Collins used this quote in reference to the role of intelligence in formulating strategy, its applicability across the domains is good advice in order to create the sought after shared understanding or common operating picture

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137. Ibid.

138. Arthur F. Lykke, Jr., "A Methodology For Developing A Military Strategy," *Military Strategy: Theory and Application* (Carlisle Barracks: U.S. Army War College, 1993) 9.

139. Ibid., 11.

140. Collins, *Grand Strategy,* 10

essential to maintain the speed and fluid nature envisioned in the operations of multi-domain battle. Kent's quote clearly implies that having your subordinates understand the reason why produces a better product as the nuances of each level of work is enriched because it is working to the reasons of the larger plan.

Strategic analyst Carl H. Builder in his RAND research study *The Masks of War* stated that "If one knows the who and why of a strategy, the what and how are likely to become obvious or secondary." Builder insists on understanding the "underlying motives" in order to ensure that the crafted strategy is not "…opaque, ambiguous and contentious." Builder goes to the heart of the problem as ambiguity of purpose across the domains would derail any strategy applied to the MDB concept and must be avoided. [141]

So where does the "why" fit into the Lykke formula? Lykke's original strategic model was illustrated as a three-legged stool with "Ends (military objectives)" and "Means (military resources)" brought into stable alignment by the "Ways (methods of applying force)" to provide a military strategy "seat" which supported the national security interests or the load which the stool holds up.[142] The risk factors to any strategy was depicted as a wedge that threatened to upset the three-legged stool and was the ever-present variable to judge the efficacy of the Ends, Ways and Means construct. [143]

To test the formula Lykke offered William O. Staudenmaier's evaluation of the Ends, Ways and Means against three considerations of "suitability" for the ends, "feasibility" for the means and "acceptability" for the ways as a test

141. Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis,* (Baltimore: Johns Hopkins University Press, 1989) 53.

142. Arthur F. Lykke, Jr., "Toward An Understanding Of Military Strategy" *Military Strategy: Theory and Application* (Carlisle Barracks: U.S. Army War College, February 2001) 182.

143. Ibid.

or assessment of any given strategy.[144] This formula and evaluation criteria was revived and synthesized in an article by H. Richard Yarger in 2012 and can be expressed in the following table: [145]

Ends (objective)	What is to be accomplished?	Is it Suitable? Will its attainment accomplish the desired effect
Ways (courses of action)	How it is to be accomplished?	Is it Acceptable? Are the consequences of cost justified by the importance of the desired effect?
Means (resources)	What instruments are to be used?	Is it Feasible? Can the action be accomplished by the means available?

To continue and expand upon the three-legged stool illustration, the degree of risk or the shifting weight of national security interests can make the stool inherently unstable, threatening to up end the considered strategy. A four-legged chair is by design much more suitable to withstand the changing and dynamic variables of the weight placed upon it and the wedges thrust against it. As Lykke stated, the "why" should be added into the strategic formulation and thus forms the fourth leg. By adding Motivation to the Ends, Ways and Means the formula would include the following:

144. Lykke, "A Methodology For Developing A Military Strategy," 11.

145. H. Richard Yarger, "Toward A Theory Of Strategy: Art Lykke And The U.S. Army War College Strategy Model", *U.S. War College Guide to National Security Issues, Volume 1: Theory of War and Strategy*, 2012 Edited by J. Boone Bartholomees Jr. (Carlisle: Strategic Studies Institute Book) 49.

Motivation (interests)	Why is it to be accomplished?	Is it Reasonable? Is the strategy in alignment with and proportional to the National interests and capable of withstanding moral, legal, and ethical scrutiny?

The test would evaluate if the strategy and associated actions are "reasonable" in both its alignment and proportion to the National interest, the region of operation and perceptions in the international arena. This last point is what is missing in our current calculus in dealing with the myriad of new types of conflict such as hybrid, gray zone, cyber and information warfare. An appraisal to what is proportional or reasonable in each regional incident in application of an ends+ways+means approach would act as a check to possible misapplications of force, missteps and adventurism.

Thus, the Lykke formula so enhanced, would carry its own internal and external evaluation criteria as advocated by Colonels Lyles and Cormier in their Strategic Appraisal Tool (SAT) which infuses "critical thinking" to the formula through "A deliberate approach that illuminates their perspectives, possible motivations, interests and goals…of how external actors and entities will act, react and seek to influence events at the strategic level." [146] Questioning the "why" or "motivation" of all involved provides constant reappraisal to allow the Lykke model to be useful in not only American and coalition strategic formulation but now internalizes the SAT concept to be used to consider the strategies of the

146. Ian Lyles and Dan Cormier "The Strategic Appraisal Tool" https://armywarcollege.blackboard.com/bbcswebdav/institution/REP/Course%20Files/DNSS/Core%20Courses/Regional_Studies_Program/NS2204_East%20Asia/Readings/AY18_RSP_EAP_LSN01_REQ01_Lyles%20Cormier_Strategic%20Appraisal%20Tool.pdf (accessed May 29, 2018) 3

competitors. Again, the authors advocate that "Understanding the perspectives and motivations of other relevant actors at the international level is a necessary step in designing competent national polices and strategies." [147]

Lyles and Cormier advocated in their conclusion that their SAT concept be used as a check on the Lykke model. Adding "Motivation" and the "why" as the fourth leg of the model ensures that it is incorporated during strategy formulation and used in "monitoring a strategy for success and failure, as well as for clarifying assumptions." [148] Armed with an understanding of the motivations of a strategy fulfills General George C. Marshall's determination at the onset of World War II to "…explain to our boys in the field *why* we are fighting, and the *principles* for which we are fighting…" and ensures a direct link from our most senior leadership to the immediate actions of Krulak's corporal that the ends, ways and means are aligned with our national interest across all the domains. [149] Maybe the Lykke critics will agree.

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147. Ibid., 7
148. Ibid., 8
149. Frank Capra, *The Name Above the Title: An Autobiography* (New York: Macmillian, 1971) 326