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THE UNITED STATES ARMY IN 2035 AND BEYOND

A COMPENDIUM OF U.S. ARMY WAR COLLEGE STUDENT PAPERS

VOLUME FOUR (2017)

Samuel R. White, Jr.
Editor

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The United States Army in 2035 and Beyond

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STRENGTH *and* WISDOM

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Foreword

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

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

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

Adversaries and potential adversaries are investing heavily in capabilities that offset U.S. legacy systems and processes. Increasing readiness may bring a short-term benefit, but as long as the modernization gap continues to widen, the U.S. Army will find itself overmatched in legacy systems by its traditional competitors – and counter-matched in emerging asymmetric areas by a growing number of non-traditional ones. The absence of sustained overmatch in previously uncontested physical domains will place U.S. forces in an unfamiliar position.

Supremacy and superiority in the physical domain will be temporary at best and unlikely at worst. In the future, the concept of decisive point may well be different. In fact, a decisive point may not exist at all – or may have to be created. Lethality and adversary reach will make offensive action less decisive in some domains. Maneuvering to positions of advantage may be impossible and the future principles of war [particularly offensive, mass and maneuver] may not apply – or will be fundamentally different.

While advantages in the physical domains may be brief and few, sustainable decisive advantage could be gained in the cognitive domain – the boundary-free area of the battlefield which involves knowing, predicting and deciding. Though not a domain in the strictest doctrinal sense, the cognitive dimension of human (and artificial or amplified) intelligence (AI/IA) and organizational perception is a ripe arena for future conflict.

In the future, individuals, teams, units and the entire force could operate far more cognitively connected than today – almost as a single cognitive organism. There is great potential for common understanding …. collective decision making …. and unified anticipatory action. Unlike the physical domains, dominance in the cognitive domain is less vulnerable to asymmetric offset. Adversaries may attempt to prevent each other from gaining knowledge, but offsetting the advantage once it is achieved is difficult. Knowledge is not fungible – something is either known or it is not.

Advantages in the cognitive domain could be deep and long-lasting. In future conflict, ambiguity will increase despite interconnectedness.

The velocity and scale of activity will make it difficult to discern the important from the unimportant; the real from the fake. Adversary spoofing, deception, and data manipulation and corruption will create a common operational picture that is part-fact, part-fiction. This murky situational awareness will feed decision cycles that will be compressed by pervasive data and near-instantaneous communications.

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

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

The pace of advances in Artificial Intelligence and Intelligence Amplification create an urgency for the Army. They are areas of intense competition and development by industry as well as by potential competitors and will be the first-principles in building a sustainable advantage in the future. Beyond fielding a force that simply competes in the physical domains, the Army of 2035+ must be designed to dominate and achieve overmatch in the cognitive

domain; for the greatest potential for superiority / supremacy lies here.

Samuel R. White, Jr
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Defining the Future Army

Lieutenant Colonel Michael J. Kimball

In an effort to define what the Nation needs from its Army in 2035, it is first important to briefly describe what the future environment and threats look like. It is safe to assume that nuclear war has not occurred in 2035 and it's safe to assume that the "4+1" still remain as the nation's serious threats. However, it is possible that of the 4 main peer-peer threats, China will be diminished as a military threat. This will be due in part to the U.S. and Chinese economies being so inextricably linked as to prevent the use of force. In 2035, The Multi-Domain Battle concept will have matured into doctrine and will be trained in Army formations and tested at the Combat Training Centers. The years between now and 2035 will be a time of increased military competition. Our adversaries and allies will constantly struggle for numerical and technological superiority on the battlefield. In the year 2035, the U.S. Army will possess increased lethality, be lighter and more mobile, operate with dispersion as a norm of ground combat and will have leveraged current and future technology to gain discreet advantages over our adversaries.

Dispersion

The Army in 2035 will be forced to operate with dispersion as a key tent rather than "digging in" for protection. Protection will be gained and maintained through constant movement and dispersion of units. This will create mission command challenges that may not be easily mitigated through the use of future technological capabilities. The enemy will constantly attempt to deny or degrade U.S. mission command systems. Communications and connectively may be fleeting and dispersed units may often be operating without contact to adjacent or higher organizations.

Dispersion will be even more integrated into operations by the Army's sustainment units. The days of the Division Support Area and Brigade Support Area consolidated in mass and in the rear of the formation will have ended. In the future, support units will require an area that is tens of kilometers wide and equally as deep in order to protect forces from enemy lethal and non-lethal effects. Dispersion will also be combined with masking or hiding a unit's physical, electromagnetic and cyber signatures or making those signatures appear to be something different.

Divisions are the Future Tactical Formation

The main fighting force in the year 2035 will be the Division and not the Brigade Combat Team (BCT) – but this paradigm shift will not happen overnight. Part of this is due to the overwhelming responsibility that we as an Army have placed on the BCT Commander and his formation. The BCT commander has evolved into the ground version of the Navy ship captain – gods at sea. The same has happened to our BCT commanders. However, by 2035 the sheer expanse of technical capability and technical capacity will overwhelm the BCT formation causing decision paralysis. The Division Commander and the more robust and experienced division staff will be required for resourcing and synchronizing the entire division and not merely just helping the BCT fight its fight. Currently, Division commanders have no way to shape the deep fight in order to aid the BCT in their close fight. However, by 2035, the Army should develop and create new technologies and units to provide the division commander with a means to shape the entire division area of operations thereby assisting the BCT commanders to focus on their portion of the close fight. This will bring a renewed sense of priority and mitigate paralysis in the BCT formation. Again there are challenges. Because the Army designed its fighting force with the BCT as the building block, there is currently no maneuver space within the United States to effectively train a Division. In 2035, in order for the Army is to utilize Divisions as an actual tactical formation and not just a higher headquarters, then we must identify additional resources (namely terrain) to adequately train these formation.

Future Fighting Formations

The fighting formations in 2035 must be lighter and more maneuverable but yet have enough protection and lethality to survive. A lighter force will ensure more efficient deployments and enable the United States to project combat power forward with minimal strategic lift assets. A more maneuverable force will enable our formations to quickly adapt and exploit advantageous positions on the battlefield. The formations in the future must have the protection capabilities to ensure survival, but cannot so bulky or heavy to lose speed and agility. These last two qualities, speed and agility, go hand in hand with being able to out maneuver threat forces to enable friendly force. Lastly, future formations must have increased lethality; the Army must be able to out-range adversaries and provide adequate punch to efficiently neutralize or destroy enemy forces. An increased capability in future formations could be realized through manned-unmanned teaming (MUM-T). The pairing of machines and the soldier provides opportunities to increase lethality, protect formations and bring multiple dilemmas to any future threat. By combining man and machine, the future force could have the ability to exponentially increase its capability by utilizing ground vehicles paired with unmanned "wingmen" that could deceive the enemy – or rapidly surprise the enemy and then bring overwhelming firepower on the enemy while minimizing risk to soldiers. In addition to pairing ground maneuver formations, the future Army should also pair rotary wing aircraft with Unmanned Aerial Vehicles (UAVs). By using the UAVs in mass, future formations could overwhelm the enemy's radar capability which could then open a window of opportunity to destroy enemy targets. Another benefit to the MUM-T is already realized today and will be fully matured by 2035. Using MUM-T for resupply convoys and to support sustainment throughout the battlefield will reduce the number of Soldiers needed for sustainment operations and therefore free manpower could be used to grow our maneuver formations.

Future Soldiers

U.S. Army soldiers in 2035 may have exo-skeletal suits that enhance soldier performance and increase individual lethality, protection and

agility. These suits could magnify the soldiers' current physical ability and amplify their cognitive abilities. The technology of these suits will have matured so that the suits are lightweight, durable, and easily replaced using three dimensional printers – which in 2035 could be resident in all company-sized formations. In addition to exo-skeletal suits and ubiquitous 3-D printing capability, soldiers on the battlefields of 2035 might possess an enhanced medical capability. This medical capability will quickly and efficiently diagnose and recommend treatment for all physical injury ailments. This will increase the survivability of the force and enhance the fighting forces' resiliency. Finally, all soldiers might be equipped with technologically advanced individual weapons that will provide a mix of lethal and non-lethal munitions that can be quickly employed to bring effects on the future battlefield. These weapons will be constructed out of durable, lightweight materials that will operate in all conditions and their parts can be fabricated by three dimensional printers to speed recovery and repair time.

Future Institutional Changes

By the year 2035, the institutional Army should have undergone a fundamental change and have begun grooming and teaching leaders of the force to accept prudent and intelligent risk. This will create leaders who are not risk averse, thus fostering and propagating the tenants of Mission Command. Additionally, these future leaders will accept minor mistakes or minor failure as a learning point. They will not stifle initiative and thereby promoting innovation and ingenuity within their formations. By accepting innovation and embracing Mission Command, our future formations will have the capacity and capability to accept and harness the latest technologies to create advantages on the battlefield. Future commanders will empower their subordinates and trust them to make decisions faster than our adversaries thus creating discreet windows of opportunity. The future leaders of the Army will have truly realized and trained Multi-Domain Battle and be experts at cross-domain operations. These leaders will recognize and apply effects in one domain that immediately support or create opportunities in another domain.

In 2035, our Nation will need an Army that is lighter, more maneuverable, possess increased lethality and has the leadership that trusts their subordinates and encourages initiative throughout the force. The Army of 2035 will be postured to rapidly deploy and deter or assure or Allies while securing our Nation's vital interests. This future force will provide numerous options to our most senior leaders and will be ready when our Nation calls.

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Rising Regional Powers and the Future Army

James W. Mancillas, Ph.D.

Predicting and planning for the Army of tomorrow has been and continues to be a strategic challenge. Increasing the difficulty of this challenge is the volatile and rapidly changing character of today's strategic environment. Many military service chiefs, including previous Chairman of the Joint Chief of Staff Martin Dempsey, share this sentiment. In the 2015 National Military Strategy he stated, "[t]oday's global security environment is the most unpredictable I have seen in 40 year of service."

His response and many like it are understandable for numerous reasons. Perhaps the most significant reason is that many expected the end of the cold war to usher in a new era. The collision of the two great global powers, the United States and the Soviet Union, and their conflicting global visions, had concluded. America and the west won. It was assumed that liberal democracies, democratic values and entwined global commerce would create a world unified in peace. Conflict would occur only at the fringes, and these conflicts would be minor; resolved through calm negotiations and coalitions of nations working in unity. Most importantly, the international order, established at the end of World War Two and defended throughout the cold war, would persist without the need for a strong military force. That was the prediction.

However, what emerged after the close of the cold war was a world much like the world before. It is a world whose nature had not changed. A world of nations states acting in response to three seemingly immutable factors: *fear*, *honor*, and *interest*. Russia has reemerged in response to an expanding NATO and what it *fears* as a threat to its territorial and cultural sovereignty. China is rising to reclaim its *honor* after suffering a self-described century of

humiliation. Iran, North Korea, and Violent Extreme Organizations (VEOs) each seek to expand their regional power and influence. And America, geographically secure, uses its military across the globe predominately to maintain stability and international order to protect its *interests* in commerce.

Just as the nature of future conflict is somewhat predictable – at least on a grand scale, the character of future conflict is also somewhat predictable – again, on a grand scale. The character of future conflicts will be defined by the geography of the battlefield, the technologies employed, the economic and political strength of the competitors, and the social-cultural values of the combatants. These environmental factors will define the tactics used to achieve the strategic goals determined by the nature of future conflict (fear, honor, and interest). Thus in order to understand what kind of Army the Nation needs in 2035 and beyond, it is necessary to critically examine the anticipated environment of 2035 and beyond – the geography, the economy, and the technology.

The Geography

The geography of 2035 is much as it is today. The two grand oceans that geographically insulate the United States from foreign militaries also shape how the country engages the world. Whether for trade or military purposes, transit across the Atlantic and Pacific oceans, 3500 and 5500 miles wide respectively, require the United States to overcome the "tyranny of distance." While other nations have interests in influencing global maritime, air and space domains, it is the United States, because of its geographical isolation, that considers these domains first, often at the expense of land domain.

Unlike the United States, many other nations exist in tightly interlocked land based communities. These nations have regional security concerns arising from geographical and cultural border disputes and concerns over control and access to natural resources. As a result, the military identity of these nations tends to be more defensive than the United States and far more concerned about regional land based security.

Regional powers in 2035, notably China, Germany, and Brazil, will continue to seek to benefit economically through shared access to the global commons. However, these regional powers will likely seek regional adjustments to the current world order. These adjustments will include changes to current territorial and sovereign boundaries and redefining the global commons with an emphasis towards favoring regional hegemonies.

These future regional powers could be viewed as slowly creeping empires, growing at their edges. They will patiently pursue deep strategic visions with an economy of force, simultaneously employing the full spectrum of national power: diplomatic, economic, social-cultural manipulation/persuasion and military might. With respect to the United States, they will be operating with the initiative. They will be able to readily project and sustain heavily armored land forces. They will have the advantage of choosing the time and place of conflicts. Proximity will allow them to concentrate forces, surge into contested space, and buy the time to consolidate gains and establish defensive positions. Yet, much like Russian offensives in Ukraine, Georgia, and Estonia, these conflicts are likely to remain limited in scope, and regionally based.

The Economy

In 2035 the United States will still be a global leader in economic prosperity and strength. Yet while economic strength persists, its economic hegemony will have ended. China will have reached economic parity with the United States and together they will dominate the new economic landscape. The remaining top ten economies will include India, Japan, Germany, and Brazil, as well as the United Kingdom, France, Canada and Russia. Further, during this time frame the world population will increase by nearly a billion people. The populations of Europe, the United States and China will be will generally remain stable, while projected population increases, and likely future resource and cultural frictions, will occur most notably in the region spanning from Asia (India) through Africa.

The implications of these economic and demographic trends are multifold. The first is that ten major economies will disproportionally

dominate global business and resources. This will continue the trend of increasing complexity from an increasingly multipolar world. Further these economies will wield significant diplomatic influence in their region and in the international arena. This diplomatic influence will tend to erode international commitments to the current international order on issue of "regional" concerns. This effect will confound and delay the development of international opposition to regional affairs and conflicts.

A second implication is that as the economic and diplomatic influence of regional powers grows, there will be growing aspirations and justifications to reshape the world order – and current international norms will be increasingly challenged. These justifications (of "success") will embolden regional powers to imprint their regional norms onto the international landscape.

A third implication is the economic strength of these regional powers will result in peer-to-peer and near peer-to-peer military capabilities, (relative to U.S. forces). Likewise, the capacity advantages afforded the United States by its relative economic strength will likely be offset by the geographical disadvantage of the nation in regional conflicts.

And a final consideration is that the growing populations in the region from India through Africa do not overlap with regions of economic development. This will likely result in increased levels of instability. Humanitarian crisis and political discontent, conditions ripe for weak states and VEOs, will likely persist and worsen throughout this region through 2035 and beyond. As a result, small wars and counter insurgency operations will remain common in the lexicon of the U.S. Army.

The Technology

War and technology have been inextricably linked throughout the ages and will continue into the future. Since the emergence of organized conflicts, combatants have engaged in an evolutionary tit-for-tat that continuously advances battlefield technology, a trend

that continues through today. Adversaries have sought to unhinge military parity (and/or disadvantage) through:

1. Coherent and unified strategy
2. Use of geography, natural features and events
3. Rapid development and exploitation of short-lived technological advantages

In 2035 the rapid development and diffusion of technologies, and scientific knowledge that underpins them, will result in near technological parity between competitors. The economic engines of future regional powers ensure that they will have timely access to the capabilities of that era. Technology – such as stealth, precision munitions, Artificial Intelligence informatics, robotics, and secure communications – in a fundamental sense will not offer significant advantages. Robot tanks engaging robot tank killers and stealth drone swarms engaging anti stealth drone swarms will result in contests of parity and attrition.

The implications the 2035 technological landscape are important. If temporary technological advantages are to exist, they will be:

1. Ppurpose built
2. Rapidly fielded
3. Employed by well-trained armies

In an era of technological parity, general-purpose materiel will at best maintain parity, while being susceptible to attacks focused on the compromises inherent in one-size-fits-all technological platforms. Stockpiles and depots of materiel will become rapidly outdated and ineffective. And only those armies that can rapidly train and promulgate operational concepts will hold fleeting advantages.

Recommendations for the Army of 2035

In consideration of economic, demographic and technological trends, the Army of 2035 will face a complex and militarily competitive environment. Future adversaries emanating from regional powers will likely:

1. Possess technological parity both in capability and regional scale capacity
2. Operate with short lines of communication close to their national borders
3. Operate with clear strategic goal
4. Possess battle space initiative by employing defense-in-depth A2AD materiel to protect well-established defensive positions

In order to address these challenges the future Army will need to be one that:

1. Continues to be innovative, flexible and agile
2. Is equipped with materiel systems, purpose built and designed specifically, to dislodge combatants from contested environments
3. Operates as the most mobile and sustainable Army in the world

Future Army acquisition programs should be focused on the development of modular operating platforms. The development of core land mobility platforms: light, medium, and heavy, that can be quickly adapted through "bolt" on modifications implementable below the depot level to specific terrain, protection, and fire capabilities should be pursued. These common platforms will:

1. Allow quick fielding of materiel that is best suited to the environment
2. Minimize logistics
3. Minimize training while increasing tactical proficiencies
4. Allow for increased diversity and experimentation on the battlefield – thus capitalizing on the agility and ingenuity of soldiers

Future Army operations will be increasingly multi domain. The Army should reinvest in edge of the (land) domain equipment and materiel. The Army of the future will need organic deep fires capabilities and brown water/river patrolling assets. These capabilities will allow the Army to open domain space to allow sister services to gain toeholds in A2AD environments.

The Army of the future will be facing exceptional challenges in an anarchic world. It will often be disadvantaged in time and space. It will be constrained by fiscal and human capital resources. It will likely still be fighting the timeless internal conflict between institutional inertia and the need for innovation. Yet, as in the past, the Army's strengths and ability to overcome these challenges will be found in the wisdom and strategic vision of its leadership and the innovation and dedication of its soldiers.

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Creating the Army of 2035 for All Levels of Warfare

Lieutenant Colonel Christopher Nemeth, USAF

Abraham Lincoln is said to have mused, "The best way to predict the future is to create it."[1] The global arena is akin to 4-dimensional chess with the complexities of geopolitics playing at the forefront and increased technology proliferation acting as an enabler to whoever chooses to use it. The era of technology exclusivity for the United States and its allies is drawing to a close. With technology advancement in an increasingly interconnected world, applying resources in the proper areas is critical to ensure continued global influence. The U.S. Army in particular has placed the majority of its resources against readiness for today's fight; glaring gaps in modernization are the result. Investments must be deliberately made at each level of warfare to maintain pace with near peer competitors.

Before examining the Army of 2035, it is useful to draw insights from the recent past. The U.S. Air Force's RQ-1 Predator unmanned aerial system (UAS) came into the limelight in 1999 during the Kosovo War. The RQ-1 is the unarmed predecessor to today's armed MQ-1 Predator. Testing on the RQ-1 began in the early 1990s, nearly a decade earlier than its first operational success.[2] In 2001, shortly after the September 11th attacks on the United States, the first armed MQ-1 Predator successfully employed hellfire missiles from half a world away via remote split operations.[3] Fast forward to 2017, the

1. Paul B. Brown, "The Best Way to Predict the Future," August, 29, 2014, https://www.inc.com/paul-b-brown/the-best-way-to-predict-the-future.html (accessed May 13, 2017)

2. John D. Blom, *Unmanned Aerial Systems: A Historical Perspective* (Fort Leavenworth, KS: Combat Studies Institute Press, 2010), 92-93.

3. Ibid., 107-108.

Predator has given way to a family of highly capable UASs such as the MQ-9 Reapers, MQ-1C Grey Eagles, and RQ-4 Global Hawks. The improvement in UAS technology helped evolve U.S. military operations, and even changed political calculus at the strategic level. To further this illustration, the first MQ-9 Reaper went from concept in 2003 to operational use in 2007.[4] This example is analogous to the timeframe from now until 2035. It is likely that different branches of technology may evolve in the next 18 years, just as the Predator went from first testing to operationally firing hellfire missiles in less than a decade. The timeline was further compressed once the technology matured; only four years were needed for the next evolutionary branch in UAS advancement.

The convergence of capabilities and technologies make it paramount to address all levels of warfare, from the tactical commander to the strategic leader. Tactically, battlefield commanders in 2035 must be aware of the battlespace like never before. This isn't simply Blue Force Tracker, which displays physical locations of friendly forces. It must include, cyber and electronic warfare signatures and footprints. Troops at the tactical level must have keen awareness of their electronic signatures. As General Mark Milley, Chief of Staff of the Army, points out: "This type of battlefield will place a very high premium on independent, relatively small formations that are highly lethal and linked to very long-range precision fires."[5]

Soldiers must be adept at connected and disconnected operations. They must also be skillful at operating seamlessly whether fully mission capable or severely degraded. Sensor to shooter timelines will be critical to battlefield success and will also be tied to campaign success. The only way this happens is through realistic training that exercises the full spectrum of capabilities throughout all domains and, as importantly, tests the ingenuity of our troops through authentic degraded scenarios. By 2035, the U.S. armed forces must take advantage of any small advantage at decisive speed. Technology will be complex and the domains connected to

4. Ibid., 109.

5. C. Todd Lopez, "Milley: Army on Cusp of Profound, Fundamental Change," October 6, 2016, https://www.army.mil/article/176231 (accessed May 14, 2017).

form a sizeable advantage to the commander who can proficiently apply multi-domain benefits.

The ability of our tactical leaders to leverage capabilities outside their direct command can only be achieved through realistic training. The United States won't win future wars in a single domain, therefore it can't train in only one. The U.S. Army must make significant investment in both augmented and virtual reality simulation. Both technologies are critical to give our soldiers an innate understanding of the complexities of the future operating environment. Virtual reality technology is immersive, placing soldiers in a completely simulated world. Augmented reality technology is imperative to train soldiers with actual equipment while being able to simulate the effects from other domains. At a minimum, the technologies must be interoperable throughout the services and interagency. Ideally, it would be interoperable multi-nationally as well. Both technologies must be leveraged throughout the domains with the main objective of training a multi-domain savvy military with an ancillary effect of demystifying the cyber and space domains.

Virtual and augmented simulation would provide realistic training to the military but cultural change must also accompany it. Our forces must train to failure. The training scenarios must be sufficiently difficult and adaptive, that may mean failure for the participants. Failure in training is far more preferable than failure in actual battle. The luxury of dominating the majority of the battlespace won't exist; the training must take a similar path and continue to test our forces to failure. In this manner, synergies and creativity can be realized.

At the operational level of war, the concern about interoperability will remain unchanged. The Army must be interoperable with the rest of the joint and multi-national community. The idea of creating and taking advantage of windows of opportunity on the future battlefield is taking shape throughout the military. The premise is that the United States won't be able to maintain supremacy in a domain in future warfare, it must take advantage of windows of opportunity toward a specific objective. The velocity and rapidity of evolving and emerging threats might only allow small temporal openings to create such opportunity.

The operational leader must have the ability to distress, saturate, and cause multiple dilemmas for the adversary. Allowing the adversary to be proactive from a defensive posture is a recipe for certain failure. The future Army must be poised to strike hard when a window is created and conversely, be prepared to take decisive action to create an opportunity for another domain. The armed forces will be inextricably joint, like never before. One service will not be self-sufficient against a peer threat. Gaps in one service must be the strengths of another.

The strength of the U.S. Army of 2035 will be offense. The threat picture against a near peer adversary will never be clearer than before the start; the U.S. Army must be able to seize the initiative and strike decisively at the beginning of a conflict to open windows of opportunity in the other domains. To strike decisively, intelligence must be predictive and anticipatory, and, as importantly, disseminated to the hands of those that need it most. Further investment in artificial intelligence is required to predict the actions of a formidable threat. Artificial Intelligence can aid the commander at the operational level as a tool that accounts for millions of variables and predicts logical outcomes of the enemy, which in turn allow for the most informed decisions possible.

At the strategic level, the leadership of the Army and our armed forces must make critical decisions now in order to create the ideal Army of 2035. Among the most pressing is a vision and focus of the future force to technology investment. Generally speaking, Department of Defense acquisition has focused on exquisite weapons systems that are outstanding at what they do, but can barely stand on their own proverbial weight because of the mountain of requirements. This practice has led to massive cost overruns, delays in schedule, and ultimately weapons systems that are good at everything but great at nothing. Technology increases in so many areas in the last two decades should enlighten an acquisition strategy focused on systems with a specific purpose. For example, this concept is commonplace with swarm technology. Many cheap, expendable, specifically designed drones work in concert with one another to achieve specific

effect. No one node can do it all, the swarm must work together for synergistic results.

Perhaps it is time to take the tactical swarm example to the macro level. Does the Army need a 90-ton Abrams? Similarly, are optionally-manned vehicles the path of the future? The armed forces current acquisition strategies suggest the answer to both questions is yes. However, if the answer to the questions becomes no, a wide array of options open up. If the requirement for optionally-manned is removed on some vehicles in favor of unmanned, they can get lighter and have far different characteristics. A good amount of weight and expense is used to design survivable and ergonomic crew space. But in the unmanned variant, if the added armor, life support, and internal situational awareness systems were removed, there are immense capabilities that may substituted in their stead. If these vehicles were designed with a specific purpose they logically would be lighter and cheaper, thus giving them a degree of expendability. Expendability is a characteristic that most battlefield commanders don't use in today's limited warfare, but may come to the forefront against a near peer military.

Getting to the future battlefield will be a problem. A capable adversary will begin contesting the Army well before the actual fighting begins and well before Army forces have deployed. Expendable aerial and ground vehicles capable of delivering situational awareness would also contribute to deception and force the enemy to react. The enemy reaction, in and of itself, may lead to a window of opportunity where advantage can be gained in one of the domains. Additionally, a percentage of capabilities throughout the armed forces will be necessary to preserve a counterpunch capability. Relatively cheap and expendable assets can serve to create multiple problems for an adversary on multiple fronts and mask our true intentions. Tactical and operational adversary missteps are likely to open opportunities for the future U.S. Army to act upon.

A major strategic obstacle that must be overcome is the large bureaucracy within the U.S. Department of Defense and Interagency. Bureaucracies tend to protect themselves – this is both a strength and a weakness. As a global superpower for over a half century,

the U.S. bureaucracies protect the armed forces from assuming too much risk. This can also have the unintended effect stifling creativity and the ability to change course in acquisition projects. Inertia in a major acquisition system may make it nearly impossible to abandon, even though it may appear that is the reasonable path. The current system also lends itself to incremental improvement of existing weapons systems rather than radical concepts and capability-based acquisition. Bureaucracies often need shocks to the system to initiate massive change and reform; the shocks tend to come in the forms of mandate from strategic leadership or, more likely from crisis.

To prepare the Army of 2035 leaders today must invest wisely at all levels of warfare. Acquisition strategy may need serious revision and leadership should seek investment in weapons systems that excel at a single purpose but work in concert with other systems. This strategy would provide sufficient numbers to achieve mass; a principle of war that has taken a backseat to precision in modern warfare. A near peer adversary will survive the first U.S. conventional strike. Congruent strategy using all domains must be utilized to ensure the United States retains a counter-punch capability.

The Future Army: What Ground Force Does the United States Need?

Colonel Eric Van Den Bosch

A Strategy for Tomorrow

There are countless governmental organizations, think tanks, and visionary profiteers that conduct extensive research and offer advice to our Senior Army Leaders on a vision of the future world – the operational environment, the threats, and our military capabilities. All of the predictions are wrong in some respect; at least their past performance has proven this in more cases than not. In their defense, each visionary appropriately caveats their prediction. They all use language to underpin their assertions as one of many possible futures. However, just because they have been wrong more often than they have been right, their work still promotes consideration of what the United States needs in a future Army. Similarly, this paper will offer a vision of what the future Army should look like. This vision will highlight tensions, as no solution is perfect, that create distinct trade-off decisions. While all aspects of the Army's Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P) should be considered, this analysis will only focus on doctrine, organizational concepts, and some key technology issues. A notional common operational environment is provided as a basis for this analysis.

Operational Environment of 2050

Underlying this analysis is the assumption that a possible future environment is predictable. One element of the operational environment in 2050 asserts a growing population will significantly increase in interconnectivity between people with similar values.

Technology will likely enable individuals to choose to connect with more people. Technology algorithms will actually help channel people into the groups with similar interests. While innocently constructed to give consumers their most favored products for commercial profit, this connectivity may result in more polarized and homogenous groups on a global scale. Cultural and political interests can also create virtual groupings on a global scale. Individuals may seek these groups and information that confirms their beliefs while avoiding dialogue with groups that have differing beliefs. These groupings empower non-state groups and impact the political environment surrounding these issues.

Armed conflicts, including cyberspace activity that results in physical conflicts, will likely surge as competition is amplified between non-state groups to achieve their own social, economic, and security interests. This conflict may also include inciting nation states to act. Law enforcement agencies will likely respond to these conflicts to identify, detain, and prosecute malicious actors, as well as diffuse potential violence between non-malicious groups. Military armed conflict will likely become limited in scope and duration due to the increased lethality and destructive power of military weapon systems.

Politicians will be required to gain additional control over national instruments of power. The informational warfare environment may outweigh the combined diplomatic, economic, and military elements of power. Diplomatic norms and resolutions will be enforced via domestic and international law enforcement agencies to maintain government legitimacy and credibility. Economic/financial, military, and intelligence elements of national power will be relatively subordinate tools to power of information. However, nation states will likely still utilize all means necessary to secure their national interests and objectives.

What Type of Army is Needed?

Nation states in 2050 may only use military options that are of extremely short duration: hours to weeks – not months and years. Political careers, which depend on popular support in a hyperactive social media environment, may no longer survive prolonged military

action – in a democracy or an autocracy. In response, the Army must be re-designed to be organizationally and operationally relevant to assemble combat power in hours, execute effectively, and disengage rapidly. In contrast, today's Army is designed to gradually build combat power to conduct sustained operations on land. If the Army does not take this likely future condition seriously, it may become irrelevant because it will not be able to respond quickly enough to overseas contingency operations. U.S. Special Operations Command (SOCOM), the Navy, the Air Force, and U.S. Cyber Operations Command (CYBERCOM), may be the only rapidly available U.S. fighting forces operating in the land domain capable of meeting these political demands. The larger Army may retain the primary mission to defend the homeland, but become irrelevant in global combat operations unless the global basing strategy is rebalanced with the national interests and required response times.

Vision of the Force of 2050

The Army in the year 2050 will break away from the traditions of the recent past to its original constitutional purpose – defend the homeland and intervene in foreign lands only for extremely vital national interests. When the United States needs to apply military power overseas, a rapidly deployable lethal force must be narrowly focused – but not 'light fighters.' Expeditionary aspects of the Future Force should be designed with the primary constraint that any active duty organizations will depart from the United States and arrive at full combat power within 72 hours anywhere in the world. Nothing else should be a greater priority. Being expeditionary will require deliberate trade-offs. Having a bigger, more lethal, and more protected weapon system may mean nothing if the force cannot arrive to the fight in time to achieve the national objectives. War will continue to become more lethal and Soldiers will still perish in combat operations. Nation States will continue to construct layered defenses to protect their sovereignty and prevent intrusions across their borders. Military readiness may become meaningless if the force does not have sufficient time remaining to respond militarily after authorization for the use of force has been made. This shortened window of opportunity may require earlier decisions and result in

less optimal decisions. Armies are designed primarily to be effective and resilient. Efficiency is less important than effectiveness when facing an existential national threat.

Ground and air based weapons platforms, should be jointly designed to deliver an effective joint force to rapidly execute major combat operations. Force modernization planning must be far sighted, due to the long acquisition timelines, or it will result in lost future capabilities. Commanders will require faster combat power projection in order to conduct operations inside the adversary's decision cycle. The current force structure labors over weight and volume limitations to arrive responsively into denied areas via increasingly limited transportation methods. Without re-imagining and re-designing how the ground force strategically deploys, the proposed vision of what force the nation needs cannot be obtained. The Air Force alone would have to double their personnel and quadruple transport aircraft to deliver the current force overseas within 72 hours.

Organization

The organizational structure of the Army of 2050 requires a command and control structure that is mobile, deployable, and responsive – not a large, immobile target for the adversary. To meet this goal, Divisions and Corps headquarters should merge into a single Operational fighting headquarters (OP HQs-2050) and provide the core of a joint mission force. This could also be an air-based multi-platform headquarters that could control groupings of (10-25) Brigade Combat Teams (BCT-2050) and Operational Fires Teams (OFTs). Each BCT-2050 will be smaller and more agile than a current brigade combat team, yet have more direct fire power from advanced technology. This may be analogous to the Navy migrating away from battleships toward smaller destroyers. Battleships were replaced by smaller, faster destroyers that are proportionally more lethal when the battleship became too expensive and too vulnerable to the smaller and less expensive torpedo boats in an asymmetric maritime fight.

The Future Force should reduce the size of a BCT – and double the number of BCTs. Long range capabilities (including rockets, missiles, counter-space, and cyberspace) should be removed from the BCT, while direct-fire capabilities (including directed energy and electronic warfare) should be enhanced to close with and kill the enemy. All operational indirect fires systems, including cyberspace operations, should be migrated to a joint Army-Air Force air-based fires platform. The OFTs should occupy the high-ground regardless of geographic and urban terrain features. Fuel and munitions resupply should be conducted in the operational rear area, as well as integrated with autonomous aerial refueling platforms to reduce some of the battlefield logistics protection challenges in contact with the enemy.

Within the BCT-2050, the basic building block should be semi-autonomous, manned-unmanned teaming (MUM-T) comprised of a human leader with an aerial surveillance swarm capable of seeing the threat in multiple spectrums; a non-lethal direct fire weapons ground platform with directed energy, air defense, and electronic warfare capabilities; and, a lethal direct fire weapons ground platform (aviation, tracked, or wheeled) to kill the threat. A platoon leader should have a group of four MUM-Ts with additional human-on-the-loop support and ground/aerial pilot, lethal gunner, and non-lethal gunner oversight. The BCT should contain twenty-five MUM-T platoons and eliminate the need for separate company and battalion formations. The BCT of the Future Force may eliminate organizational constructs that can create barriers to information exchange. This reorganization may increase actionable intelligence and collaboration between platoons to meet the BCT-2050 Commander's intent.

The BCT should also receive automatic operational level fires (land, maritime, air, space, and cyberspace) support as every MUM-T becomes a sensor for the OFTs to incorporate into the overall intelligences, surveillance, and reconnaissance (ISR) common operating picture for the ISR-Fires mission support. The BCT HQs should have two field command posts in the close area, and a third virtual command post in the operational rear. The distributed HQs

structure, along with semi-autonomous MUM-T platoons, create increased command redundancy and resiliency.

In summary, the expeditionary Future Force 2050 will be able to globally deploy an entire 2017 Corps-equivalent of combat power in hours to days to meet the requirements of the 2050 operational environment. It should have three main levels of organization. A primary Operational HQs (OP HQs 2050) will command up to 25 direct-fire BCTs and 25 aerial-based OFTs; which are significantly more mobile, responsive, and survivable to surge strike, covering, and counter-fires in support of the BCTs. The BCT should have a swarm of 25 lower-cost, more-lethal MUM-T platoons with autonomous robotic systems for ISR swarms, combined with non-lethal and lethal direct fires. Flattening the organization significantly should increase speed of information flow and responsiveness of the BCT-2050.

Doctrine

The above organizational concept matches well with the Multi-Domain Battle (MDB) concept that is emerging through collaboration between the Army and the Marine Corps. The emphasis of MDB is really about deliberately adding employment of capabilities in one domain (Land, Air, Maritime, Space, and Cyberspace) to create effects within its own domain, while also gaining advantages by employing effects that cross into the other domains. This is specifically incorporating cyberspace, electromagnetic, and space into joint operations concepts. While some argue that MDB is really just integrating joint capabilities in all domains. The counterpoint is a need to think differently about the employment of cross-domain capabilities to increase the range of options for leaders to leverage both symmetrical and asymmetrical capabilities against threat employment vulnerabilities. Revolutions in doctrine are needed from the 1980's era Air-Land Battle to adapt to a congested battlespace that is faster, more precise, and more destructive than ever before. The lumbering armored formations of today can be targeted from every domain. Speed in assembling, deciding, and acting are becoming more essential. While seemingly overused recently, the

idea of a swarm is a relevant concept for the Future Force. The swarm concept utilizes lower cost building blocks that can be rapidly massed with maneuver and surprise and then dispersed into the environment to avoid being destroyed. In a hyperactive information environment, cameras and social media may prevent systems from hiding from the adversary – in dense urban, as well as future rural, environments. Speed and maneuver through dense and constricted terrain, are essential in a future environment where the population, and therefore the threat, sees every move the BCT makes.

The Challenge

The operational environment of 2050 should have a significant increase in population that will be interconnected by technology to an exponential degree. Reviewing communications technology from 30 years ago, in the 1980's basic phone service, analog cameras, and dial-up modems provided internet access for 64 kilobit personal computers. These gave way to current handheld devices that converge those services with a million times more interconnectivity and computing capacity in a much smaller package. Many experts profess a similar convergence of services, increased computing power, and smaller sized packages will occur proportionately in the next 30 years. The Army incrementally improves its capabilities – taking advantage of improvements, but generally is averse to over-investing in high-risk, high-reward capabilities. Even when the Army does invest in certain emerging technologies, it does not sufficiently invest at a rate to realize game changing capabilities.

Arguably those who apply more exponential scale thinking will be closer to the target of the Future Force of the Army in 2050. Exponential scale thinking, for example, is taking the advances of the last 30 years and applying that level of change in the next 5-10 years, so that the capabilities in the year 2050 advances the same as our last 100-150 years, instead of only the last 30 years. Some experts, have difficultly envisioning this as little more than science fiction. Human linear thinking, combined with the U.S. Government defense appropriations and Department of Defense's bureaucratic processes, creates a relatively straight-line of future progress – at

industrial age, vice information age (or innovation age), velocity. For game-changing, revolutionary progress, the Army needs Senior Leaders who think and embrace change in exponential terms. At a minimum, if only an evolutionary incremental approach can be achieved, innovation cycles need to be greatly accelerated. Even the Defense Department's Third Offset Strategy, currently, is a technology investment methodology that is risk-adverse. In general, it spreads funding across all the science and technology efforts to see which may emerge as valuable for large scale military application in the future. We need Senior Leadership to create the change the Nation needs for the Army of the Future.

Envisioning the Army of 2030-35

Lieutenant Colonel Troy Denomy

As with the periods prior to World War I and the inter-war period between World Wars I and II, the U.S. Army is entering a period of transition and uncertainty. Much is caused by external factors, such as globalization, fiscal constraints, and a general increase of insecurity world-wide. These factors, along with the myriad of missions demanded of the Army, have placed Army leadership in an almost untenable position. Because of the time required (measured in years to decades) to develop, acquire, field, organize and train, Army leadership must establish a viable vision within the next three years for the 2030-35 Army.

Prior to describing an envisioned Army for 2030-35, the future operating environment for the Army must be established through a set of informed assumptions. Two critical assumptions emerge as the most necessary to address, the proliferation of technology and fiscal resource availability.

Because of globalization and several other lesser factors, the proliferation of technology will continue and become even more pervasive in the 2030's. Moreover the velocity of technological change will only increase. These dynamics suggest that rising powers will continue to emerge and the United States will no longer maintain the envious status as the world's most modernized and dominate military.

Another assumption that exerts enormous influence on the characteristics and capabilities of the future Army is the fiscal challenges within the United States. While recent economic growth has occurred, the fiscal crisis that is the rub of federal mandatory versus discretionary spending versus revenue, will continue. This assumption dictates that the Department of Defense will not have

unlimited resources to design the future force, much less the Army. Hard choices will be required about capabilities and force structure, balanced with readiness.

Before unveiling the 2030-35 Army, fundamental understanding regarding the role of the future Army must be conducted If the conclusion is that the Army will be asked to conducted operations and missions along the entire Range of Military Operations, then leaders must chose a baseline on which to optimize the Army. In general, the Army's first order principle and purpose is to defend the nation from existential threats. While terrorism may well remain a global threat and homeland concern, it likely is not an existential threat to the nation. Consequently, the most dangerous threat ought to be considered and planned against, a peer (or near-peer) adversary with Anti-Access, Area Denial and power projection capabilities.

The two major linchpins to adversary A2AD capabilities are their significant air defense and long range fires capabilities. These capabilities, when combined with sophisticated Intelligence, Surveillance and Reconnaissance capabilities from terrestrial, space, and electronic means, creates a formidable adversary. As the Army Chief of Staff, General Mark Milley, recently stated, in the future battlefield, if a unit is stationary for any length of time, it will be targeted and destroyed.[1] This thinking carries significant implications to the Army of 2035; it must be organized and possess necessary capabilities such as, layered protection and survivability through multiple methods, highly mobile, lethal in the close and deep fights, and capable of employing both manned and unmanned systems.

Due to the pervasive, highly precise and lethal indirect fires encountered on the 2035 battlefield, maneuver forces must be highly mobile and survivable The Brigade Combat Team (BCT) – or some variant – will likely remain the Army's cornerstone for organizing tactical maneuver forces. Within the maneuver BCTs, a Reconnaissance and Surveillance Strike Group (RSSG) – like

1. Sydney J. Freedberg Jr., "Army Races to Rebuild Short-Range Air Defense: New Lasers, Vehicles, Units," Inside Defense, February 21, 2017, http://breakingdefense.com/2017/02/army-races-to-rebuild-short-range-air-defense-new-lasers-vehicles-units/ (accessed May 24, 2017).

organization and Armored Brigade Combat Team (ABCT) should form the cornerstone of the Army's tactical formations. While there is current discussion to organize a fifteenth ABCT, in 2030-35 the Army ought to organize around eighteen ABCTs and no less than five RSSGs. Additionally, to counter future peer adversaries, both of these organizations must contain requisite organic protection, fires, and robotic mobility capabilities. The growth of these two ABCTs will come at the expense of Stryker Brigade Combat Teams (SBCTs) and, more dramatically, from Infantry Brigade Combat Teams (IBCTs). Given the fiscal challenges, modernization of these formations or their critical enablers must be the priority, starting in the FY19 President's Budget Request.

SBCTs will be still required on the future battlefield. SBCTs provide a large dismounted infantry force that is highly mobile on improved surfaces, but less so cross-country. However, the substantial dismounted infantry capability will be required to augment ABCTs, especially during urban operations. While somewhat survivable, SBCTs will be considered the *middle-weight* force and will become a critical capability to secure contested rear areas and to conduct stability operations. Therefore, the 2030-35 Army will need six to nine SBCTs.

In 2030 IBCTs are still not markedly more mobile or survivable, and therefore are a liability in a conflict against a peer adversary. While IBCTs are the easiest to deploy, they lack the mobility, survivability and lethality to provide an effective counter to peer adversaries. However, given their ease of deployment, the IBCTs in 2020-35 will be employed as rapid/initial deployers to demonstrate U.S. resolve and commitment. More importantly, IBCTs provide the Army with a force that can gain access to restrictive terrain and will augment ABCTs for urban operations. Therefore, the 2030-35 Army will require six IBCTs.

The characteristics and mission sets for the various BCT formations provide focus for materiel development. Given the ABCT's role in defeating a peer, combat vehicle modernization must be emphasized, if for no other reason that combat vehicle development and modernization generally takes more time. Unfortunately, combat

vehicle modernization has taken many missteps in the past (e.g., FCS and GCV) and has not undergone a true modernization since the 1980's. As the war winning formations for the Army, ABCT combat vehicle modernization must begin in earnest.

In 2030-35, all formations must be survivable. Formations that are not armored are at significant risk. Further, formations must be protected through both active and passive means. Fundamentally, protection capabilities attempt to get inside the enemies kill chain through an if-then logic chair: first, don't be seen; if seen, don't be hit; and if hit, survive. Examples of active protective capabilities include Indirect Fire Protection Capability (IFPC) and Active Protection Systems (APS), both of which are in various degrees of development and production today. Examples of passive protection include decoys, signature management, camouflage and armor.

Like protection, mobility is a vital capability required on the future battlefield. This capability is one of the key logic considerations behind emphasizing the RSSG and ABCT. Tracked combat platforms enjoy more mobility than wheeled platforms and can support heavier weight densities. Inhibitors to tracked vehicle mobility are largely weight-related, driven by volume under armor in order to achieve crew protection. This is a critical concern in modern combat vehicles. The tracked combat platforms of 2030-35 will achieve their survivability through enhanced protection capabilities, thereby allow modest weight reduction. Furthermore, emerging advances in metal forming and forging techniques will allow improved force protection (armor) capabilities per pound. Additionally, hybrid engines will be integrated into all combat platforms which will reduce the fuel logistical burden and provide battery recharging capability to both on, and off platform systems. The reduced logistical burden also increases the tactical and operational mobility of the formation.

Currently, the ABCT is the most lethal formation in the Army, but it must grow even more lethal to prevent a fair fight with a peer adversary. The ABCT's organic lethality, measured in both direct and indirect fires must increase substantially. Examples of direct fire lethality improvements range from "upgunning" the Bradley Family of Vehicles or its replacement (whether an existing combat vehicle

in another country's inventory or a new developmental item) with unmanned or man-accessible turrets with 30mm or 40mm cannons to a new 130mm, Anti-Tank Guided Missile (ATGM) capable, cannon on the Abrams Main Battle Tank. Additionally, the development and subsequent integration of a true fire and forget ATGM for the Bradley (or its replacement) will increase both the lethality and survivability of the ABCT. Interestingly, both Germany and Israel are exploring many of the same paths and provides the Army a possible partnering opportunity with both countries' ongoing modernization efforts.

The battlefield of 2030 will be inundated with precision indirect fire. The ABCT and RSSG must have the organic capability to not only conduct counter-fire, but also to achieve the tactical effects, whether suppressing or neutralizing enemy forces. Therefore, as Army leadership has already identified, there is a critical need for increased long range fires, such as rockets and surface to surface missiles.[2] Furthermore, to overwhelm enemy forces, hypersonic and loitering munitions must be developed and integrated at all echelons.

Today's breaching operations and attack aviation deep attack will be too contested for manned systems. In 2035, many aviation and mobility/counter-mobility tasks and organizations should become largely robotic. Manned and Unmanned Teaming is essential to increase the survivability and effectiveness for both missions. Unmanned systems (i.e., robots) will be used as breach forces on the ground and air to identify, destroy and initially penetrate tactical air defenses, thereby not exposing manned platforms to enemy pre-planned engagement areas or kill boxes.

Similarly, unmanned systems should be heavily employed in urban operations. Robots can be employed as reconnaissance, breaching, decoy and support by fire platforms. Ultimately, robots will provide augmentation ABCT, SBCT and IBCT dismounted infantry in urban areas.

2. Jen Judson, "Multi-Domain Battle Drives Army Toward New Missile," Defense News, October 4, 2016, http://www.defensenews.com/articles/multi-domain-battle-drives-army-toward-new-missile (accessed May 24, 2017).

While focused on Army formations and capabilities, any war of the future will undeniably require a joint approach. Moreover, it will take a joint effort to efficiently and effectively deploy the Army to theater. While beyond the scope of this paper, substantial analysis and resources must be applied to U.S. power projection platforms and capabilities. Likewise, the Army must continue its investment in the Army Security Force Assistance Brigades to improve partner capacity and to compete and win in Phases 0 through 2. Losing these phases makes winning Phase 3 difficult; *an ounce of prevention is worth a pound of cure*.

While the Army of 2030-35 seems impossibly far into the future, in actuality it is not. Ten to fifteen years is required to develop, acquire, field and train any future Army. With that timeframe in mind, the time to make hard decisions about what that Army ought to be is within the next three years. For the U.S. Army to defeat a peer adversary that will have access to much of the same technology, it must be highly mobile, protected, and lethal. Prioritization, more than anything else, is required to have an Army that can defeat a peer adversary fifteen years from now. Any requirement or initiative that does not achieve this purpose should be questioned and receive a lower priority.

Future Army 2035

Colonel Phillip Smallwood

Strategic leaders must understand the nature and character of modern warfare in order to assess and visualize how to influence change and prepare forces for tomorrow's fight. The objective of this paper is to visualize the United States Army in 2035 and explore the capabilities that may be fielded to the operational force. Specifically, as a result of the Defense Innovation Initiative, the institutional Army's thrust to be more innovative must result in the acceleration of technology and the development of key, essential capabilities. Army Futures Command will be evolved by 2035 and will have the potential to accelerate niche capabilities to the field over the next two decades.

Five key capability areas that show potential in 2017 must be accelerated as a result: rotary wing aviation, obscuration and vision acuity, operational energy, robotics and man unmanned teaming. These particular capabilities become the first technical offsets based on their 2017 Technology Readiness Level and their commercial application and development.

Rotary Wing Aviation

Mobility on the battlefield is a critical force multiplier. The ability to move troops, equipment and supplies continues to be a key and essential capability but in 2035 rotary wing aviation's threat continuous to be anti-air weapons and integrated air defense systems. Army aviation research and development efforts will make significant progress over the next two decades in aviation capability.

In the first decade, rotary wing aircraft will continue to be developed and refined ahead of peer nation development efforts. The Aviation Center of Excellence will make significant progress on the future

vertical lift program specifically on a heavy lift platform that can maneuver freely in the deep battlefield. By 2035, the first autonomous heavy lift rotary wing prototype will be developed and tested at the Joint Warfighting Assessment (currently the Army Warfighting Assessement). In 2030, the Initial Capabilities Document (ICD) for an autonomous rotary wing, heavy lift mobility platform is published to define a platform that can move significant quantities of supplies wherever they are needed in the deep maneuver battlefield. In 2035, the forward operating battlespace is saturated with future anti-access systems and area denial weapons that reinforce the need for a heavy lift capability to maneuver in the deep battle area undetected and remotely.

Low observable (LO) system limitations will continue to be an issue but LO performance improvements will reinforce the operational capability and its effectiveness. Such platforms will eventually enhance mobility of the operational force and their equipment. By 2035, rotary wing aviation will also make significant strides in its ability to reduce other typical signatures associated with rotary wing platforms. These improvements will improve the survivability of rotary wing assets particularly against shoulder fired threats who depend on these ques for prelaunch and targeting.

Obscuration and Visual Acuity

Obscuration on the battlefield will re-emerge as a capability to conceal operations such as breeching missions and bridge operations. The smoke generators of old used messy, 55 gallon drums of fog oil which create a logistic nightmare. By 2035, smoke generating canisters and configurable platforms will produce smoke on target for extensive time periods, as needed. In addition, robotic smoke generators will enable downwind smoke generation in non-permissible areas.

Visual acuity technology, better known as camouflage is developed by 2035 and used extensively across ground force platforms due to its tremendous performance in concealing system platforms. This technology uses a thin carbon fiber like material to create a camouflage capability that will allow a platform to change colors

based on its environment. The platform or system will act like a chameleon and adapt to their environment by blending with their surroundings. This special manmade material is applied to the entire outside of a tank or vehicle and uses a processer to emulate the surface material color of its environment, significantly improving the camouflage and survivability. This technology will significantly reduce the observation distance while the direct fire distance is extended in affect improving the targeting and acquiring fundamentals of front line platforms.

Operational Energy

Operational energy will make significant strides in development over the next 18 years specifically in the ability to generate and store energy to be used at a later time. This area of development is critical due to the high demand of energy required to power individual soldier mission command electronics and information systems. The robotic systems of 2035 will also create a significant demand of energy increasing the criticality of energy to support the operational force. The ability to produce and store energy is a focus that will be accelerated over the next 18 years by industry since industry has such a need for it in the commercial sector. This technology will be transferred to the military application as required.

Robotics and MUM-T

Robotic capabilities will be a significant part of the force in 2035 and beyond. The technology maturation of robotics will lead all other areas of development and will be accelerated by the commercial sector's Industrial Research and Development (IRAD) spending and progress. Robotic mobility, maneuver and control will be significantly enhanced and developed by 2035 as well as robotic abilities to perform detailed tedious tasks such tying a shoe or folding a piece of paper. Training and learning among robotic systems will progress by shared learning among systems that reduce the requirement for extensive programming to train robots to perform difficult tasks.

The weaponization of robotics and associated safety and policy issues will hamper the military operationalization of such

capabilities. Robotic capabilities will be developed to perform tasks under fire like breeching obstacles and assaulting machine gun nest. These capabilities will also perform logistic functions like arming, refueling and resupply. The man-unmanned teaming (MUM-T) concept of 2017 will expand significantly by 2035 and be used extensively across all platforms for all functional areas and mission sets. The robotic evolution will reinforce the MUM-T development.

Institutional Army

The institutional army will change based on the reality of budget constraints and material development concerns with requirements and development integration. In the next decade, senior leaders recognize the need for more integration between the requirements and material development communities to ensure timely and accurate system development.

A new organization within the U.S. Army's Training and Doctrine Command will emerge, called the Innovation Directorate. This organization will be led by a material developer brigadier general and staffed by acquisition professionals whose primary task in the Army Capability and Integration Center (ARCIC) is to integrate the requirements community with the material developers. The innovation directorate will also be the Army's single face to industry and the science and technology community. This organizational change in ARCIC will improve the material development efforts and lead to the technology acceleration in the categories identified in this paper. This new ARCIC Innovation Directorate will leverage the scientific industrial base to develop new concepts and capabilities that have application to both commercial and military.

The duel applications to both sectors will incentivize industry to use IRAD funding, accept the development risks while maturing technology to the appropriate level, so the Department of Defense (DoD) can adopt once the technology is ready. Once ready for DoD application, Army acquisition will cost share with industry to further develop the technology for military use and as applicable transfer any development progress back into the commercial variant. This model will be the primarily framework that accelerates robotics

development in the future and matures both the commercial and DoD markets.

Conclusion

> *No matter how clearly one thinks, it is impossible to anticipate precisely the character of future conflict. The key is to not be so far off the mark that it becomes impossible to adjust once that character is revealed.*
>
> —Sir Michael Howard, Historian[1]

Sir Howard, eloquently and precisely identifies how impracticable it is to predict precisely the future of armed conflict. What's essential is to be as close as possible to reality that minor adjustment can be made once the truth is known. Implying the character of warfare is continuously changing hence leaders must assess their strategies calibrating as information dictates. Senior leaders educated on theory and war strategy have the foundation to apply raw experience and intuition to make optimal decisions about force readiness for future warfare. In a VUCA (volatile, uncertain, complex and ambiguous) environment the key is continuous assessment of the changing nature and character of war so adaptation is minimal.

The character of war will change as technology evolves and Moore's law holds true as the pace of technology continues to accelerate. The organizational change in ARCIC adds the Innovation Directorate which provides the acquisition arm necessary to leverage industry and reduce the disparity between requirements and material development. The development model with industry to leverage their commercial IRAD and its application to military will prove successful and accelerate capabilities specifically in areas where a commercial market exists. This model will shift the risk of early research and development to industry and allow innovation and technology to drive how the future force fights in 2035.

1. Developments Concepts and Doctrine Centre (DCDC). UK. Sir Michael Howard quotes in the Ministry of Defense: Strategic Trends Program Future Character of Conflict, 2. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/ file/33685/FCOCReadactedFinalWeb.pdf .

The joint coalition force is the strength of the military in 2035 and beyond making the capability overmatch requirement the priority for military superiority on the future battlefield. Joint doctrine, tactics, techniques and procedures will be driven by technology, for example, MUM-T and robotics will dictate how remote platforms are employed and how unmanned systems reinforce manned systems and engage targets based on the enemy situation. The combination of remote, robotic, unmanned and manned platforms with visual, electromagnetic and acoustic signature reduction technology will change how the future joint, coalition force maneuvers, fires and communicates on the battlefield of 2035.

The Future Army is Uninhabited

Lieutenant Colonel Christopher Korpela, Ph.D

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

—General Mark Milley,
U.S. Army Chief of Staff

The character of war is changing. Scholars, military practitioners, and historians all echo this same sentiment. In order to prepare and adapt to the current and almost certain future complex adaptive environment, the United States Army should change the way it develops weapons systems and adopt a more expeditionary, urban-focused mindset.

First, the Army should transition away from expensive, heavy, and human-centric weapons platforms such as legacy tanks, self-propelled artillery, and fighting vehicles and move to unmanned or uninhabited systems. The weapons systems widely known as the "Big Five" (Abrams tank, Bradley fighting vehicle, Apache attack helicopter, Black Hawk utility helicopter, and Patriot air defense missile system) among others are difficult to deploy, require large amounts of maintenance and fuel, and may be out-matched in a multiple operator to one-vehicle paradigm.

Second, changes in the acquisition, research, and development cycles should allow for a more agile adoption of cutting-edge technologies that can quickly become obsolete in the current fielding process. Third, the Army should abandon large forward operating bases and logistical hubs that are extremely expensive and large fixed targets. These overseas installations are particularly vulnerable against near peer adversaries.

Lastly, there are significant challenges to unmanned systems in terms of reliability, trust, control, training, and doctrine. However, future state and non-state adversaries are currently investing in unmanned and autonomous systems with the potential for overmatch in the near term.

Adversaries

The future Army will face adversaries from both state and non-state actors that are pursuing unmanned and autonomous weapons. U.S. military forces could quickly be overcome by enemy systems that can adapt faster without human input. In future war, overwhelming intelligence gathering could require near instantaneous decision-making and effectively render current command and control mechanisms obsolete.[1] Russian development in autonomous weapons has produced, among other things, drones, tele-operated tanks, and humanoid robots.[2]

The Chinese are also rapidly pursuing drone and unmanned technologies. Low-cost, asymmetric threats by non-state actors have proven dangerous for U.S. military forces and homeland security. The proliferation of improvised explosive devices of all types in the Iraqi and Afghan theaters has demonstrated that inexpensive, commercial off-the-shelf technology and some electronics knowledge can be combined to significantly impact high tech operations. Autonomous GPS-guided and semi-autonomous unmanned aerial vehicles are changing the paradigm in their employment now and in the future.

Uninhabited

The future Army is uninhabited. Many scholars prefer to use this term rather than unmanned since there can be confusion as to the level of control by the human operator. Uninhabited means that the

1. Doug Wise, "Future Warfare Will Not Allow Meaningful Human Control," The Cipher Brief, January 15, 2017, https://www.thecipherbrief.com/article/tech/future-warfare-will-not-allow-meaningful-human-control (accessed May 21, 2017).

2. "Threat Report 2017: New Dangers and the American Tech to Beat Them," Popular Mechanics, February 6, 2017, http://www.popularmechanics.com/military/weapons/a25062/threat-report-russia-china/ (accessed May 22, 2017).

operator is still in control of the vehicle but from another displaced or distant location. In today's context, unmanned also implies a human in control as with the U.S. Air Force's remotely piloted aircraft (RPA) program (commonly referred to as drones). Both unmanned and uninhabited will be used synonymously and interchangeably. But regardless of the terminology, the physical human presence is removed from the system and opens up a much larger trade space in terms of protection, lethality, and deployability.

A future uninhabited ground combat vehicle could weigh 10 tons compared to the greater than 70 ton weight of the current main battle tank. Rather than designing around crew protection, a smaller, lightly armored unmanned tank could be developed that was nearly disposable with a focus on long-range sensing to acquire and track targets. Direct fire weapons will soon be obsolete so the lethality from the unmanned tank will be derived from its main gun, but instead from an array of non-line-of-site, loitering, and aircraft delivered munitions that could provide the same degree of lethality. For close-in protection from infantry and smaller vehicles, this system could include a small caliber cannon and machine gun as common in existing fighting vehicles. With a reduced emphasis on protection as a first principle, power plant options become broader to include electric motors which would simplify design, maintenance, and reduce signature.

The ability to deploy these systems becomes possible through airlift measured in terms of hours and days rather than months using sea-based vessels. Uninhibited platforms could include decoys to confuse adversaries, remove soldiers from direct contact in the battlefield, and more easily introduce greater autonomy to the system.

Technology-focused

The future Army embraces technology. The Army could gain insights from a comparison of the U.S. Marine Corps and the U.S. Air Force in their views of the future. The Marines are already experimenting and training with unmanned amphibious landings using a combination of robots, drones, and assault vehicles. These unmanned platforms all have human operators and include a

combination of mine/beach clearing, intelligence, surveillance, and reconnaissance (ISR) assets, and weaponized systems.

These exercises are critical for evaluating and improving tactics, techniques, and procedures (TTP), doctrine, and generating valuable lessons learned.

In contrast, the Air Force continues to develop human-centric fighters and bombers such as the infamously expensive F-35 joint strike fighter and proposed B-21 long-range bomber. An uninhabited Army must rely on technology in order for the remote operators to perform reconnaissance missions and engage enemy forces. While there is concern with lost data-links, electronic warfare, cyber-attacks, and adversarial control of U.S. unmanned systems, the advantage of proximity facilitates a better command and control relationship as compared to RPAs and similar type systems.

For example, soldiers operating an unmanned combat vehicle would remain within a terrain feature (e.g. behind a hill) or perhaps maintain line-of-sight with the platform. This proximity allows for tethered operations, directional line-of-sight links (lasers), and radio communications using high-gain, spread spectrum directional non-line-of-sight waveforms. While autonomy will assist with human operators, the Army in 20 years will most likely involve soldiers performing similar tasks as they do now but from remote locations. In an effort not to overpromise, this author believes that soldiers will still maintain positive control over weapons engagement in 2035.

Expeditionary

The future Army is expeditionary. The potential increased global reach of smaller, less expensive, unmanned assets provides a way reduce large footprints of soldiers and bases across the world. Not only do expansive logistical hubs and networks prove to be easy targets, they are also extremely expensive to maintain. In an era of fiscal constraint (which will likely continue for the foreseeable future), the United States simply cannot afford to maintain a forward posture all over the globe. In the face of a near peer competitor, fixed basing will not be possible.

The U.S. Army should adopt an expeditionary mindset where combat power is projected from the homeland and not from forward operating bases in conflict zones or permanent overseas stations. Future warfare may require constant movement in order to prevent detection and all domains may be contested.

A Division Readiness Brigade model could be maintained to provide an immediate response anywhere at any time in the world. These future Brigade Combat Teams (BCT) could consist of non-mechanized infantry with small robotic assets providing reconnaissance, load-bearing, targeting, and lethal force as needed. The goal would be to have the same lethality of an armored brigade but the deployability of a light infantry team. Non-line-of-sight munitions capable of launching from a wide variety of platforms could provide the needed lethality to defeat armored adversaries. The support tail of this light BCT would be much shorter than an armored or mechanized infantry equivalent.

Further, this unit would be able to maneuver in open rural conflict zones or congested and cluttered urban environments. Large, armored formations are quickly becoming relics of the Cold War that will no longer have a place in the future operating construct. An expeditionary approach reduces overseas footprints and mandates a smaller, more agile force capable of global reach from home.

Urban

The future Army is urban. Future warfare will include operations that occur in large, densely populated, costal megacities. Over half of the world's population currently resides in urban areas and that percentage will likely increase drastically over the next 25 years. In recent remarks at the Association of the U.S. Army, General Milley stated:

> *In the future, I can say with very high degrees of confidence, the American Army is probably going to be fighting in urban areas….We need to man, organize, train and equip the force for operations in urban areas, highly dense urban areas,*

and that's a different construct. We're not organized like that right now.[3]

With the current focus on maneuver and fires in open terrain, the military will need to continue to shift to smaller, adaptable units that are distributed across the battlefield and able to operate in narrow, urban corridors. These types of challenges are currently in the draft proposal of the Multi-Domain Battle doctrine. Current BCTs do not have the requisite composition to maneuver in a megacity. However, an uninhabited approach of smaller, faster, disposable, and precisely lethal weapons and ISR systems could offer the ability for small, distributed units to effectively operate in these vast, chaotic, urban areas.

Challenges

Uninhabited and eventually autonomous weapons systems offer potential advantages in future warfare but also present many legal and ethical challenges in addition to the inherent risk in turning over decision-making to machines. The level of risk for emerging technologies and probability of unexpected or errant behavior is perhaps the greatest concern such as collateral damage or the inability to control an autonomous weapons system once enabled. Friendly and adversary autonomous agents in close proximity could quickly escalate a conflict without a human involved in the decision.

Despite the challenges, the Army should adopt an uninhabited mindset with soldiers in control of lethal decision making. This change would largely be seen in the movement away from the single, exquisite weapons platforms to those that are small, cheap, unmanned, expendable, and fast. Unmanned systems can trade reduce survivability for increased lethality and deployability. An uninhabited approach could lead to reduced costs and potentially avoid extensive research, development, and long acquisition cycles as with current weapons platforms.

3. Michelle Tan, "Army Chief: Soldiers Must be Ready to Fight in 'Megacities'," Defense News, October 5, 2016, http://www.defensenews.com/articles/army-chief-soldiers-must-be-ready-to-fight-in-megacities (accessed May 21, 2017).

The Army of 2035: Going Low Tech in a High Tech World

Mr. Mark Hamilton

The world has enjoyed over seventy years without a major superpower war. However, factors may challenge this limited peace. Climate change will continue to have significant implications for regional and world stability. Access to clean water is increasingly becoming a friction point. Prime food production belts may disappear or shift across national borders towards the poles as the global temperature rises. Forty percent of the world's population living within 100 kilometers of the coastline may become displaced due to rising oceans.[1] Acidification of the oceans and lack of clean water for aquaculture threaten vital food sources. In 2016, "fish provided more than 3.1 billion people with almost 20 percent of their average per capita intake of animal protein."[2] These environment impacts associated with climate change will be amplified by the resource demands from a population that will be close to 9 billion by 2035.[3] The rise of China and a revanchist Russia will challenge the current world order of U.S. hegemony. These factors lead to an increased possibility that the United States will face a peer nation on the battlefield in the future. What kind of Army should the United States have to fight peer nations in 2035?

1. Marc Levy, "Percentage of Total Population Living in Coastal Areas," http://sedac.ciesin.columbia.edu/es/papers/Coastal_Zone_Pop_Method.pdf (accessed May 18, 2017).

2. Food and Agriculture Organization of the United Nations, The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all (Rome: Food and Agriculture Organization, 2016), 71, http://www.fao.org/3/a-i5555e.pdf (accessed May 18, 2017).

3. Worldometers, "World Population: Past, Present, and Future," http://www.worldometers.info/world-population/ (accessed May 18, 2017).

Over the past two decades, the U.S. Army and indeed the whole of the Department of Defense (DoD), has focused resources and attention on counterterrorism, Iraq, and Afghanistan. At the same time, Russia and China have been modernizing their militaries and closing the U.S. military's technological edge. In effort to once again achieve military overmatch, the DoD is investing in technologies to include "robotics, autonomous operating guidance and control systems, visualization, biotechnology, miniaturization, advanced computing and big data, and additive manufacturing like 3D printing."[4] These advanced technologies will influence and shape all aspects of the DoD. Doctrine, organization, training, materiel, leadership and education, personnel, facilities and policy (DOTMLPF-P) may all need to be modified to accommodate these advanced technologies. Soldiers of all ranks will become increasingly reliant upon those technologies much like they currently rely on the U.S. Global Positioning System (GPS) and digital maps to find their way on the battlefield.

The challenge arises because U.S. adversaries understand that reliance on technology is both a source of U.S. strength and a vulnerability. Today, the Russian military has significant electronic warfare (EW) systems such as the Krasukha-4 and the Pole-21, which can jam radars, aircraft, and GPS.[5] China and Russia both have very advanced offensive cyber capabilities that could disrupt or degrade the U.S. military's effectiveness on the battlefield. The dichotomy of technological emersion of the future warriors and the high potential for operating in a degraded and "manual" environment may have dire consequences for the Army of 2035. One way in which the

4. Robert O. Work, "The Third U.S. Offset Strategy and its Implications for Partners and Allies," Willard Hotel, Washington, DC, January 28, 2015, http://www.defense.gov/News/Speeches/Speech-View/Article/606641/the-third-us-offset-strategy-and-its-implications-for-partners-and-allies (accessed September 18, 2016).

5. Paul McLeary, "Russia is Winning the Electronic War," Foreign Policy, October 21, 2015, http://foreignpolicy.com/2015/10/21/russia-winning-the-electronic-war/ (accessed May 21, 2017): Army Recognition, "Pole-21 electronic countermeasures system to enter in service with Russian armed forces," http://www.armyrecognition.com/october_2016_global_defense_security_news_industry/pole-21_electronic_countermeasures_system_to_enter_in_service_with_russian_armed_forces_tass_11310161.html (accessed May 21, 2017).

Army and the other services can overcome this dichotomy is by accounting for a degraded technological environment throughout DOTMLPF-P.

The Army has started the process of preparing for a degraded environment with the publication of The U.S. Army Functional Concept for Movement and Maneuver 2020-2040, which states, "[a]dversaries will deny U.S. and allied space-based intelligence, reconnaissance, PNT capabilities…and secure satellite communications."[6] This pamphlet should drive future Army DOTMLPF-P and capabilities development to incorporate operations in a contested environment. However, DoD's fascination with the latest technological advancement and the contractors willing to support that fascination does not bode well for integration of "low-tech" options.

The U.S. military's reliance on the positioning, navigation and timing (PNT) that GPS provides cannot be overstated. The PNT provided by the GPS enables precision weapons, remotely piloted systems, and the ability to maneuver effectively. Because of this reliance across multiple systems, the DoD is developing advanced technologies to better overcome potential adversaries capabilities. In conjunction with the investments in technology, the Army should reinvigorate training in low-tech solutions such as land navigation using a lensatic compass and a map; much like the U.S. Navy is once again teaching celestial navigation using sextants.[7] While the Army still incorporates use of a lensatic compass during basic training, soldiers are not regularly required to demonstrate their proficiency once they graduate. They are much more apt to use their cellphone with an integrated digital compass or the latest land navigation app to find their way than to use their lensatic compass and a paper map.

6. U.S. Department of the Army, The U.S. Army Functional Concept for Movement and Maneuver 2020-2040, TRADOC Pamphlet 525-3-6 (Washington, DC: U.S. Department of the Army, February 2017), 11, http://www.tradoc.army.mil/tpubs/pams/tp525-3-6.pdf (accessed May 21, 2017).

7. Geoff Brumfiel, "U.S. Navy Brings Back Navigation By The Starts For Officers," National Public Radio, February 22, 2016, http://www.npr.org/2016/02/22/467210492/u-s-navy-brings-back-navigation-by-the-stars-for-officers (accessed May 22, 2017).

Some solutions that the Army of 2035 should develop in order to fight in a contested environment might not be technical in nature but doctrinal. Over the past twenty years, communication capability has significantly improved and has enabled a high degree of synchronization, command, and control. It has also enabled intelligence, surveillance, and reconnaissance (ISR) information to be collected and distributed in near real time throughout the battlefield. Current warfighting tactics, techniques, and procedures (TTPs) rely on this nearly ubiquitous communication architecture. Preparing to fight a near peer requires that the U.S. Army and the other services reexamine their TTPs to account for degraded communications and ISR. With degraded communications and ISR, units will have to operate with a higher level of autonomy in an uncertain environment. Operational orders and mission command will need to enable this higher level of autonomy. Current Army doctrine on Mission Command supports this concept.

> *An effective approach to mission command must be comprehensive, without being rigid. Military operations are affected by human interactions and as a whole defy orderly, efficient, and precise control. People are the basis of all military organizations. Commanders understand that some decisions must be made quickly and are better made at the point of action. Mission command concentrates on the objectives of an operation, not how to achieve it.*[8]

In reality, operational orders can be overly detailed and viewed as restrictive in nature. Excessively complex operational orders runs counter to current doctrine and do not provide the flexibility that mission command will require in a contested environment with degraded communications and limited ISR.

While remotely piloted and autonomous systems will be more prevalent in the Army of the future, soldiers in the battlefield will still be the key for achieving a decisive victory. Those future soldiers will need to have the cognitive flexibility to both rely on and accept

8. U.S. Department of the Army, Mission Command, Army Doctrine Reference Publication 6-0 (Washington, DC: U.S. Department of the Army, May 12, 2012), 1-2, https://fas.org/irp/doddir/army/adrp6_0.pdf (accessed May 21, 2017).

increasing amounts of interconnectedness and advanced technology while maintaining the ability to succeed when the adversary degrades or denies use of that technology. It is generally accepted that the Digital Natives of today will excel at functioning in a much more technologically dependent Army of the future.[9] The issue will be to ensure that the future solders will be able to accomplish their mission without their technology. Critical to this will be the required training and maintenance of those perishable skills. As the old axiom states, "you need to train like you fight." The Army will need to reinforce operating in a degraded at their training centers. While this has started to occur, there are still some concerns and issues.

One of the most significant issues is that the training necessary to practice in a degraded environment adds to an impossible training schedule. A 2015 study found that there was "nearly 20 months of annual mandatory training crammed into a 12-month calendar year."[10] While future systems may need less training to operate them individually, the complexity in synchronizing effects may increase the required training, and operating in a degraded environment will certainly increase the need for training. For both the current force and the force of the future, the Army should review its internally imposed training requirements and work with Congress to reduce the mandated annual training requirements imposed on DoD. The quantity of mandatory training not only affects the time available for training but the amount of required resources to fund the training.

The U.S. Army should be prepared to fight an adversary that can degrade or deny the critical technology that the Army relies upon. In the future, this will become more important as the likelihood of conflict with a peer nation may increase and the Army's reliance on

9. Digital Natives "have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age." See Marc Prensky, "Digital Natives, Digital Immigrants," On the Horizon 9, no. 5 (October 2001): 1, http://www.marcprensky.com/writing/Prensky - Digital Natives, Digital Immigrants - Part1.pdf (accessed May 22, 2017).

10. Crispin J. Burke, "No Time, Literally, For All Requirements," April 04, 2016, linked from the Association of the United States Army web site, https://www.ausa.org/articles/no-time-literally-all-requirements (accessed May 22, 2017).

technology will only increase. This will require the Army to ensure that its DOTMLPF-P simultaneously supports the technological capabilities of the future and ensure operational effectiveness when those technologies are not available.

The Virtues of a Semi-Autonomous Army

Lieutenant Colonel Charles B. Cain, USAF

By 2035, the U.S. Army must solve the conundrum of rising personnel costs, declining readiness, and adversaries which can act to achieve their political goals well before a U.S. based land force can mobilize and deploy to counter them. One way to do this is to transform into a more semi-autonomous army.

A semi-autonomous army is not a robot army, but instead one in which a single soldier can direct multiple platforms. Those platforms will have narrow artificial intelligence that, under human direction, will allow them to perform basic tasks without direct human guidance. For example, a soldier would remotely task a vehicle, or group of vehicles to move from point A to point B and those vehicles would notify the soldier if it were to see any enemy troops or other intelligence or information requirements along the way. Similarly, a semi-autonomous tank platform would have image and signature recognition algorithms that, while traveling over a planned route, would allow it to positively identify a certain type of vehicle, notify the soldier, request permission to engage, and then engage that target.

The central idea is that the soldier will be relieved of the hands-on tasks associated with operating an individual vehicle or weapon. The soldier will be free to focus on directing the mission through multiple semi-autonomous vehicles. Once given a task, those vehicles will only require the soldier's permission or guidance during specified events or phases of the mission or if they encounter a situation not accounted for in the plan.

There are three main virtues of this semi-autonomous army. First, an army can be smaller both in terms of numbers of soldiers and size of equipment without sacrificing combat power. Second, it

enables a new readiness paradigm, where, through a combination of live and virtual training environments, an army can improve readiness at a lower cost and embed readiness in the programming of semi-autonomous platforms. Finally, because the vehicle can be unmanned, they can be lighter, more compact, and more energy efficient. This lets an army deploy more force faster with fewer logistics requirements and get to a theater in time to matter. This is especially important to be a credible deterrent against near-peer competitors who have an advantage of operating near their home territories and the ability to contest a large traditional deployment.

Still, a semi-autonomous army takes nothing away from the individual soldier. In fact, it makes individual soldiers more important than ever, as it multiplies their combat effectiveness, enables more frequent, in-depth training and higher readiness. It also enables soldiers to get to the fight faster and achieve a position of strength, less exposed to enemy fires, and before an enemy has had time to form a deliberate defense.

A semi-autonomous army is built on a system of man and machine teams. In this system, soldiers focus on the tasks that soldiers do best, like quickly assimilate complex information to form a plan, define objectives, take calculated risks, and then rapidly adjust those elements as the situation develops. The semi-autonomous machines will focus on the tasks they can do best, namely the dull and dangerous work that an army must do to move and maneuver in order to close and destroy an enemy.[1] They will have sufficient capabilities to sense and avoid obstacles, see and engage designated targets with high precision, and then quickly move to cover or concealment.

Since these semi-autonomous machines only need task direction, not direct employment, soldiers can task multiple machines at once, then ensure that those machines are following their direction. Depending on the complexity of the operation, as few as six soldiers,

1. U.S. Army Training and Doctrine Command (TRADOC), Pamphlet 525-3-6, The U.S. Army Functional Concept for Movement and Maneuver, 2020-2040, February 2017, 7, www.tradoc.army.mil/tpubs/pams/tp525-3-6.pdf (accessed May 18, 2017).

positioned either remotely or from a local command vehicle, could operate the equivalent of up to a 14-tank company.[2] Two would operate the company's semi-autonomous tanks, two would evaluate intelligence, surveillance, and reconnaissance information while supporting communications and coordination with higher echelons, and two would be ready to serve in relief.

This ten-fold reduction may be less dramatic in infantry, support, or headquarters units, but there could be similar personnel reductions through automation. For example, a semi-autonomous logistics convoy could operate with far fewer soldiers, less security, and much less risk to those soldiers as they need not be physically present in the convoy. A rifle company would move through an urban area in smaller, more dispersed groups, augmented by semi-autonomous systems that carry their gear, provide precise covering fire, detect and engage snipers, defend against mortars and rockets, and lead the way in dangerous situations like urban breaching operations. These same systems would stand guard during rest periods, reducing the number of soldiers required to provide security.

As before, the soldier would focus on the thinking and planning tasks humans do best, while the machine would do the dull or dangerous tasks they are suited for. Besides multiplying the combat effectiveness of an individual soldier, fewer soldiers require few recurring personnel costs. They also cost less to keep ready. Conversely, the training soldiers receive will be better as their tasks could be realistically replicated in a combination of live and virtual training environments.

It is difficult to simulate hands-on infantry or armored vehicle tasks in a realistic manner. Live-fire exercises like those at the National Training Center (NTC) are best, but they are also expensive. However, if the focus of a soldier's training could shift from the hands-on task of operating a machine or weapon to cognitive tasks like understanding a situation and commanding semi-autonomous machines to achieve desired objectives, soldiers could

2. Congressional Budget Office, The U.S. Military's Force Structure: A Primer, July 29, 2016, 24, https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51535-fsprimer.pdf (accessed May 18, 2017).

realistically train for those cognitive tasks in a virtual environment. That environment could consist of other soldiers distributively. commanding groups of semi-autonomous vehicles together in a virtual environment against a virtual enemy. Instead of going to the NTC or to reduce the time spent at NTC, the brigade could train at home station using simulators. For armored units, it could be much like an aircraft simulator, with full motion immersive video, and operating from the same command consoles they will deploy with, in order to practice employing their semi-autonomous machine formations in multiple combat situations. For infantry, it could involve virtual reality headsets with semi-autonomous vehicle controllers as part of a massively multiplayer training environment. With these tools, soldiers could quickly explore multiple iterations of the same problem by employing those forces in various terrain, weather conditions, and acting as part of a larger force or working independently in a denied communications environment.

The soldier's training task would be to learn how to work with and employ their semi-autonomous machines. The machines would also be learning, through self-taught, deep reinforcement learning artificial neural network. But this learning would be exponential. Once one machine learns something useful, it would share it across the machine force. Whereas each soldier needs to be taught a task individually, and periodically train for that task, a machine only needs to learn once. What it learns would be shared with other machines – and after that they never forget. This concept of constant machine improvement and embedded readiness is a key virtue of a semi-autonomous army. Semi-autonomous systems that could achieve embedded readiness turn the initial technology investment into future readiness, without the recurring cost. Just as importance as readiness, being able to deploy a large force to a theater in time to affect the decision making of a potential adversary is necessary for that force to serve as a deterrent and to achieve national objectives should deterrence fail. A virtue of a semi-autonomous army is that it can do that, in ways that are not possible today.

A semi-autonomous army would be a more compact army that has a smaller logistics footprint. Since unmanned vehicles do not need to

have space for a crew, they would be smaller. In turn, they could be lighter, because they have less volume to protect. This would allow them to be faster and more fuel efficient, making them harder to target and able to operate independently for longer. Being lighter and more compact, more vehicles could fit on an aircraft or in pre-positioned stock. For example, if a semi-autonomous tank-equivalent vehicle weighed only 10 tons, seven could fit on a C-17, instead of just one M1A2 Abrams tank.[3]

At that size, an entire armor company of 14 tank-equivalent vehicles, a command vehicle, ammunition, fuel, and supplies could fit on three C-17s with room to spare. Extrapolating to an entire Armored Brigade Combat Team, the number of C-17 sorties to airlift that unit could be reduced from 420 over 23 days to 60 over four days (assuming one-seventh the size and a commensurate reduction in volume).[4] 60 sorties and four days makes airlifting an armored force in a short period of time a much more credible threat than 420 sorties and 23 days. At one-seventh the weight, additional transportation options would become available. These more compact unmanned vehicles could be stored in inter-modal shipping containers that could discretely cross-load directly from ship to truck, rail, or river barge.[5] They could semi-autonomously self-deploy because they are light enough to travel over existing roads, bridges, and tunnels. The speed of deployment across multiple transportation modes would complicate an adversary's efforts to contest that deployment and make the land component a much more credible deterrent force.

Existing pre-positioned stock locations could also hold a greater number of vehicles in a combat-ready configuration. Similarly, smaller and less visible pre-positioned stock locations could be stationed close to areas of possible use.

3. U.S. Air Force Fact Sheet, "C-17 Globemaster III," http://www.af.mil/About-Us/Fact-Sheets/Display/Article/104523/c-17-globemaster-iii/, (accessed May 18, 2017).

4. Congressional Budget Office, The Army's Future Combat Systems Program and Alternatives, August 1, 2006, 35-36, https://www.cbo.gov/sites/default/files/109th-congress-2005-2006/reports/08-02-army.pdf, (accessed May 18, 2017).

5. Container Solutions, "Shipping Container Specification," http://containersolutions.net/specifications/ (accessed May 22, 2017).

A critical weakness of a semi-autonomous army would be the need for communications with the soldiers commanding the vehicles. The key to overcoming this would be multi-layered, redundant, jam-resistant lines of communication with robust lost-link procedures. This could be achieved through line-of-sight directed energy communications using lasers or microwaves, balloons or unmanned aerial vehicles carrying relay nodes to extend that direct line-of-sight, or through satellite capabilities.

Still, semi-autonomous machines would not necessarily require constant communication. They would be directed, but not driven by soldiers. Given an objective and a plan, they could achieve it semi-autonomously following a set of rules of engagement, perhaps only querying their soldier commanders if something were not going according to the plan. This would be mission command for a man-machine team. The rules of engagement and constraints on this semi-autonomous action should match the sophistication of situational awareness and target discrimination the machines could demonstrate.

The private sector is developing this type of technology today. Semi-autonomous truck shipping is advancing rapidly, and the task-oriented, narrow artificial intelligence that drives these systems is showing great promise.[6] By working with the private sector to adapt these methods to military applications and adjust them for contested electromagnetic environments, this technology could be ready in time to transition the army from a force focused on the only soldiers to a force focused on what soldier and machines can do together.

The way to field these capabilities is not to wait until the technology is completely mature. The best approach is to experiment – determine what works and what doesn't, not just in terms of technology, but also in terms of organization, doctrine, and synchronization of joint fires. Use stand-in placeholder platforms where technology isn't

6. Mike Isaac, "Self-Driving Truck's First Mission: A 120-Mile Beer Run," The New York Times, October 25, 2016, https://www.nytimes.com/2016/10/26/technology/self-driving-trucks-first-mission-a-beer-run.html; Joon Ian Wong, "A fleet of trucks just drove themselves across Europe," April 6, 2016, https://qz.com/656104/a-fleet-of-trucks-just-drove-themselves-across-europe/ (accessed May 20, 2017).

ready, then replace the placeholders as technology development permits. Focus on building the organization and doctrine alongside an upgradeable technology platform and eco-system. Get the equivalent of the iPhone 1 or Tesla Roadster in the hands of soldiers now so they experiment and help innovate and iterate to get to the iPhone 8 or Tesla Model 3. The current efforts by the Defense Advanced Research Projects Agency (DARPA) and the U.S. Army Research, Development and Engineering Command (RDECOM) are on the right track, but they need funding priority.[7] If Army leadership can agree that a semi-autonomous army is a prospective solution to the personnel costs, readiness, and deployment timelines issues of today, they should fund research and development, along with concept experimentation to enable a rapid transition to that future.

Between now and 2035, the U.S. Army has the time to solve the conundrum of rising personnel costs, declining readiness, and the time-distance-mass problem of adversaries that can act before a U.S.-based land force can deploy to counter them. The virtues of a semi-autonomous army point to an organization, training, and technology concept that could solve this problem. It would allow an army to be smaller both in terms of numbers of soldiers and size of equipment without sacrificing combat power. Then, through live and virtual training it could improve readiness at a lower cost. Finally, with lighter and smaller platforms, it could deploy more force faster with fewer logistics requirements and get to a theater in time to matter. The rewards of a semi-autonomous army outweigh the risks and represent a credible path forward to solve U.S. Army funding, readiness, and mobility issues without reducing U.S. Army capabilities or U.S. land power.

7. Dr. Timothy H. Chung, Defense Advanced Research Projects Agency (DARPA), "OFFensive Swarm-Enabled Tactics (OFFSET)" briefing slides, January 30, 2017, www.darpa.mil/attachments/OFFSET_ProposersDay.pdf (accessed May 22, 2017); Robert W. Sadowski, U.S. Army Research, Development and Engineering Command (RDECOM) Robotics Community of Practice, "Enabling MUM-T within Army Formations," briefing slides, Jan 30, 2016, www.darpa.mil/attachments/DARPA_MUMT_Updates.pdf (accessed May 20, 2017).

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Nuclear Misconceptions: Correcting the Record for the Army of the Future

Colonel Adam Walton

Ronald Reagan once famously said: "The trouble with our liberal friends is not that they are ignorant, but that they know so much that isn't so." In many ways, this reflects the Army's views on nuclear warfare. Unwitting victims of our national experience, our organization has developed a collective misunderstanding regarding the use and realities of nuclear weapons. There are three conditions that predicate this ignorance. The first two are fundamental assumptions that frame the nuclear problem. The first assumption is that our nuclear adversaries, peer or emerging, can be deterred and defeated through conventional means alone. The second flawed assumption is that any nuclear use will open a Pandora's Box resulting in an unlimited nuclear exchange culminating in a state of mutually assured destruction (MAD). The third condition is a lack of understanding that arises from the aggregation of threats and clutters our understanding of nuclear effects and the realities of a nuclear battlefield. While a nuclear battlefield is not an absolute certainty, the likelihood of nuclear weapons use in the future is much greater than today. This record must be corrected if we seek to develop a resilient Army capable of victory on the battlefield of the future.

The urgency to correct this record can be found in context of the 2016 National Military Strategy. This strategy identifies five enduring mission areas that constitute the intellectual framework of how the joint force is to be employed to address challenges both now and into the future. One of those mission areas is to deter the use of weapons of mass destruction (WMD). The Director of the J-5, Joint Staff has specifically described this as the requirement for the joint force to deter by maintaining the ability "to operate

pre-nuclear, trans-nuclear and post-nuclear and have success in that environment should we be required to do so."[1] We can think of pre-nuclear as those tasks required to maintain a credible deterrent and a demonstrated willingness to employ it if needed. Trans-nuclear tasks are those that ensure the survivability and continued effectiveness of both our conventional and nuclear assets. Post-nuclear operations include both the demonstrated ability and willingness to employ forces after such an event in order to deny the enemy's objective. Thus, preparedness itself constitutes a credible deterrent to a nuclear threat and may dissuade an adversary's development and employment of such a capability. The elimination of tactical nuclear weapons from the Army mission set in the 1990's has lulled it into a sense of complacency with regards to operations in a nuclear environment. The Army's current approach to WMD focuses more on consequence management operations than on generating a resilient and nuclear capable combat force. In order to contribute as an effective member of the joint force, specifically in the post-nuclear arena, the Army needs to address this issue and the misconceptions which are based upon flawed assumptions regarding nuclear warfare that are pervasive throughout the organization.

The first flawed assumption is that our nuclear adversaries, peer or emerging, can be deterred and defeated through conventional means alone. This assumption allows us to wish away the nuclear problem by attributing our rational on the enemy – "if we don't use nukes, they won't use nukes." This fundamentally ignores the role that nuclear weapons play in the doctrine of our adversaries. The role nuclear weapons play in the strategy of our near peer competitors is unlikely to decrease in the near future. Despite U.S. efforts to decrease the role of nuclear weapons in its foreign policy, Russia sees its nuclear arsenal as central to retention of its power, prestige, and influence in the world.[2] Over the past 20 years Russian nuclear

1. Kenneth F. McKenzie, U.S. Marine Corps, Director, Strategic Plans & Policy, J5, "Army Strategy Conference," presentation (U.S. Army War College, Carlisle Barracks, PA, April 26, 2017) https://www.youtube.com/watch?v=1li-uaYzLrI&index=5&list=PLYtGRVo8O_W0PtoXYCSyynSyA0UtfOmRq (accessed May 7, 2017).

2. Daniel Goure, "Moscow's Visions of Future War: So Many Conflict Scenarios So Little Time, Money and Forces," The Journal of Slavic Military Studies 27, no.

use doctrine has shifted from exclusively that as a deterrent in global and regional conflict against nuclear armed opponents to applications of tactical nuclear munitions in small conflicts, including local wars, against potentially non-nuclear opponents, including terrorism.[3] Further, the use of tactical nuclear weapons is seen as the primary and only means to counterbalance U.S. advantages in conventional capabilities gained by stealth and precision munition technologies.[4] Russian objections to U.S. sponsored missile defense capabilities in Eastern Europe are based largely on the fact that these would erode the effectiveness of the critical balance they attempt to achieve with tactical nuclear weapons.[5]

Much less is understood about China's nuclear intent and aspirations. Despite having much smaller nuclear arsenals than either Russia or the U.S., the actual size of China's nuclear arsenal is in debate. Most analysts infer that China maintains a stockpile of up to 300 warheads, however, some assess that the number may be nearly six times greater due, in part, to estimated production quantities of uranium and plutonium.[6] These assessments are further obscured by China's construction of nearly 3000 miles of tunnels used to protect and conceal its nuclear arsenal.[7] China openly claims a no-first-use policy; however, it has repeatedly indicated that it would consider use of nuclear weapons in the event of U.S. conventional intervention in a conflict with the breakaway province of Taiwan.[8] In this scenario, China espouses a policy of escalation with regard to regional conflicts that is similar to Russia's.

Aside from the role these weapons play in the near peer competitor strategies, there is an increased likelihood emerging adversaries will

1 (March 10, 2014): 75.

3. Marcel Van Herpen, "Russia's Embrace of Tactical Nuclear Weapons: Its Negative Impact on U.S. Proposals for Nuclear Arms Reductions," Cicero Foundation Great Debate Paper, no. 11/04 (September 2011): 15-16.

4. Goure, "Moscow's Visions of Future War," 81-82.

5. Ibid., 81-84.

6. Henry D. Sokolski, *Underestimated: Our Not So Peaceful Nuclear Future* (Carlisle Barracks, PA: Strategic Studies Institute and U.S. Army War College Press, January 2016) 44-45.

7. Ibid., 47.

8. Ibid., 45-46.

turn to nuclear weapons capabilities. Increased global concerns over the impact of fossil fuels and climate change will most likely lead to an increase in demand for nuclear power capabilities. This shift is desirable not only for economic reasons, but also for political status and prestige.[9] Countries with declared intent to develop nuclear power programs by 2035 include Saudi Arabia, United Arab Emirates, Jordan, Turkey, Algeria, and Egypt.[10] The widespread proliferation of peaceful nuclear power also permits the propagation of knowledge, expertise and infrastructure that are capable of supporting a nuclear weapons program as a spin-off, and presumably clandestine, industry. Efforts to contain illicit weapons development will be further complicated by the dual use nature of the technologies involved. States capable of crossing the threshold from nuclear power to nuclear arms will likely use these weapons as a deterrent to regional aggressors as well as a means to offset the various and prohibitively expensive technological advantages of the world's great powers. Regardless of U.S. intent to deter these threats in a purely conventional manner, nuclear weapons represent a relatively inexpensive and proven deterrent to U.S. aggression.

The second assumption that is pervasive in the Army's mindset is that any nuclear weapons use will open a Pandora's Box resulting in an unlimited nuclear exchange that culminates in a state of mutually assured destruction (MAD). This assumption directly follows from the Cold War, Soviet-era paradigm. However, we must consider that our contemporary adversaries and the world geopolitical situation are dramatically different today and will change into the future. We must acknowledge the possibility for limited, as opposed to unlimited, nuclear war. Gibbons and Kroenig postulate that the threat of deliberate nuclear use between nuclear capable states is increasing in the contemporary operational environment.[11] They define deliberate use as "the intentional detonation of a nuclear weapon or weapons

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

10. Sokolski, *Underestimated: Our Not So Peaceful Nuclear Future*, 60.

11. Rebecca Davis Gibbons and Matthew Kroenig, "Reconceptualizing Nuclear Risks: Bringing Deliberate Nuclear Use Back In," *Comparative Strategy* 35, no. 5 (December 7, 2016): 407-422.

against an enemy target or engaging in an intentional process of nuclear threat and escalation whereby a nuclear detonation against an adversary is the end result."[12] They further identify five possible scenarios where this deliberate use is possible in the contemporary geopolitical context. The first such possibility is the use of a nuclear weapon against a non-nuclear state.[13] While a seemingly unpopular prospect, it in fact is the first and only scenario in which nuclear weapons have ever been employed. The U.S. nuclear strikes against the Japanese homeland were employed, in part, to bring about an end to a protracted conventional conflict and therefore represent a possibility for future use. Additionally, both U.S. nuclear strategy and Russian military doctrine allow for the use of nuclear weapons in response to unconventional WMD by a state entity.[14] A second possibility is employment of nuclear weapons in a "splendid first strike" where a nuclear power launches a preemptive attack aimed at eliminating an adversary's nuclear capability.[15] This approach was at the crux of U.S. and Russian nuclear strategies throughout the Cold War and is generally considered an implausible approach in context of the massive nuclear arsenals maintained by each side. However, conventional approaches to eliminating fledgling nuclear programs have been employed with moderate success in the case of Israeli airstrikes against Iraq's nuclear reactor program in 1981 and Syrian reactor facilities in 2007.[16] Gibbons and Kroenig describe a third possibility for use motivated by a "use 'em' or lose 'em'" calculus.[17] In this scenario a weak or threatened nuclear state uses its arsenal to gain desired effects when facing the risk of losing its nuclear capability to a "splendid first strike" or similar threat. This scenario is contemporarily plausible in the case of North Korea

12. Ibid., 408.

13. Ibid., 409.

14. Secretary of Defense Robert M. Gates, *Nuclear Posture Review Report 2010* (Washington, DC: U.S. Department of Defense, April 2010); Russian Federation, *The Military Doctrine of the Russian Federation*, trans. Carnegie Endowment for International Peace (Washington, DC: Carnegie Endowment for International Peace, February 5, 2010, http://carnegieendowment.org/files/2010russia_military_doctrine.pdf (accessed February 14, 2017).

15. Gibbons and Kroenig, "Reconceptualizing Nuclear Risks," 410.

16. Ibid.

17. Ibid., 410-411.

where they might rightfully assume that a U.S. first strike would be oriented with that goal in mind. A fourth approach to the deliberate use of nuclear weapons is that of "nuclear brinksmanship."[18] In this case two parties engage in the escalation of a nuclear crisis where "the state that is willing to run the greatest risk of nuclear war before backing down will win the crisis as long as it does not end in catastrophe."[19] Historically, the Cuban missile crisis, and currently the juxtaposition of a nuclear armed India and Pakistan represent examples of this brinkmanship approach. A final option for deliberate use of nuclear weapons is that of engaging in a "limited nuclear war."[20] In this case of conflict between two nuclear armed states, one side engages in a nuclear strike limited in size and scope designed to demonstrate willingness to escalate the conflict. This extreme form of brinksmanship requires that the target of such a strike be of limited value to the opponent so as to create an element of disproportionality should they choose to respond. The desired end state of such an approach is to force an adversary to capitulate rather than risk further nuclear escalation and all of its consequences. These scenarios describe the possibility of multiple outcomes short of MAD.

Oversimplification to a MAD outcome has led to the mythology of universal effect. That is to say, that if all nuclear exchanges lead to MAD then all nuclear detonations are equally devastating and will produce "nuclear winter" fallout events. In reality, nuclear weapons effects are extremely scalable both from a blast and residual contamination perspective. Immediate effects (blast, burn and overpressure) can be scaled from meters to kilometers depending on the type, yield and employment of the selected warhead. Residual radiation and fallout can also be controlled by these same factors. Furthermore, these residual effects also have relatively predictable and measurable decay rates. The resulting residual radiation fields may actually be traversable or survivable within hours or days. However, the net result of this assumption is the belief that once a nuclear device has been employed that the

18. Ibid., 411.
19. Ibid.
20. Ibid., 412.

character of the conflict has fundamentally changed. In the Army mindset, we quickly walk the line of logic: 1) the conflict is now "nuclear," 2) the Army no longer employs nuclear weapons, and 3) the fight is no longer ours. The absolute nature of the MAD concept leads to a defeatist misconception that "we are all dead anyways" so why bother to consider the next stage of the conflict. We even tend reinforce this notion in our collective training events. For example, consider the frequent observation that if a WMD event is presented in a training exercise it is classically introduced as the culminating event. This further reinforces the doomsday effect in the mind of the soldier. Additionally, it fails to exercise the critical systems needed to survive and fight after such an event. As a result, our doctrine is hypothetical and unrealistic when it comes to addressing post-nuclear event warfare.

The final condition we must address as an Army is the aggregation of threats. Nuclear hazards have been traditionally grouped with other WMD, a somewhat ill-defined convention. Throughout most of the 20th century the U.S. military grouped these into Nuclear, Biological and Chemical (NBC) weapons. This grouping in the contemporary construct is now Chemical, Biological, Radiological and Nuclear (CBRN) or, depending on context, includes Explosives to form the grouping CBRNE. Aside from the relationship between nuclear events and subsequent radiation hazards, these broad categories of weapons have little in common. However, we tend to view responses and effects of these environments as identical. From a nuclear perspective consider the following misconceptions frequently voiced by soldiers. It is common belief that a nuclear detonation will create large areas of impassable terrain. In reality, nuclear effects on terrain force commanders to assume risk when maneuvering but do not necessarily render terrain impassible. There is also a belief that Mission Oriented Protective Posture (MOPP) is required for survivability in a nuclear environment. This ignores the fact that chemical defense suits offer little additional protection in a radiation environment. Additionally, there is a belief that decontamination actions are critical after encountering a nuclear hazard. In actuality decontamination operations are undertaken to either provide troops with temporary relief from MOPP or to

reconstitute a unit all together. Provided that appropriate shielding is available, there may be little urgency or need to decontaminate to maintain combat effectiveness. These examples demonstrate a basic level of confusion that is created by aggregation of threats rather that considering each hazard as its own unique challenge.

The most obvious solution these problems, and often knee jerk reaction, is to introduce new training requirements. While there is little doubt that this must be done, in the already crowded training space attempts to add more events to the plate may lead to further desensitization and misconceptions of this critical issue. Organizational solutions to disaggregate our response to bundled threats are also seemingly obvious and attractive points to attack this problem. However, the most difficult task is to unlearn the flawed assumptions that our organization and its senior leaders have been indoctrinated with over the course of their careers. Strategies to address the Army's shortcomings as part of the joint force mission to deter the use of WMD require adjustments to the underlying assumptions our leaders have regarding the use of nuclear weapons. This record must be corrected if we seek to develop a resilient Army capable of victory on the battlefield of the future.

Build a Better Communications Architecture

Colonel Adam Boyd

To act upon lines far removed from each other, and without communications, is to commit a fault which always gives birth to a second.

—Maxim XI, Napoleon Bonaparte[1]

The United States Army continues along a trend of becoming more expeditionary. As we approach the next twenty years, it is increasingly evident that the U.S. Army will be less forward-based and more reliant on the ability to forward deploy. In an expeditionary environment, the Army will depend on redundant, reliable, and interoperable communications networks and architecture for successful operations against near-peer threats.

In order to be successful in developing a communications architecture that is survivable on the battlefield of tomorrow, the U.S. Army should begin investing in the technology today. To develop this technology, the Army must appropriately define the requirements necessary to transmit data across vast distances in the operational area, even when the environment is degraded. Specifically, the Army should develop the capability for data to travel across multiple medium, using multiple routes through the electromagnetic spectrum. Failure to create redundant modes of communication will result in a larger risk to mission and risk to force.

In the future, we can expect any adversary to contest all domains, including the electro-magnetic spectrum. Given that all domains

1. David G. Chandler, *The Military Maxims of Napoleon* (New York: Macmillan Publishing Company, 1987), 59.

will be contested, it will be imperative for all echelons to be capable of operating in degraded environments. This will necessitate the ability to operate semi-independently, with little contact or access to data from higher echelons of command. Specifically, this means operating on the last orders given, executing the mission and intent of the higher command.

Reliable communications are those capabilities required to transmit data from sender to receiver, knowing that the message will arrive as sent. Since the invention of the computer, memory, processing power, and hard drive space has become more powerful and faster. Additionally, raw computing power has become less expensive. One might make the argument that programming has become less elegant, since current personal computers have greater processing power. In fact, smart phones have more computing power than the computers used by NASA to put a man on the moon. With programming becoming more bloated, data requirements continue to increase, which will, in turn, grow bandwidth requirements to send and receive data. With better programming, or at least better compression schema, bandwidth requirements can become more manageable.

The expeditionary nature of the U.S. Army of the future will require significant bandwidth requirements and processing capabilities. With the ubiquity of sensors on the battlefield, there will be a greater glut of data and information that will stretch processing capacity and capability. With continued improvements in cellular technology in the commercial space, there becomes a greater expectation that tactical communications will be able to keep pace. However, given the expected degradation of the electro-magnetic spectrum through the fully contested domains of space and cyber, we cannot expect or rely on significant bandwidth available in a theater-opening circumstance.

The U.S. Army has two potential alternatives to solve the challenge associated with bandwidth limitations: increase availability of bandwidth, or reduce the data streams. There have been many advocates over the years of creating “thin-client” computing, which is very bandwidth reliant. The future Operation Environment (OE)

requirements make thin-client computing less than ideal. In fact, with greater processing of data forward on the battlefield, it may become even more possible to reduce the data that must pass across echelons. Creating more bandwidth, while more desirable, may actually be more problematic. A possible method to ensure bandwidth might be to create a better, more redundant and survivable architecture.

Redundant communications would describe the multiple available pathways for data to travel from sender to receiver. Regardless of analog or digital, data must transmit through some physical medium, either hardline or air-gapping by messenger, or through some form of the electro-magnetic spectrum. In the simplest terms, the Army uses Primary, Alternate, Contingent, and Emergency (PACE) plans to satisfy the requirement of redundancy. However, in the future operating environment, it may be necessary to have more than a simple, PACE plan. Redundancy in a degraded communications environment will require more unique techniques for ensuring that data reaches its intended recipients.

While the concept of frequency hopping across the frequency spectrum might ensure that data remains encrypted (thus preventing an adversary from accessing the data), it is still a relatively fragile means of communication. Timing problems, radio line-of-sight issues, and electronic attack are all risks that frequency hopping data must navigate. If there was a communications architecture that transmitted the same data across multiple communications streams, the data would be more likely to arrive to its intended recipient. For example, sending targeting data simultaneously through FM communications, space-based communications, and through tactical internet simultaneously might be the best "primary" method of communications to ensure no disruptions in communications. If any single mode of communications becomes compromised, the data still arrives at the recipient through one of the other methods of communications. However, multiple, simultaneous communications pathways would increase the electronic signature for anyone transmitting data.

Another methodology for potential redundancy in communications would be the use of a land-based, peer-to-peer style communications

mesh architecture. A sufficiently developed peer-to-peer network would allow data to travel through the most efficient route to the recipient. In this architectural construct, rather than large, server-based central nodes, each system that has data processing and communications capability would share the load and burden of the communications network. This architecture would be similar to creating a neural network of computers to share the computational load of large-scale, processing-intensive calculations. If one particular node in the architecture mesh is compromised, data would simply, reroute through the next closest, most expedient node. This architecture might best serve at lower, tactical echelons, where systems, vehicles, and command posts are closer in geographical proximity. However, when coupled with simultaneous, multiple pathway communications, this communications mesh architecture could mean the difference between data lag, and near real-time situational awareness. The Enhanced Position Location Reporting System (EPLRS) could be the basis on which this mesh architecture. Although discarded for satellite-based communications such as the Joint Capabilities Release (JCR), EPLRS was a ground-based communications architecture of hardware and software that provided near real-time situational updates on the battlefield. In fact, the Air Force installed EPLRS onto some of its platforms to communicate with the Army, but was overshadowed by the adoption of JCR.

Interoperable communications will continue to be a requirement for future operations, both across the joint force, as well as with multinational partners and allies. Without the ability to share information, the Army will likely not be successful in achieving its mission objectives. In order to solve the interoperability issue in communications, there are two, primary recommendations. First, it will be imperative to create a single, widely used message format, especially for digital data. In the past, the joint force was mindful about ensuring that mission command systems would adhere to the U.S. Messaging Text Format (USMTF) for all digital communications. However, over the last 15 years, the Army slowly moved away from USMTF towards more proprietary messaging, based on the mission command system type. By updating, refining, and implementing the USMTF, the joint force would better be

prepared for interoperability. Further, the USMTF format would be available to partners and allies to ensure that communications would be aligned in any operational environment.

In conclusion, the U.S. Army must improve its communications architecture and networks in the next 20 years. Any future architecture must be reliable, especially in degraded environments. The easiest solution for reliability is to increase bandwidth available to tactical formations, while reducing the data loads sent. Improved networks will only be possible across redundant means of communications. Specifically, the idea of the PACE plan must be augmented with a concept of simultaneous transmission of data across multiple streams to ensure that the data arrives at the intended recipient. Finally, the U.S. Army must champion the refinement and reintroduction of the USMTF, ensuring interoperability across our joint force, as well as easing the integration of multinational partners and allies.

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Technologies for the Changing Character of War

Colonel Jason Wesbrock

When the rifled musket gained prominence in mid-1800s, it significantly changed the character of war. As the Army prepares forces for operations in 2035 and beyond, the Army is looking to technology once again to revolutionize the character of war. To begin this change, Army leadership must define the 2035 operating environment and seek capabilities optimized for that operating environment. Assumptions about the national budget, technology proliferation, lethality of the battlefield, and the need to synthesize information will continue to shape the environment through 2035 and beyond. The Army is at the precipice of a major revolution in the character of war and must identify key technologies and prioritize their development. First, however, the Army must define the operating environment of 2035 and beyond (OE 2035).

The primary mechanism that will shape the Army's preparation for the 2035 battlefield is the current Department of Defense (DoD) budget – and it is continually shaped by the historic guns vs. butter debate about how the government should allocate funds. However, the challenge is that in 2015 discretionary spending only accounted for 32% of the national budget, and DoD received approximately 50% of the discretionary spending budget.[1] Increasing the DoD budget within non DoD discretionary spending (16% of the budget) leaves little room for significant change, and requires decreasing

1. Congressional Budget Office, "The Federal Budget in 2015," January 6, 2016, https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/graphic/51110-budget1overall.pdf (accessed May 23, 2017); Congressional Budget Office, "The Federal Budget in 2015: A Closer Look at Discretionary Spending," https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/graphic/51112-discretionaryspending.pdf (accessed May 23, 2017).

funding to other federal agencies such as Department of State and the Environmental Protection Agency. With the national debt increasing exponentially every day, and many in America dependent on social programs, the allocation of funds within the government will likely see more money going to pay the national debt and mandatory spending programs at the expense of discretionary spending. The shift in funding away from discretionary spending highlights the first insight into the OE 2035: Without significant changes in the global economy, funding for the DoD will remain constrained, making necessary the prioritization of funds to achieve key objectives for future force development.

The second OE 2035 insight focuses on the development and proliferation of technology. As technology continues to evolve and make life for humans more convenient and connected, the technology will proliferate to greater percentages of the population. As this technology proliferates, state actors and non-state actors will find nefarious ways to leverage technology to support their cause and to exploit enemy vulnerabilities. This proliferation of technology may enable current and future adversaries to acquire capabilities on par with technologies formerly reserved for state actors. The drive to make human life easier through advanced technologies leads to the second OE 2035 insight: Technology proliferation will result in the unintended consequence of making the battlefield more lethal.

As technology proliferates, near peer competitors will seek to develop more advanced technologies to counter U.S. capabilities. Current efforts by Russia and China show development of technologies to offset U.S. strengths and capitalize on perceived U.S. weaknesses. For example, through Russia's development of long-range artillery and air defense systems it seeks to push U.S. air assets outside the optimal effectiveness range, stripping U.S. forces of their air dominance, and leaving ground forces potentially exposed to artillery fire. The Russians couple their massed artillery fires with electronic warfare to identify large signatures in the electro-magnetic spectrum, target the signature, and destroy it through long-range, precision fires.

United States research efforts are focused on countering adversary capabilities through the development of advanced autonomous technologies and the codification of the multi-domain battle concept to open windows of opportunity. However, despite significant efforts to aid commanders, they may remain challenged in identifying when a window of opportunity is open. A smart adversary would capitalize on this challenge by feinting an open window of opportunity in order to ambush U.S. Forces. Development of technologies on both sides will likely increase the accuracy and effectiveness of munitions, and may make visualizing the battlefield more challenging. The third insight to OE 2035 is that as result of this increase in lethal munitions, capabilities, and challenges to visualization, the battlefield will become increasingly more lethal for soldiers on both sides.

One benefit from the proliferation of technology is the ability to acquire large amounts of information. The challenge, however, remains to quickly process all the information, and identify actionable intelligence that aids in development of situational understanding or drives a particular decision or action. A retired senior Army leader recently commented that he often found out after the fact that someone knew a key piece of information he needed to influence or make a decision, but that person did not know it was needed and did not get it to the senior leader in time to affect the decision.[2] Advances in technology to gain information leads to the OE 2035 insight: Acquired information will continue to increase, making synthesizing this data increasingly more challenging.

With these four insights about the future operating environment, the Army should seek technology that can offset likely adversary capabilities. These capabilities should:

1. Allow for quick synthesis of large amounts of information
2. Minimize the need to place soldiers into positions of risk
3. Augment soldiers' capabilities to make them more survivable and lethal

2. During several personal discussions with a retired senior Army leader, one of the many things we discussed was intelligence collection and the inability of staffs to synthesize the vast amount of data and the challenges with getting the information to decision makers at the appropriate time.

Below are three technologies the Army should focus development to mitigate the challenges of the future operating environment.

Processing the vast amount of information acquired through advances in collection technologies will require the use of artificial intelligence to synthesize and link large quantities of seemingly random information. Medical professionals currently use IBM's Watson to help in oncology diagnoses and treatment options. Watson does this by sorting through large quantities of medical records, professional journals, and many other records to find similar symptoms in other patients and how they were treated. Watson searches records in other countries, in foreign languages, and makes recommendations that the physician might otherwise not have been able to consider because of the physician's inability to read and synthesize the information.

Artificial intelligence like IBM's Watson could sift through data much quicker, link together seemingly unrelated bits of information, and make recommendations to national military commanders and staffs. The commanders and staffs would still have to assess the validity of the recommendation, and decide how to act on the information. Consider how current missile defense systems rely on automation to quickly make calculations and take appropriate action faster than a human could. This has created a reliance on artificial intelligence that military leaders have grown comfortable using. Using artificial intelligence to aid in making other decisions may similarly help commanders, and likely will make the battlefield less lethal…at least for the side that first embraces such technology.

The lethality of the future battlefield will drive requirements for autonomous and robotic systems to reduce threats to soldiers. The United States already uses unmanned systems, and is further developing robotic systems for the future. However, U.S. leaders clearly articulated they would not pursue autonomous weapon systems. Our nation's adversaries likely will not restrain themselves from developing autonomous systems, and an adversary using autonomous systems will have a marked advantage over forces relying on human decision-making. This advantage will further increase the lethality of the battlefield for forces not using autonomous systems.

The resultant high casualty rate of such a conflict could quickly cause public support to wane. As public support decreases, sending soldiers into harm's way also becomes less acceptable. This loss of support may drive the need to further develop and use autonomous and robotic systems. The Army can choose to develop this capability now, with a human somewhere in the loop for decision-making with the option to allow full autonomy, or leaders may find themselves forced to develop the technology during a conflict.

Another option to increase Soldier survivability is to increase and improve armor, sensors, and weapons. Developing heavier platforms to withstand the onslaught of firepower anticipated in future war is counterproductive. As platforms become heavier with armor they: become less maneuverable, and take more time and assets to deploy. These large armored platforms also become likely targets for the adversary. A potential solution may be smaller, more maneuverable systems that protect a single soldier while providing the soldier with armor and weapons. This may necessitate developing a powered exoskeleton type suit that augments the capabilities of an individual soldier. The suit could be scalable depending on the soldier's mission. As an example, the need for survivability may require more and heavier armor, resulting in something akin to Heinlein's mobile infantry suit.[3] A scout version might trade reduced armor for increased speed, and heavier weapons for communications packages. The necessary technology for such a suit may not be available in 2035, but by 2050 it is conceivable. If the Army chooses not to seek autonomous weapons systems, added protection for soldiers may increase survivability.

As the Army prepares forces for operations in 2035 and beyond, the Army is looking to technology once again to revolutionize the character of war. Assumptions about the national budget, technology proliferation, lethality of the battlefield, and the need to synthesize information will continue to shape the environment through 2035 and beyond. To address these assumptions on the future operating environment, the Army should develop and integrate technologies

3. Robert A. Heinlein, *Starship Troopers*, 3rd ed. (New York: The Berkley Publishing Group, 1987), 99-100.

such as artificial intelligence, autonomous systems, and systems to aid soldiers in survivability and lethality. Through development and implementation of these technologies, the Army can maintain itself as a capable force to deter and defeat adversaries throughout this revolution of the character of war.

Developing Future Army Civilian Leaders

Mr. Will Funches

All organizations now say routinely, "People are our greatest asset." Yet few practice what they preach, let alone truly believe it.

—Peter Drucker[1]

In order to develop leaders of 2035, the United States government must maintain a competitive edge in implementing aspects of talent management principles to enhance the steps needed to maintain Department of Defense (DoD) civilians in a complex and uncertain 21st century. Today's government is confronted with an aging workforce and budget constraints. How long can the government do more with less? This will impact the government's competitive edge. According to an online article: "The United States Army today is widely known to be among the finest and most effective warfighting forces in the world."[2] If this is to remain true, the Army and other federal agencies must prioritize the civilian workforce to support the DoD's mission. After more than 15 years of conflict, it is time for the government to take a look at its processes and policies to develop and train its employees. If not, federal and defense organizations will face challenges in building and sustaining their next generation of leaders.

1. Peter Drucker "The New Society of Organizations" Harvard Business Review, September-October 1992, quoted in Friedman et al. p.1. Delivering on the Promise: How to Attract, Manage and Retain Human Capital. Brian Friedman, James Hatch, David M. Walker, *The Free Press*, 1998 (NY, NY).

2. "Countries Ranked by Military Strength,"http://www.globalfirepower.com/countries-listing.asp (accessed 13 October, 2016).

Talent management has a range of definitions. In an ends, ways and means construct, talent management is a way successful corporations maintain their competitive edge in the global economic environment. Talent management is ensuring that the right people, at the right time, are placed in the positions to successfully execute the mission. Tom Wilson, the Chief Executive Officer of Allstate Corporation suggests effective talent management starts at the top and talent management is his priority.[3] The civilian sector has talent management programs in place to continue to educate and train employees. According to a Government Accountability Office (GAO) report, "nearly eight in ten federal agencies have no active plan in place to recruit Millennials, the generation projected to comprise 75-80 percent of the workforce in the next decade."[4] In today's society it is extremely important that civilian government leaders are proficient at understanding the complexity of the strategic environment and it is essential to train and retain civilian leaders.

The former Secretary of Defense Aston Carter unveiled "The Force of the Future" campaign, "which is about staying the best when it comes to our people." Secretary Carter explains, "Generations change, technologies change, labor markets change. That's why one of my responsibilities now – and a job for all of us in the years ahead – is to make sure that amid all this change DoD continues to recruit, develop and retain the most talented men and women America has to offer."[5] Today's leaders have set the foundation for managing talent and often times continue to push old ways of thought.

The world is changing rapidly and the government is still stuck in the past – in old ways of managing personnel and their skillsets. By 2035 we may be confronted with adversaries with increased scientific proficiency and capabilities far beyond what exist today. It is important to root new behaviors in social norms and overcome bureaucratic resistance to change.

3. Tom Wilson, *The CEO's role in Talent Management*, http://corporateresponsibility.allstate.com/workforce/talent-management (accessed October 17, 2016).

4. Ibid, 3.

5. Carter Unveils Next Wave of Force of the Future Initiatives, "Aston B. Carter" http://www.defense.gov/News/Article/Article/795625/carter-unveils-next-wave-force-of-the-future-initiatives (accessed October 12, 2016).

Kotter's eight stage process of leading major changes is:

1. Establishing a sense of urgency
2. Creating the guiding coalition
3. Developing a vision and strategy
4. Communicating the change vision
5. Empowering broad-based action
6. Generating short-term wins
7. Consolidating gains and producing more change
8. Anchoring new approaches in the culture [6]

Based on the eight stages, there are two significant limitations towards the "Force of the Future": Stage 5, empowering broad-based action; and Stage 8, anchoring new approaches in the culture.

Leaders will need to change the rigid management culture and climate by adapting to the desires and needs of the workforce – both military and civilian. It is essential that senior leaders of 2035 are open to exploring technologies like algorithms and Artificial Intelligence (AI) to enhance productivity and decision making. For example, if a government agency is seeking to hire the best possible applicant, then AI can be of use to quickly analyze a large amount of applicant and organizational data to find an ideal match.

Federal agencies and leaders have an opportunity to shape their workplace, empower employee commitment and remember that the key focus is supporting them as they step into roles. In the context of cultural change, leaders must be proactive, engaged and personally committed to leading change. U.S. Army War College professors, Leonard Wong and Stephen Gerras, observe that, "certainly new systems, policies, and procedures can force changes in behavior, but often what senior decision makers truly desire is a shift in attitudes."[7]

6. John P. Kotter, *Leading Change*, (Boston: Harvard University, 1996), 21.

7. Stephen J. Gerras and Leonard Wong, "Changing Minds in the Army: Why It is so Difficult and What to Do about It," Strategic Studies Institute (Carlisle Barracks, PA: U.S. Army War College Press, October 28, 2013).

Leaders today run the risk of continuing to create talent gaps and losing the best candidates to private sector. Imagine utilizing AI services to scan employees' email at the aggregate level to determine if the workforce as whole is happy with the organizational environment and provide insights as to strategies to improve satisfaction and ultimately retention. Leaders can leverage these data by providing employees with more attention before their next performance evaluation and structuring developmental programs that meet the needs of a majority of the organization, favoring associated characteristics of the developed software.

It is imperative that leaders are adaptive to change and to step out of their comfort zone and analyze issues in depth with a more systemic mindset. According to Stephen J. Gerras, "…as critical thinking skills develop so will the ability to empathize with other points of view, an important capability of a culturally-savvy officer."[8] Critical thinking is a strong attribute of leadership; it creates a chain reaction into the culture of the staff and has a strong impact on the mission.

In order to develop and foster talented federal employees, federal agencies must support and promote career development of current and future leaders. It is essential that U.S. policy leaders change the current structure of developing employees to match future technologies of 2035. In October 2016, the Obama administration released a report entitled, "Preparing for the Future of AI." The report explored the effects of AI in the U.S. job market and offered that AI should be welcome by government leaders to develop employees. AI can be used to track or predict employees who maybe meandering to the end of their career and monitor, and advise those who aim at upward mobility in their field. AI can add constant mentorship to employees and, in an environment in which leaders are challenged to find time for employee assessment and counseling, it can provide an untiring and unblinking "teammate" in employee development.

Projections from the GAO predict that 58% of senior executives and 45% of GS-15s will reach retirement eligibility by 2017.It is

8. Stephen J. Gerras, "Thinking Critically about Critical Thinking: A Fundamental Guide for Strategic Leaders," in *Planner's Handbook for Operations Design*, Version 1.0 (Suffolk, VA: Joint Staff, J-7, October 7, 2011), C-1-C-27.

vital that the government enhance its recruiting process to attract the next generation of talent. DoD is correctly looking at implementing changes to current policies. Secretary Carter said "we're seeking authority from Congress to directly hire civilian employees from college campuses….This has potential to be a real game-changer for us. Our civilian recruiters will be able to go to a campus job fair, do some interviews, and if they find someone who's the right fit, they can make a tentative offer on the spot, pending security clearance."[9] This effort must continue. The current government hiring practices are outdated and must be optimized for a mid-21st century workforce. The key to attracting talent is to welcome change and a priority within all levels of management.

Talent management should be a top priority within the Army and DoD. If done right, it can drive the performance of an organization. AI has already started to transform the American workplace. There are many questions about AI and the future, but in order to introduce technologies for 2035 we must start with U.S. policy makers. In a time where the federal government is being told to do more with less, there are fewer talented people to hire, they are even harder to keep and the methodologies and processes are nonexistent to compete in today's talent competition. We are long past the age of strong agricultural and industrial base, it is important to understand that people are our strongest asset.

9. Ibid, 3.

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Seamless Transition: A Total Army Approach to Personnel Management

Chaplin (COL) James L. Boggess, USAR

I have served my entire career in the reserve components, with 16 years in the Army National Guard (ARNG) and 17 years in the U.S. Army Reserve (USAR). Over that time, I have attended military schools, been deployed, and twice served in an Active Guard/Reserve (AGR) status. As I near the end of my career, I have ten Department of Defense Form 214s (DD214s) and will receive at least one more before I retire. When I transitioned from the Army National Guard to the Army Reserve it took over a year to get my National Guard records transferred to the Army Reserve system. The Army personnel systems are antiquated and cumbersome, do not support a total force, and must be improved to allow the Army to attract and maintain the rich talent pools necessary to stay competitive in the future.

Historically, worker loyalty was rewarded and rewarding. A generation or two ago it wasn't uncommon for workers to spend their entire adult lives in one community, working for one or two employers. Reserve component soldiers often spent entire reserve component careers in a single state's National Guard or a single Army Reserve command. But this dynamic is changing. While there will always be a cadre of career active duty soldiers, the tendency in the future will likely be for soldiers to move in and out of the reserve component – alternating between active duty assignments and assignments in both the ARNG and USAR. The Army should acknowledge this trend and adopt a human resources system that is flexible, open, and adaptable. – a single management system for all components, the Regular Army, the Army National Guard, the Army Reserve, and the inactive Reserve.

In the future, the Army must use a radical new approach that is designed to provide maximum flexibility, a system I term "Seamless Transition." Once a soldier has entered the system in any component, they retain the ability to move (or be moved) between the four designations simply by having their status changed in the system. This personnel management system would track all active duty and inactive duty points, and develop a continuous electronic DD214 report available for download at any time, much like the current Department of the Army form 5015 *Chronological Statement of Retirement Points* (DA5015).

A Seamless Career in the Total Army

What would this new system look like? Let's say that Sally Goodwire wants a career in cyber security. She applies and is accepted to a state college on a military scholarship. A stipulation of her scholarship is membership in the Army National Guard. She attends training during summers and monthly unit training assemblies with her local guard unit. This provides Lieutenant Goodwire with some income and a scholarship while she obtains valuable military experience and leadership training.

Upon completion of her degree, Lieutenant Goodwire transitions to active duty where she is promoted to Captain and serves in U.S. Cyber Command for four years, meeting a critical Army need and obtaining valuable experience. However, Captain Goodwire can make significantly more money working cyber security in the private sector, and now that she is married and wants to start a family, active duty isn't compatible with her stage of life. In 2017, Captain Goodwire would likely separate from the Army and no longer be an available asset. Even if she wants to come back at some future time she will most likely lose rank, and in some cases, won't be allowed to come back at all, a major loss of a valuable investment for the Army.

However, Captain Goodwire is living in 2035 and the Army has fully embraced Seamless Transition. In her case, she gives U.S. Cyber Command and Human Resources Command (HRC) a six-month notice that she desires to leave active duty now that she has fulfilled her service obligation. HRC, working through public/private

partnerships, helps Captain Goodwire find a job in the private sector which will leverage her Army experience and give her experience the Army can use in the future.

Since Captain Goodwire wants to start a family, she transitions to the Inactive Ready Reserve (IRR). This isn't the old "simply a list of names" IRR, instead it is the next generation of the Individual Mobilization Augmentee (IMA) program. Captain Goodwire is placed against a critical mobilization slot in case the Army needs to expand quickly. Prior to her release from active duty Captain Goodwire is given two weeks of temporary duty at her newly assigned command to familiarize her with their mission and her role as an IMA. For the next four years, as Captain Goodwire and her husband have two beautiful children, she works 16 hours a month, on-line, to maintain her military skills and attends a two-week annual training with her assigned command.

After her family is firmly established and she has obtained four years of critical private sector experience, Captain Goodwire is promoted to Major and is ready to be more active in the Army. By giving HRC a six-month notice, she moves from her IMA position to an Army Reserve Troop Program Unit slot where she once again attends monthly unit training assemblies and annual training. After another three years, the Army begins to expand due to a new threat and impending conflict. HRC alerts Major Goodwire that positions in her specialty are opening up and she has been selected to transition back to active duty to fill a critical war-time need.

After the conflict, Major Goodwire is offered a key management position with a private sector cyber security firm and requests transition back to the reserve component. HRC assigns her to an Army National Guard position where she is promoted to Lieutenant Colonel. Based on her expertise, a few years later HRC requests that Lieutenant Colonel Goodwire returns to active duty to oversee the development of a new unit in cyber security and she is promoted to Colonel. Such is the Army career of Colonel Goodwire, seamlessly transitioning between active and reserve components based on a synthesis of her needs, the Army's needs, and the Nation's security.

Retirement

In order for Seamless Transition to meet its full potential, a new retirement system is needed. This new retirement system could replace the current binary system (based on "good years" of service) with an integrated system based purely on points, providing targets for various levels of retirement. For example, currently a "good active duty year" is the accumulation of at least 360 active duty points (one per day of service) while a "good reserve component year" is the accumulation of at least 50 points from any source.[1] In 2017, a soldier must obtain a minimum of 20 "good years" to qualify for retirement and there are two separate retirement systems, the reserve component retirement system, which provides soldiers a stipend after age 60, and the active duty retirement system, which provides a stipend immediately upon retirement.

In the future, a new, purely points-based retirement system could assign retirement points in much the same way as the current reserve retirement system, but with no regard to "good years." Retirement stipends would be computed using the total number of points and the soldier's final grade (similar to the high three currently used by the reserve component). Once soldiers obtain a minimum of 1,500 points (the current equivalent of just over four years of active duty or approximately twenty years of purely reserve component training) through any combination of duties, they are guaranteed a small retirement stipend at age 67. The system would use gates to encourage continued participation. For example, at 2,000 points the retirement stipend begins at age 66 and drops one year for every 500 points earned until the 10,000 point level, which is equivalent to about 27 years of active federal service. At 10,000 points the soldier would be eligible for a retirement stipend immediately upon retirement regardless of age. This system rewards loyalty while maintaining flexibility for our Soldiers for Life.

1. 15 points for simply being in a reserve component unit (membership points); 1 point for every 4 hours of unit training assembly (inactive duty points), extension course points, and 1 point for every day on active duty (Annual Training, Active Duty for Training, Active Duty Operational Support, etc.)

Using Colonel Goodwire's 30-year career as an example, we can get an idea of how this system might work. Over the course of her career, Colonel Goodwire served approximately eight years in the Army National Guard, six years in the Army Reserve, four years as an IMA, and has twelve years of Active Federal Service. Over the course of her service she accumulated approximate 6,000 points. Based on the accumulation of 6,000 points, Colonel Goodwire would start drawing her pension at age 58.[2] Assuming the new system would be similar to the existing reserve retirement system, Colonel Goodwire's 6,000 points will be divided by 360 in order to convert them to equivalent years of service, which, in this case is 16.6 years. This number is then multiplied by 2.5% to determine the percentage of the current Colonel base pay which will be her starting stipend. In Colonel Goodwire's case, after 30 years of commissioned service, Colonel Goodwire would receive a stipend equaling 41.6% of the base pay of a Colonel at the time of her retirement when she becomes eligible at the age of 58. In the intervening time, often called "grey area retirement," Colonel Goodwire would maintain certain benefits such as access to Servicemembers' Group Life Insurance, Post Exchange and Commissary access, Reserve Tri-Care Select, and several others.

This new retirement system also allows the Army to offer incentives when hiring private sector specialists to fill critical military personnel shortfalls. For example, in 2017 when the Army recruits a senior private sector medical specialist (e.g., thoracic surgeon) to fill a critical military personnel shortfall, the most the Army can offer to the specialist is accession as a field grade officer and the accompanying professional pay. These specialists are often in their forties or fifties and can only serve for a short time before reaching sixty years of age, the maximum age for commissioned service. This means that under the current system most, if not all, of these special accessions would have no ability to earn a retirement.

2. Retire stipends begin at age 67 with 1500 points and decrease one year for each additional 500 points earned. In this example [(6000-1500)/500=9] Colonel Goodwire is eligible to draw a pension at age 58 (67-9).

Under the pure points system, these specialists are eligible for a retirement stipend after earning 1,500 or more points (the equivalent of just over four years on active duty). In the case of our thoracic surgeon who accessed on to Active Duty as a Colonel and serves five years training Army doctors, he would accumulate approximately 1,800 points making him eligible for a retirement stipend equal to 12.5%[3] of the base pay of a Colonel when he becomes eligible at the age of 67. Given the expected increase in the complexity of cyber, medicine, space, artificial intelligence, and autonomous weapons, the flexibility of this retirement system provides an incentive for accessing other senior private sector specialists as military officers to fill critical personnel shortfalls.

Conclusion

The Global War on Terror and the resultant operations have required a Total Army approach with an unprecedented number of Army National Guard and Army Reserve soldiers serving on active duty for short durations of time. Many of these reserve component soldiers have multiple deployments and, therefore, multiple DD214s. With different personnel management systems, different pay systems, and different retirement systems, the current situation is difficult to understand and error-prone. By the year 2035 the Total Army concept must truly be realized with one pay system, one personnel management system, and one retirement system for all Army components.

The flexibility, ease of use, and incentives to remain a valuable part of the Total Army will make Seamless Transition a critical part of managing the future force. In the future, soldiers will have more opportunity to move between active duty and reserve service, filling key private sector positions, and greatly enhancing the technical professionalism of the Army. As the Army becomes more technical, it will become more important to be able to leverage the best talent. To attract and keep the best talent, the Army must be flexible enough

3. The surgeon's 1,800 points are divided by 360, which is the equivalent of five years. Five is then multiplied by 2.5% to determine the percentage of retirement pay (5 x 2.5 = 12).

to the accommodate soldier's needs while always having the right people available at the right time to answer our nation's call. Seamless Transition provides that flexibility and leverages private sector skills to enhance the Army's mission.

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