



THE OPERATIONAL ENVIRONMENT AND THE CHANGING CHARACTER OF *WARFARE*



OCTOBER 2019

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Foreword

The United States Army faces multiple, complex challenges in the Operational Environment (OE). The Army will confront strategic competitors in an increasingly contested battlefield across every domain. The emergence of hypersonic weapons, application of artificial intelligence, machine learning, nanotechnology, and robotics are but a few of the disruptive technologies with which we must contend. Coupled with these new technologies will be new approaches to warfare that continue to seek means to degrade our strengths and exploit our weaknesses. Evolving geopolitics, impactful demographic shifts, competition for resources, and challenges to classic structures, order, and institutions coupled with hyper-connectivity – the Internet of Things – will add additional layers of complexity.

Strategic competitors like Russia and China are heavily investing in and incorporating emerging technologies in order to exploit assessed overmatch opportunities in areas such as anti-access and area denial, cyber, combat robotics, and direct/indirect fire. They are challenging U.S. superiority across all domains – space, cyber, air, sea, and land. One of the challenges associated with the changing character of warfare comes not just from the emergence of disruptive technologies and our adversaries' embrace of them, but also from the ways in which they adopt hybrid strategies that challenge traditional symmetric advantages and conventional ways of war.

This assessment does not seek to predict the future, but rather describe the evolving OE. It is crucial to understand what the OE looks and feels like to Warfighters in order to shape our application of combat power and how we train our formations to meet these challenges. This deep look at the future allows us to examine our assumptions about warfare, force structuring, and capabilities requirements.

This assessment is vitally important to every member of the Army team – from the brand new Soldier, to general officers, to career Army Civilians. Shared understanding of the environment is essential to preparing our people, setting the context for readiness, informing our modernization efforts, and guiding us in reforming our processes to meet new challenges.

Victory Starts Here!

A stylized, handwritten signature in dark ink, appearing to read 'Theodore D. Martin', with a long horizontal flourish extending to the right.

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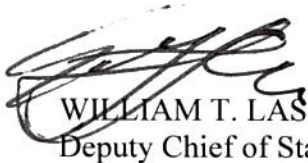
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Military Operations

The Operational Environment and the Changing Character of Warfare

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History. This is a new U.S. Army Training and Doctrine Command (TRADOC) pamphlet.

Summary. This pamphlet provides the Operational Environment that Army forces will encounter as described by the TRADOC G-2 and United States Army Futures Command (AFC). It presents a continuum divided into two distinct timeframes, The Era of Accelerated Human Progress (2017-2035) and the Era of Contested Equality (2035-2050), which depict different doctrinal and technological challenges that the U.S. Army will face in the near to mid future.

Applicability. This pamphlet applies to all Department of the Army activities that develop doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF) capabilities.

Proponent and exception authority. The proponent of this document is the Deputy Chief of Staff, TRADOC G-2, 950 Jefferson Avenue, Fort Eustis, VA 23604-5763.

Suggested improvements. Submit changes for improving this publication on Department of the Army Form 2028 to TRADOC G-2, 950 Jefferson Avenue, Fort Eustis, Virginia 23604-5763.

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Summary of Change

TRADOC Pamphlet 525-92

The Operational Environment and the Changing Character of Warfare

This new pamphlet, dated 7 October 2019-

- o Describes the Operational Environment the Army will face through 2050 in collaboration with Army Futures Command (throughout).

Contents

	Page
Chapter 1 Introduction	5
1-1. Purpose.....	5
1-2. Scope.....	5
Chapter 2 The Operational Environment (OE) and the Changing Character of Warfare.....	5
2-1. Forecasting the future: Toward a changing character of warfare	5
2-2. Critical drivers	6
2-3. Modernizing adversaries	7
2-4. The continuum	7
2-5. Accelerated human progress	8
2-6. Contested equality.....	8
2-7. OE future trends.....	8
Chapter 3 The Era of Accelerated Human Progress (2017-2035)	11
3-1. A convergence of thought and technology erodes U.S. post-Cold War advantages	11
3-2. The pacing threat.....	13
3-3. True strategic competitors.....	14
Chapter 4 The Era of Contested Equality (2035-2050): A View of the Future.....	15
4-1. Changing warfare.....	15
4-2. Strategic strength	15
Chapter 5 Warfare in the Deep Future	17
5-1. The more things change, the more they are the same.....but are different	17
5-2. Information operations.....	18
Chapter 6 The Changing Character of Warfare in the Era of Contested Equality.....	19
Chapter 7 To a Changed Character of Warfare	21
Chapter 8 Conclusion.....	24
8-1. Precipice of change	24
8-2. Laying the groundwork.....	25
Glossary	25

Figure List

Figure 2-1. Global trends	6
Figure 2-2. Expanding doctrine and capabilities	7
Figure 2-3. Flashpoints and fault lines.....	8
Figure 2-4. Convergence.....	9
Figure 3-1. The “2+3” threat.....	12
Figure 3-2. Potential game changers to 2035.....	13
Figure 4-1. Potential game changers in 2050.....	16
Figure 5-1. Human evolution boosted by technology.....	18
Figure 7-1. Mid-century revolution	21
Figure 7-2. Homeland sectors vulnerable to disruption.....	24

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Chapter 1

Introduction

1-1. Purpose

U.S. Army Training and Doctrine Command (TRADOC) Pamphlet 525-92, The Operational Environment and the Changing Character of Warfare, describes the conditions Army forces will face and establishes two distinct timeframes characterizing near-term advantages adversaries may have as well as breakthroughs in technology and convergences in capabilities in the far term that will change the character of warfare. The Operational Environment and the Changing Character of Warfare describes both timeframes in detail accounting for all aspects across the diplomatic, information, military, and economic (DIME) spheres to allow Army forces to train to an accurate and realistic Operational Environment (OE).

1-2. Scope

This pamphlet is the culmination of five-years of effort involving all elements of the U.S. Army's TRADOC G-2 and supports the collaborative Army transition to an OE developed by TRADOC and United States Army Futures Command (AFC). Critical inputs, thoughts, and lessons about the future resulted from the Army Mad Scientist Initiative, which brings together cutting-edge leaders and thinkers from the technology industry, research laboratories, academia, and across the military and Government to explore the impact of disruptive technologies, including robotics, autonomy, artificial intelligence, cyber warfare, megacities, biology, neurology, and material sciences. This was further augmented by AFC's Futures and Concept Center and its Campaign of Learning, which included the "How the Army Fights", Future Force Design, and Deep Future Wargame events. Work across the TRADOC G-2 OE Enterprise, particularly our monitoring and assessment of twelve key trends and technological game changers added further to the body of knowledge for this pamphlet.

Chapter 2

The Operational Environment (OE) and the Changing Character of Warfare

2-1. Forecasting the future: Toward a changing character of warfare

The U.S. military, and therefore, the U.S. Army, finds itself at a historical inflection point, where disparate, yet related elements of the OE are converging, creating a situation where fast-moving trends across the DIME-spheres are rapidly transforming the nature of all aspects of society and human life – including the character of warfare. These trends include significant advances in science and technology, where new discoveries and innovations are occurring at a breakneck pace; a dizzying pace of human interaction and a world:

- a. That is connected through social media and the "Internet of Things" and all aspects of human engagement where cognition, ideas, and perceptions, are almost instantaneously available;
- b. Where economic disparities are growing between and within nations and regions; where changing demographics—like aging populations and youth bulges—and populations moving to

urban areas and mega cities capable of providing all of the benefits of the technological and information-enabled advances;

c. With competition for natural resources, especially water, becoming more common;

d. And where geopolitical challenges to the post-Cold War U.S.-led global system in which strategic competitors, regional hegemonies, ideologically-driven non-state actors, and even super empowered-individuals are competing with the U.S. for leadership and influence in an ever-shrinking world.

These trends must be considered in the military sphere, matched with advances in our adversaries' capabilities and operational concepts, and superimposed over a U.S. military that has been engaged in a non-stop state of all-consuming counter-insurgency warfare for the last 15-plus years. The result is a U.S. military, and an Army in particular, that may find itself with the very real potential of being out-gunned, out-ranged, out-protected, outdated, out of position, and out of balance against our adversaries. These potential foes have had time to refine their approaches to warfare, develop and integrate new capabilities, and in some cases expedite growing changes in the character of warfare.

2-2. Critical drivers

An assessment of the OE's trajectory through 2050 reveals two critical drivers – one dealing with rapid societal change spurred by breakneck advances in science and technology and the other with the art of warfare under these conditions, which will blur the differences in the art of war with the science of war. These drivers work along a continuum beginning in the present in a nascent form, and rapidly gaining momentum through a culmination point around 2050. First, the trends referenced above will create an OE marked by instability, which will manifest itself in evolving geopolitics, resurgent nationalism, changing demographics, and unease with the results of globalization creating tension, competition for resources, and challenges to structures, order, and institutions. Instability also will result from the rapid development of technology and the resulting increase in the speed of human interaction, as well as an increasing churn in economic and social spheres. A global populace that is increasingly attuned and sensitive to disparities in economic resources and the diffusion of social influence will lead to further challenges to the status quo and lead to system rattling events like the Arab Spring, the Color Revolutions in Eastern Europe, the Greek monetary crisis, the United Kingdom's withdrawal from the European Union, and the mass migrations to Europe from the Middle East and North Africa, many of which will come with little warning. Also, the world order will evolve with rising nations challenging the post-Cold War dominance of the U.S.-led Western system. New territorial conflicts will arise in places like the South China Sea, compelling us to seek new partnerships and alliances, while climate change and geopolitical competition will open up whole new theaters of operation, such as in the Arctic.

Global Trends and Challenges to Structure, Order, and Institutions (2017-2050)

- *Evolving geopolitics*
- *Resurgent nationalism*
- *Changing demographics*
- *Unease with globalization*
- *Competition for resources*
- *Rapid development of technology*
- *Disparities in economic resources and social influence*
- *Perceived relative deprivations*

Figure 2-1. Global trends

2-3. Modernizing adversaries

The second driver deals with the combination of this instability with adaptive, thinking adversaries who are modernizing, and will continue to modernize their capabilities and adjust them to this changing OE. Throughout this continuum, these adversaries will present an array of

Expanding Doctrine and Capabilities

Our adversaries already are working to develop new methods and new means to challenge the United States. These efforts will only continue and attenuate through 2050. We can expect to encounter:

- *Multi-domain threats*
- *Operations in complex terrain, including dense urban areas and even megacities*
- *Hybrid Strategies / “Gray Zone” Operations*
- *Weapons of Mass Destruction*
- *Sophisticated anti-access/area denial complexes*
- *New weapons, taking advantage of advances in technology (robotics, autonomy, AI, cyber, space, hypersonics etc.)*
- *Information as a decisive weapon*

threats that will be lethal and will be presented across multiple domains (land, sea, air, space, and cyber.) Our adversaries will operate in and among populations and in complex terrain, and endeavor to negate many of our own traditional technological advantages and force us to operate with degraded capabilities and take advantage of the infrastructure and other resources cities offer. They will adopt hybrid strategies that take advantage of a range of capabilities that deny us a conventional force-on-force fight unless the situation is

Figure 2-2. Expanding doctrine and capabilities

advantageous to the adversary. They will use proxy forces that provide plausible deniability, yet directly allow them to not only shape the battlespace, but even achieve their objectives without risking a wider conflict. Similarly, they also may choose to work with, sponsor, or support terrorist or criminal entities to achieve a similar end. Irregular operations, often in concert with proxies, terrorist, or criminal activities, operating within a “Gray Zone” short of war, will challenge our ability to come to grips with the enemy and perhaps present an unfavorable cost-benefit equation to our political leaders. Our adversaries will rely on strategic capabilities, such as weapons of mass destruction, information operations, and direct cyber-attacks designed to give us pause in responding to their actions and provide them the strategic space they need to operate. Space is becoming an increasingly congested, commercialized, democratized, and contested domain. State and non-state actors compete to enhance their ability to operate while working to deny what was once an area of superiority. Finally, they will develop conventional force structures capable of providing anti-access and area denial capabilities designed to keep us from entering forces into a battle space, or at a minimum, provide an operational barrier that we will have to spend time and resources to breach.

2-4. The continuum

With these drivers in mind, our analysis of the OE and its implications on the future of warfare through 2050 allows us to envision a continuum divided into two distinct timeframes. Warfare in each of these timeframes must contend with the same timeless competitions with which commanders have engaged for generations, but the way these competitions play out reveals two distinct waypoints, or eras in which we move toward a changed character of warfare.

2-5. Accelerated human progress

The first is the Era of Accelerated Human Progress, which can roughly be considered from the present through 2035, and relates to a period where our adversaries can take advantage of new technologies, new doctrine, and revised strategic concepts to effectively challenge U.S. military forces across multiple domains. Our adversaries in some cases will have superior, or near equal capabilities bolstered by advantages in time, space, and perception, and when employed effectively – often in a hybrid and multi-domain fashion – they can prevail over a U.S.-led force. The Era of Accelerated Human Progress represents an evolutionary movement rooted in the present, but clearly advancing to a new state of affairs.

2-6. Contested equality

The second is the Era of Contested Equality, running roughly from 2035 through 2050. This period is marked by significant breakthroughs in technology and convergences in terms of capabilities, which lead to significant changes in the character of warfare. During this period, traditional aspects of warfare undergo dramatic, almost revolutionary changes which at the end of this timeframe may even challenge the very nature of warfare itself. In this era, no one actor is likely to have any long-term strategic or technological advantage, with aggregate power between the U.S. and its strategic competitors being equivalent, but not necessarily symmetric. Prevailing in this period will depend on an ability to synchronize multi-domain capabilities against an artificial intelligence-enhanced adversary with an overarching capability to visualize and understand the battlespace at even greater ranges and velocities. Equally important will be controlling information and the narrative surrounding the conflict. Adversaries will adopt sophisticated information operations and narrative strategies to change the context of the conflict and thus defeat U.S. political will.

Flashpoints and Fault Lines

Crises and conflicts will be in familiar areas, although some could appear in unfamiliar locales:

- *Baltics / Eastern Europe*
- *Other Russian Near-Abroad*
- *Arctic (Russia, China, U.S., Canada, and Europe)*
- *Balkans*
- *Syria/Iraq/Turkey/Iran/Kurds*
- *Greater Middle East / North Africa*
- *Israel-Palestinians*
- *Israel-Iran-Hizballah*
- *Sunni / Shia Rivalry*
- *South China Sea*
- *Southeast Asia (China, Vietnam, Indonesia, Burma)*
- *India-Pakistan*
- *China-India*
- *China-Taiwan*
- *Korean Peninsula*
- *Sub-Saharan Africa (Nigeria, West Africa, Humanitarian)*
- *Horn of Africa*
- *Mexico*
- *Venezuela-Colombia*

Figure 2-3. Flashpoints and fault lines

2-7. OE future trends

Recent decades have witnessed far-reaching changes in how people live, create, think, and prosper. Our understanding of these changes is a prerequisite to further understand how the strategic security environment and the character of warfare itself transformed the present into the Era of Transition, and then into a culmination point -- somewhere around 2035 – where the combination of technology, speed of human interaction, and the convergence in the realms of

nanotechnology, quantum computing, biology and synthetic biology, neurological advancements, and the omnipresence of information moves us into the Era of Contested Equality.

Convergence

The impact of the development of so many new and potential revolutionary technologies is made all the more disruptive by the convergence phenomenon. Virtually every new technology is connected and intersecting with other new technologies and advances. The example of the contemporary “smart phone”, which connects advances in cellular telephones with a camera, gaming, miniaturized computing, and the Internet has completely transformed, and in many ways disrupted, contemporary life. Future convergences between various technological advances are likely to be equally disruptive and equally unpredictable, but the areas in which we foresee the most likely convergences are:

- *Biology and bio-engineering, to include optimizing human performance*
- *Neurologic enhancement*
- *Nanotechnology*
- *Advanced material sciences*
- *Quantum computing*
- *Artificial intelligence*
- *Robotics*
- *Additive manufacturing*

Figure 2-4. Convergence

a. Live. Humanity will become richer, older, more urban, and better educated, but the uneven distribution of this progress will accelerate tension and conflict. Shifting demographics, such as youth bulges in Africa and aging populations of traditional allies and competitors, will threaten economic and political stability. The convergence of more information and more people with fewer state resources will constrain governments’ efforts to address rampant poverty, violence, and pollution, and create a breeding ground for dissatisfaction among increasingly aware, yet still disempowered populations.¹ These factors will be attenuated by a changing climate, which likely will become a direct security threat. Risks to U.S. security include extreme weather impacting installations, increased resource scarcity and food insecurity, climate migration increasing the number of refugees and internally displaced peoples, and the Arctic as a new sphere of competition. The addition of over seven billion people over the last century has altered geography itself, and cities now sprawl over large areas of the globe and contain almost two-thirds of the world’s population.² These numbers will only increase. Some megacities will become more important politically and economically than the nation-state in which they reside.³ Life will become both easier and more complex, with those able to take advantage of the leading edge of technological advancement increasingly exploiting those who cannot. New social stresses and fractures will lead to strife and population migrations, which in turn create further

¹ Natalie Myers, Jeanne Roningen, Ellen Hartman, Tina Hurt, Scott Tweddale, and Patrick Edwards. *People, Infrastructure, and Conflict: Analyzing the Dynamics of Infrastructure Disruption and Community Response*, conference paper submitted to Mad Scientist Conference 2016: Strategic Security Environment in 2025 and Beyond.

² Mr. Esteban Ortiz-Ospina and Mr. Max Roser, *World Population Growth*. Published online at OurWorldInData.org, retrieved from: <https://ourworldindata.org/world-population-growth/> [Online Resource], (2016).

³ Mr. Colin Wood, *The Human Domain and the Future of Army Warfare: Present as Prelude to 2050*, conference paper submitted to Mad Scientist Conference 2016: Strategic Security Environment in 2025 and Beyond.

challenges for urbanized areas. Furthermore, the move of large numbers of people to large urban areas and megacities will strain resources, as these areas will become increasingly reliant on rural areas for food, water, and even additional power. From a military perspective, cities represent challenges, opportunities, and unique vulnerabilities.

b. Create. Although more human beings stress available resources, population growth has also compounded the rate of innovation and technology development. Human creativity is now clearly the most transformative force in the world, both enhancing human life, but also upending it, and – at times – precipitating catastrophic, disruptive events. Information technology will continue to improve exponentially, and most of the developed world already is instrumented in some way. Nearly every person on Earth has access to a connected, mobile device. Advanced material capabilities have, and will continue to extend the trend of reduced size, weight, and power requirements, as nanomaterials, metamaterials, and bespoke structures allow multifunctional assemblies, vastly improving overall systems integration, reliability, and performance. Advanced materials also foster increases in battery power and performance, allowing large amounts of power to be stored across a distributed grid, and miniaturized storage powers mobile robotics and vehicles of all types. Advanced robotic vehicles could serve as mobile power generation plants and charging stations, while highly dexterous ground robots with legs and limbs could negotiate complex terrain allowing humans access to places otherwise denied.

c. Think. Artificial intelligence (AI) may be the most disruptive technology of our time: much of today’s “thought” is artificial, vice human. Breakthroughs in AI and deep learning enable reasoning intelligent systems that, though not sentient, administer and optimize a great many aspects of modern life. Advanced physio-mechanical interfaces enable human-machine integration to include optimized searching of massive indexes of data, direct access to large-scale computing power, and life-like experiences through virtual reality.⁴ The revolutionary impact of “trans-humanism” challenges the very definition of “human” – with profound ethical dilemmas that remain unresolved.⁵ Big data techniques interrogate massive databases to discover hidden patterns and correlations that form the basis of modern advertising – and are continually leveraged for intelligence and security purposes by nation states and non-state entities alike. However, certain operational environments are data-scarce. Missing inputs caused by data gaps inhibit a narrow AI’s ability to provide the envisioned benefits in assessing the OE, limiting military application. Quantum computing, first applied to encryption functions, is now a key computing enabler, especially for artificial intelligence.⁶ A mature Internet of Things connects and integrates the devices of the information realm with formerly inert objects – structures, motors, or appliances – of the physical realm. AI will become critical in processing and sustaining a clear common operating picture in this data-rich environment. Neuroscience has enhanced our understanding of brain function, including neural plasticity, and has enabled advanced techniques for human-machine interfacing. A better understanding of the machinery

⁴ Ms. Kimberly Amerson and Dr. Spencer B. Meredith III, *The Future Operating Environment 2050: Chaos, Complexity and Competition*, conference paper submitted to Mad Scientist Conference 2016: Strategic Security Environment in 2025 and Beyond.

⁵ Wood.

⁶ Paul Horn, *The Future of Information*, presentation to the Mad Scientist Conference 2016: The Strategic Security Environment in 2025 and Beyond, (8 August 2016).

of the mind has found commercial application in the acceleration of speed and retention in learning. In the most connected and wealthy parts of the world, cell phones and computers will all but disappear as physical, hand held devices. Select individuals will directly connect to cyberspace through neural implants or augmented reality systems painted directly on a retina. If we have not yet reached the “singularity”, where AI and machines are capable of outperforming the human mind, we will nonetheless have reached a point where AI, machines, and man-machine teaming open new possibilities in this realm.

d. Prosper. Although AI and its associated technologies will shatter many industries and livelihoods, a wide range of advances continue to create new sources of wealth and economic development – while also significantly impacting the strategic security environment.⁷ Robotics and autonomous systems will underpin the smooth functioning of advanced societies. Additive manufacturing, computer-aided design, and millions of industrial robots will dislocate significant portions of the global supply chain. Virtually anyone in the world with access to a computer system and three-dimensional printer will be able to “print” anything from drones to weapons. Encrypted blockchains will be massively disruptive to commerce functions.⁸ Together with robotics, autonomy, and AI they comprise a perfect storm for “blue collar” and “white collars” alike, causing vast economic displacement as formerly high-quality information technology and management jobs follow the previous path of agricultural and manufacturing labor. Militaries, paramilitaries, mercenary groups, criminal elements, and even extremists groups all will be able to take advantage of this potential pool of manpower. Biotechnology will see major advances, with many chemical and materials industry being replaced or augmented by a “bio-based economy” in which precision genetic engineering allows for bulk chemical production. Individualized genetics enable precise performance enhancements for cognition, health, longevity, and fitness. The low cost and low expertise entry points into genome editing, bioweapon production, and human enhancements will enable explorations by state, non-state, criminal, and terrorist organizations. Competitors may not adopt the same legal regulations or ethics for enhancement as the U.S. causing asymmetry between the U.S. and those choosing to operate below our defined legal and ethical thresholds.

Chapter 3

The Era of Accelerated Human Progress (2017-2035)

3-1. A convergence of thought and technology erodes U.S. post-Cold War advantages

Advances in these various arenas already have begun to shape how our potential adversaries think about and plan for war against the United States. Having witnessed U.S. military operations from Operation DESERT STORM through recent operations in Iraq and Afghanistan, our main potential adversaries – the so-called “2+3” of Russia, China, North Korea, Iran, and radical ideologues, such as ISIS – came to the realization that U.S. military superiority in terms of superbly trained personnel operating highly capable equipment able to operate effectively and in a synchronized fashion across all domains of conflict could be mitigated by factors of time, space, distance, and perception.

⁷ Peter Singer, remarks to the Mad Scientist Conference 2016: The Strategic Security Environment in 2025 and Beyond, (9 August 2016).

⁸ Sherree DeCovny, “Are Bitcoin and Blockchain Technology the Future?” *CFA Institute*, (6 January 2016).

The “2+3” Threat

- **Russia** can be considered our “pacing threat,” and will be our most capable potential foe for at least the first half of the Era of Accelerated Human Progress. It will remain a key strategic competitor through the Era of Contested Equality.
- **China** is rapidly modernizing its armed forces and investing heavily in readiness and technological research. Its rapid development means that it likely will surpass Russia as our pacing threat sometime around 2030.
- **North Korea** lacks the capabilities of Russia or China, and its large but outdated military, its credible ballistic missile force, expanding cyber capabilities, and nuclear capabilities make it a significant regional threat for at least the first half of the Era of Accelerated Human Progress.
- **Iran** for the first part of the Era of Accelerated Human Progress represents a non-nuclear regional hegemon, but is likely to develop nuclear weapons sometime prior to 2035. Its geography and mastery of hybrid conflict involving proxies, coupled with ambitious military reforms means it is likely that Iran remains a key concern to 2035.
- **Radical Ideologues and Transnational Criminal Organizations** like ISIS, al-Qa’ida, Lebanese Hizballah, or Latin American drug cartels and other groups which will sprout up in reaction to the unfolding OE will remain difficult and capable threats through 2035, and probably beyond. Although individual groups will rise and fall, radical ideologues and transnational criminal organizations will be able to match terrorism and insurgency with increasing access to commercially available technologies and connections to nation states and criminal elements to remain viable.

While the U.S. military may not necessarily have to fight Russia, China, North Korea, or Iran, it is likely that U.S. forces through 2050 will encounter their advanced equipment, concepts, doctrine, and tactics in flashpoints or trouble spots around the globe.

Figure 3-1. The “2+3” threat

Key adversaries are now thinking in terms of hybrid strategies, which allow them to operate at times and places of their choosing, often at a level below the threshold of warfare using proxies, private contractors, or criminal elements often directly targeting the will of a national population or the decision-making apparatus of a nation-state or a transnational organization/alliance, like NATO or the European Union. Early signs of this trend were seen in the hybrid strategies adopted by Iran, and then later still with Russian activities in the Crimea, Ukraine, and Syria, and now covered by the term Russian New Generation warfare. While many of these ideas are not new, the fundamental difference beginning around 2017 is the ability of the 2+3 actors to match traditional operations, hybrid strategies and asymmetric warfare tactics with new technologies and capabilities that prevent, stall, or complicate the U.S. ability to bring forces to bear before our adversaries can achieve their political objectives. Russia and China have led the way in this regard, focusing on the development of sophisticated anti-access/area denial capabilities, long-range fires, electronic warfare and deception capabilities, space-based sensors and anti-space weapons, advanced forms of information operations, weapons of mass destruction, and cyber capabilities, while North Korea and Iran have focused on narrower, less-comprehensive, and less technically sophisticated variants of these capabilities.

Potential Game Changers to 2035

Evolutionary technologies that, if matured and fielded, can provide a decisive edge over an adversary unable to match the capability or equal the capacity:

- **Multi-Domain Swarms** – Massed, coordinated, fast, and collaborative. Overwhelm target systems, disaggregate, and work in homogenous or heterogeneous teams.
- **Advanced ATGM & MANPADS** - Proliferate more rapidly than Active Protection systems develop, putting armored vehicles and helicopters at risk.
- **Robotics** – 40+ countries develop military robots with some level of autonomy.
- **Space** – 70+ nations operating in space. Increasingly congested and difficult to monitor. PNT at risk.
- **Chemical Weapons** – Non-traditional agents developed to defeat detection and protection capabilities.
- **Camouflage, Cover, Concealment, Denial, & Deception (C3D2)** – Creates uncertainty and challenges multi-discipline intelligence.
- **Cannon/Rocket Artillery** – Long range artillery, hardened GPS munitions defeat jamming. Point air defense systems defend against PGM.
- **Missiles** – Developed for greater range and improved accuracy using inertial guidance. Hypersonics – high speed (Mach 5 or higher) and highly maneuverable.
- **Computing/Cyber** – Human-Computer interaction is transformed. Processing power increases exponentially. Big Data and Quantum Computing.

Figure 3-2. Potential game changers to 2035

Even our radical ideologue adversaries, such as ISIS, al-Qa'ida, or Lebanese Hizballah, as well as criminal organizations and drug cartels are able to employ complex combinations of terrorism and unconventional operations mixed with traditional military capabilities and commercial off-the-shelf technologies to challenge U.S. dominance. The convergence of these new capabilities with hybrid strategies has fractured the U.S. concept of joint, phased, multi-domain operations by allowing our adversaries the opportunity to quickly mass force and capabilities, protected by their anti-access/area denial, long-range fires, and even weapons of mass destruction to achieve their objectives in a phase short of actual conflict, to negate, or at least mitigate, the advantages in maneuver and precision that the U.S. joint force has grown accustomed. In effect, our adversaries are beginning to understand that they can use these capabilities and strategies to deny U.S. forces the ability to operate seamlessly across domains, while at the same time delivering effects – particularly in the cyber, space, and information realms – which afford them the opportunity to win and achieve objectives before even engaging U.S. forces in combat, and creating a political dilemma for U.S. leadership of having to overturn a fait accompli.

3-2. The pacing threat

Our adversaries' capabilities to successfully carry out such strategies will increase through 2035, as rapid innovation in key technologies increases their capabilities to challenge U.S. forces across multiple domains. Russia will be our pacing threat, and will pose the most sophisticated and challenging threat during at least the first half of this period. It has already been investing for more than a decade in new capabilities to "overmatch" U.S. airpower, precision targeting,

and the U.S. ability to deploy into a decisive theater.⁹ In addition to a whole array of new weapons systems it has developed, Moscow has been studying and investing technologies, such as robotics, advanced computing, hypersonics, space systems, and biological enhancements to human performance.¹⁰ China also is rapidly modernizing its armed forces and developing new approaches to warfare. Beijing has invested significant resources into research and development of a wide array of advanced technologies.¹¹ Coupled with its time-honored practice of reverse engineering technologies or systems it purchases or acquires through espionage, this effort likely will allow China to surpass Russia as our most capable threat somewhere in the second half of the period. North Korea and Iran will continue to pose significant regional threats, although each has unique capabilities to threaten U.S. forces or interests outside of its direct region: North Korea in the form of its ballistic missiles, nuclear weapons, and cyber capabilities¹², and Iran's ability to rely on proxies and a global state-sponsored terrorist infrastructure.^{13, 14} It also is likely that Iran will develop and deploy nuclear weapons by the latter half of this time period. Non-state actors – radical ideologues, super-empowered individuals, and international criminal elements -- could take advantage of some of the same factors that nation-states have considered, yet will match them with a willingness to rely on other, non-conventional capabilities to achieve their own objectives. No matter which permutation of non-state actor we face, each will be able to draw upon the same advances in technology and the speed of human interaction to raise their capabilities. This may include partnering with, or accepting the support of nation states to acquire advanced weapons, taking advantage of the availability of commercial technology to enhance their own capabilities, developing their own unique systems and capabilities, and relying upon a deft understanding of social media and online communications to wage their own information operations.

3-3. True strategic competitors

At some point during this time period, and really for the first time since the Second World War, it is likely that the United States could face a true strategic competitor who will have an ability to operate in multi-domains, a capability to deny domains to U.S. forces, and who will be able to operate with certain technological advantages over a U.S. force. This challenge is further

⁹ Kristin Ven Bruusgaard, "Crimea and Russia's Strategic Overhaul," *The U.S. Army War College Quarterly: Parameters*, Autumn 2014,

http://strategicstudiesinstitute.army.mil/pubs/parameters/Issues/Autumn_2014/11_BruusgaardKristin_Crimea%20and%20Russia's%20Strategic%20Overhaul.pdf.

¹⁰ Valery Gerasimov, "The Value of Science Is In the Foresight: New Challenges Demand Rethinking the Forms and Methods of Carrying out Combat Operations," *Military Review*, January-February 2016, http://usacac.army.mil/CAC2/MilitaryReview/Archives/English/MilitaryReview_20160228_art008.pdf.

¹¹ Anthony Cordesman with Joseph Kendall, *Chinese Strategy and Military Modernization in 2016: A Comparative Analysis*, CSIS: Washington, DC: December 5, 2016, https://csis-prod.s3.amazonaws.com/s3fs-public/publication/161208_Chinese_Strategy_Military_Modernization_2016.pdf.

¹² Office of the Secretary of Defense, "Report to Congress: Military and Security Developments Involving the Democratic People's Republic of Korea," January 5, 2016, https://www.defense.gov/Portals/1/Documents/pubs/Military_and_Security_Developments_Involving_the_Democratic_Peoples_Republic_of_Korea_2015.PDF.

¹³ GEN Lloyd J. Austin III, "Statement of General Lloyed J. Austin III, Commander U.S. Central Command Before the Senate Armed Services Committee on the Posture of U.S. Central Command," March 8, 2016, http://www.armed-services.senate.gov/imo/media/doc/Austin_03-08-16.pdf.

¹⁴ Dexter Filkins, "The Shadow Commander," *The New Yorker*, September 30, 2013, <http://www.newyorker.com/magazine/2013/09/30/the-shadow-commander>.

compounded by our reliance on coalition warfare with allies that might not be able or willing to modernize at the same pace as the U.S. The United States will face a situation where its strategic advantages held during the post-Cold War period – our broad network of alliances and partners that allowed for the forward deployment of a sophisticated, highly-capable joint force – will erode, allowing for increasingly aggressive challengers fielding a full-range of modern, advanced capabilities with hybrid strategies to challenge our ability to bring forces to the fight while undermining our political and national will to do so. Our adversaries’ investments in electronic warfare and space control will threaten our command and control and multi-domain capabilities, while remaining forward bases, naval forces, and aircraft are menaced by advanced integrated air defense systems and long-range fires, including cruise and ballistic missiles. The ability of our joint force to operate effectively in the air and maritime domains hundreds of miles from our coasts will be challenged, which in turn will create new complications for forces operating in the ground domain. By 2035, it is likely that military capabilities among key great powers and even by relatively capable regional powers – augmented dramatically by rapid technological innovations and their convergence with each other in a number of areas – will create an uneasy balance, with no one power having a dramatic relative advantage over its rivals.

Chapter 4

The Era of Contested Equality (2035-2050): A View of the Future

4-1. Changing warfare

The changes encountered in the Era of Accelerated Human Progress begin a process that will reshape the global security situation and fundamentally alter the character of warfare. While its nature remains constant, the speed, automation, ranges, both broad and narrow effects, its increasingly integrated multi-domain conduct, and the complexity of the terrain and social structures in which it occurs will make mid-century warfare both familiar and utterly alien. Before delving further into an analysis of warfare in 2035-2050, we need to first look at the Contested Era’s broad OE.

4-2. Strategic strength

During the Era of Contested Equality, great powers and rising challengers have converted hybrid combinations of economic power, technological prowess, and virulent, cyber-enabled ideologies into effective strategic strength. They apply this strength to disrupt or defend the economic, social, and cultural foundations of the old Post-World War II liberal order and assert or dispute regional alternatives to established global norms. State and non-state actors compete for power and control, often below the threshold of traditional armed conflict – or shield and protect their activities under the aegis of escalatory weapons of mass destruction (WMD), cyber, or long-range conventional options and doctrines.

It is not clear whether the “2+3” threats faced in the Era of Accelerated Human Progress persist, although it is likely that China and Russia will remain key competitors, and that some form of non-state ideologically motivated extremist group(s) will exist. Iran and North Korea may remain threats, may have fundamentally changed their worldviews, or may not even exist by mid-century, while other states, and combinations of states will rise and fall as challengers during the 2035-2050 timeframe. The security environment in this period will be characterized

Potential Game Changers through 2050

Revolutionary technologies that, when developed and fielded, will provide a decisive edge over adversaries not similarly equipped. This technological advantage will most probably be temporary.

- **Laser and Radio Frequency Weapons** – Scalable lethal and non-lethal directed energy weapons can counter aircraft, UAS, missiles, projectiles, sensors, and swarms.
- **Rail Guns and Enhanced Directed Kinetic Energy Weapons** – Non-explosive electromagnetic projectile launchers provide high-velocity/high-energy weapons.
- **Energetics** – Provides increased accuracy and muzzle energy.
- **Synthetic Biology** – Engineering and modification of biological entities has potential weaponization.
- **Internet of Everything** – Every device, both military and commercial, will have network connectivity. Everything becomes a sensor, and everything becomes hackable. Opportunity and vulnerability.
- **Power** – Future effectiveness depends on renewable sources and reduced consumption. Small nuclear reactors are potentially a cost effective source of stable power.

Figure 4-1. Potential game changers in 2050

by conditions that will facilitate competition and conflict among rivals, and lead to endemic strife and warfare, and will have several defining features.

a. The nation-state perseveres. The nation-state will remain the primary actor in the international system, but it will face both new and growing challenges domestically and globally. Trends of fragmentation, competition, and identity politics will challenge global governance and broader globalization, with both collective security and globalism in decline.^{15,16} As the world becomes further digitized, states will share their strategic environments with networked societies which can pose a threat by circumventing governments that are unresponsive to their citizens' needs. These online organizations are capable of gaining power, influence, and capital to a degree that challenges traditional nation-states. Many states will face challenges from insurgents and global identity networks – ethnic, religious, regional, social, or economic – whose members may feel a stronger affinity to their online network than to their nationality, which could result in either resisting state authority or ignoring it altogether.

b. Diffusion of elite capabilities. Russia, China, and the United States will continue to lead the world in power, dominance, and technology, but other states and actors will develop more advanced abilities in specific arenas. Rising competitors will be able to acquire capabilities through a broad knowledge diffusion, cyber intellectual property theft, and their own targeted investments without having to invest into massive “sunken” research costs. This diffusion of knowledge and capability and the aforementioned erosion of long-term collective security will lead to the formation of ad hoc communities of interest. The costs of maintaining global hegemony at the mid-point of the century will be too great for any single power, meaning that

¹⁵ CSA SSG Cohort IV, *The Character of Warfare 2030 to 2050: Technological Change, the International System, and the State*, (12 July 2016).

¹⁶ Bruce Nussbaum, “Peak Globalization,” *Harvard Business Review*, (20 December 2010).

the world will be multi-polar and dominated by complex combinations of short-term alliances, relations, and interests.

c. This era will be marked by contested norms and persistent disorder, where multiple state and non-state actors assert alternative rules and norms, which when contested, will use military force, often in a dimension short of traditional armed conflict.

Chapter 5

Warfare in the Deep Future

5-1. The more things change, the more they are the same.....but are different

During the Era of Accelerated Human Progress, we began to see and understand that the character of warfare was beginning to change. These changes included warfare that was contested in all domains, required faster decisions and decision analysis to be made, needed to take advantage of narrower – in terms of time and space – opportunities, often characterized as windows, saw the proliferation of weapons of mass destruction, occurred in complex, congested terrain, involved hybrid strategies and combatants, and was increasingly difficult to resolve conclusively.

By mid-century, warfare likely will follow a similar pattern, but will be enhanced by more advanced, sophisticated capabilities, take advantage of artificial intelligence to improve decision-making and even further increase speed in terms of integration, decision-making, and operational imperatives, occur at even longer ranges, and deliver a range of effects whose impact and destructiveness are both broader and more precisely delivered. Unmanned systems, including advanced battlefield robotic systems acting both autonomously and as part of a wider trend in man-machine teaming, will account for a significant percentage of a combatant force. Swarms of small, cheap, scalable, and disposable unmanned systems will be used both offensively and defensively, creating targeting dilemmas for sophisticated, expensive defensive systems. Swarming systems on the future battlefield will include not only unmanned aerial systems (UAS) but also swarms across multiple domains with self-organizing, self-reconstituting, autonomous, ground, maritime (sub and surface), and subterranean unmanned systems. Laser and radiofrequency weapons drawing upon small, lighter, and much more portable sources of power, will become more practical, and will further increase the ranges and lethality of direct fire weapons, particularly defensive weapons designed to counter aircraft, unmanned aerial vehicles, and ground systems. Communications will be critical, and advances in quantum computing, networking, and the Internet of Things will make the need to communicate both easier, and more difficult in the face of the same technologies used to counter an enemy's communications capabilities. Advances in hypersonic delivery systems, space systems, hypervelocity rail guns, and other systems, coupled with new types of conventional and unconventional warheads will dramatically increase the scope of battlefields, with precision strike effects capable of being delivered rapidly from a continent away. Advances in WMD, including the development of a range of nuclear payloads, advanced chemical weapons employing new technologies and understanding of chemistry and chemical engineering, and perhaps most significantly, biological weapons, present a devastatingly lethal and disruptive WMD threat profile. Exquisite precision weapons allow an adversary to regularly produce critical effects necessary to further their plan.

Human Evolution Boosted by Technology

Singularity is the point at which AI exceeds the collective intelligence of mankind, which will radically and irrevocably change the relationship between man and machine. There are several divergent possibilities regarding the singularity:

- *As optimistic singularity advocates such as Ray Kurzweil have suggested, AI improves human life in every way, from healthcare, to emotional evolution, to intergalactic space travel.*
- *Unboxed general artificial superintelligence improves and evolves at such an exponential rate it escapes human restrictions, perspectives, and morality. It threatens the very existence of humanity.*
- *Humans evolve their own cognitive abilities through learning developments, brain implants, artificial stimulants, and non-AI high-performance computing to match, or at least keep pace with AI.*

AI has the capacity to change paradigms, revolutionize everyday life, and take mankind to exciting new horizons. However, it also may be capable of incredible destruction, malice, and lines of thinking and decision making that are dangerous to mankind. This duality will be critical as actors develop military applications for AI.

Figure 5-1. Human evolution boosted by technology

Destruction of key nodes in an opposing force or enemy nation allows measured effects to produce desired conditions. Massed fires and weapons of mass effects retain great utility to produce cognitive shock and possibly disintegrate the coherency of an armed force. Although mass effects do destroy the means for war, they are more properly viewed as an attack on the will to continue the fight. The speed of engagements in this era – which routinely involve lasers, hypersonic weapons, cyber-attacks, and artificial intelligence – will far exceed the reaction time of humans. The decision-making process will require much greater speed; information and intelligence will need to be quickly gathered and assessed so that commanders can make the decisions at increasingly rapid rates. As a result, engagements will be fast, but campaigns could be protracted series of kinetic engagements or conflicts short of war.

5-2. Information operations

Under these conditions, no one nation will have an overwhelming technological advantage over its rivals. As a result, sophisticated information operations, enabled by advances in artificial intelligence, high-performance computing, detailed socio-political analysis, data analytics, and a detailed understanding of social media means that the Era of Contested Equality competitors will engage in a fight for information on a global scale. The information battle will be waged with well-crafted ideas and narratives combined with pervasive and globally-reaching cyber, electronic warfare, information operations, and psychological warfare tools. Coercion through the cognitive dimension is not only possible, but often is the first, and the decisive recourse in conflict, and is an ongoing, persistent activity between opposing powers. Winning the war before the battle is fought through information operations will become an imperative, and land forces will need to contribute to perception management in the cognitive dimension as a core element of military operations.

Chapter 6

The Changing Character of Warfare in the Era of Contested Equality

The changing character of warfare in the Era of Contested Equality is best understood as a series of enduring competitions that would be recognizable to commanders in any era of history. What is different, however, are changes in the operational environment and technology that are so significant, extensive, and pervasive, that they collectively manifest a distinct, and transformed character of warfare that is faster, occurs at longer ranges, is more destructive, targets civilians and military equally across the physical, cognitive, and moral dimensions, and if waged effectively, secures its objectives before actual battle is joined.

a. Finders vs hiders. As in preceding decades, that which can be found, if unprotected, can still be hit. By mid-Century, it will prove increasingly difficult to stay hidden. Most competitors can access space-based surveillance, networked multi-static radars, drones, and swarms of drones in a wide variety, and a vast array of passive and active sensors that are far cheaper to produce than to create technology to defeat them.¹⁷ Quantum computing and quantum sensing will open new levels of situational awareness. Passive sensing, especially when combined with artificial intelligence and big-data techniques may routinely outperform active sensors, leading to a counter-reconnaissance fight between autonomous sensors and countermeasures – “a robot-on-robot affair.” These capabilities will be augmented by increasingly sophisticated civilian capabilities, where commercial imagery services, a robust and mature Internet of Things, and near unlimited processing power generate a battlespace that is more transparent than ever before. This transparency may result in the demise of strategic and operational deception and surprise. Hiding is possible, but will require dramatic reduction of thermal, electromagnetic, and optical signatures. For a hider to defeat a finder, it generally must not move or emit. Tactical techniques, such as going to and below ground, or hiding in plain sight through dispersion or near constant relocation can augment technological solutions to assist the hiders, with dense urban areas offering the best option for hiding. The complete destruction of the near ubiquitous sensors arrayed against a land force will not be feasible, although high-powered microwave systems may be able to clear limited corridors. More successful methods would involve techniques to deceive finders vice destroy them. These could include cognitive, autonomous electronic warfare assets that assess signals and develop real-time countermeasures during engagements. Land forces also will employ advanced camouflage, cover, and deception, ranging from tactical obscurants, decoys, and signature reduction through elaborate strategic, multi-domain deception operations.

b. Strikers vs shielders. The competition between strikers and shielders is one of the most telling examples of the change in the character of warfare in this era. Precision strike will improve exponentially through mid-century, with the type of precision formerly reserved for high-end aerospace assets now extended to all domains and at every echelon of engagement. The proliferation of intelligent munitions will enable strikers to engage targets at greater distances, collaborate in teams to seek out and destroy designated targets, and defeat armored and other hardened targets, as well as defiladed and entrenched targets. Combatants, both state and non-state, will have a host of advanced delivery options available to them, including

¹⁷ Shawn Brimley, Center for a New American Security, *While We Still Can: Arresting the Erosion of America's Military Edge*, (17 December 2015).

advanced kinetic weapons, hypersonics, directed energy, including laser, microwave, and electromagnetic pulse, and cyber. A maneuver Brigade Combat Team has over 2,500 pieces of equipment dependent on space-based assets for position, navigation, and timing and Low Earth Orbit is cluttered with satellites, debris, and thousands of pieces of refuse. Space-based assets will become increasingly integrated into these striker-shielder complexes, with sensors, anti-satellite weapons, and even space-to-earth strike platforms fielded by many actors. At the same time, and on the other end of the spectrum, it will be possible to deploy swarms of massed, low-cost, self-organizing unmanned systems directed by bi-mimetic algorithms to overwhelm opponents, which offers an alternative to expensive, exquisite systems. With operational range spanning from the strategic – including the homeland – to the tactical, the application of advanced fires from one domain to another will become routine. A wide range of effects can be delivered by a striker, ranging from point precision to area suppression using thermobarics, brilliant cluster munitions, and even a variety of nuclear, chemical, or biological systems. Shielders, on the other hand, will focus on an integrated approach to defense, which target enemy finders, their linkages to strikers, or the strikers themselves. To defeat defenses, a striker must win the salvo competition by increasing the size and pace of their attacks, which may require using smaller weapons carried in larger numbers of strike platforms. Finally, there is a cost curve competition, in which advanced technology and artificial intelligence could create large numbers of inexpensive, but capable systems which could overcome more expensive capable systems. As a result of these developments, mid-century combatants will have to make decisions along a sliding scale between mass and precision, with capabilities giving actors an unprecedented ability to make choices and trade-offs in terms of capability, effect, and cost.

c. Planning and judgment vs reaction and autonomy. The mid-century duel for the initiative has a unique character. New operational tools offer extraordinary speed and reach and often precipitate unintended consequences. Commanders will need to open multi-domain windows through which to deliver effects by the sophisticated balancing of careful planning to set conditions with the ability to rapidly exploit opportunities and vulnerabilities as they appear to achieve success against sophisticated defensive deployments and shielder complexes. This will place an absolute imperative on intelligence, surveillance, and reconnaissance, as well as on intelligence analysis augmented by artificial intelligence, big data, and advanced analytic techniques to determine the conditions on the battlefield, and specifically when, and for how long, a window of operation is open. Decision cycle times will decrease with AI-enabled intelligence systems conducting collection, collation, and analysis of battlefield information at machine speed, freeing up warfighters and commanders to do what they excel at – fight and make decisions. Man-machine teaming will become the norm in terms of staff planning, with carefully trained, educated, and often cognitive performance-enhanced personnel working to create and exploit opportunities. This means that armies no longer merely adapt between wars, but do so between and during engagements.

d. Escalation vs de-escalation. The competition between violence escalation and de-escalation will be central to stability, deterrence, and strategic success. Violence is readily available to a wide-range of actors, and on unprecedented scales. Conventional and cyber capabilities can be so potent as to generate effects on the scale of WMD. During the Era of Accelerated Human Progress, we encountered hybrid strategies and “Gray Zone” operations, which essentially demonstrated a willingness to escalate a conflict to a level of violence that

exceeded the interests of an adversary to intervene. Over time, these tentative, early steps evolved into a more subtle understanding of how cyber effects could devastate without overt violence, and how disparate non-violent activities can quickly compound to significant strategic consequence. Additionally, long-range strikers and shielder complexes, which extend from the terrestrial domains into space – taken together with cyber technology and more ubiquitous finders – are significantly destabilizing and allow a combatant a freedom of maneuver to achieve objectives short of open war. The ability to effectively escalate and de-escalate along a scalable series of options will be a prominent feature of force design, doctrine, and policy at mid-century.

Chapter 7

To a Changed Character of Warfare

Our vision of the OE brings with it an inexorable series of movements which lead us to ponder a critical question; what do these issues mean for the nature and character of warfare? The nature

Mid-Century Revolution: A Changed Character of Warfare

- *The moral and cognitive dimensions are ascendant.*
- *Integration across the DIME.*
- *Limitation of military force.*
- *The primacy of information.*
- *Expansion of the Battle Area / hyper-destruction.*
- *Ethics of warfare shift.*

of war, which has remained relatively constant from Thucydides through Clausewitz, to the Cold War and to the present, certainly remains constant through the Era of Accelerated Human Progress. War is still waged because of fear, honor, and interest, and remains an expression of politics by other means. However, as the Era of Accelerated Human Progress advances, and we move to the Era of Contested Equality, it becomes apparent that the character of warfare has changed to a point where other basic questions, such as those contemplating the very definition of war or those looking at whether fear or honor are removed as part of the equation.¹⁸ In the

Figure 7-1. Mid-century revolution

2035-2050 timeframe, warfare does indeed look different from its early-century model in several key areas.

a. The moral and cognitive dimensions are ascendant. The proliferation of high technology coupled with the speed of human interaction and pervasive connectivity means that no one nation will have an absolute strategic advantage in capabilities, and even when breakthroughs occur, the advantages they confer will be fleeting, as rivals quickly adapt. While individual nations may have real advantages in certain technologies or capabilities, it is unlikely that any will have a decisive edge, meaning that a rough strategic parity will prevail. Under such conditions, the physical dimension of warfare may become less important than the cognitive and the moral. Military operations will increasingly be aimed at utilizing the cognitive and moral dimensions to target an enemy's will. As a result, there will be fewer self-imposed restrictions by some powers on the use of military force, and hybrid strategies involving information operations, direct cyber-attacks against individuals, segments of populations, or national infrastructure, terrorism, the use of proxies, and WMD will aim to prevail against an enemy's will.

¹⁸ Sydney J. Freedberg Jr., "War Without Fear: DepSecDef Work on How AI Changes Conflict," *Breaking Defense*, 31 May 2017, <http://breakingdefense.com/2017/05/killer-robots-arent-the-problem-its-unpredictable-ai/>

b. Integration across the DIME. Clausewitz's timeless dictum that war is policy by other means takes on a new importance, as the distance between war and policy recedes, but also must take into account other elements of national power to form true whole-of-government and when possible, collective security approaches to national security issues. The interrelationship across the DIME will require a closer integration across all elements of government, and joint decision-making bodies will need to quickly and effectively deliver DIME effects across the physical, the cognitive, and moral dimensions. Military operations are an essential element of this equation, but may not necessarily be the decisive means of achieving an end state. Building an effective and credible military deterrent will become an increasingly important and relevant policy tool, and it must be capable of operating across multiple dimensions and domains, while retaining the flexibility to integrate with other elements of national power.

c. Limitations of military force. While mid-century militaries will have more capability than at any time in history, their ability to wage high-intensity conflict will become more limited. Force-on-force conflict will be so destructive, will be waged at the new speed of human and AI-enhanced interaction, and will occur at such extended long-ranges that exquisitely trained and equipped forces facing a strategic competitor will rapidly suffer significant losses in manpower and equipment that will be difficult to replace. Robotics, unmanned vehicles, and man-machine teaming activities offer partial solutions, but warfare will still revolve around increasingly vulnerable human beings. Military forces may only be able to wage short duration campaigns before having to replace expensive equipment, and even more priceless personnel. Militaries under these conditions will need to balance exquisite, expensive capabilities against less-capable, cheaper alternatives, and also carefully balance the ratio of human soldiers to robotic or unmanned systems. As the skills and experiences that humans need to learn or acquire to be effective on these battlefields take long-times to develop, but will be expended quickly on the destructive mid-century battlefield, militaries will need to consider how advances in AI, bio-engineering, man-machine interface, neuro-implanted knowledge, and other areas of enhanced human performance and learning can quickly help reduce this long lead time in training and developing personnel.

d. The primacy of information. In the timeless struggle between offense and defense, information will become the most important and most useful tool at all levels of warfare. The ability of an actor to use information to target the enemy's will, without necessarily having to address its means will increasingly be possible. In the past, nations have tried to target an enemy's will through kinetic attacks on its means – the enemy military – or through the direct targeting of the will by attacking the national infrastructure or a national populace itself. Sophisticated, nuanced information operations, taking advantage of an ability to directly target an affected audience through cyber operations or other forms of influence operations, and reinforced by a credible capable armed force can bend an adversary's will before battle is joined. This will allow a nation to demonstrate to an adversary, or more specifically, to the adversary's political leadership or national populace, that the "value of the object" in Sir Julian Corbett's words, is too high to risk national treasure or lives. The most effective campaigns are ones that wield all elements of national power to compel an adversary to take or to acquiesce to a specific action, and it will be much easier, cheaper, and effective to use information, backed by credible military force, to achieve these goals. It also means that nations will increasingly look to use military force as a means of setting conditions for success in the political, economic, or even

information spheres. The balkanization of the internet into multiple national “intranets” could provide fewer opportunities for influence platforms and impact cyber operations. The growing presence of fake news, data, and information, coupled with deepfakes and hyper-connectivity, changes the nature of information operations. The convergence of deepfakes, AI-generated bodies and faces, and AI writing technologies – that appear authentic – are corrosive to trust between governments and their populations present the potential for devastating impact on nation-states’ will to compete and fight.

e. Expansion of the battle area. Nations, non-state actors, and even individuals will be able to target military forces and civilian infrastructure at increasing – often over intercontinental – ranges using a host of conventional and unconventional means. The revolution in connected devices and virtual power projection will increase the potential for adversaries to target our installations. Hyper-connectivity increases the attack surface for cyber-attacks and the access to publicly available information on our Soldiers and their families, making personalized warfare and the use of psychological attacks and deepfakes likely. A force deploying to a combat zone will remain vulnerable from the Strategic Support Area – including individual Soldiers’ personal residences, home station installations, and ports of embarkation – all the way forward to the Close Area fight during its entire deployment. Adversaries also will have the ability to target or hold at risk non-military infrastructure and even populations with increasingly sophisticated, nuanced and destructive capabilities, including weapons of mass destruction, hypersonic conventional weapons, and perhaps most critically, cyber weapons and information warfare. WMD will not be the only threat capable of directly targeting and even destroying a society, as cyber and information can directly target infrastructure, banking, food supplies, power, and general ways of life. Limited wars focusing on a limited area of operations waged between peers or strategic competitors will become more dangerous, as adversaries will have an unprecedented capability to broaden their attacks to their enemy’s homeland. The U.S. Homeland likely will not avoid the effects of warfare and will be vulnerable in at least eight areas (see figure 7-2.)

f. Shift in the ethics and law of warfare. Traditional norms of warfare, definitions of combatants and non-combatants, and even what constitutes military action or national *casus belli* will be turned upside down and remain in flux at all levels of warfare. The changed character of warfare may result in challenges and stresses to the existing law of warfare paradigm with corresponding significant changes on how the future Army operates. Does cyber activity, or information operations aimed at influencing national policy rise to the level of warfare? Is using cyber capabilities to target a national infrastructure legal if it has broad societal impacts? Can one target an electric grid that supports a civilian hospital, but also powers a military base a continent away from the battle zone from which unmanned systems are controlled? What is the threshold for WMD use? Is the use of autonomous robots against human soldiers legal? Is using a human Soldier in a dangerous situation ethical when there are robots available? These, and more questions will arise, and likely will be answered differently by individual actors.

g. The changes in the character of war by mid-century will be pronounced, and are directly related and traceable to our present. The natural progression of the changes in the character of war may be a change in the nature of war, perhaps sometime in the later end of this assessment or in the second half of the century.

Homeland Sectors Vulnerable to Disruption

Targeting the Homeland allows an adversary to delay U.S. forces' ability to deploy or intervene in a conflict and directly target the nation's political decision-making process and will to fight.

- **Agriculture & food supply** – Those areas affecting acquisition, processing, and availability of foodstuff
- **Finance, banking, and commerce** – Disruption of financial networks, availability of funds, confidence in markets, and access to retail
- **Rule of Law / Government institutions** – Degrade confidence in the Government's ability to provide functioning, stable, and legitimate law and order, services, and governance
- **Transportation** – Prolonged interruption of air, cargo, and public sectors
- **Medical** – Loss of services, corruption of supply chain, inability to react to pandemics
- **Water** – Contamination of public supply, disruption of distribution, and loss of access to water
- **Power** – Disruption to the electromagnetic spectrum over wide areas and interdiction of power generation
- **Entertainment and information** – Attacks against arenas and public gathering places, prolonged internet denial, and loss of confidence in journalism

Figure 7-2. Homeland sectors vulnerable to disruption

Chapter 8

Conclusion

8-1. Precipice of change

Forecasting the future, particularly the deep future, is a daunting task, but the global trends that we have discerned through our study of the OE and captured in this assessment in terms of how we live, create, think, and prosper, are rapidly gathering momentum and shaping every facet of society and international discourse, including security policy and warfare. An analysis of the OE shows these trends to be inexorable, bringing with them rapid and often uncomfortable changes that will force us to reevaluate many aspects of strategy, policy, and our very lives. So what can we, as an Army, learn from this analysis? The first, and most important lesson is to understand and internalize the idea that we stand at a precipice of change, where our time-honored successes and the ideas, concepts, doctrine, equipment, training, and personnel that achieved them probably are insufficient to achieve successes in the near term, and certainly are, if not revised or re-assessed, insufficient in the mid- to long-terms. We already have seen our most capable potential challengers – the “2+3” – take advantage of new technologies and military thought to form niche, and in some select cases, even wide-spread overmatch against U.S. joint capabilities. Starting with this present, and our understanding of the transformative impact of technology and the increasing speed of human interaction, an analysis of the OE shows that these trends will only intensify, moving through an Era of Accelerated Human Progress, where the distance between our own capabilities and effectiveness and our adversaries', recedes and then levels, to a mid-century point where capabilities and technologies are relatively even between actors, and true advantage comes in the art of mastering a series of interconnected competitions across all domains that seek effects in multiple dimensions.

8-2. Laying the groundwork

For the Army, the ultimate drivers of the future will depend largely on the imminent decisions we make today with respect to strategy and policy, concepts, innovation, and adaptation. Although the future that we postulate in this paper is not certain, the trends we see demonstrate that the character of warfare is changing. For the nation and the Army to succeed, we must quickly learn and internalize this fact, and lay the groundwork today for success in the future.

Glossary

Section I Abbreviations

AFC	United States Army Futures Command
AI	artificial intelligence
DIME	diplomatic, information, military, and economic
OE	Operational Environment
TRADOC	U.S. Army Training and Doctrine Command

Section II Terms

Deepfakes

A technique for human image synthesis using artificial intelligence and generative adversarial networks that superimposes false images or videos onto original images or videos creating the impression that the edited version is authentic.

Operational Environment (OE)

A composite of the conditions, circumstances, and influences that affect the employment of capabilities and bear on the decisions of the commander.

