Supporting the National Defense Strategy

A Profile of Relevant RAND Research

The National Defense Strategy (NDS) articulates goals and strategies for U.S. military planning. Issued by the Secretary of Defense, the NDS also identifies the capabilities required by the U.S. armed forces to support the strategy set forth in the National Security Strategy. It further establishes a framework for other U.S. Department of Defense (DoD) strategic guidance, including campaign and contingency planning, force development, and intelligence. The 2018 NDS represents a significant shift in focus for U.S. defense planning, from terrorism and insurgency to great-power competition.

Throughout its history, the RAND Corporation has played a role in framing, shaping, articulating, and implementing U.S. defense strategies. Beginning with the first NDS in 2005, RAND thought leaders and analysts have helped U.S. defense leaders prepare and execute the NDS. With a new NDS due to be crafted in 2022, RAND remains well positioned to continue to inform the NDS with research and analysis on defense and national security trends, policies, operations, and organizational structures at home and abroad.

This document describes RAND's contributions to shaping the 2018 NDS, as well as ongoing contributions to DoD's efforts to create the forces, posture, and operating concepts needed to achieve the goals of the NDS.

The information in this document is based on a large, long-standing, and continuously augmented body of RAND national security research, much of which is available for free download on www.RAND.org. References and links to RAND publications are supplied when available. Additional relevant RAND publications are often accessible via Intelink to users with a valid Common Access Card (CAC) or other access privileges.

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Changing Directions: Helping Shape the 2018 NDS

For the first time since the end of the Cold War, DoD has adopted a defense strategy predicated on meeting the challenges posed by other great powers and not by regional adversaries or terrorist groups. This represents a major change in direction. The executive summary of the 2018 NDS warns, "We are facing increased global disorder, characterized by decline in the long-standing rules-based international order. . . . Inter-state strategic competition, not terrorism, is now the primary concern in U.S. national security" (DoD, 2018, p. 1).

RAND analysis directly informed this shift in focus. Prior to the development of the 2018 NDS, RAND described the erosion of U.S. military superiority and the growing challenge from great-power adversaries. RAND's work highlighted two themes: **the emergence of a new international order** and **the erosion of U.S. military superiority over global competitors.**

Emergence of a New International Order

Since the end of World War II, the United States has pursued its interests in three ways: by leading in international political and economic institutions, by establishing bilateral and regional security and trade organizations, and by promoting liberal political norms—mechanisms that, in combination, constituted the foundations of the postwar international order. In recent years, that international order has come under strain amid rising great-power rivalries. At the same time, U.S. and European elections have highlighted the rise of nationalism and called into question the value to some voters of global interdependence. **RAND analysis helped U.S. decisionmakers understand the risks of a changing international system of governance and frame alternative policy options.** The analysis was briefed widely throughout the U.S. government and to officials in allied nations around the globe. Findings on the complexity and volatility of the emerging international order influenced how the NDS describes the strategic environment.

Understanding the Current International Order, Michael J. Mazarr et al., 2016, www.rand.org/t/RR1598

Erosion of U.S. Military Superiority over Global Competitors

The second theme centered on the growing challenges posed by two great-power adversaries—China and Russia. **As RAND has pointed out, China and Russia—and, to an extent, North Korea and Iran—are deliberately challenging the United States' military advantages and ability to defend U.S. interests and allies around the globe.** RAND analysis highlighted actions that each of these nations has taken to field systems, develop concepts of operations, and posture forces that systematically undermine the ability of U.S. military forces to project power abroad. The underpinning of U.S. defense strategy—the expectation of U.S. and allied military dominance—has become increasingly untenable. The potential consequences of these trends for the United States are diminished abilities to defend its strategic interests, honor its security commitments, and protect the homeland.

Specific RAND analyses highlighted the following areas of growing concern:

- Wargames and analyses dating back to the early 2000s revealed China's growing ability to contest and defeat U.S. military operations in the Western Pacific and Southeast Asia. For additional information on these projects, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.
- Beginning in 2014, RAND conducted a series of wargames that examined the dynamics of a conflict sparked by a Russian invasion of the Baltic states. The findings showed that, as North Atlantic Treaty Organization (NATO) forces are

currently postured, NATO cannot successfully defend the Baltic states against Russian aggression. This work helped galvanize the U.S. and allied response to a more aggressive Russia.

Reinforcing Deterrence on NATO's Eastern Flank: Wargaming the Defense of the Baltics, David A. Shlapak and Michael Johnson, 2016, www.rand.org/t/RR1253

- An analysis of evolving Chinese military capabilities found that China has made gains relative to the United States in most operational areas and, in some cases, with startling speed—particularly in its ability to deny U.S. access to contested areas in the Eastern Pacific. China's ability to project power beyond East Asia is limited but improving.

  The U.S.-China Military Scorecard: Forces, Geography, and the Evolving Balance of Power, 1996–2017, Eric Heginbotham et al., 2015, www.rand.org/t/RR392

- In 2017, RAND researchers briefed the NDS drafting team on the results of a RAND-funded nine-month project aimed at recasting U.S. defense strategy and forces for an era dominated by great-power rivals. That project examined the current and future challenges posed by the "4 + 1" adversaries that had been publicly identified by DoD leaders—China, Russia, North Korea, Iran, and selected Salafist-jihadi groups—and defined the types of military capabilities and postures that would be appropriate for deterring and defeating aggression by each of them. The project team posited three U.S. force levels at three levels of funding, each of which was tailored to the demands of the future security environment. The report called on DoD to abandon its decades-long adherence to the force-sizing criterion based on defeating aggression by two regional adversary states and to replace it with one focused on defeating aggression by a major-power adversary.

  U.S. Military Capabilities and Forces for a Dangerous World: Rethinking the U.S. Approach to Force Planning, David Ochmanek et al., 2017, www.rand.org/t/RR1782-1

- In congressional testimony and briefings to defense policymakers, RAND drew on a body of analysis to highlight the shifting threat posed by North Korea. Historically, the United States and its allies viewed a North Korean invasion of South Korea as the main threat. But North Korea's development of long-range ballistic missiles and nuclear weapons has radically changed this view, and North Korea has emerged as a destabilizing force.

  RAND Corporation, "North Korea's Continuous Provocations," webpage, July 17, 2017b, https://www.rand.org/mm/north-koreas-continuous-provocations

  Assessing North Korea's Chemical and Biological Weapons Capabilities and Prioritizing Countermeasures, John V. Parachini, 2018, www.rand.org/t/CT486

The culminating work in this area identified key areas in which **the U.S. armed forces' edge over competitors is eroding** and quantified these trends. China, Russia, North Korea, and Iran are modernizing their forces in efforts to exploit U.S. vulnerabilities and undermine the United States' ability to project military power. The research synthesized more than a decade of RAND, DoD, and intelligence analyses and created accessible infographics for policymakers that detailed trends in specific military capabilities and operational concepts. This work has been shared with hundreds of current and former senior military, intelligence, and government leaders and directly influenced DoD and congressional discussions about short-term and long-term military capability investments. The analysis helped build a consensus within the U.S. government about the need to reorient defense strategy and investments to address these strategic shifts and trends. For additional information on this project, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

Drafting the 2018 NDS

To improve its grasp of the military challenges presented by adversary nations and of the options available for addressing these challenges, the DoD team tasked with drafting the 2018 NDS asked RAND for help. In response, a RAND team developed a wargame—a conflict simulation—involving experts focused on four global competitors: China, Russia, North Korea, and Iran. The game set out a variety of strategic scenarios and tasked the U.S. player with responding by allocating funds to key functions in DoD, such as *creating* new units, *building* new capabilities, *preparing* forces for combat, and *deploying* forces across the globe both in anticipation of and in response to competitors' actions. **The wargame provided the NDS team with a concrete way of comparing strategic approaches and helped them visualize strategic possibilities.** The NDS team drew directly on the game results in drafting the NDS. For additional information on this project, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

RAND research helped frame and clarify the strategic challenges articulated in the 2018 NDS: the rise of great-power competition, the emergence of a new international order, and the erosion of U.S. military superiority over global competitors.

RAND work continues. In support of the 2018 NDS objectives, RAND is conducting research oriented toward the three main NDS lines of effort:

- improving lethality to build the forces and capabilities that the U.S. military needs
- strengthening alliances and cultivating new partnerships
- transforming DoD business and management practices for greater performance and affordability.

In addition, RAND analysis is examining the technological context in which these lines of effort proceed—specifically, emerging and evolving technologies and their implications for competitor nations and U.S. forces and capabilities.

In the remainder of this document, we highlight several illustrative efforts from an extensive body of completed and ongoing RAND research in each of these areas. We will update this portion of the document periodically as we continue to add relevant projects to our portfolio.

Developing a More Lethal Force: Building the Forces and Capabilities We Need

> The surest way to prevent war is to be prepared to win one. Doing so requires a competitive approach to force development and a consistent, multiyear investment to restore warfighting readiness and field a lethal force. The size of our force matters. The Nation must field sufficient, capable forces to defeat enemies and achieve sustainable outcomes that protect the American people and our vital interests. Our aim is a Joint Force that possesses decisive advantages for any likely conflict, while remaining proficient across the entire spectrum of conflict. (DoD, 2018, p. 5)

In support of the 2018 NDS strategies of fielding a more lethal force, enhancing readiness, and improving capabilities, RAND analysis has examined adversary operational capabilities and competitive strategies, as well as U.S. force needs, with a particular focus on U.S. capabilities to project forces into contested and denied environments. We highlight several RAND projects focused on the five subareas that make up this NDS line of effort: (1) prioritizing preparedness for war; (2) modernizing key capabilities; (3) evolving innovative operational concepts; (4) developing a lethal, agile, and resilient force posture and employment; and (5) cultivating workforce talent.

Prioritizing Preparedness for War

Gaining Advantage in the Gray Zone. Much of the emerging great-power competition envisioned in the NDS is likely to play out below the threshold of armed conflict, in what is sometimes termed the "gray zone" between peace and war. RAND analysis examined how the United States might respond to Russian and Chinese efforts to seek strategic advantage through coercive actions in the gray zone. These actions include Russia's use of (1) disinformation campaigns meant to undermine political institutions and (2) economic tools to extract concessions. They also include China's unprecedented expansion of artificial islands, as well as the use of law enforcement and maritime militia vessels to deter or deny the use of resources in nearby waters. The analysis suggests that the United States can begin to treat gray zone competition more as an opportunity than a risk. Leaders in Europe and Asia view Russian and Chinese gray zone aggression as a meaningful threat and are receptive to U.S. assistance in mitigating it. The authors propose a strategic concept built on four complementary efforts: (1) shaping a context supportive of U.S. and partner objectives over the long term; (2) deterring a handful of extreme forms of gray zone aggression; (3) dissuading the day-to-day use of more-elaborate gray zone techniques; and (4) sustaining resilience in the lower-level, persistent competition areas. To implement the concept, the authors propose a list of response options, including stationing permanent new military capabilities in key locations, anticipating political meddling and blunting the effects with information operations planned in advance, and denying the aggressor participation in key economic institutions.

Gaining Competitive Advantage in the Gray Zone: Response Options for Coercive Aggression Below the Threshold of Major War, Lyle J. Morris et al., 2019, www.rand.org/t/RR2942

Russia's Hostile Measures: Combating Russian Gray Zone Aggression Against NATO in the Contact, Blunt, and Surge Layers of Competition, Ben Connable et al., 2020, www.rand.org/t/RR2539

> During normal day-to-day operations, the Joint Force will sustainably compete to: deter aggression in three key regions—the Indo-Pacific, Europe, and Middle East; degrade terrorist and [weapons of mass destruction] threats; and defend U.S. interests from challenges below the level of armed conflict. (DoD, 2018, p. 6)

Detecting and Assessing Russian Destabilization Efforts. A RAND team developed a tool—the Activities and Conditions Tracker for Irregular Warfare Vulnerabilities (ACTIV)—to assist U.S. government agencies in detecting and assessing Russian destabilization efforts targeted at the United States and its allies. Over the past ten years, Russia and other adversary nations have attempted to disrupt or undercut U.S. interests and security, as well as those of U.S. allies. These campaigns typically target vulnerable environments through such means as predatory economic practices, propaganda, political subversion,

and economic influence. The difficulty of detecting and tracking such activities poses a challenge to the United States and its allies in developing successful strategies to counter and defeat these operations. ACTIV helps U.S. military leaders develop data-driven strategies regarding such activities and has already been used to inform U.S. offensive strategies. The tool and its uses have been briefed widely to senior-level audiences, including commanders at U.S. Special Operations Command, who, in turn, have presented the tool's results to larger audiences. Currently, researchers are refining and expanding the tool by conducting analyses on indirect attacks on countries both inside and outside NATO.

For additional information on this project, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

What Deters and Why. The challenge of deterring territorial aggression, which has not been a priority of U.S. strategy for several decades, is taking on renewed importance. An increasingly belligerent Russia is threatening Eastern Europe and the Baltic states with possible aggression, conventional and otherwise. China is pursuing its territorial ambitions in the East and South China Seas with greater force, including through the construction of artificial islands and occasional bouts of outright physical intimidation. And North Korea, with its rapidly advancing nuclear arsenal, remains a persistent threat to South Korea that could now include large-scale aggression. In the context of these growing threats, DoD, including multiple services and regional commands, has been assessing the relative value of defense investments oriented toward deterrence. A RAND study developed criteria that can help assess the strength of deterrent relationships—based on such factors as the perceptions of aggressors and the degree of political will implied by U.S. deployments—and provided general insights into the requirements of deterrence. These findings can help inform U.S. decisions on posture, security cooperation activities, and capability investments. For further information on this portfolio of research, contact Sally Sleeper, vice president and director, RAND Arroyo Center, sleeper@rand.org.

What Deters and Why: Exploring Requirements for Effective Deterrence of Interstate Aggression, Michael J. Mazarr, Arthur Chan, et al., 2018, www.rand.org/t/RR2451

Modernizing Key Capabilities

> To address the scope and pace of our competitors' and adversaries' ambitions and capabilities, we must invest in modernization of key capabilities through sustained, predictable budgets. Our backlog of deferred readiness, procurement, and modernization requirements has grown in the last decade and a half and can no longer be ignored. We will make targeted, disciplined increases in personnel and platforms to meet key capability and capacity needs.
>
> (DoD, 2018, p. 6)

Capabilities and Concepts to Solve NDS Operational Challenges. The 2018 NDS articulates concerns about shortfalls and gaps in U.S. operational capabilities. RAND is helping DoD strengthen the lethality of the armed forces by conducting cost-effectiveness analyses of capabilities and concepts to address these concerns. For example, RAND analyses of the Teamed Delivery Vehicle and Gunslinger concepts contributed to two new programs—LongShot and Gunslinger—that show promise for improving effectiveness in air-to-air combat, cruise missile defense, and close air support. In another project,

researchers analyzed the Hypervelocity Gun Weapon System, establishing its potential contributions to ships' self-defense and contributing to Navy and Strategic Capabilities Office deliberations to sustain prototyping activity in fiscal year 2020. RAND is also providing analytic support to the Defense Advanced Research Projects Agency's Adaptive Capability Office with the Assault Breaker II program and to the Missile Defense Agency with the development of concepts for boost-phase intercept of hypersonic, cruise, and ballistic missiles.

For additional information on these projects, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

Standing Up a New Space Service. DoD is creating the Space Force as an independent service within the Department of the Air Force to provide vital capabilities in peacetime and across the spectrum of conflict. RAND developed an analytic approach to determine which units to bring into the Space Force and to examine how a transfer might affect organizational effectiveness, efficiency, independence, and sense of identity. The analysis concluded that the majority of space activities in DoD (operations, as well as associated space intelligence and training units and space acquisition organizations) should be moved into the Space Force. The authors observed that if the Space Force were limited to being a force enabler rather than directly engaging in combat, it would have difficulty demonstrating its effectiveness and efficiency, justifying its existence as an independent service, and developing a distinctive identity. To address these concerns, the authors recommended several steps, particularly that the new Space Force should begin to define its identity by developing and clarifying space warfighting missions, promulgating a coherent space warfighting theory, and developing service-specific weapon and support systems.

A Separate Space: Creating a Military Service for Space, Michael Spirtas et al., 2020, www.rand.org/t/RR4263

Modernizing Nuclear Capabilities. The Air Force is embarking on a vast modernization of its portion of the nation's nuclear deterrence capabilities. These modernization activities face a range of challenges. Nuclear-specific tasks related to testing and certification have not been performed at scale for many decades and will need to be relearned and revised for the current conditions. This ambitious set of programs will be fielded by Air Force Global Strike Command (AFGSC), a relatively young command with a relatively small staff that has limited experience in fielding new systems. Because nuclear weapon systems are meant to deter, it is not enough for them to work reliably and effectively—all adversaries must be convinced of this ability. A RAND report identified and described means to allay these challenges. The authors recommended that the Air Force develop a master plan for two key functions: the land-based strategic deterrent and the strategic bomber deterrent. They also recommended that AFGSC reach out to other major commands to learn from their experiences in procuring and fielding weapon systems.

Managing Nuclear Modernization Challenges for the U.S. Air Force: A Mission-Centric Approach, Don Snyder et al., 2019, www.rand.org/t/RR3178

Evolving Innovative Operational Concepts

Joint Warfighting Concept Development. After two decades of counterinsurgency campaigns in Iraq and Afghanistan, the U.S. military is turning its focus to fighting large, conventional conflicts against nuclear-armed powers—namely, China and Russia. Given this challenge, the military needs top-down guidance in the form of a joint warfighting concept (JWC): a description of new ways to equip, posture, and employ forces that can reverse the erosion of military balances, especially vis-à-vis China and Russia. RAND is providing analytical and wargaming support to the Joint Staff as they draft and evaluate a new JWC in parallel with the development of a

concept of operations for a classified problem set. This project consists of two major components: (1) roundtable discussions and a synthesis session on the emerging JWCs with subject-matter experts to assist the Joint Staff writing team in refining a final JWC and (2) a series of tabletop exercises to examine the principal and alternative JWCs against the classified scenario to determine the best combination of ideas for a final JWC. The final JWC will be examined in an alternative scenario to verify its robustness across problem sets. The objective is to enable the Joint Staff to prepare a JWC that is robust across NDS demands by December 2020.

For additional information on this project, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

> Modernization is not defined solely by hardware; it requires change in the ways we organize and employ forces. We must anticipate the implications of new technologies on the battlefield, rigorously define the military problems anticipated in future conflict, and foster a culture of experimentation and calculated risk-taking. (DoD, 2018, p. 7)

An Alternative Force for the U.S. Air Force. In one approach to reversing the erosion of U.S. military dominance over great-power adversaries, RAND is helping the Air Force explore new concepts for projecting power and identify the capabilities needed to enable those concepts. RAND estimated costs for an "alternative Air Force" to be used in wargames and analyses set in 2030. The alternative force is now being used in Air Force–sponsored wargames with the goal of gaining insights about new ways of fighting. The Air Force has incorporated some of the capabilities and operational concepts from this project into its work on capability development and force design.

For additional information on this project, contact Ted Harshberger, vice president and director, RAND Project AIR FORCE, tharsh@rand.org.

Spurring Innovation in the U.S. Air Force. Early in 2018, the Air Force established its Warfighting Integration Capability (WIC)—an office within the Air Staff charged with devising new operational concepts focused on deterring and defeating aggression by great-power adversaries. RAND has worked hand-in-glove with WIC since its inception, providing quick-turn, tailored analyses; participating in concept development efforts; and supporting WIC in Air Force–sponsored wargames to test those concepts. That collaboration has produced promising new approaches for projecting power in highly contested environments; the work is continuing this year.

For additional information on this project, contact Ted Harshberger, vice president and director, RAND Project AIR FORCE, tharsh@rand.org.

Developing a Lethal, Agile, and Resilient Force Posture and Employment

Restoring U.S. Power Projection Capabilities: A Response to the 2018 NDS. A principal challenge articulated in the NDS is the declining U.S. ability to project power because of adversary forces' growing ability to deny access. The challenges posed by Chinese and Russian forces are such that simply buying more and better weapons will not reverse this trend. To restore the ability to defeat aggression by these adversaries, U.S. forces will need to conceive of and implement new approaches to power projection. Based on accumulated RAND research, a RAND Perspective laid out the broad outlines of a new approach to power projection. First, forward-based U.S. forces and

infrastructure must be able to withstand initial attacks by enemy anti-access systems and provide essential enabling capabilities for early strike operations. Second, U.S. forces must find ways to reach into contested parts of the battlespace to damage key elements of the enemy's invading forces from the outset of hostilities, without first establishing dominance in key warfighting domains. Third, if these early strikes can blunt the enemy's offensive thrusts, they can buy time for other elements of the joint force to degrade key elements of the enemy's anti-access complex and pave the way for follow-on operations. The author concluded that, with a fairly modest but sustained and predictable increase in funding for modernization, U.S. forces could field the capabilities needed to enable this new approach to projecting power and defeating aggression.

Restoring U.S. Power Projection Capabilities: Responding to the 2018 National Defense Strategy, David Ochmanek, 2018, www.rand.org/t/PE260

> Force posture and employment must be adaptable to account for the uncertainty that exists in the changing global strategic environment. Much of our force employment models and posture date to the immediate post-Cold War era, when our military advantage was unchallenged and the primary threats were rogue regimes. (DoD, 2018, p. 7)

Enabling Air Combat Operations in Denied Environments. Russian and Chinese missile capabilities—and even those of second-tier opponents, such as Iran—pose a growing threat to U.S. and allied air bases and surface vessels. To deter aggression and ensure success in a conflict, allied forces must be able to absorb and recover from missile attacks against critical facilities. Doing so requires fresh thinking about aircraft basing and dispersal; combat support prepositioning; active and passive defense measures; and camouflage, concealment, and deception operations. Over the past decade, RAND has conducted a continuing series of analyses to help the Air Force, the Office of the Secretary of Defense, and other joint organizations identify cost-effective ways to improve air base resiliency in contested environments; in particular, RAND has developed a suite of simulation tools to support quantitative trade-off analysis. Results have been used to develop and support investment decisions for both passive and active defense measures to evaluate alternative theater aircraft beddown and dispersal options (including assessment of current operational plans) and to evaluate the effectiveness of new concepts of operations.

For additional information on this portfolio of projects, contact Ted Harshberger, vice president and director, RAND Project AIR FORCE, tharsh@rand.org; or Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

Assessing the Deterrent Effect of a U.S. Overseas Presence. Should the United States continue to play a principal role in the international security system by sustaining its overseas security commitments? RAND examined the deterrent impact of U.S. forces overseas. The analysis provided clear evidence supporting the fact that the presence of U.S. heavy ground forces has a deterrent effect, particularly when deployed near, but not directly bordering, potential adversaries. The more mobile the forces, the less evidence there is of a deterrent effect. During crises, mobile forces can help avoid escalation and maintain the status quo, but such mobile forces are not necessarily well suited to altering the long-term strategic dynamics between states.

Understanding the Deterrent Impact of U.S. Overseas Forces, Bryan Frederick et al., 2020, www.rand.org/t/RR2533

Cultivating Workforce Talent

> Recruiting, developing, and retaining a high-quality military and civilian workforce is essential for warfighting success. Cultivating a lethal, agile force requires more than just new technologies and posture changes; it depends on the ability of our warfighters and the Department workforce to integrate new capabilities, adapt warfighting approaches, and change business practices to achieve mission success. The creativity and talent of the American warfighter is our greatest enduring strength, and one we do not take for granted.
>
> (DoD, 2018, pp. 7–8)

Military Education on the Chinese Concept of War. RAND analysis of the Chinese army's concept of war has become the basis for a textbook for a new joint professional military education course rolled out in 2019. The report notes that People's Liberation Army leaders understand modern warfare as a confrontation between opposing operational systems; that is, war is waged by "systems of systems" rather than by individual soldiers, ships, planes, or tanks. In the resulting "system destruction warfare," war no longer focuses on the annihilation of enemy forces on the battlefield. Rather, it is won by the side that can disrupt, paralyze, or destroy the capability of the enemy's entire operational system. Such war takes place not only on land, sea, and air but also in the space, cyberspace, electromagnetic, and even psychological domains. The work has been briefed at the highest levels in more than 20 organizations in the U.S. Air Force, Navy, Army, and Joint Staff and is being used by the Office of the Secretary of Defense to inform operational planning, intelligence, and procurement decisions.

Systems Confrontation and System Destruction Warfare: How the Chinese People's Liberation Army Seeks to Wage Modern Warfare, Jeffrey Engstrom, 2018, www.rand.org/t/RR1708

Training of Joint Qualified Officers. The passage of the Goldwater-Nichols Department of Defense Reorganization Act in 1986 resulted in significant personnel reforms in defining and developing joint military officers. Over time, policies have been updated to reflect operational considerations and to provide additional enhancements and flexibility. RAND analysis quantified and assessed the production of joint qualified officers and joint professional military education outcomes against which to assess historical trends. The authors found that, despite an increasing variety of venues in which to complete educational requirements, joint education was based on the timing and availability of officers within their career progression rather than in the preferred way in which education precedes joint assignment. They also found that the services have taken diverse approaches to talent management and the timing associated with developing joint officers. The findings led DoD to reconsider its stance on joint education and to shift joint instructional content to an outcomes-based approach. Joint policy documents are being revised to codify these results and encourage the development of new initiatives. The research also has been incorporated into a new DoD instruction on military education.

Producing Joint Qualified Officers: FY 2008 to FY 2017 Trends, Paul W. Mayberry, William H. Waggy II, and Anthony Lawrence, 2019, www.rand.org/t/RR3105

21st Century Skills for the Air Force. The job skills needed for the current century are rapidly changing. Advances in technology mean that workers must be trained in cognitive and interpersonal skills that help them adapt to new requirements; these skills are known as 21st century skills. Cognitive skills include critical thinking, problem-solving, creativity, cognitive flexibility, judgment, decisionmaking, and the ability to acquire and use information. Interpersonal skills include adaptability, collaboration, leadership, oral and written communication (including in foreign languages), cultural competency, and emotional intelligence (understanding and constructively managing one's own emotions). These 21st century skills frame an individual's ability to assess and respond to situations effectively. In a RAND Perspective, the authors share research from the private and education sectors on 21st century skills and suggest ways in which further exploration could inform and improve U.S. Air Force efforts to increase the agility of airmen. The research approaches suggested could ultimately inform the continuum of learning and development in the Air Force. First, the Air Force might examine current institutional competencies with 21st century skills to draw out relevant competencies and identify potential updates or nuances. Although many of the key 21st century skills are embedded in existing Air Force competencies, a supplementary document that calls out these skills and prioritizes them would provide the framework needed to foster their development. In addition, the Air Force should explore strategies to elevate the importance of these skills by incorporating concrete assessments of 21st century skills in promotion decisions.

Improving 21st Century Skills in the U.S. Air Force, Rebecca Herman et al., 2019, www.rand.org/t/PE275

Strengthening Alliances and Cultivating New Partnerships

> Mutually beneficial alliances and partnerships are crucial to our strategy, providing a durable, asymmetric strategic advantage that no competitor or rival can match. This approach has served the United States well, in peace and war, for the past 75 years. Our allies and partners came to our aid after the terrorist attacks on 9/11, and have contributed to every major U.S.-led military engagement since. Every day, our allies and partners join us in defending freedom, deterring war, and maintaining the rules which underwrite a free and open international order. (DoD, 2018, p. 8)

The 2018 NDS is built on the expectation of a new era of intensifying international competition, characterized by the United States confronting growing political, economic, and military competition. It focuses on three elements for building enduring, successful coalitions:

- **Upholding a foundation of mutual respect and responsibility.** U.S. alliances have shared responsibilities for resisting authoritarian trends, contesting radical ideologies, and serving as bulwarks against instability.

- **Expanding regional consultative mechanisms and collaborative planning.** U.S. military forces will develop new partnerships around shared interests to reinforce regional coalitions and security cooperation.
- **Deepening interoperability.** Combined forces will be able to act together coherently and effectively to achieve military objectives requiring interoperability. Interoperability is a priority for operational concepts, modular force elements, communication systems, intelligence-sharing, and equipment.

In light of these principles, the NDS highlights five focus areas with respect to alliances and partnerships: (1) expanding Indo-Pacific alliances and partnerships; (2) fortifying the NATO alliance; (3) forming enduring coalitions in the Middle East; (4) sustaining advantages in the Western Hemisphere; and (5) supporting relationships to address significant terrorist threats in Africa. RAND is conducting work in all of these areas, continuing to examine how the coming era of international competition might play out and how the United States can adapt by strengthening existing alliances and forging new security partnerships.

Strengthening Alliances

Strengthening NATO's Amphibious Forces. In a series of seminars and wargame exercises, RAND supported efforts by NATO's Allied Maritime Command and by U.S. Marine Forces Europe and Africa to establish a U.S.-European amphibious task force to respond to contingencies, including a major war. The seminars and exercises led military leaders to recognize the urgent challenge involved in establishing command and control of allied maritime and amphibious forces for the multinational amphibious task force. These results prompted the decision to form a new NATO command—the Joint Force Command Norfolk—which is exploring an enhanced role for amphibious forces within the NATO alliance. This decision was confirmed in the July 2018 NATO Summit declaration.

NATO's Amphibious Forces: Command and Control of a Multibrigade Alliance Task Force, Gene Germanovich et al., 2019, www.rand.org/t/RR2928

Deepening Defense Ties in the Indo-Pacific Region. Key U.S. partners in the Indo-Pacific region—Australia, Japan, the Philippines, and South Korea—are also cooperating with such non–U.S.-treaty countries as India, Indonesia, and Vietnam, which have aligned themselves more closely with the United States as China has grown both more powerful and more assertive in recent years. As a consequence, important new linkages and security commitments among regional actors are forming, with substantial consequences for the United States, China, and the Indo-Pacific region. In addition, the United States continues to enjoy strong support across the region, and numerous actors are expanding their security partnerships out of a desire to reinforce the existing regional order centered on U.S. alliances in order to help share the burdens of maintaining security. The analysis points out the importance of understanding the diverse motivations that regional actors have for expanding and deepening their regional security partnerships. In some cases, counterterrorism and counterpiracy, not Chinese assertiveness, are driving increased cooperation. The analysis also highlights key areas for building partner capacity.

The Thickening Web of Asian Security Cooperation: Deepening Defense Ties Among U.S. Allies and Partners in the Indo-Pacific, Scott W. Harold et al., 2019, www.rand.org/t/RR3125

Interoperability with Strategic Partners. In recent decades, the United States has engaged with multinational partners and allies in military operations, highlighting the need for the increased interoperability of systems. RAND researchers examined the current state of interoperability and developed an approach to identifying future interoperability needs. The authors

developed a framework to assess the different kinds of benefits the Army might derive from increased interoperability with various partners and the possible costs and challenges associated with achieving interoperability. Building on this work, RAND conducted an analysis of alternatives for selecting an enduring interoperability measurement system. The Army adopted the recommendations and requested a follow-on focus to developing a new prototype system (Army Interoperability Measurement System, or AIMS). Results have been used to create multiple records of decisions between the U.S. Army and several of its critical partners.

Targeted Interoperability: A New Imperative for Multinational Operations, Christopher G. Pernin et al., 2019, www.rand.org/t/RR2075

Understanding the Emerging Era of International Competition. Follow-on work to RAND's analysis of the emerging international order concluded that competition is likely to be most intense between a handful of specific states with status grievances and countervailing regional and global alliances and coalitions, including the wider international community. The competition is likely to be most intense and persistent in nonmilitary areas of national advantage, and the targeting of other societies in these areas creates emerging and poorly understood risks of escalation. Managing rivalries, conflicts, and the risks of escalation—rather than winning or losing—is a more useful mindset for understanding the emerging era.

Understanding the Emerging Era of International Competition: Theoretical and Historical Perspectives, Michael J. Mazarr, Jonathan S. Blake, et al., 2018, www.rand.org/t/RR2726

Cultivating New Partnerships

Informed Strategies for Strengthening Alliances and Attracting New Partners. In a series of analyses for the Air Force, RAND evaluated the Air Force's approach to partner capability assessment. RAND suggested revisions, validated these revisions through country-specific case studies, and developed a formalized process for implementing a new data-driven approach for Air Force resource decisions. RAND also assessed how nine U.S. allies and partners are responding to China's growing assertiveness in the region and how the Air Force, joint force, and U.S. government can strengthen key relationships. RAND recommended that the Air Force develop five-year security cooperation plans with Australia (for Indonesia and Malaysia) and Japan (for the Philippines and Vietnam) and that the joint force focus on engaging Indonesia, Malaysia, Thailand, and Vietnam. The Chief of Staff of the Air Force and the Commander of Pacific Air Forces used the analysis to shape their approach during visits to the region in September 2019.

For additional information on this project, contact Ted Harshberger, vice president and director, RAND Project AIR FORCE, tharsh@rand.org.

Reforming Security Sector Assistance for Africa. Although the NDS focuses on great-power competition, it also stresses the importance of security collaborations in key regions. The United States has sought to combat threats in Africa mainly by providing security sector assistance (SSA) to partner governments on the continent. A RAND team assessed the effectiveness of U.S. SSA to Africa going back to the Cold War period. The analysis found that U.S. SSA has a mixed record in Africa. In the post–Cold War era, SSA appears to have had little or no net effect on political violence. In peacekeeping contexts, however, SSA has reduced the incidence of civil wars, terrorism, and state repression. Many of the practices associated with SSA in peacekeeping contexts might be adopted in other environments. The authors recommended a programmatic focus on U.S. investments in the capabilities needed to produce durable improvements in its African partners' internal security.

Building Security in Africa: An Evaluation of U.S. Security Sector Assistance in Africa from the Cold War to the Present, Stephen Watts et al., 2018, www.rand.org/t/RR2447

The National Will to Fight. An important consideration in assessing potential security partners or sizing up adversaries is a nation's "will to fight." What drives some governments to persevere in war at any price while others choose to stop fighting? It is often less-tangible political and economic variables rather than raw military power and capability that ultimately determine national will to fight. RAND analysis explored how these variables strengthen or weaken a government's determination to conduct sustained military operations. Understanding our allies' and adversaries' will to fight is essential in planning for future contingencies. This understanding can help identify weaknesses and vulnerabilities that can be exploited (in the case of adversaries) or addressed (in the case of allies).

The National Will to Fight: Why Some States Keep Fighting and Others Don't, Michael J. McNerney et al., 2018, www.rand.org/t/RR2477

Will to Fight: Analyzing, Modeling, and Simulating the Will to Fight of Military Units, Ben Connable et al., 2018, www.rand.org/t/RR2341

Aligning Security Cooperation Activities with Strategic Goals in the Asia-Pacific Region. Military-to-military security cooperation (SC) activities are intended to strengthen relationships with U.S. partners, enhance partner military capabilities, and facilitate access to foreign countries should a contingency require it. RAND researchers examined U.S. Army SC processes in the Pacific Command and developed a framework to link tactical- and operational-level SC activities with strategic goals for the region. The analysis also identified information requirements for units conducting SC activities. The planners for SC events are typically not the same personnel who conduct them. Coordinating information flows and developing clear strategic themes shared with all participants would ensure that all participants are working from the same information. The SC strategic evaluation process could also be improved by specifying in advance the intermediate outcomes that should be observable if SC events are indeed contributing to strategic-level goals.

Pacific Engagement: Forging Tighter Connections Between Tactical Security Cooperation Activities and U.S. Strategic Goals in the Asia-Pacific Region, Stephen Watts et al., 2018, www.rand.org/t/RR1920

Transforming Organizational Performance

> Delivering performance means we will shed outdated management practices and structures while integrating insights from business innovation. (DoD, 2018, p. 10)

To achieve optimal results in a resource-constrained environment, DoD and the broader national security community need to modernize processes and practices and perform as efficiently as possible.

As the operator of three of DoD's federally funded research and development centers, RAND has a long and successful history of helping DoD save money, steward resources efficiently, and improve organizational performance. Recent analysis in support of the NDS has focused on four areas in which DoD could potentially save substantial amounts of money and improve performance: acquisition, logistics, force development, and workforce management.

Saving the Government Money: Recent Examples from RAND's Federally Funded Research and Development Centers, RAND Corporation, 2017a, www.rand.org/t/CP485-2017-12

Improving Acquisition Efficiency

Baseline Measures for Improving Defense Acquisition. To support improved efficiency in defense acquisition, DoD asked RAND to construct a baseline of DoD's government acquisition and procurement functions, including estimates of the cost of the government portion of DoD's acquisition

enterprise. Researchers estimated these costs at between $29 billion and $38 billion in fiscal year 2017 dollars. To put these costs into perspective, researchers identified commercial benchmarks for the amount of program management levels. Researchers estimated that DoD's program management portion of DoD contracting obligations was about 1.5 percent in the past few years, which is below industry benchmarks of 2–15 percent. These results may indicate that DoD's and Congress's investments in increasing the size and quality of the acquisition workforce may be showing measurable benefits.

Baselining Defense Acquisition, Philip S. Anton et al., 2019, www.rand.org/t/RR2814

Strategies for Acquisition Agility. The Air Force and DoD have employed a range of approaches to speed the acquisition of military capabilities to keep pace with evolving threats and technology opportunities. RAND analyzed the various approaches, assessed their suitability for different conditions and types of acquisition, and identified implementation issues. Few agility techniques are universally applicable. The right one for a given acquisition depends on the conditions for application, the domains involved (e.g., requirements, budgeting, acquisition), and implementation issues. The authors observed that agility depends not just on acquisition but also on requirements, budgeting, technology, and intelligence activities. Speed may still involve making a compromise in cost or technical performance objectives.

For additional information on this project, contact Ted Harshberger, vice president and director, RAND Project AIR FORCE, tharsh@rand.org.

Modernizing Logistics Planning and Systems

Evaluating the Effectiveness of the Joint Logistics Enterprise for Supporting the NDS. A RAND project is assessing the ability of DoD's joint distribution and sustainment enterprise to meet the demands associated with conflicts against great-power adversaries. The analysis is examining whether current planning sufficiently accounts for the effectiveness of current decision processes in meeting warfighting demands in contested environments. Analysis to date has found important planning gaps that limit the ability of the enterprise to implement the NDS and offers options to address these gaps.

For additional information on this portfolio of projects, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

Modernizing the Naval Operational Supply System. The Navy uses 16 core information systems to help it manage afloat supply operations for its 276-vessel battle force. Its disparate, outdated systems have problems with reliability, supportability, maintainability, and affordability. The Navy asked RAND to help in conducting an analysis of alternatives for the service's future operational supply, food service, and retail operations capability, known as the Naval Operational Supply System, or NOSS. The analysis concluded that commercial-off-the-shelf software offers the best options for modernizing this system and recommended that the Navy move forward with such approaches. The Navy has options to manage the risks of choosing any alternative. It could, for example, minimize risk by prototyping. Furthermore, ensuring that the requirements are achievable without significant customization could also minimize risk.

Naval Operational Supply System: Analysis of Alternatives, Bradley Wilson et al., 2018, www.rand.org/t/RR2403

Improving Force Development

Improving Force Development in DoD. DoD's processes for assessing future challenges and adjusting force plans and investment priorities to meet those challenges have not produced satisfactory results. Recognizing this, RAND funded a small effort to identify the causes of this failure and develop recommendations for improving performance. In a RAND Perspective, the author recommended a series of changes to DoD's processes and organization for force assessment and development. He also suggested seven operational challenges that could be used to better focus analysis and force design within DoD.

Improving Force Development Within the U.S. Department of Defense: Diagnosis and Potential Prescriptions, David Ochmanek, 2018, www.rand.org/t/PE302

Rethinking Workforce Management

Military Compensation as a Human Resource Tool. Military compensation strategy offers a useful avenue for helping the services meet readiness objectives. The strategy includes attracting and retaining personnel; motivating effort; inducing members to fill the ranks, positions, and jobs for which they are best suited; and, eventually, separating personnel at the end of their careers. Drawing on a large body of research, RAND analysis described the role of military compensation as a strategic human resource tool. The author found that, in recent years, military pay has exceeded the 70th percentile for both officers and enlisted personnel, raising the question of whether military pay is set appropriately relative to civilian pay. The primary source of flexibility and efficiency in the military compensation system turns out to be only a small fraction of cash compensation; special and incentive pays are not as efficient as they could be in providing incentives for retention and performance. In addition, the military retirement system—which represents a substantial share of military compensation—is funded on an accrual basis, but the current methodology for computing the accrual rate results in inaccurate budget estimates and incorrect incentives for making defense resource decisions. To address these concerns and improve results, the author recommended that DoD assess whether the 70th percentile of civilian pay for civilians with similar characteristics to military personnel continues to be the right benchmark for setting military pay. In addition, she recommended that DoD (1) improve how special and incentive pays are set to increase flexibility and efficiency and (2) explore improvements in the method used to calculate retirement accrual rates.

Setting Military Compensation to Support Recruitment, Retention, and Performance, Beth J. Asch, 2019, www.rand.org/t/RR3197

Reforming Military Retirement. The new Blended Retirement System (BRS) represents the first major change to the armed services' retirement system since the end of World War II. The system blends the traditional, 20-year benefit annuity with a defined contribution plan (similar to a 401K) that the government and service members pay into. The plan is intended to lower the costs of the retirement system while sustaining the same force size and mix as the legacy system for enlisted personnel and officers in each service. RAND analysis helped shape the BRS, which went into effect in 2018. The most recent RAND analysis assessed the potential impact of the BRS on U.S. Army Reserve participation and the cost of continuation pay (CP), which is a mid-career bonus payment given for an agreement to serve another three years. Under a scenario in which the CP multiplier is set at the floor mandated by Congress, the BRS can support a steady-state force for the Regular Army, the Army Reserve, and the Army National Guard that is close to the current forces for enlisted personnel but not for officers in each component. Retention of Regular Army officers is too low, and participation in the Reserve and National Guard is too high. The results imply that if short-term cost considerations are of primary importance, the Army should set the CP multiplier at the floor for each component and

address retention later when retention issues emerge. The upside of this strategy is that the CP costs increase more slowly. The downside is that opt-in rates are lower, so the future cost savings of lower defined benefit costs will also be realized more slowly. Alternatively, if longer-term cost savings are of primary importance, the Army should set the multipliers for officers at the higher levels required to sustain retention. At these higher levels, opt-in rates increase, and the cost savings of lower defined benefit outlays are realized more quickly.

Effects of the Blended Retirement System on United States Army Reserve Participation and Cost, Beth J. Asch, Michael G. Mattock, and James Hosek, 2019, www.rand.org/t/RR2591

The Blended Retirement System: Retention Effects and Continuation Pay Cost Estimates for the Armed Services, Beth J. Asch, Michael G. Mattock, and James Hosek, 2017, www.rand.org/t/RR1887

Reforming the Security Clearance Process. The United States currently employs an investigative and adjudicative security clearance process that originated during World War II. Information systems and data on individuals (e.g., financial, legal, and travel data) have improved dramatically since the creation of this process. A RAND project explored a new approach to the clearance process and the detection of insider threats, known as continuous evaluation (CE). CE is a vetting and adjudication process to review, on an ongoing basis, the background of an individual who has been determined eligible for access to classified information or to hold a sensitive position at any time during the period of eligibility. The authors considered CE cost estimates, examined efficacy and best practices, and assessed some of the practicalities of employing CE. The analysis found that there is a large backlog of investigations and periodic reinvestigations. As of 2018, there were approximately 416,000 unprocessed security clearance investigations and approximately 156,000 unprocessed periodic reinvestigations. The U.S. Office of Personnel Management, the organization with primary security clearance investigating responsibility, has faced resource reductions. The analysis suggested that adopting CE approaches might save substantial amounts compared with current practices—billions of dollars over six years—and that CE would be less invasive for the cleared population (most of whom are DoD employees) and less time-intensive for investigators.

Assessing Continuous Evaluation Approaches for Insider Threats: How Can the Security Posture of the U.S. Departments and Agencies Be Improved? David Luckey et al., 2019, www.rand.org/t/RR2684

The Long View: Staying on Top of Technological Change

> The security environment is also affected by *rapid technological advancements and the changing character of war*. The drive to develop new technologies is relentless, expanding to more actors with lower barriers of entry, and moving at accelerating speed. New technologies include advanced computing, "big data" analytics, artificial intelligence, autonomy, robotics, directed energy, hypersonics, and biotechnology—the very technologies that ensure we will be able to fight and win the wars of the future. (DoD, 2018, p. 3)

One thread connecting the three NDS lines of effort—increasing lethality, strengthening partnerships, and improving organizational performance—is technology and the dizzying pace of technological change. Over the long term, defending U.S. security and strategic interests requires more than staying ahead of adversaries in a capabilities race or making up ground where the United States has fallen behind. The longer view requires staying on top of emerging technological trends, looking over the horizon to anticipate possible new game-changing capabilities, and attracting high-quality technology experts to the defense sector.

RAND research in this area focuses on the emergence and evolution of high-tech domains of conflict, such as cyberspace and other information environments; the implications of emerging technologies, with a particular focus on artificial intelligence (AI); and approaches to building a highly skilled technology workforce in the defense sector.

Preparing for Conflict in Information Environments

Cyberspace as a Military Domain: Lessons for NATO. NATO has identified cyberspace as a new operational domain. A RAND Perspective reviewed the new security challenges that this presents and discussed current efforts by NATO to consider and adapt its structure, forces, systems, and processes to prepare for integrating cyberspace as an operational domain. NATO's current efforts focus on enabling embryonic capabilities to face the Alliance's short-term needs. However, cyberspace as a domain of military operations is evolving rapidly, with low barriers to entry (for attackers), while military establishments have only limited experience and doctrine to guide them in operating in this domain. Therefore, NATO needs to catch up by urgently programming warfare development efforts (in such areas as research and development, concept development, feasibility studies, and experimentation and demonstration) to anticipate adversaries' intentions, disrupt their activities, and provide quick-response capabilities to warfighters. The authors advised that NATO focus on developing a more effective cyber indications and warning capability that can provide advance warning of malicious cyberactivity and detect civilian or military observation of NATO operations. Such a capability also supports a timely and clear gauge of intentions that are important in managing friction during a suspected cyber event while also providing confidence for de-escalation.

Operationalizing Cyberspace as a Military Domain: Lessons for NATO, Lillian Ablon et al., 2019, www.rand.org/t/PE329

The Risks of Virtual Societal Warfare. The evolution of advanced information environments is creating a new form of cyberaggression that involves manipulating or disrupting the information foundations of democratic societies. RAND researchers labeled this growing threat *virtual societal warfare* in an analysis of its characteristics and implications for the future. The authors observed that national security will increasingly rely on a resilient information environment that requires classic forms of information security, as well as strong mediating institutions and a population continuously inoculated against the techniques of social manipulation. They also noted that the boundary between public and private endeavors and responsibilities is blurring (national security will rely on the cooperation of private actors as much as public investments) and that conflict will increasingly be waged between and among networks. The authors concluded by pointing to several avenues of response to enhance democratic resilience in the face of this growing risk, including building forms of inoculation and resilience against the worst forms of information-based social manipulation and better understanding the workings and vulnerabilities of emerging technologies.

The Emerging Risk of Virtual Societal Warfare: Social Manipulation in a Changing Information Environment, Michael J. Mazarr et al., 2019, www.rand.org/t/RR2714

Understanding and Countering Coercion in Cyberspace. Cyberspace is a recent and rapidly evolving military domain that can be used by aggressors for coercion. A RAND analysis found that coercive cyber operations by U.S. adversaries represent a small subset of overall cyber operations globally. In addition, Russia and North Korea are more likely to have used cyber operations as a coercive tool than China and Iran are. Espionage remains the predominant purpose of states' cyber operations. Russian cyber operations appear to have had coercive intent in Ukraine, Estonia, and Montenegro. Chinese cyber operations show a continued focus on espionage but potentially with some coercive intent as a secondary objective. Iranian cyber operations are more focused on retaliating against regional neighbors and the West than they are at serving a direct coercive purpose. North Korea has routinely engaged in coercive acts in the physical world and sees cyber operations as another means to coerce others. To counter cyber coercion, the United States and its allies need to work now to develop methods to discern cyber coercion as it emerges and strategies to counter it in the future.

Fighting Shadows in the Dark: Understanding and Countering Coercion in Cyberspace, Quentin E. Hodgson et al., 2019, www.rand.org/t/RR2961

Rising to the Challenge of Artificial Intelligence

Deterrence in the Age of Thinking Machines. Up until now, deterrence has involved humans trying to dissuade other humans from taking particular courses of action. What happens when the thinking and decision processes involved are no longer purely human? RAND analysis explored how AI and autonomous systems could affect deterrence and escalation in conventional crises and conflicts. A wargaming exercise shed light on the use of autonomous systems for deterrence. In particular, the speed of autonomous systems led to inadvertent escalation. The authors concluded that the use of autonomous and unmanned systems could negatively affect extended deterrence and the U.S. ability to assure allies of U.S. commitment. Furthermore, widespread use of AI and autonomous systems could lead to inadvertent escalation and crisis instability. In general, machines will likely be worse than humans at understanding the signaling involved in deterrence, especially de-escalation. The analysts recommended in-depth evaluation of the escalatory potential of new AI and autonomous systems and operating concepts.

Deterrence in the Age of Thinking Machines, Yuna Huh Wong et al., 2020, www.rand.org/t/RR2797

Helping the Defense Department Envision the Future of AI in the Armed Forces. RAND researchers assessed the state of AI relevant to DoD and made recommendations to enhance DoD's vision for AI. The authors found significant challenges associated with DoD's current posture in AI. The DoD vision for AI—articulated in a 2018 strategy document, with the Joint Artificial Intelligence Center as the focal point—is not yet supported with the visibility, authorities, and resource commitments needed to scale AI and to manage its impact across the Department. DoD should adopt AI governance structures that align authorities and resources with its mission of scaling AI, and all agencies within DoD should create or strengthen mechanisms for connecting AI researchers, technology developers, and operators. In addition, the chief data officer should make a selection of DoD data sets available to the AI community to spur innovation and enhance external engagement with DoD.

The Department of Defense Posture for Artificial Intelligence: Assessment and Recommendations, Danielle C. Tarraf et al., 2019, www.rand.org/t/RR4229

Responding to the National Security Commission on AI. The National Security Commission on Artificial Intelligence (NSCAI) is a congressionally mandated, independent federal commission set up to elevate awareness and to inform better legislation on AI. As part of its mission, the commission is tasked with helping DoD better understand and prepare for a world in which AI might affect national security in unexpected ways. The NSCAI issued a call for "original, creative ideas" on applications of AI to national security. RAND responded with a series of essays, published in *War on the Rocks*. The essays' scope and subject matter vary considerably, touching on military deception, open-source research, how to train AI soldier robots, and the role of chess in AI, among other topics. The next phase of the NSCAI's ideas framework is for a few researchers whose essays were selected for publication—both from RAND and elsewhere—to testify before the commission.

"AI and Irregular Warfare: An Evolution, Not a Revolution," Daniel Egel et al., 2019, https://warontherocks.com/2019/10/ai-and-irregular-warfare-an-evolution-not-a-revolution

"Military Deception: AI's Killer App?" Edward Geist and Marjory Blumenthal, 2019, https://warontherocks.com/2019/10/military-deception-ais-killer-app

"How to Train Your AI Soldier Robots (and the Humans Who Command Them)," Thomas Hamilton, 2020, https://warontherocks.com/2020/02/how-to-train-your-ai-soldier-robots-and-the-humans-who-command-them

"Embrace Open-Source Military Research to Win the AI Competition," Jasmin Léveillé, 2019, https://warontherocks.com/2019/10/embrace-open-source-military-research-to-win-the-ai-competition

"What Chess Can Teach Us About the Future of AI and War," Andrew Lohn, 2020, https://warontherocks.com/2020/01/what-chess-can-teach-us-about-the-future-of-ai-and-war

"AI for Peace," Patrick S. Roberts, 2019, https://warontherocks.com/2019/12/ai-for-peace

"How to (Actually) Recruit Talent for the AI Challenge," James Ryseff, 2020, https://warontherocks.com/2020/02/how-to-actually-recruit-talent-for-the-ai-challenge

"Our Future Lies in Making AI Robust and Verifiable," Danielle C. Tarraf, 2019, https://warontherocks.com/2019/10/our-future-lies-in-making-ai-robust-and-verifiable

"First, Manage Security Threats to Machine Learning," Rand Waltzman and Thomas Szayna, 2019, https://warontherocks.com/2019/11/first-manage-security-threats-to-machine-learning

Building a Skilled Technology Workforce

Improving the Competitiveness of the DoD Cyber Workforce. In recruiting talent in cybersecurity, AI, and other technology fields, DoD faces challenges competing with the civilian technology sector. Part of the issue is compensation, which is usually higher in the civilian sector. In response, DoD created the Cyber Excepted Service workforce. To recruit talent in this area, DoD has greater flexibility in hiring individuals and in adjusting compensation to remain competitive in the labor market for cyber talent. An ongoing RAND analysis is examining current policies for recruiting and retaining members of the Cyber Excepted Service and identifying improvements in its compensation policies to improve recruitment and retention and to increase management flexibility. RAND's experience in both the cyber field and in retention among federal workers provides a quantitative foundation for the ultimate goal of developing DoD's cyber workforce retention strategy.

For additional information on this project, contact Jack Riley, vice president and director, RAND National Security Research Division, riley@rand.org.

Attracting, Recruiting, and Retaining Successful Cyberspace Operations Officers. The Air Force is facing a large shortage of field-grade cyberspace operations officers, raising concerns about retention now and in the future. In addition, the Air Force faces stiff competition from the private sector in attracting and retaining top cyber talent, and, because many

Air Force personnel receive highly technical training that further increases their marketability, the Air Force is concerned that it may lose the people it trains to the private sector. RAND analysis explored the current state of Air Force recruiting and retention in cyberspace. The authors found a perceived lack of clarity in the vision for the cyber enterprise that hinders the mission and morale. Cyber professionals often want to stay in technical positions longer than they are allowed to, and critical technical acumen may be atrophying or leaving as a result. In addition, the cyber mission is inadequately resourced, and acquisition and decisionmaking processes are not agile enough to address the cyber enterprise's needs. For DoD to address these issues, the authors recommended establishing and communicating a strategic vision for the career field and linking it to tactical-level work; creating new opportunities for cyber officers to pursue technical depth; ensuring sufficient agility in cyber training, tactics, and acquisition; and establishing enterprise-wide and forward-thinking approaches to better facilitate the cyber mission (e.g., simulations for training, consistent technology across the enterprise, agile acquisition approaches, adoption of cutting-edge technology, and keeping pace with technology in the private sector).

Attracting, Recruiting, and Retaining Successful Cyberspace Operations Officers: Cyber Workforce Interview Findings, Chaitra M. Hardison et al., 2019, www.rand.org/t/RR2618

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