

Japan-U.S. Defense Cooperation in the Age of Defense Innovation**The Challenges and Opportunities of Strategic Competition with China**Satoru Mori¹**Introduction**

What must the Japan-U.S. alliance do to retain overmatch in the long-term peacetime military competition with China in an age when defense innovation is accelerating rapidly? This question will require forward looking efforts by alliance managers in Tokyo and Washington to maintain credible deterrence in the western Pacific in the years to come. In the information revolution age—characterized by exponential datafication, expanding global connectivity, and the rise of intelligent machines²—the components of deterrent power are beginning to fundamentally shift. Dealing with short-term challenges while preparing to adapt to the future security environment is becoming ever more challenging. The character of war is changing due to the military application of artificial intelligence, big data analytics, quantum computing, and robotics, among other cutting-edge technologies. The ever-shifting global technological environment demands greater change from military organizations engaged in long-term strategic competition.

The Japan-U.S. alliance has been adapting to the shifting strategic landscape through a series of major undertakings to upgrade the alliance. The 2015 Guidelines for Japan-U.S. Defense Cooperation laid out the framework for operational coordination under new Japan's Legislation on Peace and Security, which took effect on March 29, 2016.³ The 2015 Guidelines also institutionally strengthened alliance coordination through the establishment of the standing Alliance Coordination Mechanism (ACM) and the Bilateral Planning Mechanism (BPM). On February 10, 2017, Prime Minister Shinzo Abe and President Donald Trump built on this foundation by instructing their foreign and defense ministers “to convene a Security Consultative Committee (SCC: ‘2+2’) meeting to identify ways to further strengthen the U.S.-Japan Alliance, including through the review of the respective roles, missions, and capabilities of the two countries.”⁴ The subsequent SCC meeting was held on August 17, 2017 and attended by Taro Kono, Rex Tillerson, Itsunori Onodera, and James Mattis. They delivered a joint statement announcing their intention to “explore new and expanded activities in various

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² Paul Scharre, “China’s Pursuit of Emerging and Exponential Technologies,” Testimony before the House Armed Services Subcommittee on Emerging Threats and Capabilities, January 9, 2018.

³ “The Guidelines for Japan-U.S. Defense Cooperation,” April 27, 2015, http://www.mod.go.jp/e/d_act/anpo/pdf/shishin_20150427e.pdf.

⁴ “Joint Statement,” February 10, 2017, <http://www.mofa.go.jp/files/000227768.pdf>.

areas, such as Intelligence, Surveillance, and Reconnaissance (ISR), training and exercises, research and development, capacity building, and the joint/shared use of facilities” through the review of roles, missions, and capabilities (RMC).

The ongoing RMC review will have to address various short- and mid-term challenges, but the alliance must also look beyond to the longer-term challenges resulting from the competition over defense innovation that is rapidly unfolding between the United States and China. Maintaining conventional deterrence without “assured dominance” by effectively leveraging the capabilities and resources of the United States and its allies, including Japan, will be one of the main strategic tasks for the alliance in coming years. From Japan’s perspective, the challenge of bilateral defense cooperation will require addressing two questions. First, how can the alliance best use technology to deter a militarily rising China that is becoming a peer competitor of the United States? Second, how can Japan best coordinate and cooperate with the U.S. armed forces as they evolve to compete with the People’s Liberation Army (PLA)?

The purpose of this paper is to assess the challenges and opportunities relating to Japan-U.S. bilateral defense cooperation in the context of the intensifying defense innovation competition with China. To put the bilateral defense cooperation in perspective, the first section assesses the challenge presented by the strategic competition with China. The next section then identifies key issues arising from the U.S.-China competition over defense innovation. The paper concludes by making recommendations for managing challenges and exploiting opportunities.

The Challenge of Strategic Competition with China

The central strategic challenge facing the Japan-U.S. alliance in the 21st century is preventing China from establishing regional hegemony without triggering a full-scale war while at the same time maintaining appropriate levels of economic engagement with China. This will continue to require the United States and Japan to compete with China in the security realm and engage China in the economic realm in the years to come. Bilateral defense cooperation has been evolving for more than four decades since the first Guidelines for Japan-U.S. Defense Cooperation were adopted in 1978, but the question for the alliance is whether existing bilateral security cooperation mechanisms are adequate to stand up to China’s challenge.

In addressing this challenge, the alliance must have a long-term China strategy that it is based on a clear understanding of the strategic competition and defines ends, ways, and means. The RMC review mandated by the SCC should be based on a shared understanding of what the strategic competition with China will require.

The ends of the alliance strategy will be continuously generating the military superiority and political-diplomatic influence needed to deter and counter a variety of Chinese actions and efforts aimed at establishing regional hegemony in the Asia-Pacific region. In other words, the Japan-U.S. alliance will have to be capable of coming out of any conflict with China in a comparatively better position. The alliance must also be capable of effectively confronting Chinese actions short of war, such as Chinese influence operations, on a continuous and sustainable basis. The ways through which the alliance can achieve those ends include:

- 1) Advancing economic statecraft and diplomacy to counterbalance Chinese influence in pivotal Indo-Pacific states that are vital to maintaining open access to the commons, including sea lines of communication;
- 2) Increasing the economic vitality of the Asia-Pacific region through the expansion of a high-standards trade and investment zone; and
- 3) Maintaining military superiority to deter acts of aggression by China.

This paper primarily assesses and examines the means that are necessary to pursue this third pillar. As mentioned at the outset, maintaining military superiority over China requires the United States and its allies to take into account the shift in military power generated by disruptive technologies as well as innovative operational and organizational constructs. To identify how the alliance should enhance its capabilities under such conditions, competitive dynamics will need to be examined in four main areas.⁵ These areas constitute the main lines of effort in the long-term peacetime military competition with China:

- The effort to quickly and effectively absorb civilian/commercial cutting-edge technology for military applications;
- The effort to devise new operational concepts that capitalize on existing and emerging technologies to asymmetrically exploit China's vulnerabilities and counter its offensive actions;
- The effort to reform military organizations to establish optimal command and control structures to effectively execute operations based on new operational concepts; and
- The effort to recruit, develop, and nurture a human talent pool that would sustain critical advanced capabilities and operations.

The side that leads in these four areas of competition will gain the advantage. If the United States and Japan fall behind, then China will view its freedom to use force and exercise

⁵ Andrew F. Krepinevich, Jr., *The Military-Technical Revolution: A Preliminary Assessment* (Washington D.C.: Center for Strategic and Budgetary Assessments, 2002); Idem, "Cavalry to Computer: The Pattern of Military Revolutions," *The National Interest*, No. 37 (Fall 1994): 30.

influence as expanding. In short, the Japan-U.S. alliance will lose its ability to deter China if the alliance's strategic competition efforts lag behind those of China. Thus, what the alliance needs to do in its RMC review is to assess the competitive trends in these four areas and then identify how Japan and the United States can collaborate to enhance their competitiveness vis-à-vis China.

The Shifting Nature of the Defense Innovation Competition

The strategic competition has already begun to play out between the United States and China. Beijing has started to respond to the U.S. Defense Innovation Initiative (DII) and Washington's pursuit of the Third Offset Strategy, which was officially announced in November 2014.⁶ The initial context was that China and Russia were enhancing their military capabilities in a way that was eroding U.S. conventional military superiority while the U.S. military focused on the wars in Afghanistan and Iraq.⁷ Regarding China, the challenge was initially presented as being how to overcome its anti-access and area denial (A2/AD) capabilities. This family of weapon systems was designed to produce precision-strike capabilities against high-value U.S. assets, such as forward air bases, satellites, aircraft carriers, and logistics / command and control (C2) nodes that have made possible U.S. military primacy in the western Pacific. Some of the earlier U.S. responses to this problem were to devise new operational concepts—such as the Air-Sea Battle concept and the Joint Operational Access Concept (JOAC)—for the operational dimension of innovation.

Subsequently, in October 2016, then-Deputy Secretary of Defense Robert Work explained that China and Russia were “pacing competitors” that were nearing “battle network parity” with the United States; that China and Russia have been developing capabilities for counter-network operations such as cyber warfare, electronic warfare (EW), and counterspace activities; and that the U.S. armed forces were now concentrated mostly in the continental United States, with a much smaller overseas footprint than that during the Cold War era.⁸ The nature of the competition was now shifting as it became evident that China was not simply catching up to U.S. second offset capabilities – it was also committed to a major national effort

⁶ Secretary of Defense, “Memorandum for Deputy Secretary of Defense et al. on The Defense Innovation Initiative,” November 15, 2014, <http://archive.defense.gov/pubs/OSD013411-14.pdf>; U.S. Department of Defense, “Reagan National Defense Forum Keynote: As Delivered by Secretary of Defense Chuck Hagel,” November 15, 2014.

⁷ See for example, Shawn Brimley, *While We Can: Arresting the Erosion of America's Military Edge* (Washington D.C.: Center for a New American Security, December 2015): 4-8, 13-14; U.S. Department of Defense, “Reagan Defense Forum: The Third Offset Strategy: As Delivered by Deputy Secretary of Defense Bob Work,” Reagan National Defense Forum, November 7, 2015; Robert Martinage, *Toward A New Offset Strategy: Exploiting U.S. Long-term Advantages to Restore U.S. Global Power Projection Capability* (Washington D.C.: Center for Strategic and Budgetary Assessments, 2014): 21-38.

⁸ Robert O. Work's remarks at the CSIS Conference on the Third Offset Strategy, October 28, 2016.

to eventually leapfrog the United States in the third offset competition by vigorously investing in and developing artificial intelligence (AI), quantum computing, and associated technologies. Chinese leaders also began drastically reorganizing the People's Liberation Army, as evidenced by efforts to establish the new Strategic Support Forces (SSF) in December 2015.

The fact that new strategic technologies were now being invented and developed in the commercial sector meant that the ongoing defense innovation competition would be different in nature compared to past offset strategies. As William Carter pointed out at a congressional hearing before the House Armed Services Subcommittee on Emerging Threats and Capabilities on January 9, 2018:

The success of previous offsets was based on investing in winning a race our adversaries didn't even know they were in while allowing them to focus their resources on an area of advantage that we could overcome through innovation. But today, even as we are pursuing our "third offset," China is pursuing a "first offset" of its own, and is investing in the same technologies to challenge us that we are investing in to maintain our strategic edge.⁹

Vice Chairman of the Joint Chiefs of Staff General Paul Selva has also pointed out that the Third Offset Strategy does not have a fixed destination as competitors will keep catching up.¹⁰ The Third Offset Strategy was based on the notion that the United States will be required to generate new military capabilities based on new and existing technologies, new operational concepts, and new organizational constructs in order to maintain conventional military overmatch in the long-term competition. In recent years, it became clear that the innovation cycle was going to be shorter in the current defense competition and the race for overmatch was now going full steam. China had long exploited asymmetric capabilities against the United States, but Beijing recently started building symmetric capabilities to achieve what was once known in the United States as "full spectrum dominance" at the theater/regional level.

In this strategic environment, Japan faces two challenges: 1) contriving ways to deal with an evolving Chinese military, and 2) finding ways to maintain alliance interoperability and defense cooperation with the United States. Japan will need to seriously consider what it needs to do to avoid becoming a liability in the alliance. The following sections assess the U.S.-China competition in the areas mentioned above—R&D and technology, operational and organizational constructs, and human talent—and then identify defense cooperation challenges and opportunities that need to be undertaken by the alliance.

⁹ William Carter, "Chinese Advances in Emerging Technologies and their Implications for U.S. National Security," January 9, 2018, https://csis-prod.s3.amazonaws.com/s3fs-public/congressional_testimony/ts180109_Carter_Testimony.pdf?zmxasiIZi6jHZPgAAsMYcSiSMwdw6Lg.

¹⁰ General Selva, Remarks at the Center for Strategic and International Studies, October 28, 2016.

R&D and Technology

The current strategic competition is being shaped by two fundamental features of the global technological landscape. First is the proliferation and diffusion of dual-use cutting edge technologies, such as AI, big data analytics, robotics, and other advances that are mostly invented and produced in the commercial sector. Second is the increasing rapidity of the emergence of new technologies. In the competition over research and development as well as technology acquisition and exploitation, the capacity that will define the trajectory of the competition will be the comparative ability to rapidly and effectively detect, assess, and absorb advanced technologies for military application. China is advancing its military-civil fusion strategy to synergistically absorb advanced commercial technology for military application as well as its “going out” strategy that promotes technology transfer from abroad. Meanwhile, the United States is trying to expand cooperation between the military and the information technology industry through various efforts, including the Defense Innovation Unit Experimental (DIUx).

China’s Efforts

The PLA is vigorously pursuing military applications of advanced dual-use technologies such as AI, big data, supercomputers, autonomy, directed energy, hypersonic flight vehicles and scramjet engines, biotechnology and genomics, and quantum technologies.¹¹ Toward this end, China appears to be pursuing two major lines of effort. First, it is advancing a military-civil fusion (軍民融合) strategy to absorb advanced technology from the commercial sector. Several high-level commissions—including the Chinese Communist Party’s (CCP’s) Military-Civil Fusion Development Center directed by Xi Jinping, the Central Military Commission’s (CMC) Science and Technology Commission, and the CMC’s Military Scientific Research Guidance Committee—are overseeing research and development on military-civil fusion initiatives. According to Elsa Kania, the PLA had traditionally preferred to procure from the defense industry since private companies were unable to meet the required standards and were not always eager to cooperate with the Chinese military. Yet, the PLA is now actively seeking to overcome these obstacles through an approach of “shared construction, shared enjoyment, and shared use” (共建、共享、共用) which is essentially “a state-driven approach to leverage the synergies in this dual-use technology through the efforts of multiple, interrelated policy

¹¹ Elsa Kania, *Battlefield Singularity: Artificial Intelligence, Military Revolution, and China’s Future Military Power* (Washington D.C.: Center for a New American Security, November 2017); John K. Costello and Elsa Kania, “Quantum Technologies, U.S.-China Strategic Competition, and Future Dynamics of Cyber Stability,” CyCon U.S., November 7, 2017; Elsa Kania, “Strategic Innovation and Great Power Competition,” *The Strategy Bridge*, January 31, 2018.

mechanisms.”¹² China is second only to the United States in research and development spending, accounting for 21% of the world’s total as of 2015, and its annual growth rate is 18%, making it likely that China will surpass the United States in the near future.¹³

Second, the Chinese government is advancing a “going out” strategy which encourages Chinese companies to pursue various technologies abroad. These overseas efforts include mergers and acquisitions, equity investments, venture capital, and the establishment of research and development centers. Between 2012 and mid-2017, “China-based investors engaged in tech investments amounting to \$19 billion in the United States, across 641 different deals, with particular focus on AI, robotics, and augmented or virtual reality.”¹⁴ China has been investing in the United States, particularly in emerging technology such as AI, augmented/virtual reality, robotics, and financial technology. Many of these investments have come via venture-backed startups, investments by Chinese companies, private equity, special purpose vehicles, and acquisitions.¹⁵ These Chinese efforts are part of a larger pattern of technology transfer pursued through industrial espionage, cyber theft; engagement with U.S. academic institutions; Chinese-based technology transfer organizations; Chinese research centers in the United States; talent recruitment through U.S.-based associations sponsored by the Chinese government; and leveraging of technical expertise of U.S. private equity, venture firms, investment banks, and law firms.¹⁶

The Chinese government is vigorously pursuing military applications of AI which will likely prove critical in future warfare. In its *New Generation AI Development Plan* issued in July 2017, the Chinese government declared its ambition to lead the world in AI by 2030.¹⁷ One of the plan’s focuses was to “strengthen military-civilian integration in the AI area,” which would strengthen a new generation of AI technology to support “command and decision-making, military deductions, defense equipment, and other applications.”¹⁸ These efforts are designed to “[p]romote all kinds of AI technology to become quickly embedded in the field of

¹² Kania, *Battlefield Singularity*, 19-21.

¹³ Kania, “Strategic Innovation and Great Power Competition.”

¹⁴ Kania, *Battlefield Singularity*, 10-11. See footnote k in particular for details of recent examples of China’s “going out” strategy in implementation.

¹⁵ Michael Brown and Pavneet Singh, *China’s Technology Transfer Strategy: How Chinese Investments in Emerging Technology Enable a Strategic Competitor to Access the Crown Jewels of U.S. Innovation*, Defense Innovation Unit Experimental, February 2017, 7-9.

¹⁶ *Ibid.*, 15-19.

¹⁷ The English translated version “State Council Notice on the Issuance of the Next Generation Artificial Intelligence Development Plan,” by a group of experts can be found at <https://na-production.s3.amazonaws.com/documents/translation-fulltext-8.1.17.pdf>. Other official strategic plans include *Made in China 2025* (May 2015), the “*Internet Plus*” *Artificial Intelligence Three-Year Action Implementation Plan* (May 2016), and the *13th Five-Year National Science and Technology Innovation Plan* (August 2016).

¹⁸ “The Artificial Intelligence Development Plan.”

national defense innovation.”¹⁹ Kania observes that the PLA is in the early stages of speculation about and experimentation with AI. She also points out that the PLA has placed particular focus on the use of AI in simulation, war-gaming, training, situational awareness, and command decision-making.²⁰

Another disruptive technology prioritized by China is quantum cryptography and computing. Quantum cryptography can lead to communications systems that are “theoretically unhackable and could confound cyber reconnaissance and intelligence collection efforts.”²¹ Quantum computer could “be powerful enough to overcome most of today’s advanced encryption techniques, rendering the majority of existing commercial, government, and military systems vulnerable.”²² Costello and Kania have pointed out that “the current employment of quantum communications and the future actualization of quantum computing would respectively advantage defense and offense in the cyber domain over time,” and that “quantum computing could enable an unparalleled offensive and intelligence advantage for whichever actor first develops and leverages that capability.”²³

U.S. Efforts

The focus on military application of AI came to the fore when the DII was announced in November 2014. Subsequently, it became clear that the U.S. Department of Defense initially placed AI and machine learning as one of the centerpieces of its Third Offset Strategy. Deputy Secretary Work explained in October 2016 that “initial vectors” were aimed at rejuvenating the U.S. operational battle network by capitalizing on several elements, such as: autonomous learning systems, human-machine collaborative decision-making, assisted human operations, advanced manned-unmanned system operations, and autonomous weapons that are network-enabled as well as cyber and electronic warfare hardened to permit integration of autonomy.²⁴

The U.S. Department of Defense had begun to pursue internal and external efforts to advance innovation in the technological realm. Generally, research and development have been conducted by government laboratories, non-profit research institutions, and defense companies. Recent notable internal defense research and development have included an array of new efforts. In 2014, a Defense Science Board (DSB) Summer Study assessed the opportunities and

¹⁹ Ibid.

²⁰ Kania, *Battlefield Singularity*, 12.

²¹ Costello and Kania, “Quantum Technologies,” 89.

²² Ibid.

²³ Ibid., 94.

²⁴ Robert Work, Remarks at the Center for Strategic and International Studies, October 28, 2016.

challenges of the military application of autonomy.²⁵ Meanwhile, the Strategic Capabilities Office (SCO) has spearheaded novel ways of rapidly employing existing weapon systems.²⁶ The Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L) established a Long Range Research and Development Plan (LRRDP) to leverage new technologies that could offer significant military advantage in the 2025 to 2030 timeframe, including in areas such as space, undersea, air dominance and strike, air and missile defense, and other technology-driven areas to generate new capabilities.²⁷ Finally, each of the Services is pursuing rapid prototyping.

One effort to engage enterprises outside of the traditional defense sector is the establishment of the Defense Innovation Unit Experimental (DIUx) in Silicon Valley, Boston, and Austin.²⁸ The approach taken by DIUx could be characterized as one of partnership in which engineers, investors, chief executives, and defense practitioners come together to identify opportunities for technological innovation through civil-military synergy in a collaborative manner.

Perhaps even more crucial is the effort to reform the U.S. acquisition system. The Better Buying Power (BBP) initiative was first launched in 2010 by the Under Secretary of Defense for AT&L. The third phase (BBP 3.0) began in April 2015, seeking to allow the Department of Defense (DoD) to more effectively leverage technological innovation not only from within the traditional domestic defense sector but also from the domestic commercial sector and overseas. BBP 3.0 identifies eight general lines of effort, each with specific initiatives, but most relevant initiatives in the current context sought to remove barriers to commercial technology utilization

²⁵ Defense Science Board, *Summer Study on Autonomy* (June 2016).

²⁶ SCO was established in 2012 by then-Deputy Secretary of Defense Ashton Carter, and later formalized through DoD Directive 5105.86 dated November 14, 2016. U.S. Department of Defense, DoD Directive 5105.86, "Director, Strategic Capabilities Office," November 14, 2016, http://www.dtic.mil/whs/directives/corres/pdf/510586_dodd_2016.pdf

²⁷ According to its Request for Information, the LRRDP sought "i) relatively mature technologies that may be applied in novel or unique ways to field a fundamentally different type of system capability, ii) emerging technologies that can be rapidly matured to offer new military capability or iii) technologies under development for, or being applied in, non-defense applications which can be repurposed to offer a new military capability." Memorandum for Secretaries of the Military Departments et al. "Long Range Research and Development Plan (LRRDP) Direction and Tasking," October 29, 2014, http://www.defenseinnovationmarketplace.mil/resources/LRRDP_DirectionandTaskingMemoClean.pdf; "Long Range Research and Development Plan (LRRDP) Request for Information," <http://online.wsj.com/public/resources/documents/offsetrfi1203.pdf>.

²⁸ DIUx consists of three teams – the Engagement team which facilitates a two-way exchange between the military and the entrepreneurs, the Foundry team which brings together internal and external engineers to work on maturing technologies for their focused design sprints, rapid prototyping and field trials, and the Venture team which identifies emerging commercial technologies and explores their applicability to potential military and civilian customers across the department. U.S. Department of Defense, "Secretary of Defense Speech – Remarks on Opening DIUx East and Announcing the Defense Innovation Board," July 26, 2016, <https://www.defense.gov/News/Speeches/Speech-View/Article/858155/remarks-on-opening-diux-east-and-announcing-the-defense-innovation-board/>.

or to improve DoD outreach to global markets for technology and products. These efforts involved assessing the need for policy and regulatory changes, training the workforce on how to access commercial technology and products with existing authorities, expanding databases to make available a catalogue of applicable technologies identified by acquisition and science and technology personnel in U.S. embassies and overseas locations, identifying opportunities for foreign technology solutions to solve sustainment and obsolescence challenges, and enhancing international acquisition and exportability training for personnel not in international acquisition coded positions.²⁹ BBP 3.0 also included initiatives designed to more rapidly field technologically advanced weapons systems through increasing the use of prototyping and experimentation and using Modular Open Systems Architecture (MOSA) to stimulate innovation.³⁰

The United States has made AI one of its main innovation areas. The National Science and Technology Council's Networking and Information Technology Research and Development Subcommittee issued the *National Artificial Intelligence Research and Development Strategic Plan* in October 2016.³¹ Yet this plan made only passing reference to defense applications of AI. The Department of Defense's Science and Technology (S&T) community issued the *Reliance 21* document in January 2014. This provided the overarching framework of the Department's S&T joint planning and coordination process and identified several priority areas, including autonomy, counter weapons of mass destruction (WMD), cyber, big data, and electronic warfare/protection. Subsequently, in May 2014, the Assistant Secretary of Defense for Research and Engineering (R&E) issued another document titled *DoD Research and Engineering Enterprise*. This guidance stated that one of the three principles of the defense R&E enterprise is to create technological surprise; it listed autonomy, quantum sciences, human systems, and nanoengineering/nanotechnology as areas of interest.³² The Defense Advanced Research Projects Agency (DARPA) also designated quantum science among its "core strategic thrusts" since the mid-2000s. DARPA has prioritized efforts to harness the power of quantum physics in its "breakthrough technologies for national security" by funding

²⁹ Memorandum from the Undersecretary of Defense for Acquisition, Technology and Logistics, "Implementation Directive for Better Buying Power 3.0," April 9, 2015, 9, 24.

³⁰ Reinvigorating prototyping and experimentation provided "Warfighters with the opportunity to explore novel operational concepts, supported key elements of the industrial base, and hedged against threat developments and surprises by reducing the lead time to develop and field new capabilities." Implementing MOSA was expected to enhance technology insertion especially in the most rapidly advancing areas of commercial technology such as microelectronics, sensors, and software, and allow "both pre-planned and opportunistic technology based upgrades in the areas of technology that are most subject to change." Ibid., 12, 15.

³¹ National Science and Technology Council, *The National Artificial Intelligence Research and Development Strategic Plan*, October 2016.

³² U.S. Department of Defense, *Reliance 21: Operating Principles*, January 2014; Assistant Secretary of Defense for Research and Engineering, *DoD Research and Engineering Enterprise*, May 1, 2014.

projects for advancing quantum technologies.³³ It remains to be seen how much the U.S. defense R&D enterprise will progress in quantum information science, however, because unstable funding, institutional and disciplinary obstacles, and insufficient education and workforce training are hindering advances in this area.³⁴

Challenges and Opportunities

The preliminary assessment above shows that both China and the United States are pursuing the military application of similar kinds of technology. In terms of technology development and exploitation, while one needs to distinguish between what China aspires to and what China can actually achieve, ongoing Chinese efforts appear quite determined. The Chinese military-civil fusion approach is state-driven and directed by a national plan, which could prove effective.³⁵ China is also tapping into the U.S. commercial innovation ecosystem and advancing a wide variety of activities to conduct both legal and illegal technology transfer from the United States.³⁶ On the other hand, the current efforts by the U.S. Department of Defense to advance internal research while engaging the commercial sector could continue to face challenges.³⁷ While further assessments are necessary, at first glance the current trends appear disadvantageous to the United States and “it may not be feasible for the U.S. to regain or retain uncontested technological advantage.”³⁸

The opportunity for the United States and its allies is their potential for building a technological coalition. Major U.S. allies are advanced industrialized nations and are strategic assets unique to the United States. The United States should look beyond its borders to actively leverage its major allies’ R&D ecosystems. In 2015, the gross domestic expenditure for R&D (in billions of PPP dollars) was: \$496.6 billion for the United States, \$408.8 billion for China, \$170.0 billion for Japan, \$114.8 billion for Germany, \$74.1 billion for South Korea, \$60.8 billion for France, and \$46.3 billion for the United Kingdom.³⁹ Although the United States

³³ DARPA has sought to fund various quantum technologies through the Quantum Entanglement Science and Technology (QuEST) program established in 2008. The Intelligence Advanced Research Projects Agency (IARPA), the Department of Energy, the National Institute of Standards and Technology, and the National Science Foundation have also invested in quantum information science. Costello and Kania, “Quantum Technologies,” 90-91.

³⁴ *Ibid.*, 91.

³⁵ The effectiveness of this civil-military fusion approach needs further assessment, but the magnitude and speed of the effort to acquire foreign expertise and then using it to enhance Chinese indigenous capabilities has been alarming on many fronts.

³⁶ Brown and Singh, *China’s Technology Transfer Strategy*.

³⁷ Kania, *Battlefield Singularity*, 35.

³⁸ Kania, “Strategic Innovation and Great Power Competition.”

³⁹ National Science Board, *Science and Engineering Indicators 2018*, Figure O-6, <https://www.nsf.gov/statistics/2018/nsb20181/figures>.

clearly leads in technology R&D, now is probably the time to take advantage of the diversity of its major allies. Efforts should be made to bring down regulatory obstacles that hinder joint bilateral and multilateral R&D projects. Section 881 of the National Defense Authorization Act of 2017 has taken the United States a step forward by integrating the United Kingdom and Australia, in addition to Canada, into the national technology and industrial base (NTIB). Some of the major tasks for Japan would be to establish an effective mechanism to survey, invest, protect, and eventually exploit cutting-edge technologies that emerge in Japan; and to prioritize bilateral and multilateral R&D projects to satisfy Japan's defense needs. Japan, in the long run, should ultimately aspire to join the United States' NTIB. Expanding the DoD's global technological outreach program, and thereby creating an environment with higher potential for synergistic research and development, could be key as China will not be able to replicate alliance-based defense technological cooperation.

Operational Concepts and Organizational Constructs

New concepts of operations and organizational constructs need to go hand in hand if they are to prove effective. Asymmetries in operational and organizational constructs could create advantages between the competitors and prove crucial if an armed conflict were to break out. Both China and the United States are moving toward joint operations and integrating their command and control structures while technological innovation progresses concurrently.

China's Efforts

The 2015 China Defense White Paper announced that the PLA's concept of operations was going to change from "local wars under informatized conditions" to "informatized local wars." At the center of this concept was the notion of system vs system operations (SvS operations) featuring information dominance, precision strikes, and joint operations.⁴⁰ SvS operations require accelerating operational response times to enhance firepower and maneuver, especially by shortening and streamlining decision making and sensor to shooter times to get inside an opponent's decision cycle; and enabling units to operate with greater independence in dispersed deployments in a non-linear battlespace, yet synchronizing operations within a centralized command structure that allows for some initiative.⁴¹

To realize SvS operations, the Chinese government advanced two major lines of effort for organizational reform. First, it established a two-level joint operational command system

⁴⁰ The State Council Information Office of the People's Republic of China, *China's Military Strategy*, May 2015, Section III.

⁴¹ Kevin Pollpeter, "Testimony before the U.S.-China Economic and Security Review Commission: Hearing on China's Advanced Weapons," February 23, 2017.

with key decision-making nodes at the CMC and theater levels. Joint operations command centers (JOCCs) have been created at the CMC and at each of the five theater commands that have been assigned operational authority over most combat forces, except the Rocket Force units that could be controlled by the CMC.⁴² Second, the PLA moved to integrate Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) capabilities into joint operations through the establishment of the Strategic Support Force (SSF). The SSF is responsible for conducting intelligence and reconnaissance activities for space, cyber, and electromagnetic domains, which form the necessary information warfare infrastructure for “informatized local wars.” The SSF also provides operational support to the theater commands, although the specific manner through which it relates to the theater commands remain unclear.⁴³ The SSF’s Space Systems Department seems to be responsible for at least the co-orbital counterspace mission, and the SSF’s Network Systems unit appears to be tasked with jamming satellite communications and global positioning signal (GPS) signals as well as conducting computer network operations against satellites and space facilities.⁴⁴

Further down the road, the PLA “anticipates a shift toward future ‘intelligentized’ (智能化) warfare, in which AI will be integral as information technology has been in today’s ‘informatized’ warfare’ (信息化).”⁴⁵ The PLA has closely analyzed DARPA’s Deep Green program, which was aimed at developing systems to assist battlefield command decision-making through advanced predictive capabilities. Some Chinese military thinkers anticipate that the move to intelligentized warfare would take human commanders from “in the loop” to “on the loop,” making them planners, administrators, and commanders, thereby enabling “ever more rapid decision-making and an accelerating tempo of operations to achieve the initiative.”⁴⁶ Kania points out that “the PLA could be the first to conceptualize or operationalize new concepts of operations for AI in future warfare.”⁴⁷ She notes that the PLA has been investing heavily in research and development of various military applications of AI, including “intelligent and autonomous unmanned systems such as swarm intelligence; AI-enabled data fusion, information processing, and intelligence analysis; applications in simulation, war-gaming, and training; the use of AI for defense, offense, and command in

⁴² Joel Wuthnow and Phillip C. Saunders, *Chinese Military Reforms in the Age of Xi Jinping: Drivers, Challenges, and Implications* (Washington D.C.: National Defense University, 2017): 24-28.

⁴³ *Ibid.*, 29.

⁴⁴ Kevin L. Pollpeter, Michael S. Chase, Eric Heginbotham, *The Creation of the PLA Strategic Support Force and Its Implications for Chinese Military Space Operations* (Santa Monica: RAND Corporation, 2017): ix.

⁴⁵ Kania, *Battlefield Singularity*, 12.

⁴⁶ *Ibid.*, 14, 16.

⁴⁷ *Ibid.*, 34.

information warfare; and intelligent support to command decision-making.”⁴⁸ However, she suggests that “it seems unlikely that the PLA will progress imminently toward ‘full’ autonomy, given the organizational tendencies to centralize control and recognition of the advantages of combining human and artificial intelligence.”⁴⁹

U.S. Efforts

In October 2016, Deputy Secretary Work explained that the Third Offset’s initial vectors were planned to be infused into operational and organizational constructs to enhance conventional deterrence. He noted that this would improve the U.S. ability to wage multi-domain battle, exploit cross domain fires, get inside an adversary’s decision cycle (by making decisions and maneuvers quicker than the enemy), leverage dispersal sanctuary and speed, and regain the edge in the salvo competition. He emphasized that the major components of the Third Offset Strategy were not only technology, but also operational concepts and organizational constructs.⁵⁰

Many joint operating concepts and supporting concepts guide U.S. forces, but one of the developing concepts of operations is Multi-Domain Battle (MDB).⁵¹ It is still under development, but Commander of the U.S. Pacific Command (PACOM) Admiral Harry Harris has been underlining its significance in recent months. At the WEST 2017 conference in February 2017, Harris stated that “the Multi Domain Battle and Cross Domain Fires concepts are the right approaches we need to adopt in order to win future battles,” and revealed that he had established a Multi Domain Battle Tiger Team at PACOM.⁵² He argued that a Combatant Commander “must be able to create effects from any single domain to targets in every other domain in order to fight tonight and win... I’d like to see all the Services use autonomous technologies to help the Joint Force commanders expand the kill chain.”⁵³ Three months later, at the LANPAC 2017 conference, Harris emphasized that the MDB concept was not only endorsed by the Army and the Marine Corps, but that “the Navy and Air Force are also convinced that this is the right way for us to organize to fight our way through those contested

⁴⁸ Ibid., 21. For a detailed illustration of PLA’s projected employment and military application of AI, see pages 21-32.

⁴⁹ Ibid., 18.

⁵⁰ Work’s remarks at the CSIS Conference on October 28, 2016.

⁵¹ “Joint Concept Structure,” undated, http://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/jointconcepts_structure.pdf?ver=2017-12-28-162033-073.

⁵² Admiral Harry Harris, “WEST 2017 Keynote: ‘The View from the Indo-Asia-Pacific’,” February 21, 2017. Harris also emphasized that U.S. Forces “must make real efforts to reap real advantages in artificial intelligence, or A.I., and collaboration between people and computers, also known as man-machine teaming.”

⁵³ Ibid.

environments where the Joint Force doesn't necessarily possess a clear advantage over the adversary."⁵⁴

Subsequently, in December 2017, the U.S. Army Training and Doctrine Command (TRADOC) published a 79-page working document that attempted to define the MDB concept.⁵⁵ Although this concept is still in development, three major characteristics of the first version stand out. First, the MDB concept introduces the notion of "competition" which refers to situations in which "[p]eer adversaries compete to separate alliances and defeat partners below the threshold of armed conflict and challenge the traditional metrics of deterrence by conducting operations that make unclear the distinctions between peace and war."⁵⁶ This notion of competition appears to be identical with what has been referred to as "gray zone" operations. In a conflict with a peer competitor, China or others would likely shift from competition to armed conflict and back to competition again. During competition, the U.S. joint force and allied forces would deter and defeat adversary aggression by conducting proactive stabilization campaigns, contesting destabilization campaigns, deterring escalation through the application of flexible deterrent options and rapid deterrence response options, and preparing for immediate transition into armed conflict should the adversary attack.⁵⁷ The objective here would be to prevent the escalation into armed conflict and extend competition on favorable terms by contesting the adversary's reconnaissance, unconventional warfare, and information warfare. Another aim would be to deter an adversary from using its conventional capabilities while preparing to transition to armed conflict, so that forward-postured forces would be able to fight to turn denied space into contested spaces.⁵⁸

Second, U.S. forces are expected to operate under network-degraded environments, so "resilient formations" are necessary under such conditions. Formations need to maneuver semi-independently without secured flanks, constant communications with higher headquarters, or continuous lines of communication. Such formations also need to be cross-domain capable, projecting and accessing power in all domains in order to present an adversary with multiple dilemmas. The intensity of operations and the adversary's ability to deny or degrade communications require resilient formations to execute the mission command philosophy,

⁵⁴ Admiral Harry Harris, "Association of the United States Army LANPAC Symposium and Exposition," May 24, 2017.

⁵⁵ U.S. Army Training and Doctrine Command, *Multi-Domain Battle: Evolution of Combined Arms for the 21 Century, 2025-2040*, version 1.0, December 2017.

⁵⁶ *Ibid.*, 2.

⁵⁷ *Ibid.*, 21.

⁵⁸ *Ibid.*, 29-35. Once a crisis escalates into armed conflict, the U.S. Joint Force will defeat the enemy's ISR, defeat or suppress the enemy's strike system, defeat or suppress the enemy's IADS, defeat the enemy's maritime forces, defeat the enemy's ground forces, deter the use of nuclear weapons, conduct information environment operations (IEO), and ultimately achieve conditions for a favorable conclusion of armed conflict. *Ibid.*, 37-45.

which requires units to operate without direct communication and control based on a common understanding of the mission objective.⁵⁹

Third, the concept of “convergence” is a new idea introduced in Multi-Domain Battle. Convergence represents an evolution of combined arms, referring to the act of applying a combination of capabilities (lethal and non-lethal, whether within a domain or cross-domain) in time and space for a single purpose. Exploiting multiple combinations of cross-domain operations could create physical, virtual, and cognitive “windows of advantage” to achieve objectives by enabling cross-domain maneuver and fires. Windows of advantage are likely to be a requirement for maneuver in the increasingly lethal and complex operating environment since the adversary’s systems are organized to place friendly forces in overlapping fields of fire at extended ranges over prolonged periods of time. The convergence concept is reportedly different from integration in that it requires organizations and elements that are organically organized, trained, authorized, and equipped to access, plan, sequence, and operate together in and across multiple domains at all times, not just during a conflict.⁶⁰

A new organizational construct that incorporates the MDB concept would require two properties: networked integration and rapid decision-making architecture. First, a new organizational construct would have to effectively enable the convergence of capabilities and the exploitation of cross domain fires, and thus, will likely be characterized by the integration of command and control across components. Admiral Harris stated at the LANPAC 2017 conference that “[i]deally we’ll get to a point where we see the Joint Force as a network of sensors and shooters allowing the best capability from any single service to provide cross-domain fires... Stronger, more agile networks and command structures supported by a forward-postured Integrated Joint Force will be required to realize the benefits of this Multi-Domain Battle concept.”⁶¹ Second, a new organizational construct will have to enable rapid decision-making with regard to the highly complex maneuver of units operating in various domains practicing dispersal and convergence in a synchronized manner. This will require autonomy for both military intelligence and command decision-making assistance. As Bob Work explained in October 2016, one of the aims of the initial vectors of the Third Offset was to operate inside the adversary’s decision cycle.⁶² Admiral Harris also stated that “AI and man-machine teams take advantage of autonomy to ultimately inject more time back in the human’s decision cycle to make time our ally – and the enemy of our enemy. And technology is mature enough, in my

⁵⁹ Ibid., 3.

⁶⁰ Ibid., 3, 25.

⁶¹ Harry Harris, “Association of the United States Army LANPAC Symposium and Exposition,” May 24, 2017.

⁶² Work’s remark at the CSIS conference on October 28, 2016.

opinion, to do that right now.”⁶³ A rapid decision-making architecture will have to integrate autonomy to deal with a new operating environment in which competing sides leverage AI, big data analytics, autonomous weapons, and other advanced systems.

Organizational reform in the U.S. national security apparatus has progressed in the area of space defense. For example, the Joint Interagency Combined Space Operations Center (JICSpOC) was established in October 2015 through the efforts of U.S. Strategic Command, Air Force Space Command, and the intelligence community.⁶⁴ JICSpOC was renamed the National Space Defense Center (NSDC) on April 1, 2017, and transitioned to 24/7/365 operations on January 8, 2018. The NSDC directly supports space defense unity of effort and expands information sharing in space defense operations among the Department of Defense, the National Reconnaissance Office (NRO), and other interagency partners. It integrates the warnings and indications from the NRO with the data from military space assets so that the National Command Authority can defend all U.S. assets in space. The NSDC is expected to increase the resilience of the space enterprise and the delivery of space capabilities to the United States, the joint warfighter, and allied partners.⁶⁵

Challenges and Opportunities

The trend toward joint operations appears to be symmetrical, with both the Chinese SvS operations and the U.S. MDB concept emphasizing rapid decision-making and streamlined command as well as delegated operations. It remains to be seen when jointness will be achieved by the Chinese theater commands and the U.S. combatant commands. Some of the major challenges for the United States are the pace at which C4ISR network integration can be advanced, the speed at which U.S. forces can harness autonomy for defense intelligence and command decision support, and the quality of training for operations in both the competition phase and network-degraded environments. More importantly, the United States would have to proactively seek to leverage existing or new technologies in novel ways to create “second vectors” in its offset strategy.

From Japan’s perspective, taking measures to enable the Japan Self-Defense Forces (JSDF) to operate effectively with the U.S. forces that execute Multi-Domain Battle will be a key challenge in terms of interoperability but also an opportunity for operational and organizational innovation. These measures could include integrating defense intelligence

⁶³ Harry Harris, “Association of the United States Army LANPAC Symposium and Exposition,” May 24, 2017.

⁶⁴ U.S. Department of Defense, “New Joint Interagency Combined Space Operations Center to be established,” September 11, 2015.

⁶⁵ Air Force Space Command Public Affairs, “National Space Defense Center transitions to 24/7 operations,” January 26, 2018.

derived from various ISR platforms to enhance multi-domain situational awareness in a combined concept of operations with the United States; assuring cyber resilience for intelligence, surveillance, and reconnaissance platforms and C4ISR networks; introducing autonomy into the JSDF battle network; conducting combined military exercises with the United States and other U.S. allies to executing Multi-Domain Battle in gray zone situations or under network-degraded conditions; and advancing military construction and exploring sea-basing options for dispersal locations within and around Japan. Such efforts could create major opportunities to enhance allied interoperability.

With regard to space and cyberspace, it remains to be seen whether the existing organizational asymmetry between China and the United States regarding space and cyberspace command and control will have any significant impact on the relative military effectiveness of the two countries. China has been moving to integrate forces operating in the space, cyber, and electronic warfare domains by establishing the SSF, while the United States has the NSDC for space defense operations and the U.S. Cyber Command for cyber operations. As Todd Harrison has pointed out, China has been developing more advanced space systems that mirror U.S. space capabilities and has also made advances in many counterspace technologies that could threaten U.S. space systems through kinetic, non-kinetic physical, electromagnetic, and cyber means of attack.⁶⁶ Space and cyber operations require mutual support, so an ideal organizational construct for these mutually dependent domains require further study.

From Japan's perspective, the main challenges are to build the JSDF's cyber and space capabilities to a level that would allow meaningful operations, as well as to make the necessary legislative changes to enable those capabilities to be used in impactful ways. It has been reported that Japan's next National Defense Program Guidelines (NDPG) could establish a joint cyber-space-electronic warfare command for the JSDF, but it remains to be seen whether such an idea will actually be adopted in the current review process.⁶⁷ Beyond that, Japan and the United States will have to consult on ways to operate in cyberspace, in information warfare during situations short of armed conflict, and in armed conflicts. These areas present an opportunity to explore bilaterally-coordinated information warfare efforts between the allies.

⁶⁶ Todd Harrison, "Testimony before the U.S.-China Economic and Security Review Commission, Hearing on China's Advanced Weapons," February 23, 2017.

⁶⁷ "Uchu, Cyber, Bouei Kyouka e Soshiki Shinsetsu Nennai ni Taiko Minaoshi [Strengthening Defense in Space and Cyber, New Organization to be Established, Review of Program Guidelines]," Asahi Online, January 24, 2018.

Human Talent

Given that access to advanced commercial technologies are similar between the competing sides, and that both sides are orienting toward operational and organizational constructs that possess similar characteristics, asymmetries in human talent could potentially play a critical role in the trajectory of the long-term peacetime military competition. The objective of human talent development seems to have at least two components. First, it requires recruiting and educating top experts in cutting-edge technologies such as AI, quantum computing, and robotics that form the foundation of the defense human talent pool. Second, it requires nurturing military commanders, operators, and administrators to prepare them to exercise complex judgment in an AI-enabled Data-to-Decision process.

China's Efforts

One of the main pillars of China's 2017 national strategy for artificial intelligence was to improve education and recruitment of top AI talent. Section 1-4 of the national strategy stipulated that its focus was on the "introduction of international top scientists and high-level innovation teams in neural awareness, machine learning, automatic driving, intelligent robots, and other areas."⁶⁸ The Chinese government apparently sees attraction and development of leading talent in AI as a crucial effort to enhance China's competitiveness in the field.⁶⁹ Elsa Kania has pointed out that the PLA "will likely take advantage of AI to increase the sophistication of its simulations, war-gaming, and even training."⁷⁰ Particularly noteworthy is the fact that "the application of AI to war-gaming is seen as a way to enhance research on trends in warfare, while advancing education and training."⁷¹

⁶⁸ "State Council Notice on the Issuance of the Next Generation Artificial Intelligence Development Plan," translated version by experts, July 20, 2017, <https://na-production.s3.amazonaws.com/documents/translation-fulltext-8.1.17.pdf>.

⁶⁹ The Chinese government plans several lines of effort to pursue this goal. The first kind of effort is to continue using the "Thousand Talents" plan that is designed to bring technology to China by recruiting Chinese engineers abroad with "offers of career advancement, increased compensation, the opportunity to do basic research or to lead their own labs in China." The second kind of effort is to utilize a global database of Chinese scholars to match specific technology needs to pools of overseas talent, and "pay overseas Chinese scientists and engineers to return home for short periods of lucrative service that may include teaching, academic exchanges, or working in government-sponsored labs," an effort called "Spring Light." Michael Brown and Pavneet Singh, *China's Technology Transfer Strategy*, 19.

The third kind of effort is to establish AI studies and research as a new discipline by launching AI majors in universities, expanding master's and doctoral programs, and the founding dedicated AI research institutes. Graham Wester, Rogier Creemers, Paul Triolo, and Elsa Kania, "China's Plan to 'Lead' in AI: Purpose, Prospects, and Problems," New America website, August 1, 2017.

⁷⁰ Kania, *Battlefield Singularity*, 28.

⁷¹ Ibid.

U.S. Efforts

The U.S. National Science and Technology Council issued a document titled *Preparing for the Future of Artificial Intelligence* in October 2016. This guidance recommended efforts to ensure an appropriate increase in the size, quality, and diversity of the AI workforce, including AI researchers, specialists, and users, by integrating AI, data science, and related fields throughout the U.S. science, technology, engineering, and math (STEM) education system.⁷² More narrowly within the Department of Defense, the Defense Innovation Board (DIB) has played a role in delivering recommendations for how the Department of Defense can attract promising STEM talent.⁷³ Secretary of Defense Ashton Carter promulgated the “Force of the Future,” which was a series of initiatives aimed at improving human resource management in the Department of Defense.⁷⁴ These efforts sought to expand the Department’s ability to acquire and capitalize on civilian expertise, as well as to tap into top human talent in higher education.

Regarding education and training, Deputy Secretary Work also pointed to the educational aspect of wargaming in a directive calling for increased use of wargaming. He stated that promoting operational excellence and strategic thinking through wargaming among those enrolled in the Professional Military Education programs will generate ideas and insights

⁷² National Science and Technology Council of the Executive Office of the President, *Preparing for the Future of Artificial Intelligence*, October 2016, 26-28.

⁷³ Recommendations by the DIB include: 1) establishing a career track for computer scientists in the military that will provide incentives for service members to specialize in computer science and programming fields; 2) creating new and expand existing programs to attract promising civilian and military STEM talent; 3) reaching into new demographic pools of people who are interested in the work DoD does but otherwise wouldn’t be aware of DoD opportunities; 4) establishing a DoD center for studying artificial intelligence (AI) and machine learning (ML) and building expertise and capacity in these areas across the Department; and 5) expanding exchange programs and collaboration with industry and academic experts in this field. Defense Innovation Board, “Recommendations,” #2, #5, <http://innovation.defense.gov/Recommendations.aspx>

⁷⁴ Two notable efforts were undertaken based on this initiative that promoted human talent pooling. First, the Defense Digital Service (DDS) was established to acquire civilian expertise on information technology within the Department. The DDS is “composed of a small team of talented engineers and digital experts, brought in to the Department on a temporary basis from the private sector to work with senior leaders to improve the Department’s technological agility and solve its most complex IT problems.” Most recently, the DDS was tasked to lead the Cloud Executive Steering Group, a department-wide task force at the Pentagon that is expected to accelerate the adoption of commercial cloud infrastructure and platform services. “Fact Sheet: Building the First Link to the Force of the Future,” undated, https://www.defense.gov/Portals/1/features/2015/0315_force-of-the-future/documents/FotF_Fact_Sheet_-_FINAL_11.18.pdf; Patrick Shanahan, “Pentagon: We Want You — to Get Us Into The Cloud Much Faster,” *Defense One*, November 6, 2017.

Second, the use of Science, Mathematics, and Research for Transformation (SMART) Defense scholarship was planned to be increased in order to attract talent and to place scholarship graduates to mission critical STEM position in the Department’s workforce. “Fact Sheet: The Next Two Links to the Force of the Future,” undated, https://www.defense.gov/Portals/1/features/2015/0315_force-of-the-future/Fact-Sheet-The-Next-Two-Links-to-the-Force-of-the-Future.pdf.

that can directly inform policymakers.⁷⁵ Perhaps most significantly, U.S. forces have begun to accumulate experience using AI in real-world campaigns. The Deputy Secretary of Defense has directed establishment of the Algorithmic Warfare Cross Functional Team (AWCFT) to accelerate the Department of Defense's integration of big data and machine learning in an effort code-named Project Maven.⁷⁶ The use of AI for defense intelligence in actual campaigns will provide U.S. forces firsthand experience with autonomous data analysis.

Challenges and Opportunities

The trajectory of the competition to nurture and attract AI/STEM talent remains to be seen, but perhaps the most significant asymmetry may exist in the area of human talent development. Although both China and the United States are using AI for wargaming and simulations, the United States has started to use AI for defense intelligence purposes, and its growing use will expose an increasing number of defense intelligence consumers and producers to AI. This will provide the United States with an opportunity to test, evaluate, and improve algorithms through combat experience, as well as allow a new generation of AI-experienced commanders and operators to emerge. This is a potentially valuable asset that China cannot match. The challenge for the United States is building trust in AI within the U.S. military and expanding its utility since there will likely be cultural resistance as well as periodic failures during experimentation. From Japan's perspective, human talent attraction is already a very difficult endeavor, so sending the best STEM talent to the United States appears to create more opportunities. The JSDF could also explore the opportunity to engage the U.S. military through AI-based wargaming as well as obtaining information regarding lessons learned from Project Maven to accelerate the introduction of AI into the Japanese national defense system.

Policy Recommendations and Conclusion

As the Japan-U.S. alliance looks ahead to the defense innovation competition with China, it must address the challenges and harness the opportunities that are emerging in the areas of technology R&D, concept of operations, organizational constructs, and human talent. Below

⁷⁵ Deputy Secretary of Defense to Secretaries of the Military Departments et al., "Wargaming and Innovation," February 9, 2015, <https://paxsims.files.wordpress.com/2015/04/osd-memowargaming-innovationdepsecdefworkfeb15.pdf>.

⁷⁶ The directive stated that AWCFT will initially provide Processing, Exploitation, and Dissemination (PED) for computer vision algorithms for object detection, classification, and alerts based on data from tactical Unmanned Aerial System and the Mid-Altitude Full-Motion Video (FMV) in support of counter-ISIS operations, and if ISR PED is successful, the AWCFT is expected to prioritize the integration of similar technologies into other defense intelligence mission areas. Deputy Secretary of Defense, "Establishment of an Algorithmic Warfare Cross Functional Team (Project Maven)," April 26, 2015, https://www.govexec.com/media/gbc/docs/pdfs_edit/establishment_of_the_awcft_project_maven.pdf.

are some policy recommendations that Japan and the United States should consider for the long-term military competition with China.

R&D and Technology

- Japan should establish a National Security Science Board (NSSB) to survey, monitor, nurture, protect, and eventually exploit emerging technologies developed in Japan for potential defense applications. The NSSB should establish a national technology database to be shared with the United States and with other major U.S. allies that are potential partners in joint defense research and development. The United States should leverage its alliance network with major defense partners to forge an international consortium for defense technology cooperation on research and development.⁷⁷
- Japan should vigorously promote and advance international joint research and development programs in areas in which Japan and the United States share common defense technological interests.⁷⁸

⁷⁷ The Japanese national government's investment in R&D amounts to 15.41% (2015) of total R&D investment in Japan, and the share of defense R&D within the national government's science and technology R&D budget amounts to only 3.5% (2017). The Ministry of Education, Culture, Sports, Science and Technology (MEXT) assumes 64.6%, and the Ministry of Economy, Trade and Industry (METI) assumes 15.6% of the national R&D budget. This means that the effort to expansively track and monitor emerging technologies would have to have a government-wide reach beyond the Ministry of Defense (MoD) or its R&D arm, the Acquisition, Technology and Logistics Agency (ATLA), especially when dual-use technologies will have national security implications in a wide variety of context. A National Security Science Board (NSSB) – formed by STEM experts and strategists – should be established to seek out and monitor emerging technologies developed in Japan as well as advise the Director of the National Security Secretariat (NSS) on policy actions for nurturing, protecting and exploiting technologies with national security implications. The NSSB should also establish a national defense technological database to be shared with the United States and its allies so that opportunities for international joint research and development are widened. The United States can potentially maximize such opportunity by leveraging its alliance network with major defense partners for the purpose of facilitating multilateral joint research and development. Above figures are from the Ministry of Economy, Trade and Industry of Japan, *Wagakuni no Sangyogijyutsu ni Kansuru Kenkyu Kaihatsu Katsudou no Doukou* [Trends in Research and Development Activities Related to Japan's Industrial Technology], (June 2017): 4, 23.

⁷⁸ In August 2016 Japan's ATLA issued its *Medium- to Long-Term Technology Outlook* regarding future defense technology acquisition looking over the next twenty years. It identified four major areas of future defense equipment technologies and promising technologies:

- *Unmanned Technology*: This area includes autonomous, swarm control and power supply to respond to complex missions, ensure operator's safety, and to overcome functional & performance restrictions derived from manned system.
- *Smart Technology and Network Technology*: Artificial intelligence for smart technology including advanced autonomy, and to process big data promptly; and Information and communication technology to enable wide-area distributed "System of Systems" capable to resist cyberattack.
- *High-power Energy Technology*: High-power energy technology including high-power laser & microwave for immediate response and long duration combat that can offset enemy's quantity advantage such as saturation attacks that employ cruise missiles.
- *Improve function & performance of Legacy Systems*: Material, sensor and guided missile component technologies are expected to improve function & performance of legacy systems.

- Japan and the United States should respectively establish an experimental TECH/CONOP co-development process in which defense technology developers and operators come together to develop options for novel concepts of operations that exploit emerging and existing technologies. A bilateral or multilateral forum between the United States and its major allies should be convened to explore viable advanced technology/operational concepts.⁷⁹

Interoperability and Operational Concepts

- With regard to ISR cooperation, Japan should pursue the establishment of a Common Operating Picture (COP) while introducing common standards of cyber and EW resilience and system integrity for all U.S. and JSDF ISR platforms.⁸⁰
- The Japanese and U.S. governments should develop coordinated response plans for gray zone situations by incorporating elements of “competition” contained in the Multi-Domain Battle concept.⁸¹

Unmanned system technologies will be particularly crucial for Japan when it faces China’s advantage over mass and quantity in various realms such as air space defense, maritime defense, and also directed energy weapons will be essential in managing the cost-exchange ratio competition when facing the threat of missile salvo attacks. These circumstances make Japan particularly positive for joint research and development. Japan and the United States should also look toward initiating joint research on counter-swarm technologies and tactics as it could have considerable tactical and operational implications for the alliance. Both countries should also advance the MOSA model for weapons development and procurement so as to maximize opportunities to leverage advanced technologies developed in both countries.

⁷⁹ For the purpose of creating new concept of operations based on emerging and existing technologies, the full range of selected stakeholders from the technology side and the operations side should come together to explore new grounds in technological and operational innovation. A certain degree of diversity among the participants should create an interactive environment that could stimulate new ideas. This dimension of the defense innovation competition will be crucial as there will be a continued demand to stay ahead in the long-term competition with China.

⁸⁰ In order to realize the full potential of the MDB concept, sensor networking should apply to the U.S. Forces, but ideally could also apply potentially to Japan and other major U.S. allies. Achieving a high degree of multi-domain situational awareness will probably prove key to executing military operations in the years to come. Since the United States’ greatest strength lies with its alliance network, U.S. allies’ ISR platforms should be fully leveraged to stay ahead in the ISR competition with China. Defense intelligence data collected from a wide variety of U.S. and allied sensors should be integrated to produce a COP that China would not be able to replicate. This will mean that intelligence data collected by a large number of ISR sensors will have to be EW- and cyber-resilient. If allied sensors were less “trustworthy” than those of the U.S. Forces, then the advantages of multi-domain situational awareness based on combined ISR network would not be fully realized. Therefore, the United States and major U.S. allies should agree on a common standard of cyber and EW resilience for ISR platforms.

⁸¹ One of the challenges of gray zone competition for Japan in the Southwestern region is airspace defense against PLAAF aircraft and territorial defense against Chinese maritime entities. Japan could potentially consider the introduction of unmanned systems to cope with increasing numbers of intercepts, but will have to also examine competitive dynamics resulting from such a shift. For example, if JASDF were to introduce drones for emergency scramble operations against incoming PLAAF aircrafts, PLAAF could also replicate such a move. As PLAAF is likely to possess more drones than JASDF, and the nature of escalation could change in the era a “drones vs drones” competition, Japan will have to carefully examine various options ranging from revising concept of operations for emergency scramble intercepts to adopting the manned-

- The JSDF and U.S. forces should plan a whole range of training, exercises, wargames, and other measures to prepare for combined operations under network-degraded or network-denied environments.⁸²

Organizational Constructs

- The JSDF should devise an internal roadmap for a new organizational construct that would make combined multi-domain operations effective in the western Pacific theater of operations. In order to realize the full potential of MDB, both U.S. forces and the JSDF should respectively pursue C2 integration, and the JSDF should devise a plan to introduce autonomy into its battle network.⁸³

unmanned patrol teaming. Another potential area that would require operational coordination during gray zone competition would be information operations. In the event that a crisis emerges in the East China Sea, China is likely to manipulate information in order to create advantages. Japan and the United States should examine possible Chinese tactics and devise counter-tactics for the information domain.

⁸² An extensive training program for off-network operations or mission command would be essential to prepare for operating under network-degraded or off-network environments. The necessity of combined operations by the United States and Japan will require maneuver coordination even under network-disabled conditions, and this would require deep mutual understanding of their respective doctrines and organizational cultures. One of the major tasks for the JSDF would be assist in generating “windows of advantage” for U.S. strike forces, and thus, identifying and hardening potential emergency facilities and locations will prove crucial. Japan should hedge against the risks of losing the network by investing in robust landline communication architecture that would connect emergency facilities and locations to be used by allied forces within Japan when taking dispersed formations. It has often been pointed out that Japanese geography should be capitalized on for operational purposes, but examination of the ways in which this can be realized should move beyond enhancing resiliency of Japanese bases and facilities.

⁸³ In order to realize the full potential of MDB, two major lines of effort should be sought. First, both the U.S. Forces and the JSDF should pursue C2 integration in two phases. The first phase would be advancing C2 integration within their respective Forces, and in the second phase, the U.S. Forces and the JSDF should seek to link sensor-to-shooter networks for combined operations. If the second phase can be realized, then JSDF units would become enablers for generating “windows of advantage” by providing cross domain fires for the U.S. units on a timely basis and amplify U.S. striking power in the theater. Also, on the Japanese side, a mechanism to ensure command coordination between the Japan Coast Guard and the JSDF should be established to deal with gray zone situations, and all real-time intelligence should be shared with the U.S. government through the ACM so that U.S. Forces could prepare to take appropriate responses to counter Chinese actions during the competition phase. Second, the JSDF should introduce autonomy into its battle network. Autonomy should be leveraged for network security monitoring, defense intelligence data processing, and eventually for command decision-making assistance to enable rapid decision and operational maneuvering. For autonomous weapons, the JSDF will need to establish directives for defining what missions are suitable for fully autonomous weapons and what missions are not suitable, and ideally, these directives should be shared with the U.S. Forces. It would appear that interception operations against unmanned weapons would be appropriate for fully autonomous response, but offensive lethal operations will have to be controlled through the humans “in the loop” model. However, bilateral consultations should examine the issue of how the United States and Japan would confront adversaries that use fully autonomous weapons for lethal offensive operations, so that there will be a common ground or a baseline from which the U.S. Forces and the JSDF would formulate guidelines and directives for dealing with this problem.

- The Japanese and U.S. governments should assess the appropriate command and control structures for joint operations in the space and cyberspace domains.⁸⁴

The above recommendations address only a fraction of the complex challenges and opportunities arising from the long-term strategic competition with China. Initiatives to advance human talent development will require a study beyond the scope of this paper. The United States is entering an era in which it is likely to face a serious challenge from a peer competitor. Whether the United States and its allies will be able to lead in the defense innovation competition will affect their ability to prevent undesirable outcomes in the western Pacific and alter the risks and costs required to prevent those adverse outcomes. Yet, the United States also has the opportunity to leverage its most enduring asset: its allies. Harnessing the benefits of major U.S. alliances will be key since China will not have the luxury of this asset. Japan will need to play a more active role in the effort to deter China in the long run. Thus, it will be vital for Japanese leaders to define and implement defense innovation initiatives that generate strategic asymmetries in technological, operational, organizational, and human talent terms to leverage those asymmetries against Chinese weaknesses.

⁸⁴ Since the PLA established the SSF and integrated its space, cyber and electronic warfare capabilities, the two governments should continue to examine its operational implications. Regarding organizational construct, the United States and Japan should respectively question whether there would be any advantages accrued by making space command organizations and cyber command organizations joint. With regard to combined operational coordination, Japan would have to boldly and aggressively increase its cyber and space capabilities, and examine what type of cyber and space operations will be needed to deter and defend against Chinese cyber operations and counterspace operations. The 2015 Defense Cooperation Guidelines have an independent Chapter VI devoted to bilateral space and cyberspace cooperation, but through further consultations, the alliance should move on to the next step to incorporate Chapter VI into Chapter IV where cooperation and responses to various phases from peacetime to wartime are defined.