

STATEMENT BY

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SENATE ARMED SERVICES COMMITTEE
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EMERGING THREATS AND CAPABILITIES**

ON

“Artificial Intelligence Initiatives within the Defense Innovation Unit”

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Introduction

Chairman Ernst, Ranking Member Peters, and distinguished Members of the Subcommittee on Emerging Technologies and Threats, thank you for inviting me to appear before you today to discuss the Defense Innovation Unit (DIU) and our efforts in artificial intelligence (AI) alongside my colleagues at the Defense Advanced Research Projects Agency (DARPA) and the newly formed Joint Artificial Intelligence Center (JAIC).

AI is fundamentally redefining how we live, work, and fight wars. Within the Department of Defense (DoD), AI has the potential to transform how the Department operates at all levels, from business to the battlefield. In the face of competition from China and Russia, DoD aims to maintain its technological edge through establishing a more decentralized, experimental procurement approach: cultivating a leading AI workforce, engaging academic, commercial, and international allies and partners, and developing ethical and lawful guidelines for AI use.¹

China and Russia have recognized the enormous commercial and military potential of AI and are investing heavily to become dominant in the field. In its *13th Five-Year Plan (2016–2020)* and subsequent industrial plans, the Chinese government has outlined a comprehensive, whole-of-government strategy to become the global leader in AI.² In July 2017, the State Council released the *Next-Generation Artificial Intelligence Development Plan* that laid out a 2020 target for Chinese AI technology and applications to match international developments and create a \$22.3 billion (Renminbi [RMB] 150 billion)³ domestic market.⁴ By 2025, China will aim to achieve major breakthroughs in AI and increase its domestic market to reach \$59.6 billion (RMB 400 billion).⁵ To achieve these targets, China's National Development and Reform Commission (China's industrial policy-making agency) funded the creation of a national AI laboratory, and Chinese local governments have pledged more than \$7 billion in AI funding.⁶ In addition, Chinese firms and the Chinese government are leveraging U.S. talent and ecosystems through the establishment of research institutes in the United States, investment in U.S. AI-related

¹ U.S. Department of Defense, *Summary of the 2018 Department of Defense Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity*, (February 12, 2019), <https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/1/SUMMARY-OF-DOD-AI-STRATEGY.PDF>.

² Central Committee of the Communist Party of China Central Compilation and Translation Press, *The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China (2016-2020)*, (March 17, 2016), 64.

³ For this testimony, the exchange rate is: \$1 = 6.72 RMB.

⁴ PRC State Council, *Xinyidai rengongzhieng fazhan guihua de tongzi [Next-Generation Artificial Intelligence Development Plan]*, PRC State Council-2017-35 (July 20, 2017).

⁵ Ibid.

⁶ “2017 Annual Report to Congress,” (U.S.-China Economic and Security Review Commission, November 15, 2017), 525-527; 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, January 2018).

startups and firms, recruitment of U.S.-based talent, and commercial and academic partnerships.⁷ Russia is similarly focused on building its AI capacity but is behind the United States and China in terms of overall AI investment, research, and startups.⁸

Underscoring the potential magnitude of AI's impact on the whole of society, the breadth of its applications, and the urgency of this emerging technology race, President Trump signed the executive order, *Maintaining American Leadership in Artificial Intelligence*, on February 11, 2019, launching the American AI Initiative. This was immediately followed by the release of DoD's first-ever AI strategy.⁹ These documents emphasize the essential role of research and development (R&D) across the Federal Government, business, and academia to maintain U.S. leadership in AI, bolster national security, and safeguard the values shared by the United States, its allies, and partners.

To increase intergovernmental coordination, DIU will engage with DARPA and JAIC, among other DoD entities focused on AI, as well as make its commercial knowledge and relationships with potential vendors available to any of the Services and Service Labs. For example, DIU will be working with the Services and Defense Agencies as DoD customers for the projects it undertakes. AI projects today include work with the Air Force, Army, Navy, and components as well as the Joint Chiefs of Staff. DIU also works with the Defense Innovation Board and the newly established Congressional Commission on AI to leverage the best practices and learnings from the commercial software industry executives who participate on the Board.

In particular, we anticipate a close partnership with JAIC, the outlines of which DIU has already agreed upon with Lieutenant General Jack Shanahan. As JAIC matures, we anticipate that DIU will be at the leading edge of the Department's National Mission Initiatives (NMIs), proving that commercial technology can be applied to critical national security challenges via accelerated prototypes that lay the groundwork for future scaling through JAIC. DIU looks to bring in key elements of AI development pursued by the commercial sector, which relies heavily on continuous feedback loops, vigorous experimentation using data, and iterative development, all to achieve the measurable outcome, mission impact.

⁷ Ibid.

⁸ Alina Polyakova, "Weapons of the Weak: Russia and AI-driven Asymmetric Warfare," (Brookings Institution, November 14, 2018); "Artificial Intelligence - A Strategy for European Startups: Recommendations for Policymakers," (Asgard and Roland Berger, May 14, 2018).

⁹ *Maintaining American Leadership in Artificial Intelligence*, Exec. Order No. 13859, 84 Fed. Reg. 3967 (February 11, 2019). U.S. Department of Defense, *Summary of the 2018 Department of Defense Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity*.

Reinvigorating Outreach to Commercial Technology Companies: Defense Innovation Unit

DIU is focused on accelerating commercial technology into the hands of men and women in uniform. Its staff is comprised of active duty military from every service, civilians, and individuals with extensive private sector experience and deep ties into venture capital and startup communities. DIU partners with the Services, Combatant Commands, and component organizations to seek out and rapidly prototype advanced commercial solutions - spanning AI, autonomy, cyber, human systems, and space - to address military challenges ranging from the tactical level to the defense enterprise. Within OUSD(R&E) and the broader DoD, DIU is unique in its focus on developing and fielding commercial hardware, software, and methodologies within an approximately 24-month timeframe.

Accessing R&D and mature AI-driven technologies advanced by the commercial sector is an essential component of the strategic approach defined by the *2018 Department of Defense Artificial Intelligence Strategy* and the paradigm shift from “defense industrial base” to “national security innovation base” prescribed by the *2018 National Defense Strategy*. Senior leaders in the Department understand that DoD no longer holds a monopoly on emerging technologies like AI that will sway strategic, deterrent, and battlefield advantage in future wars.¹⁰ U.S. businesses began outspending the Federal Government in R&D in the 1980s, and now, industry-funded R&D represents approximately 67 percent of total U.S. investments.¹¹

Moreover, venture capital funding for AI-related companies reached record highs in 2018, increasing 72 percent from 2017 totaling \$9.3 billion.¹² With offices in Silicon Valley, Boston, Austin, and Washington, D.C., DIU is embedded in the core innovation ecosystems where these deals are taking place, AI startups are thriving, and top tech companies and universities are conducting groundbreaking research.¹³ DIU’s location not only facilitates deeper ties with leading edge companies but allows the Department to establish a closer relationship with venture

¹⁰ Ben FitzGerald, Alexandra Sander, Jacqueline Parziale, “Future Foundry: A New Strategic Approach to Military-Technical Advantage,” (Center for a New American Security, December 2016).

¹¹ DIU exists, in part, in response to the growing disparity between federal and commercial R&D, leading to a global technology landscape in which commercial companies are leading the development of some of the world’s most advanced technologies: “In 1960, the United States accounted for 69% of global R&D, with U.S. defense-related R&D alone accounting for more than one-third of global R&D. The federal government funded approximately twice as much R&D as U.S. business. However, from 1960 to 2016, the U.S. share of global R&D fell to 28%, and the federal government’s share of total U.S. R&D fell from 65% to 24%, while business’s share more than doubled from 33% to 67%. As a result of these global, national, and federal trends, federal defense R&D’s share of total global R&D fell to 3.7% in 2016.” Moshe Schwartz and Heidi M. Peters, “Department of Defense Use of Other Transaction Authority: Background, Analysis, and Issues for Congress,” Report no. R45521 (Congressional Research Service), 43.

¹² “MoneyTree Report: Q4 2018,” (PricewaterhouseCoopers and CB Insights, 2019), <https://www.pwc.com/us/en/moneytree-report/moneytree-report-q4-2018.pdf>.

¹³ The top five states for AI investment in 2018, in order, were California, Massachusetts, New York, Texas, and Washington. Ibid.

firms as they scout the horizon for their next big bets and take into consideration clear demand signals from DoD.

DIU seeks to lower barriers to entry into the defense market by more closely matching commercial terms and contracting speeds via its Commercial Solutions Opening (CSO) solicitation process, which leverages Other Transaction (OT) authority. Traditional acquisition pathways overburden technology companies operating with little or no prior DoD contracting experience and runways that are often shorter than the typical time to award a contract under the Federal Acquisition Regulation. Shaping the DoD into a better customer through new processes allows the Department to acquire the best commercial technology faster and cheaper than the traditional system. Furthermore, new acquisition pathways create more opportunities for national security service, making DoD a more competitive employer of AI and other sought-after tech talent through commercial contracts.

While cultural divides and ethical differences are often blamed for the lack of closer cooperation between DoD and Silicon Valley, more often than not, the true deterrent is misaligned economics.¹⁴ Since DIU opened its first competitive solicitation using the CSO process in June 2016, there has been no shortage of top-performing companies interested in working alongside our DoD partners to solve some of the toughest military challenges. DIU has awarded contracts to 103 of these companies, 43 of which are first-time, non-traditional DoD contractors.¹⁵

DIU's AI Strategy & Projects

Commercial AI companies are active across a wide range of sectors and the opportunities for dual-use applications within DoD are vast. The DIU AI portfolio focuses on understanding, tracking, and vetting these commercial companies' ability to solve high-impact problems identified by our military leadership and DoD partners. The portfolio team combines depth of commercial AI, machine learning, and data science experience from the commercial sector with military operators. As a foundational technology, AI-driven solutions appear across a number of DIU projects administered by other portfolio teams, however, the AI portfolio specifically prioritizes projects that address three major impact areas where AI is proven to excel:

¹⁴ Rachel Olney, "The Rift Between Silicon Valley and the Pentagon is Economic, not Moral," War on the Rocks, January 28, 2019, <https://warontherocks.com/2019/01/the-rift-between-silicon-valley-and-the-pentagon-is-economic-not-moral/>.

¹⁵ The 2018 OT Guide defines non-traditional defense contractor as "an entity that is not currently performing and has not performed, for at least the one-year period preceding the solicitation of sources by DoD for the procurement or transaction, any contract or subcontract for the DoD that is subject to full coverage under the cost accounting standards prescribed pursuant to section 1502 of title 41 and the regulations implementing such section (see 10 U.S.C. 2302(9))." Defense Acquisition University, *Other Transactions (OT) Guide*, (November 2018), <https://aaf.dau.mil/ot-guide/>.

1. Computer vision: AI and machine learning adds automation to object recognition and infrastructure assessment; for example, DIU is prototyping computer vision algorithms in humanitarian assistance and disaster recovery scenarios.
2. Large dataset analytics and predictions: AI and machine learning can help make sense of massive datasets and patterns more efficiently and cost-effectively than human analysts; for example, DIU is prototyping predictive maintenance applications for Air Force and Army platforms.
3. Strategic reasoning: AI and machine learning has the capacity to inform top-down planning in environments characterized by uncertainty, missing information, and speculation; for example, DIU is prototyping an application that leverages AI to reason about high-level strategic questions, map probabilistic chains of events, and develop alternative strategies.

Furthermore, DIU has a strategic partnership with JAIC wherein DIU's prototype AI applications "pull" on commercial capabilities, prove and measure their applicability to mission imperatives, and (if successful) are transitioned to JAIC to be scaled and integrated into their NMI. In previous testimony before the House Armed Services Subcommittee on Emerging Threats and Capabilities, Dr. Lisa Porter, Deputy Under Secretary of Defense for Research and Engineering, discussed the need to rigorously assess AI performance against quantitative metrics tied to specific mission needs.¹⁶ DIU's partnership with JAIC aims to institutionalize the rigor Dr. Porter spoke of -- the AI portfolio's prototype projects are designed to drive metrics, establish benchmarks, and contribute infrastructure towards a common foundation as described by the *2018 Department of Defense Artificial Intelligence Strategy*.¹⁷

Following are three specific use cases and projects which employ AI technology:

Applying Computer Vision to Humanitarian Assistance and Disaster Relief

In 2018, DIU hosted the xView Challenge to test computer vision and the use of algorithms to automatically identify objects from images. The competition attracted more than 4,000 submissions from 100 participants from around the world including companies, universities, and individuals. The top performing algorithms were 300 percent more accurate than the government produced baseline, which helps advance computer vision proficiency across four core elements of overhead imagery analysis. The winning algorithm was then used to automate post-disaster assessments in the wake of Hurricane Florence, assisting emergency personnel to quickly identify flooded areas and impassable roads. This use of AI holds the potential to automate post-disaster assessments and accelerate search and rescue efforts on a global scale.

¹⁶ Dr. Lisa Porter, Deputy Under Secretary of Defense for Research and Engineering, testimony to the Subcommittee on Emerging Threats and Technologies, House Armed Services Committee, December 11, 2018, <https://docs.house.gov/meetings/AS/AS26/20181211/108795/HHRG-115-AS26-Wstate-PorterL-20181211.pdf>.

¹⁷ U.S. Department of Defense, *Summary of the 2018 Department of Defense Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity*.

Scaling Predictive Maintenance to Improve Readiness and Cut Costs

DIU's predictive maintenance prototype project provides a specific example of the synergy that we plan to foster between OUSD(R&E) and JAIC. DIU identified a leading commercial airline industry supplier of predictive maintenance solutions and launched a six-month prototype for E-3 Sentry aircraft maintenance. The prototype began with testing predictions at the part and sub-part level against historical actuals to establish the robustness of the AI and its relevance to operational decision-making. This methodology effectively assesses the accuracy of the AI predictions, how much they matter, and in which areas the most impact can be expected (as defined by cost and/or platform availability). Early results of Air Force applications indicate a potential 28 percent decrease in unscheduled maintenance on the E-3 across six sub-systems and more than 32 percent reduction on the C-5 across ten sub-systems. DIU is partnering with JAIC to scale this solution across multiple aircraft platforms, as well as ground vehicles beginning with DIU's complementary predictive maintenance project focusing on the Army's Bradley Fighting Vehicle. This is one of DIU's highest priority projects for FY19 given its enormous potential for impact on readiness and reducing costs.

Automating Cyber Vulnerability Detection & Remediation

DoD's current vulnerability discovery process for weapons systems software lacks the capability to scale because it relies on time and labor-intensive human search and analysis. According to an October 2018 GAO report, \$1.66 trillion of weapon system development is at risk due to the scale of unmitigated cyber vulnerabilities.¹⁸ One of the tools to address these vulnerabilities is DIU's Project VOLTRON, which is an active prototype project that has demonstrated artificially intelligent detection of previously unknown vulnerabilities in classified weapons systems. The project seeks to demonstrate autonomous exploitation and patching; development of an application programming interface (API) for extensibility; and integration into DoD software development environments. This would give the DoD an end-to-end capability that goes from writing software free of vulnerabilities to remediating vulnerabilities in compiled mission software for which source code is not available. The products from Project VOLTRON help make DoD owned systems more resilient to cyber attacks and inform program offices of configuration errors faster and with less errors than humans. An initial capability demonstration of the commercial technologies leveraged by VOLTRON yielded previously undiscovered bugs within the first few minutes of testing against representative aircraft software provided by a defense contractor. In addition, previously unknown vulnerabilities have already been discovered in currently fielded aircraft systems. Integration into software development pipelines will ensure that most vulnerabilities can be found and remediated before future systems go into production and/or deployment.

¹⁸ United States Government Accountability Office, *Weapon Systems Cybersecurity: DoD Just Beginning to Grapple with Scale of Vulnerabilities*, GAO-19-128 (October 2018), <https://www.gao.gov/assets/700/694913.pdf>.

Tremendous Opportunity for DoD/Commercial Collaboration

Commercial industry is breaking ground on AI applications supporting a wide range of business areas and there is a tremendous opportunity to re-establish and grow the ties between the user communities in DoD, commercial entrepreneurs, and partners in universities and labs dedicated to performing the basic research that provides a foundation for future advances. While DIU has found the vast majority of high-tech companies focused on AI to be willing and enthusiastic partners, there is work yet to be done to provide and encourage an open dialogue with the private sector and researchers about applications and principles of use for this powerful tool. DIU will continue to solve DoD problems with commercial AI solutions to bring the Department new capabilities and encourage non-traditional technology firms to work with DoD to grow the national security innovation base.