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Technology Development Initiatives of the U.S. Department of Defense: Rapid and Flexible Incorporation of Private Commercial Technologies

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In response to the fact that China is catching up with the U.S. by introducing precision-guided weapons and stealth technology, which have warranted American military advantage, the U.S. Department of Defense (DoD) is actively working to obtain advanced technologies, including AI, that are developed by the private sector. These advanced technologies have been noticeably incorporated outside the regular framework of the existing federal procurement system in a fast and flexible manner, using "Other Transaction Authorities (OTA)" including contracts with individual companies and consortium agreements based on industry-government-academia cooperation

1. Advanced Technology from the Perspective of the U.S. Defense Authorities

The technology policy of the DoD derives from the notion that America's military edge accrued from its lead in advanced technology. The underlying historical background of this is that in the Cold War era, the United States pursued the Offset Strategy where it regained deterrence through the military application of advanced technology when it faced an unfavorable military balance with the Warsaw Pact and the Soviet forces. In the 1950s after the Korean War, when Warsaw Pact forces appeared to be at an advantage in terms of conventional forces, the United States regained deterrence by developing tactical nuclear weapons by capitalizing on its advantage in the area of nuclear physics. Following the Vietnam War in the late 1970s and 1980s, the Soviet Union was reaching nuclear parity with the United States, the United States regained deterrence once again by developing precision-guided weapons and stealth weapons

based on its lead in the area of microelectronics.[1] These instances came to be known as the first and the second Offset Strategy respectively.

Upon ending the wars in Afghanistan and Iraq, the DoD became concerned with the fact that China and Russia were modernizing their weapon systems for high-end conflict. What made the U.S. defense authorities particularly wary was China's Anti-Access/Area Denial (A2/AD) system – a family of weapons system centered around precision-guided weapons and sensors that essentially constitutes China's theater offensive capability – that threaten U.S. forces in the western Pacific. Initially, the DoD considered overcoming this operational problem through the AirSea Battle concept (later JAM-GC), but it later reassessed the issue of military competition with China and Russia by focusing on how to exploit emerging technologies. In November 2014, then-Defense Secretary Chuck Hagel announced that the DoD would embark on a department-wide effort named the Defense Innovation Initiative (DII) and through it pursue the Third Offset Strategy.

The Third Offset Strategy that America decided to pursue sought to establish a new concept of operations and organizational constructs that enable faster decision making by incorporating Artificial Intelligence (AI), robotics, and other technologies into the U.S. battle network and implementing an integrated management of multidimensional military power encompassing army, navy, air force, space, and cyberspace. It was not long, however, before it became clear that China was also intending to use similar technologies for military purposes.

Furthermore, there was a growing recognition that the private sector has a larger R&D budget than the government sector globally, and many advanced technologies are dual-use developed by the private sector. Thus, the U.S. defense enterprise could no longer monopolize cutting-edge technologies that could be incorporated into the weapons system. Those technologies are distributed across the private sector in major developed countries and can also be accessed and utilized by China, America's principal competitor. It was now clear that the United States and China were competing for the military use of the same technologies such as AI, machine learning, quantum information science, autonomous unmanned systems, directed energy (laser), and hypersonic technologies.

It is thought, therefore, that even if America outpaced China in the military use of advanced technology, the time it will take for China to offset that advantage would be shorter, resulting in a repeated competition of offset and catch-up. America's traditional offset strategy sought to maintain its advantage in military technology for decades based on the monopolistic development of advanced technology in the defense sector – it was now much harder to realize this kind of prolonged advantage in the current technological environment. Furthermore, China had introduced a military-civil fusion strategy for R&D and was making advancements in quantum technology and other fields.

A sense of urgency was now developing among the defense establishment regarding the defense technological competition with China. Consequently, relevant U.S. federal agencies are now working harder together to prevent advanced technology from being transferred to China through both illegal and legal means. In addition to securing supply chains related to national defense , the U.S. defense authorities are also actively incorporating technologies from the private sector to which they had no access before. By using Other Transaction Authorities (OTA) – a flexible means that simplifies the normal Federal Acquisition Regulations requirements – the DoD is concluding contracts with large companies, small and medium-sized enterprises (SMEs), non-profit organizations (NPOs), research institutions, and firms that had no previous R&D transactions with the DoD before and thus promoting prototyping efforts to militarily use advanced technology in a flexible and rapid manner.

2. Contracts with Individual Companies

The U.S. defense authorities have established interfaces with various private companies, a notable one being the Defense Innovation Unit (initially and formerly DIUx). The DIU aims to increase contacts with new industrial sites including Silicon Valley, Boston, Massachusetts, and Austin, Texas. This organizational response came from the prospect that defense innovation would have to depend on technologies developed beyond the traditional defense industry.

DIU not only serves as a bridge between DoD and private companies developing technologies that may meet military operational demands, but also plays a role in applying DoD's investment budget to individual technological development projects. The DIU takes a form of partnership where technologists, investors, business executives, and defense policy practitioners work jointly on projects.[2] DIU is currently working in the following technological fields:

DIU's technology focus[3]

Advanced Energy & Materials	- Advanced Power & Energy Storage
	- Next Generation Fuels & Mobility
	- Materials & Sustainment
Artificial Intelligence	- Machine Learning Predictions
	- Big Data Analysis
	- AI Enhanced Decision Making

Autonomy	- Maritime Autonomy - Unmanned Aerial Systems - Counter-UAS - Ground Autonomy
Cyber	- Assess Threats - Secure - Defend - Enable
Human Systems	- Lethality - Survivability - Readiness
Space	- Peacetime Indications & Warnings - Responsive Access to Mission-Designated Orbits - Reduced Latency Communications & GPS Resiliency - Hardware-to-Software Transformation Modernization - Multi-Orbit Operations & Logistics

The original DIUx consisted of three teams: Engagement, Foundry, and Venture. The Engagement Team connects the military to entrepreneurs and introduces entrepreneurs to military challenges. The Foundry Team gathered the military and private engineers and engaged them in design, prototype development, and testing for military use of immature technologies. For example, it examined the use of virtual reality, augmented reality, space technology, advanced aerial robotics, and autonomous systems. The Venture Team, which is the largest in the three, explored the potential of new private technologies to be used by the DoD. If a promising technology was found, the DIU and relevant organizations within the DoD jointly invested in its developer. Those who received investments were diverse, ranging from individuals to large companies.[4]

Each military force also introduced a similar initiative. For instance, the U.S. Air Force's AFWERX initiative has launched an investment scheme called AFVentures to facilitate the military use of advanced commercial technologies. Development funds are provided under two programs: the Small Business Innovation Research (SBIR) and the Open Topic and Small Business Technology Transfer (STTR) Open Topic.[5]

3. Use of the Consortium System

Forming a consortium (public-private joint enterprise) is a way for the DoD to effectively access advanced technologies developed in the private sector. Consortia that have been formed to date include:

- National Spectrum Consortium
- National Armaments Consortium
- Consortium for Command, Control, and Communications in Cyberspace
- System of Systems Security Consortium
- Medical CBRN Defense Consortium
- Medical Technology Enterprise Consortium
- National Advanced Mobility Consortium
- Vertical Lift Consortium

Designed to develop prototypes in this way, DoD's OTA is legally based on Title 10 of the U.S. Code 2371 and Section 815 of FY 2016 National Defense Authorization Act (Amendments to other transaction authority). These consortia allow participants to network and team with each other. Moreover, they allow member companies to find out the government's needs on any particular technology, and also allow the government to understand the technologies of member companies and their development potential before entering into contracts. Another benefit is that the government can access a wider base of technologies as it becomes easier for SMEs and non-traditional players with no history of transaction with the DoD to participate in its R&D projects. Furthermore, there is also an incentive for more entities to join; for example, when SMEs and non-traditional players account for a large proportion of participating entities, the cost burden of large companies and proven contractors is alleviated.

One of the most recent examples is the Defense Advanced Research Projects Agency's (DARPA) 100-million-dollar contract with the Texas A&M Engineering Experiment Station (TEES) that is effective for up to five years. Based on this contract, Texas A&M University has established the University Consortium for Applied Hypersonics (UCAH) to advance a project that links the results of academic research on hypersonics with technological development in collaboration with government agencies such as the U.S. forces, defense research facilities, the National Aeronautics and Space Administration (NASA), and the Department of Energy as well as major companies and SMEs. The development of hypersonic weapons requires the integration of various individual technologies, and so participants from diverse fields need to cooperate.

According to TEES, 41 institutions from 23 states are committed to participating in the UCAH and this number is expected to increase in the future to include additional institutions from Canada, Australia, and the United Kingdom.[6]

4. Conclusion

America's competition with China over the military use of advanced technology is likely to last for a long while. Given America's tight defense budget, the idea of compensating for quantity with quality – i.e., technological innovation – would likely gain wider support going forward. In this context, one important competitive factor will be how fast the United States can advance through the so-called "Valley of Death" – the process through which basic research develops into practical application, in this case weapon systems and associated architectures. Against this background, as mentioned above, defense system prototyping using private commercial technologies has been noticeably widespread and has become one of the key pillars of DoD's technological development policy. Also, like the UCAH case above, international joint R&D projects could be undertaken through a consortium model. Japan may need to pay attention to this kind of technological development framework when exploring joint R&D opportunities with the United States.

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[1] After the Korean War, it was found out that the North Atlantic Treaty Organization (NATO) forces were inferior to the Warsaw Pact forces in terms of conventional forces in Europe. The Eisenhower administration deployed tactical nuclear weapons to offset this imbalance in conventional forces – this was later called the First Offset Strategy.

While America was intervening in Vietnam starting in the mid-1960s, Soviet enhanced its nuclear capability and, in the 1970s, achieved nuclear parity with the United States. During the Yom Kippur War of 1973, Soviet conventional weapons (the same types as those deployed in Europe) proved sufficiently effective against U.S. conventional weapons in actual combat, raising concern again about NATO's disadvantage in conventional forces in Europe. After a series of studies and research projects, the DoD found out that the United States could the Soviets in the area of microelectronics. The Carter administration's Defense Secretary Harold Brown and Under Secretary of Defense William James Perry supported DARPA and other organizations to successfully develop a prototype for the precision-guided weapons system composed of sensors, information fusion networks, and precision-guided munitions through the Assault Breaker project. This was combined with the 1982 version of the U.S. Army FM100-5 doctrine (AirLand Battle) (and reflected to some degree in NATO's new Follow-on-Forces Attack doctrine) resulting in the Soviet army recognizing that the United States now had conventional forces in place that were comparable to the striking power of nuclear weapons. This became known as the Second Offset Strategy. See Satoru Mori, "Betonamu senso go no amerika niyoru tsujo senryoku no kakushin—'ofusetto senryaku' no kigen to keisei ni kansuru yobiteki kosatsu" [America's innovation in conventional forces after the Vietnam War—preliminary thoughts on the origin and shaping of the Offset Strategy], Paper submitted to the American Politics and Diplomacy Session at the 2016 Annual Convention of Japan Association of International Relations, October 16, 2016.

[2] U.S. Department of Defense, "Secretary of Defense Speech—Remarks Announcing DIUx 2.0," May 11,

2016, https://www.defense.gov/News/Speeches/Speech-View/Article/757539/remarks-announcing-diux-20/; 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/.

[3] DIU, "Solutions-Portfolio," at https://www.diu.mil/solutions/portfolio.

[4] "Secretary of Defense Speech—Remarks on Opening DIUx East."

[5] AFWERX, "AFVentures," at https://www.afwerx.af.mil/afventures.html.

[6] David Vergun, "DOD Awards Applied Hypersonics Contract to Texas A&M University," *DoD News*, October 26, 2020, at https://www.defense.gov/Explore/News/Article/Article/2394438/dod-awards-applied-hypersonics-contract-to-texas-am-university/.