The Value of Experimentation, not Demonstration

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Introduction

Ongoing regional conflict highlights an increasingly complex and interconnected battlespace. Notably, technology is creating new opportunities to co-evolve operational concepts and tactics with the tools of warfare. With the accelerating pace of change in warfare, success can depend more on rapid adaptation via novel combinations of capabilities across domains than on speed, range, or warhead size. The degree of cross-domain and cross-system coupling needed to win in this reality challenges traditional service-by-service and program-by-program approaches to technology-enabled operational concepts. The Chinese People's Liberation Army (PLA) has demonstrated remarkable speed in developing new military capabilities – especially in missiles and aircraft – and has complemented that with rapid scaling of inventory. This combination of speed and scale conspires to make one of the biggest problems facing the Department of Defense (DoD) not just performance attributes or quantities of systems, but its very agility to operate, and stresses the historical approach of episodically filling operational gaps with service-specific acquisition priorities. As adversaries advance their capabilities, DoD needs new ways to prototype and experiment with joint systems-of-systems that transcend traditional service boundaries and enable rapid adaptation.

To address these challenges, the DoD launched the Rapid Defense Experimentation Reserve (RDER) in 2021 to drive joint experimentation and accelerate capability development. This effort has undergone considerable refinement since its launch and is now structured to focus on solving military problems with available capabilities, rather than maturing or introducing specific products.

The goal of RDER is finding innovative, technology-enabled solutions at the operational level of war before war manifests. This does not mean that all or even most RDER experimentation is done at the operational level or run at a joint level; rather the experimentation should be informed by the problems and/or opportunities that exist at that level. By addressing problems at the operational level—such as C5ISRT[1] at scale—RDER naturally pursues joint solutions that don't inherently map onto one particular service or operating domain. No single service has the responsibility for joint command and control (C2). However, some new capabilities – like a kill chain that leverages sensors and munitions from multiple services – require not only the technical work of integrating sensor and shooter, but also exploration of how to best employ the new capability, which units should command the effect, and which others should support it.

Thus, the RDER initiative is designed to help bridge the gap between service-specific priorities and capabilities, and emerging opportunities for joint solutions, including technology-enabled operational concepts and systems-of-systems that can address the critical operational problems combatant commanders face.

In October 2024, the Hudson's Center for Defense Concepts and Technology and the National Defense Industrial Association Emerging Technologies Institute co-hosted an event to discuss DoD's efforts in joint experimentation, and how RDER is bridging the "Valley of Death"[2] in ways that transcend funding gaps to acquisition. The event featured Thomas Browning, Performing the Duties of Assistant Secretary of Defense for Mission Capabilities (ASD(MC)), and Director of Requirements and Resources (J8) at United States Indo-Pacific Command (INDOPACOM), Robert (Bob) Stephenson. Highlighting past projects, ASD Browning shared examples of how RDER transitions promising technologies or changes our understanding of what is possible through a structured cycle of ideation, prototyping, and mission integration. Mr. Stephenson discussed the role of command requirements in identifying technology gaps and partnering with RDER to accelerate critical capabilities. Both speakers stressed the importance of coalition-building, adaptive development, and engaging industry to refine and test solutions in realistic settings. This approach not only supports the execution of joint warfighting concepts, but also helps shape innovative methods to meet evolving geopolitical and technological challenges.

1 Command, Control, Communication, Computers, Cyber, Intelligence, Surveillance, Reconnaissance, and Tracking

2 A full recording of the "Advancing Joint Experimentation to Solve Operational Problems" event can be found on the Hudson Institute's YouTube channel here: https://www.youtube.com/watch?v=-MGI7VRbIG8&t=930s

Experimentation is not Demonstration

The RDER effort is intended to be distinct from the demonstrations often pursued by services or industry.[3] Typically, demonstrations validate that a single system or small group of systems work as advertised by the developer and meet the requirements set by DoD. In contrast, true experimentation – as implemented by RDER – represents a different approach organized to assess a variety of solutions to specific mission-oriented problems. Rather than validating requirements, experimentation focuses on hypothesis, learning, and discovery. Joint experimentation explores what might be possible when systems are combined in novel ways to solve cross-service operational problems. This approach enables operators and technologists to refine concepts through iteration, discover unexpected interactions between systems, and understand where assumed requirements need revision, based on actual operational use. Through OSD R&E's Mission Capabilities (MC) office, DoD is beginning to systematize a "problem-first" approach — when historically, the services led with new system concepts to replace old ones or fill gaps.

Results from previous RDER activities highlight why this distinction matters. For example, when RDER evaluated electronic attack capabilities from two services that appeared redundant, rather than conducting comparative demonstrations to select a "winner," the experimentation process revealed the systems were complementary in ways that were not obvious beforehand. The process generated understanding that enabled technical integration and operational innovation – with the services ultimately collaborating on software development after discovering their complementary capabilities. This experimental mindset reflects a cultural shift for the DoD acquisition community, treating uncertainty not as risk to be eliminated, but as an opportunity for discovery of both technical possibilities and concepts of employment.

Why Joint Experimentation is Needed Now

Many of DoD's most pressing operational challenges arise from joint operations that require integrating systems and technology in novel ways. Success in future wars will demand a shift away from organic sensor-shooter combinations and independent, domain-specific service operations. While such capabilities remain important, warfighting advantage is increasingly derived from hyperconnected kill chains that cross service boundaries, with speed of adaptation required to keep pace with peer competitors. As ASD Browning noted, "[i]t used to be organic sensors and organic shooters. You tell them go [accomplish those objectives] and come back to tell me how it went. But modern warfare demands decisions at a much broader scale than we've ever had to [operate on] before." This shift has been accelerated by the proliferation of uncrewed systems, commercial space capabilities, and the need to integrate effects across all domains.

However, both the problems and technological solutions transcend individual service boundaries. The traditional approach of developing requirements first and then demonstrating individual systems struggles to address this new reality. Joint experimentation provides a way to discover how systems can be combined in novel ways, to understand the interactions between new technologies like uncrewed systems and legacy platforms, and to rapidly evolve concepts of operation alongside technical capabilities. Joint experimentation enables the rapid learning and adaptation needed to deploy cross-service operational capabilities in this dynamic environment. The potential for joint integration is not just about creating new concepts; it is also about finding ways to implement them, experiment with them, refine them, and scale them into the deployed force.

3 Jon Harper, "Pentagon to test whether counter-drone systems can operate effectively under electronic attack," DefenseScoop, July 25, 2024, https://defensescoop.com/2024/07/25/pentagon-test-counter-drone-systems-operate-electromagnetic-environment/#:~:text=During%20a%20call%20with%20reporters,contributed%20reporting%20for%20this%20story
Lockheed Martin, "Successful SWIFT Demonstration Showcases Lockheed Martin And Altera Collaboration With OUSD (R&E), Highlighting The Future Of Electronic Warfare And Microelectronics," Lockheed Martin, September 30, 2024, https://news.lockheedmartin.com/2024-10-30-Successful-SWIFT-Demonstration-Showcases-Lockheed-Martin-and-Altera-Collaboration-with-OUSD-R-and-E-Highlighting-the-Future-of-Electronic-Warfare-and-Microelectronics#:~:text=Releases,-Newsroom&text=Bethesda%2C%20Md.%2C%20Sept.,Flight%20Test%20(SWIFT)%20demonstration

The evidence from Ukraine and other current conflicts shows that adversaries are moving quickly to adapt new technologies and operational concepts. As Mr. Stephenson emphasized, "Watching what's happening...we [at INDOPACOM] just feel this urgency to move faster than traditional acquisition allows." INDOPACOM faces unique challenges in its area of responsibility that requires joint capabilities. Each service is developing operating concepts that have smaller force footprints and are dispersed, but are connected across a wide operating area.[4] This is to increase the cost of Chinese strikes and avoid single points of failure. However, this places a greater burden on logistics, communications, and C2. To reach an effective level of deterrence and reduce the likelihood of a war in response to a Chinese amphibious invasion of Taiwan, INDOPACOM is prioritizing a range of joint capabilities, including integrated air and missile defenses, long-range precision strike, and joint C2.[5]

Adopting a Campaign Approach

RDER represents a shift in how DoD approaches joint capability development. Rather than operating as a mechanism to push new material solutions like the Joint Capability Technology Demonstrations (JCTDs) of years past, or even the original concept of a "reserve" or discretionary money in the hands of the Pentagon, RDER has evolved into an evolutionary campaign of experimentation focused on specific operational challenges. RDER's objective is to coordinate disparate organizations across DoD, including the services, combatant commands, the Office of the Secretary of Defense (OSD), and industry partners to address joint problems that lack a clear "owner." Through two-year cycles, combatant commands identify warfighting problems and RDER matches them with promising technologies and novel combinations of existing capabilities.

Each RDER "class" follows a structured progression. First, the ideation phase identifies the most pressing joint capability gaps and breakthrough technologies. This is followed by a mission integration phase, which connects the technologies to operational needs by leveraging modeling and simulation (M&S) to evaluate potential solutions. The last phase focuses on funding and assessing initial prototypes during experiments. OSD oversees and resources service prototyping and evaluates those technologies through Technology Readiness Experiments (T-REX) and integration in major theater exercises. The program is working to create compelling, evidence-based cases for a technology's transition to a service through a cycle of studying warfighter challenges and potential new technologies through advanced modeling and simulation, prototyping and experimenting, and finally transitioning those capabilities.

The program's approach alternates between broad Indo-Pacific focused campaigns on odd years (e.g., '23, '25, and '27) and targeted deep dives into specific challenge areas like contested logistics or forward base defense in even years (e.g., '24, '26, and '28). Of the first graduating class of the 2023 projects, about 70% found transition paths to services or operational use. Though, ASD Browning emphasized that if everything transitioned "we didn't set the bar high enough," as experimentation must include some higher-risk efforts that fail to find an owner. The emphasis on 2-year timelines and concrete operational problems helps to drive urgency and focus which traditional acquisition approaches often lack.

> **"[t]he North Star is the warfighter challenge...not transitioning things."**

4 Doll, Abby, Yvonne K. Crane, Gian Gentile, D. Sean Barnett, John Gordon IV, Timothy R. Heath, Jeffrey W. Hornung, Mark Hvizda, Sale Lilly, Bradley Martin, David A. Ochmanek, Stephanie Anne Pillion, Barry Wilson, and Emily Yoder, The Backbone of U.S. Joint Operations: Army Roles in the Indo-Pacific. Santa Monica, CA: RAND Corporation, 2023. https://www.rand.org/pubs/research_reports/RRA1784-1.html

5 Adm Davidson, Philip S. ***Transforming the Joint Force: A Warfighting Concept for Great Power Competition***. U.S. Indo-Pacific Command. March 3, 2020. https://www.pacom.mil/Media/Speeches-Testimony/Article/2101115/transforming-the-joint-force-a-warfighting-concept-for-great-power-competition/

While RDER's primary goal is enabling DoD to execute the current Joint Warfighting Concept (JWC)[6], there are also opportunities to create new concepts as well. Often, warfighters may use new capabilities in ways that are innovative enough to define new methodologies. However, RDER's primary focus is closing the gaps in the services' ability to execute the JWC. This drives a different approach to prototyping and experimentation: one focused on rapidly learning what combinations of capabilities might solve pressing operational needs, rather than demonstrating compliance with pre-defined requirements developed as part of the traditional acquisition process. RDER represents a pathway to address urgent operational needs. As Mr. Stephenson emphasized, they "cannot wait until 2027" for traditional acquisition processes when facing rapidly evolving threats in the Western Pacific. The command actively participates in shaping RDER priorities, consistent with the INDOPACOM commander's blunt requirement: "I need to be able to see my enemy, I need to be able to blind my enemy, I need to be able to kill my enemy." RDER provides INDOPACOM with a mechanism to more rapidly field integrated joint capabilities to maintain advantage in their theater.

Experimentation Drives Acquisition

Experimentation not only enables DoD to better understand how to stitch different systems together, but also contributes to more informed acquisition decisions. This approach moves beyond ensuring that the technology achieves a desired effect under specified operational conditions and meeting specific technical requirements. Focusing on combatant commanders and their operational problems provides a mechanism for offices like OASD(MC) to direct their expertise and resources toward activities that address discrete near-term missions prioritized by the warfighting community. While there are technical aspects to this problem, as the Hudson Institute and NDIA ETI's joint report, "Integrated by Mission – Federated for Execution" outlines, this effort also "requires aligning programs and stakeholders around shared mission problem statements that cut across traditional system or domain boundaries."[7] For example, how do U.S. forces maintain target custody with sensors owned by different DoD components (e.g., National Geospatial-Intelligence Agency, National Security Agency, U.S. Air Force, etc.)?

The challenge of organizing DoD development and acquisition activities around mission-based constructs (like kill chains) is not largely a technological issue; it is cultural. Experimentation acts as a bridge between the research and development (R&D), acquisition, and warfighting communities by facilitating collaborations that connect technology developers with real-world operational needs. The speed of technological development and proliferation demands that the DoD experiment, fail fast, learn, and rapidly move forward. Through RDER, the DoD has established a structured cycle (ideation, mission integration, and prototyping) to identify joint capability needs and test potential solutions. This cycle connects innovative R&D outputs with acquisition pipelines, positioning technologies for rapid transition to the warfighting community. The experimentation process involves continuous engagement with operators, developers, and acquirers, ensuring that each phase – concept development, testing, and refinement – is guided by input from both the acquisition and operational communities.

Leadership buy-in is essential for transitioning new technologies. Experimentation, as exemplified by RDER, provides real-world evidence for the utility of a particular technology, new integration between systems, or new employment concept, which enables combatant commands to not only advocate for its transition, but also increase the analytical framework to incorporate new developments into service plans and programs. In a budget-constrained environment, experimentation allows decision makers to assess developing technologies against real-world scenarios for operational effectiveness, suitability, and urgency.

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6 The Joint Warfighting Concept is defined as a threat-informed, operational concept that provides an overarching approach to how the Joint Force will operate and fight as a team across all domains.
General (Ret.) Milley, Mark A. ***Strategic Inflection Point: The Most Historically Significant and Fundamental Change in the Character of War Is Happening Now—While the Future Is Clouded in Mist and Uncertainty.*** National Defense University. JFQ 110, 3rd Quarter 2023. https://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-110/jfq-110_6-15_Milley.pdf

7 Clark, Bryan, Miles, Wilson, et al. ***Integrated by Mission – Federated for Execution***. The Hudson Institute and National Defense Industrial Association's Emerging Technologies Institute. September 2024. https://www.hudson.org/defense-strategy/integrated-mission-federated-execution-bryan-clark-dan-patt

Engaging Services in Joint Experimentation

For any experimentation – including joint experimentation – to be successful, it must be coordinated with the services. It is well understood that acquisition is tightly controlled by each service, so experimentation must be well-integrated into service strategies and programs. Through the concept of experimentation, there are several ways that DoD can refine technologies and warfighting methodologies: partnerships between combatant commands and DoD's testing offices, using high technology readiness level (TRL) technologies, and leveraging modeling and simulation tools – all of which will better support the deployment of new capabilities.

Partnerships with different DoD testing components by the combatant commands underpins effective experimentation. These components provide combatant commands with additional testing capability, technical expertise, and data collection resources during exercises. This type of partnership is also necessary for building warfighter feedback into the design cycle. For example, INDOPACOM has partnered with the Strategic Capabilities Office and individual service program offices to leverage supplementary testing infrastructure. The Test Resource Management Center (TRMC) is also a key partner for producing infrastructure and data analysis to support INDOPACOM's evaluation of different capabilities.

Later-stage experiments often act as rehearsals. For example, INDOPACOM will conduct a major exercise with uncrewed vehicles in the spring to better understand command structures at a variety of operational levels, from Joint Task Force Commanders to individual units. This approach leads to an emphasis on the use of technologies at higher TRLs to increase the likelihood of near-term transition. However, this does not exclude lower TRL technologies for potential utility.

Advanced modeling, simulation, and live, virtual, constructive tools are integral to joint experimentation and exploring potential future conflicts. These tools allow DoD to simulate and analyze complex, high-fidelity scenarios while not physically revealing developing capabilities to adversaries. For example, Pacific Fleet recently completed Global 19,[8] and is planning for Global 20, which helps mature INDOPACOM's concepts of operation and identify capability gaps. Lessons learned from different modeling and simulation activities – such as analyzing the nuances of distributed maritime operations – informs INDOPACOM's integrated priority list, determining both the capabilities and quantities of capabilities needed. This list gives the J8 a unique opportunity to highlight specific gaps and needs directly to DoD leadership and Congress, which helps to inform budget requests and the Congressional appropriations process.

Through the idea of "enduring engagement" with the requirements and acquisition community, OASD(MC) has positioned themselves to help ensure technologies meet both service and combatant command needs. INDOPACOM's partnership with OSD, especially OUSD(R&E) in particular, supports pathways to experimentation and ensures that resources are aligned to transition successful projects to programs of record.

8 The Global wargames examine the dynamics of strategic deterrence, assurance, and escalation management and assess joint warfighting capabilities in the Pacific Fleet's area of responsibility. Additional reading can be found here:
https://usnwc.edu/News-and-Events/News/US-Strategic-Command-US-Pacific-Fleet-Hold-Combined-Wargame-at-US-Naval-War-College
https://nps.edu/documents/144713579/150521407/O%27Hara+-+NWC+Wargaming.pdf/433e5cab-13a2-601d-5472-0ab921c5e25d?t=1716558647077

Case Study – Joint Fires Network (JFN)

Former INDOPACOM commander Admiral Aquilino's launched the JFN effort in Spring 2023 with his clear statement of an operational problem: the lack of a C2 capability for coordinating joint fires. Rather than launching a traditional acquisition program, RDER took an experimental approach leveraging an existing architecture from the MC's Vanguard Force Command Capability and DARPA's Assault Breaker II initiative.

Within a month of Admiral Aquilino identifying the need for C2 capabilities, contracts were in place with initial demonstrations beginning in December 2023. RDER supported rapid prototyping and experimentation that enabled a multi-site fielding of JFN by the following April—just 12 months from initial concept to operational use. The experimentation progression moved from modeling and simulation to evaluating architectural options, through limited technical demonstrations, to full integration in theater exercises such as Valiant Shield[1] and Northern Edge.[2] Rather than trying to solve every joint C2 challenge, the focus remained on the specific operational problem of coordinating joint fires. By April 2024, INDOPACOM had a multi-site, fielded system operational.

The JFN graduated from RDER with demonstrated operational utility and a clear transition path—in this case through an innovative, first-of-its-kind, service-led model with the Air Force taking responsibility for program transition through its C3BM program office. The success of JFN showed how experimentation could rapidly address joint gaps that don't fit neatly into traditional service lanes, while still finding a sustainable transition path through existing organizational structures.

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1 *Allies Come Together in the Indo-Pacific: Valiant Shield 24*. U.S. Indo-Pacific Command. June 4, 2024. https://www.pacom.mil/JTF-Micronesia/Article/3798393/allies-come-together-in-the-indo-pacific-valiant-shield-24/

2 *Northern Edge 23-1: Alaska's Role in Joint Force Readiness*. Pacific Air Forces. May 25, 2023. https://www.pacaf.af.mil/News/Article-Display/Article/3408236/northern-edge-23-1-alaskas-role-in-joint-forces-readiness/

How Joint Experimentation Presents Multiple Paths to Partnership

RDER and related joint experimentation initiatives offer multiple "entry points" for both traditional defense contractors and commercial technology companies to participate in solving operational challenges. There exists a variety of different DoD programs, experiments, and forums, which may at first glance appear unclear as to how they vary. However, they are intended to provide industry with opportunities to engage different offices – each with their own technical needs – to ensure that DoD's requirements are understood.

The primary avenue to engage with RDER is through RDER industry days, where operational problems are shared at appropriate classification levels. Each industry day begins with a threat brief and input from the combatant commander on their highest priorities. Rather than prescribing specific solutions, these events expose industry to specific warfighter challenges and enable "speed dating" between companies and government personnel with specific technical areas of interest.

Importantly, these events include representatives from the Defense Innovation Unit (DIU), the Chief Digital and Artificial Intelligence Office (CDAO), Strategic Capabilities Office (SCO), and Defense Advanced Research Projects Agency (DARPA), ensuring that even if a capability is not appropriate for RDER funding, it can find the right path to adoption. In addition to acting as a "dating service" for industry and DoD, the OASD(MC) also has internal funding through the Defense Innovation Acceleration (DIA) and Rapid Prototyping Program (RPP), which allow it to bring potential solutions from industry to prototype development.

Regional engagement through events like INDOPACOM's Pacific Operational Science & Technology (POST) Conference provides another avenue for industry to understand operational needs and demonstrate relevant capabilities. These venues allow for more detailed classified discussions of specific theater challenges and kill chain gaps. The focus remains on mission outcomes rather than specific systems. As Mr. Stephenson noted, unclassified discussions often devolves to "platitudes," while classified engagement enables meaningful discussion of operational problems. While this level of detailed information is helpful, it is limited to companies, individuals, and organizations with the standing and resources to secure and maintain clearances. Classification continues to be a challenge for nontraditional companies, as well as second-tier small businesses. It hampers DOD efforts to expand the defense industrial base, and limits DOD's access to commercial innovation.

Another aspect of RDER's industry engagement is the T-REX events, which are collaborative experiments where companies can test technologies with operators in real settings even without formal program involvement. Certain elements of the T-REX events are unclassified; however, many aspects of the assessments and some capabilities are classified. These events occur two to four times per year and the most recent T-REX event included 95 different technologies, with only a small fraction directly tied to RDER projects. This environment creates opportunities for organic discovery of complementary capabilities and novel combinations to solve operational challenges. The emphasis remains on learning and operational relevance rather than traditional demonstrations or marketing.

This multi-path approach reflects the desired shift from technology-push to problem-pull in joint experimentation. Rather than trying to sell specific systems, industry partners are invited to help solve concrete operational challenges through whatever combination of capabilities might work.

USD(R&E)'s Role in the 21st Century Fight: Why R&E and Mission Capabilities?

The role of joint experimentation and RDER within OASD(MC)'s office reflects the Title 10 responsibilities of Research & Engineering to develop and advance military technology for the Department. However, OASD(MC) represents an evolution in how R&E executes this mandate. While traditional R&E activities focus on advancing specific technologies through labs and demonstrators, OASD(MC) was created to address promising technologies that need to be integrated and experimented with in order to solve joint operational problems.

This role aligns with Congressional intent in creating USD(R&E) as the Department's Chief Technology Officer: The CTO was intended to be positioned to sit at the leverage point between the acquisition and innovation community. As shared by former Senate Armed Services Committee Professional Staff Member and NDIA ETI Executive Director, Arun Seraphin, one of the Hill's original goal when establishing the CTO role was to be able to identify new technologies in different science and technology communities (e.g., defense laboratories or commercial companies), and then find the natural transition partner. Rather than competing with service acquisition authorities under Title 10, OASD(MC)serves as a facilitator by working through existing service structures and providing the experimentation venues needed to discover how capabilities can be combined in novel ways. This is particularly critical for joint problems that don't naturally align with service-specific missions.

> **"[It] is about supporting the services… not about supplanting or altering...[and] providing the integration and ability to mix it all together."**

By focusing on experimentation rather than acquisition, OASD(MC) stays within R&E's Title 10 lane while helping bridge the gap between technology development and operational use. The success of initiatives like RDER validates this approach — not by creating new acquisition authorities, but by generating the evidence needed for services to confidently adopt new joint capabilities through their existing responsibilities.

Conclusion

The nation's technological advantage, especially in the national security sector, will not be maintained through bureaucratic and stovepiped processes. As evidenced by the establishment of the ASD(MC) office and its RDER effort, the Department is attempting to systematize a "problem-first" approach to focus on inherently joint problems. Taking advantage of the nation's innovative and technological strength requires creating a culture of rapid experimentation and learning. Collaboration across all stakeholders – industry technology developers, systems integrators, government labs, acquisition offices, operational users, and program structures and leadership – is needed to move game-changing innovations into operational use. DoD's renewed focus on experimentation is a welcome sign that the Department is thinking through how to best integrate new technologies, departing from a traditional focus on technology-first development, and allowing technology and operational concepts to evolve together.

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