Extended range multipurpose unmanned aircraft system returns from functional testing during Project Convergence 20, at Yuma Proving Ground, Arizona, September 15, 2020 (U.S. Army/Jovian Siders)

Project Convergence

Achieving Overmatch by Solving Joint Problems

By John Michael Murray and Richard E. Hagner

As the United States confronts Great Power competition (GPC), incremental improvements to individual Service capabilities will not produce a military able to decisively win on the battlefield. Although important, the enhanced range, precision, and survivability of our weapons systems are just one part of achieving overmatch. When employed effectively, advancements in artificial intelligence (AI) and machine learning, robotics, and autonomy improve our weapons systems' effectiveness by boosting the decision-making pace of our commanders and reducing the options for our adversaries. Success on the battlefield depends on whether we leverage these new technologies to create simultaneous dilemmas across multiple domains.

This article describes what Army Futures Command, in cooperation with the Air Force, Navy, Marine Corps, and coalition partners, is doing to advance emerging technologies and ensure that we achieve *convergence*—that is, the full integration of effects across all domains to reach overmatch on the battlefield. Project Convergence is the Army's contribution to the *Combined* Joint All-Domain Command and Control (CJADC2) concept and will help inform the joint warfighting concept.

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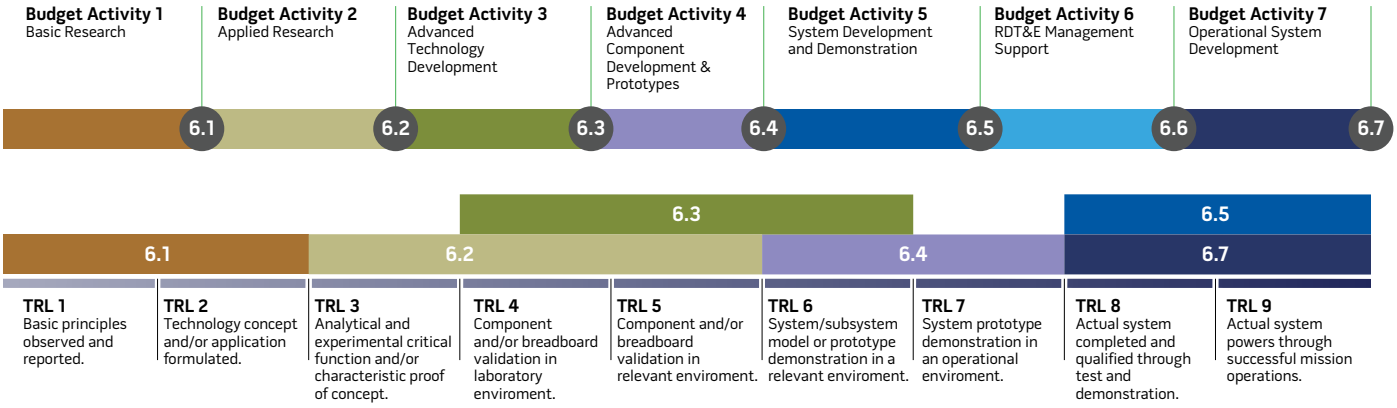
GPC and the Need for Overmatch

National security experts agree that gaps in military capability are closing. Better China-Russia relations and

Figure 1. Technology Readiness Stages

DOD Financial Management Regulation Volume 2B, Chapter 5, RDT&E Appropriations



DOD Defence Acquistion Guidebook Technology Readiness Level (TRL)

accelerated innovations in defense are "eroding U.S. military advantage."[1] Russia and China are quickly closing in on American military superiority. A Department of Defense report to Congress in 2020 describes China's goal "to become a 'world-class' military by the end of 2049" and outlines the steps the People's Liberation Army has taken to achieve that objective, including investments in emerging AI and cloud computing technologies.[2] This investment in emerging technologies could result in an asymmetric advantage—an ability to achieve an advantage in one domain through sheer speed of data processing.

The National Defense Strategy (NDS) and National Military Strategy (NMS) address the reemergence of GPC. The NDS points to "military modernization" by China and "use of emerging technologies" by Russia to achieve their respective regional goals.[3] A summary of the NMS states that "the reemergence of Great Power competition with China and Russia represent[s] the most difficult challenges facing the Joint Force."[4] The NDS and NMS acknowledge and address what policy experts have stated: the military gap between the United States and its near-peers is closing. The result is a complex and dynamic environment the likes of which the U.S. military has not faced since the end of World War II.

The challenge of GPC will likely persist for decades as countries develop and employ new systems and technologies, driving competition for information and military superiority. The goal of the United States is to deter through competition but, if needed, win in conflict. Overmatch is the key. Chairman of the Joint Chiefs of Staff General Mark Milley has called for a new modernization approach to deliver "capabilities that are 10 times more lethal than those they replace."[5] But achieving the 10 times overmatch in individual systems is cost-prohibitive and inefficient. Experts in defense modernization efforts and processes have rightly criticized the lack of integration of these systems—the lack of convergence to accelerate the kill chain.[6]

Army Futures Command leads persistent Army modernization and was created to "regain overmatch in MDO [multidomain operations]" and "provide the '10x' capability with increased range, lethality, reliability and survivability."[7] To enable true overmatch, we must expand that concept of the kill chain and develop "sensor-to-shooter webs" via a new model that shifts away from postdelivery interdependence to prerequirement integration.[8] We will accomplish this overmatch, with our partners, through Project Convergence.

A Campaign of Learning

Project Convergence is a campaign of learning designed to inform how we fight, how we organize, what we fight with, and even who we are. It incorporates the Army's modernization efforts and culminates in an annual capstone event. The approach monitors the progress of emerging technologies and science and technology investments, which allows us to assess those relatively immature technologies ripe for development and include them into the capstone event. It also shows us the technical challenges or problems we need to address to maximize the collective capability of our signature systems. In this sense, the 10 times overmatch requires only 4 times modernization for the signature programs—the remainder is accomplished through integration of emerging technologies and results in a capability greater than the sum of its parts. This assessment informs the technologies and objectives included in the capstone event. The first event, Project Convergence 20, was held at Yuma Proving Ground in August and September 2020.

Table. Project Convergence Strategy

	Aug–Sep 2020 Enhancing the Close Fight		Oct–Nov 2021 Driving Joint Integration		Aug–Sep 2022 Leveraging Joint and Allied Partners
Operational Theme	▪ MDO ▪ Penetrate ▪ Disintegrate ▪ Exploit		▪ CJADC2 ▪ JWC ▪ MDTF O&O Concept		▪ CJADC2 ▪ JWC ▪ MDTF Roles & Responsibilities ▪ Intelligence/Fires/Cyber: EW/IO Space Functional Concepts
Exercise	**Defender Europe/ JWA 20**	**Project Convergence 20**	**Pacific Sentry/JWA 21**	**Project Convergence/ PNTAX 21**	**Defender 22 (Project Convergence + JWA)**
Concepts Focus	▪ AI-enabled decision agents for overhead sensing to enable long-range fires ▪ AI-enabled target recognition ▪ Complex teaming and autonomous operations ▪ Aerial retransmission to extend tactical mesh networks		▪ Continued integration of "31 + 4" ▪ Linkage to U.S. Air Force ABMS ▪ Integrate fifth-generation fighters (as sensor and shooter) ▪ Operations in contested/denied environments ▪ Cloud technologies at the edge (validate)		▪ Capture, assess, and disseminate targeting data across joint/ multinational force ▪ Exploit LEO capabilities at the lowest echelon ▪ Directed energy ▪ Cloud technologies at the edge (scale)
Formation Focus	▪ BCT ▪ Combat Aviation Brigade ▪ Expeditionary Signal Battalion–Enhanced		▪ Division Headquarters ▪ MDTF ▪ BCT		▪ CJTF (Corps/Division) ▪ MDTF ▪ BCT ▪ Mission Partner Command Element
AFC Outputs	▪ Inform AimPoint 2035 development ▪ Validate Army data strategy ▪ Prioritize S&T investments ▪ Generate/refine requirements		▪ Inform JWC ▪ Shared situational understanding ▪ Inform joint architecture ▪ Common data model ▪ Capabilities and authorities at the edge ▪ Generate/refine requirements		▪ Inform JWC development ▪ Inform force disposition; MDTF O&O ▪ Integration with joint architectures ▪ Evolve sensor-to-shooter operational processes to emerging technologies ▪ Generate/refine requirements

Key: ABMS: antiballistic missile system; AI: artificial intelligence; BCT: Brigade Combat Team; CJADC2: Combined Joint All-Domain Command and Control; CJTF: combined joint task force; EW: electronic warfare; IO: information operations; JWA: Joint Warfighting Assessment; JWC: Joint Warfighting Concept; LEO: low-Earth orbit; MDO: multidomain operations; MDTF: multidomain task force; O&O: Operational and Organizational Concept; PNTAX: Positioning, Navigation, and Timing Assessment Exercise; S&T: science and technology.

Project Convergence 20 was designed as a proof of concept for a new way of advancing technologies. The value of Project Convergence 20, and the catalyst for its success, was the ability to bring together Soldiers and scientists from our various laboratories, program executive offices, and cross-functional teams. For 5 weeks, these teams worked together to solve interoperability problems and advance science and technology efforts, operating outside of the traditional stovepiped model. This collaboration included nightly revisions of code—an effort that would have taken months of back and forth between the engineers and scientists working on systems in our labs. The process of identifying integration barriers and immediately addressing them also highlighted the need for an open architecture design, an observation well documented by those with experience in the defense industrial complex and those in Congress.[9]

The result of this focused collaboration was the acceleration of certain programs along the technology readiness level (TRL) stages depicted in the figure. The most striking case may be that of a new capability, a government-owned target-deconfliction platform enabled by AI. This emerging capability not only deconflicts airspace but also recommends the best shooter for a given target by using AI and machine learning to assess the target and friendly capabilities and to determine the priority of the target. This example is significant for three reasons. First, from a technology-development perspective, it was able to advance from TRL 3 to TRL 6 because of the experimental conditions established at Yuma. Second, the AI aspect of this system reduced the time from sensor to shooter from minutes to seconds. Whereas a traditional call for a fire mission takes anywhere from 10 to 20 minutes, this AI-enabled capability accomplished it in less than 30 seconds in Yuma. Such a reduction in time will have a significant operational impact.

Finally, and perhaps most important, the process of integrating sensors and shooters with emerging technologies allowed us to reassess objectives. By demonstrating our ability to connect sensors to shooters in a way that dramatically reduced the time from target identification to engagement, we were able to reevaluate what the joint kill web requires to be effective. We went into Project Convergence 20 with the objective of connecting "any sensor, any shooter, and any C2 node." Through the weeks of resolving technical issues and contemplating the implications of what we had accomplished, we adjusted that objective to "all sensors, the best shooter, and the right C2 node." Although we want to utilize all sensors available, convergence requires that we identify the best shooter and right C2 node at the speed of relevance.

We approach this AI-enabled objective attentive to the concerns policy experts have expressed about ensuring there is always a person making the decision—this is Army policy.[10] Though the discussion of human-in-the-loop and human-on-the-loop is important for determining how we employ AI, robotics, and autonomy, we first need to prove that we can develop the loop. Future war will occur at machine speed. Militaries able to engage at that speed will have a decisive advantage. Project Convergence allows us to test our ability to employ these technologies across the joint force.

AI is just one emerging military technology the Army and its adversaries are pursuing. Policy experts advising Congress have identified autonomous weapons, hypersonics, directed energy, biotechnology, and quantum technology as areas of both opportunity and concern.[11] Project Convergence is a venue to test and conduct analysis on these technologies. Project Convergence 20 set the foundation for Army modernization efforts moving forward. Convergence, however, is not just about Army systems; a common concern among policymakers is how we integrate with joint and coalition partners.[12] We began to address this concern at Yuma, when the Marine Corps provided an opportunity to include an F-35B. Initially, the F-35B could not communicate with ground troops. By the end of the exercise, the F-35B integrated into the kill web as a sensor for ground shooters and a shooter for ground observers. This example presents just one type of problem that we want to work with the joint force to solve.

Informing Joint Concepts by Solving Joint Problems

The Army Modernization Strategy offers guidance on such matters as what we fight with, how we fight, and who we are.[13] Project Convergence puts that guidance into action by establishing a systematic sequence of events designed to integrate the systems we fight with, inform how we fight, and develop the force required to win in the age of GPC. The table shows Army Futures Command's approach to executing the Army Modernization Strategy through Project Convergence. Building on Project Convergence 20, next year's capstone event will focus on joint integration by using joint mission threads to test and evaluate emerging technologies. In 2022, the capstone event will include British and Australian technologies that we and coalition partners will begin to integrate.

Winning matters—but winning together matters more. As we turn to Project Convergence 21, we will focus specifically on the joint force. Project Convergence 21 will build on Convergence 20 in two substantial ways. First, it is set as a U.S. Indo-Pacific Command scenario and will incorporate the multidomain task force (MDTF), a division headquarters, and a brigade combat team. This scenario will better inform the joint warfighting concept as well as MDTF functions and requirements. The inclusion of the Air Force's Advanced Battle Management System and fifth-generation fighters provides opportunities to identify and resolve barriers to effective sensor-shooter connectivity at the joint level. This cooperation is the result of recent Army–Air Force talks and a signed memorandum of understanding between General Charles Brown, chief of staff of the Air Force, and General James McConville, chief of staff of the Army, and the need for both Services to inform the Joint Staff–led JADC2 effort.

There is also increased understanding that "JADC2 cannot be a single approach to achieving convergence but must be a composite of several solutions tailored to the several different environments comprising the expanded battlefield."[14] Therefore, Project Convergence is the Army's contribution to JADC2, providing a tailored solution for the land domain and a way to test integration into the "expanded battlefield." This effort is similar to the Air Force approach for Advanced Battle Management System. Initially developed as an on-ramp model, the Air Force effort is now structured as "Architecture Evaluation Events" complementing Project Convergence. The Navy's integration endeavors, Project Overmatch and the Naval Introductory Flight Evaluation program, take comparable approaches to informing JADC2 requirements. These Service-driven efforts, however, are not mutually exclusive. For example, to address the challenge of linking sensors and shooters across domains, Project Convergence 21 will include the Air Force's F-35 and Navy's Aegis systems. In addition to contributing to JADC2, this interservice cooperation in Project Convergence allows us to identify and address the technical hurdles spotted in the multidomain battle concept of General David Perkins, USA, and General James Holmes, USAF.[15]

Project Convergence 22 will build on the momentum gained in 2021, continuing to contribute to JADC2 and informing the joint warfighting concept. Coalition participation in Project Convergence 22 will further develop these concepts and expand the battlefield—and introduce the *Combined* JADC2 concept. Our position going in is that we will always fight with a coalition, and thus interoperability must be fundamental to our C2 systems. Given the significant data-sharing challenges among coalition units, we are already working with our British and Australian counterparts to identify the technical and policy barriers that must be addressed prior to and during the 2022 capstone event.

Learning from the Past

Project Convergence is an ambitious endeavor. Observers have already cautioned that including too many systems too quickly could derail the new modernization effort and lead the Army astray from its goals.[16] These concerns are valid and should be kept in mind as we move forward. Fortunately, we have several historical examples to inform our approach. Some of these examples—for instance, Future Combat Systems (FCS) and Network Integration Evaluations (NIE)—illustrate how modernization efforts can become too ambitious, be ahead of emerging technology, and not meet the needs of Soldiers and commanders. Less often discussed are the success stories, such as the Louisiana and Tennessee maneuvers prior to World War II and more recent 9th

Luke Travisano, engineer with Robotic Research LLC, conducts test run of autonomous system Pegasus during Project Convergence 20 capstone event at Yuma Proving Ground, Arizona, August 24, 2020 (U.S. Army/Carlos Cuebas Fantauzzi)

Infantry Division (ID) and 4th ID modernization efforts prior to 9/11. The success and failures of these efforts not only have informed our approach but also provide a way ahead for joint force modernization.

It is natural to form opinions of a new initiative or approach by looking to past efforts meant to accomplish the same goals. When discussing Project Convergence, observers typically mention two predecessors: FCS and NIE. While both FCS and NIE ultimately failed to achieve their objectives of a modernized and network-centric force, both have critical lessons to teach us. Perhaps the most important takeaway deals with the requirements process. In the case of FCS, requirements were defined with the anticipation that promising technologies would mature along a predictable timeline. As the RAND autopsy of FCS found:

The Army's combat developers set out to design an entire brigade of networked systems and subsystems from the ground up, taking advantage of advanced technologies that were largely underdeveloped, untested, and unknown, but were assumed eventually to be capable of achieving revolutionary levels of interoperability and tactical coordination.[17]

A key component of Project Convergence is to test emerging technologies *before* they become a requirement in a program of record. The experimentation conducted at Project Convergence then determines which promising technologies are "capable of achieving revolutionary levels of interoperability and tactical coordination"[18] and which need more time to develop.

The Army's NIE design likewise relied on preset requirements. At NIE, new systems were put in the hands of operational units to test interoperability and usability; unlike those at FCS, the technologies enabling these systems were already mature. The flaw resulted from the requirements of each individual system being established prior to testing its interoperability or putting it in the hands of Soldiers. The result was multiple high-profile programs being identified as unable to either integrate into a system of systems or meet the needs of the Soldiers and commanders employing them. Project Convergence tests interoperability and leverages the Army's Soldier-centered design to inform the requirements process. This approach ensures delivery of a desirable capability able to seamlessly integrate with other systems.

Incorporating this two-pronged approach, assessing emerging technology and getting it in the hands of Soldiers and commanders, is critical to the success of Army and joint force modernization. As the RAND report on FCS astutely pointed out, "Any acquisition program faces the dual risks that the future capabilities envisioned today may not meet the actual operational needs of tomorrow and that technological progress simply may

not occur as quickly as anticipated."[19] Project Convergence addresses both threats by using real-world vignettes to inform future operational requirements and evaluating emerging technology to determine what is viable.

There are, of course, examples of successful military modernization efforts that properly considered the emerging technologies and forecasted operating environment. In the leadup to World War II, General George Marshall and General George Patton led the Louisiana and Tennessee maneuvers, respectively. At the time, the emerging technologies were aircraft, tanks, and radios, and the operating environment was Europe. These exercises not only tested the new capabilities but also identified scenarios that replicated the operational needs for war in Europe, to change how the Army fought. Today, the emerging technology is AI, robotics, and autonomy, and the future operating environment will be asymmetric, highly lethal, and hyperactive across all domains.

More recent examples of the 9th ID and 4th ID modernization reinforce the benefit of including Soldiers and command nodes in modernization efforts. Such inclusion informs how we fight and the force structure required to effectively use new systems. Incorporating headquarters at echelon (MDTF, Data and Information Viewpoint, and brigade) and Soldiers into the Project Convergence design allows us to do more than experiment with emerging technology; we can test how we employ that technology effectively through force structure, concepts, and doctrine across the joint force. At its core, Project Convergence is a process of "discovery experimentation"—that is, "a deliberately crafted and planned approach for addressing an issue long before it becomes a pressing problem" and one that "allows operators to interact with new or potential concepts and capabilities to explore their military utility."[20] This tactic, built on lessons from past modernization efforts, provides a framework to identify joint warfighting problems; evaluate potential technological solutions; contribute to joint interoperability, via CJADC2; and inform the joint warfighting concept. Project Convergence allows us to create our own "Yuma Maneuvers" to apply the pre–World War II objectives of the Louisiana maneuvers to today's joint force.

Great Power competition requires overmatch—and thus a transformation of the joint force to ensure it. General McConville has stated, "In the face of determined adversaries and accelerating technological advances, we must transform today to meet tomorrow's challenges."[21] Tomorrow's challenges are rapidly approaching, and through Project Convergence, Army Futures Command is spearheading the required changes. By leveraging joint mission threads to test and evaluate emerging technology, Project Convergence establishes a process to identify and solve joint problems. This approach to persistent modernization ensures that all efforts build toward eventual and recurring demonstration of joint force capabilities and that we remain grounded in the operational problems we are trying to solve. Collaboration widens our view and expands the collective appreciation of the challenges ahead, specifically those that our respective Services cannot solve alone. Resolving these technical challenges together, and applying new technology to known mission sets, allows us to establish a common architecture (CJADC2) and approach the new joint warfighting concept with an understanding of how we fight, how we organize, and what we fight with. **JFQ**

Notes

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