Joint Force Experimentation for Great-Power Competition

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The war game at the Naval War College came to a frustrating conclusion for the "blue" players representing the U.S. Their attempted dash across the Pacific with powerful naval forces to reinforce positions near the enemy homeland had been stopped well short of their destination by shore-based airpower. Friendly losses due to the enemy's pre-war investment in anti-access/area denial capabilities had been staggering. A quick American victory would not be possible, and a new strategy would be needed to defeat this potential adversary.

Although the location of this war game might not surprise you, the date and opponent might. It took place in 1934, and the adversary was Japan ("Orange" in the war game). Fortunately, the U.S. Navy, informed by the results, changed its war plan in time, and the rest, as the saying goes, is history. In fact, the war game was so prescient that after the war, Fleet Admiral Chester Nimitz said that "the war with Japan had been enacted in the game rooms at the War College by so many people and in so many different ways that nothing that happened during the war was a surprise—absolutely nothing except the kamikaze tactics toward the end of the war. We had not visualized these."[1]

War games and large-scale exercises like those conducted before the Second World War played an important role in our military history, and they are poised to do so again. At the direction of the Chairman of the Joint Chiefs of Staff, General Mark Milley, the Naval War College recently war-gamed a real-world scenario against potential adversaries. It was a good start, and more such war games are expected to follow as are other forms of experimentation. If they do, these opportunities to learn will once again play a vital role in the development of a joint doctrine that supports our National Defense Strategy, addresses the challenges and opportunities created by technological change, and responds to rising threats to both national and global security. If fully supported, they will help America's defense establishment to make cost-effective investments and reduce strategic risk by tapping into America's greatest asymmetric advantage: our ability to innovate.

Global Challenges

In his article "The Thucydides Trap," Graham Allison observed that a rising power and a dominant power do not usually exchange places peacefully. This is the trap into which Athens, as a rising power, and Sparta, as the dominant power, fell.[2] How can the United States, as the world's dominant power, avoid the fate of Sparta, which defeated Athens but was so weakened that it also soon collapsed? The first requirement, of course, is to recognize threats and—just as important—their nature.

The fastest-rising power in the world today is China, which has embarked on what Michael Pillsbury calls a "hundred-year marathon"[3] to

displace the United States as global hegemon. Although most observers agree that Beijing does not wish to use direct force to overthrow the American order and establish itself as the new "sun in the sky," China is clearly arming itself in a way that is meant to challenge American power in the Western Pacific. It is also seeking to compete with the United States through diplomatic, information, and economic means. The implications of these efforts are profound not just for the United States, but also for the entire world.

From the end of the Cold War until recently, we have lacked a clearly defined pacing threat: a nice problem to have had but a problem no longer. A resurgent Russia and a rising China took note of how the U.S. rapidly overwhelmed the Iraqi military in conventional warfare in 1991 and again in 2003. Since then, both nations have embarked on acquisition strategies designed to neutralize our joint warfighting advantages, now enabled by new technologies like unmanned aerial systems and stealth aircraft. By investing in relatively low-cost systems that are designed to prevent us from projecting our forces, our adversaries are now challenging our ability to achieve overmatch against our opponents on the battlefield. This asymmetric approach is called anti-access/area denial (A2/AD).

This renewed geostrategic competition is unfolding amid a revolution that has the potential to rival the Industrial Revolution in its impact. The technological revolution driving these changes in the character of war will change the 21st century battlefield as much as the Industrial Revolution changed the battlefield in the 20th century. Space, which became accessible in the latter half of the 20th century, is growing ever more congested and contested in the 21st.

America, which pioneered space travel, no longer enjoys assured access to it, removing it as one of our asymmetric advantages over our enemies. Cyberspace, which the United States also pioneered, is now shared by the entire world and has joined space as a new domain of warfare along with the more traditional domains of air, sea, and land. As our dependence on space and cyberspace has grown, so too have our vulnerabilities. The globe-spanning reach of these new domains has expanded the battlefield to the homelands of our adversaries as well as to our own "forts and ports," rendering our Atlantic and Pacific moats ineffective.

Advances in weapon technology are potentially game-changing as well. Stealth, or low-observable technology, directed energy for weapons, sensors and communications, remote-controlled vehicles, and hypersonic weapons are accelerating the speed of war from supersonic to hypersonic and beyond, to the speed of light. As if this were not mind-boggling enough, advances in artificial intelligence (AI), powered by big data and information operations that exploit social media platforms, are creating additional challenges and opportunities.

The ability of the human mind to close the OODA (observe, orient, decide, act) loop in a timely manner in response to these technological changes is increasingly at risk. The "cognitive domain" of war is not new, but its character has changed along with the other domains, perhaps making it the most significant domain of all.

To undermine U.S. power, our adversaries are employing other asymmetric means that stop short of traditional acts of war, blurring the line between peace and conflict. The so-called Russian gray zones, China's civil–military integration, Iran's proxy forces, and cyber-attacks by non-state actors have thickened the fog of war. Doctrinal discussions have moved away from the "pre-conflict phase" in favor of a continuum of conflict that encompasses competition and hostilities. We are competing with our peer adversaries and have been for a while, whether we realized it or not. Twenty-first century conflict, then, has expanded not only spatially, but also temporally.

Our Doctrinal Response

Our adversaries have reacted to our actions, and now it is our turn to counteract by

developing a new doctrine that leverages our asymmetric strengths to degrade, penetrate, and ultimately disintegrate A2/AD measures and restores our strategic reach and ability to fight on favorable terms. Our response must address both geostrategic and technological changes. It must be sufficiently compelling to achieve broad support both among U.S. policymakers and among our allies. It must also be affordable. The U.S. used a cost-imposition strategy to defeat the Soviet Union during the Cold War. We cannot allow ourselves to be driven down an unsustainable path in a similar way, as A2/AD would have us do.

To answer all of these challenges, the U.S. Department of Defense (DOD) is developing a doctrine called Joint All Domain Operations (JADO). It is still only a concept, but it builds on the work started by the U.S. Army, joined by the Marine Corps, in developing the warfighting Multi-Domain Operations (MDO) concept. It will also incorporate subsequent work done by the Air Force on the Joint All Domain Command and Control (JADC2) concept and eventually will include concepts from the Navy and Space Force as well. JADO recognizes the new domains of conflict and is intended to exploit them with cross-domain effects and will leverage our armed forces' unique and proven ability to orchestrate joint operations at all echelons.

But choosing the right doctrine is only the beginning. Multi-domain effects, by definition, transit through more than one domain. To fight and win in all domains, our joint doctrine must achieve harmony across all services and across all elements of doctrine, organization, training, materiel, leadership, personnel, and facilities (DOTMLPF) as well as policy (as in "DOTMLPF-P"). As we modernize our forces, new platforms and systems must be designed with cross-domain effects in mind.

As former Secretary of Defense Donald Rumsfeld famously observed, "You go to war with the army you have, not the army you might want or wish to have at a later time."[4] We need to ensure that the Joint Force we have is the one we want. The policy aspect is also important, particularly in the space and cyber domains where management of the electromagnetic spectrum and networks in the competition phase of conflict will mean striking a balance between civil and military requirements.

Getting the services to align doctrines and acquisition programs and to integrate operationally across domains is hard but not impossible. We came close in the final years of the Cold War under the rubric of AirLand Battle (ALB). The Army aligned all elements of DOTMLPF to support ALB, and—critically—so did the Air Force, making the vision of a seamless dual-domain operational concept a reality. Although we did not have the benefit of sophisticated computer modeling tools then, we were able to test some ALB assumptions during the massive annual REFORGER exercises in Europe. We also benefitted from the very real and bloody lessons gleaned from the 1973 Arab–Israeli War. Acquisition efforts in the Army were tailored to ALB and vice-versa.

Thus, the "Big Five" Army weapons programs still widely in use today were ideally suited to the doctrine, and the integration of joint effects in training and exercises became the norm. In the end, we were able to catch doctrinal lightning in a bottle, as proven in Operation Desert Storm against a combat-seasoned, Soviet-trained, and Soviet-equipped enemy.

The Role of Joint Experimentation

America's armed forces are again racing to refashion themselves and adjust to technological innovations, just as they did before World War II when the U.S. shifted from a constabulary Army mounted on horseback and a battleship-centric Navy to a Joint Force that is able to project airpower around the world in support of amphibious and mechanized land forces. Today, we are shifting our focus from counterinsurgency to competition against peer adversaries in peacetime and seeking to achieve overmatch against them in all domains in conflicts.

Experiments like the recent war game in Newport, Rhode Island, will play a vital role

in helping America's military to reshape itself effectively and efficiently. Experimentation through war games and exercises is conducted in a mixture of live, virtual, or constructive environments. In virtual environments, live people interact with simulated systems, as in a flight simulator. In a constructive environment, simulated people interact with simulated systems, as in a command post exercise. The degree to which each environment is present in a war game or exercise depends on the purpose of the exercise. Each form has advantages and disadvantages, and when used for the purpose for which it is best suited, each form can provide useful insights for the development and implementation of JADO.

In the past, each service conducted its own experiments, developed its own respective warfighting concepts or doctrines, and then acquired the capabilities required to execute them—and, of course, it sometimes happened the other way around. In either case, the role played by the Joint Chiefs and the Office of the Secretary of Defense (OSD) resembled that of a referee, ensuring that the services played by the rules. To fulfill the promise of JADO, the role of the Secretary of Defense and the Chairman of the Joint Chiefs should be more like that of a coach, directing the game plan for the services' modernization efforts. The playbook, however, must be informed by the lessons learned through experimentation, and those must be properly resourced. In addition, as any coach will tell you, there is no gain without pain.

As important as modernization might be, the Secretary of Defense and the Joint Chiefs of Staff have many other responsibilities and cannot devote their full attention to it. Since the 2011 inactivation of the United States Joint Forces Command (USJFCOM) as a cost-saving measure, the Joint Staff Directorate for Joint Force Development (J7) has assumed many functions related to modernization. It is responsible for doctrine, education, concept development and experimentation, training, exercises, and lessons learned. But as a staff directorate, it has no forces of its own, nor does it have teams of experienced observers schooled in joint doctrine or dedicated opposing forces ("red teams") trained to think differently. To the extent that these assets exist, they reside for the most part in the services. Nevertheless, by leveraging two initiatives called Globally Integrated Exercises and Globally Integrated Wargames, the J7 is doing a great deal to innovate and validate joint warfighting concepts.

Any attempt to achieve change, however, will encounter resistance. To help overcome parochial service perspectives, the Joint Chiefs have created a cross-functional team to study JADO. The Joint Chiefs have also tasked the services with examining "orphan" functions. The Air Force is studying command and control, the Navy has the lead for fires, the Marines are responsible for Joint Concept for Information Advantage, and the Army is analyzing the logistics requirements for this Joint Warfighting Concept. The intent of this division of labor is to help break down stovepipes and create consensus.

Exercises as Experiments. The results of these studies must be tested somehow. Despite the growing cost associated with deploying live forces, exercises conducted under realistic field conditions are still the best way to test some theories, particularly organizational designs. This will remain true as long as our ability to simulate cross-domain effects in the constructive environment is limited.

As with war gaming, America has a history of organizational experimentation during exercises that goes back to the years preceding its entry into the Second World War. Perhaps the most famous example from this time period would be the Louisiana Maneuvers (LaM), which the Army conducted to test the doctrine and weaponry it would need to face modern adversaries such as Germany. This massive exercise placed experimental armored and mechanized units and the Army Air Corps into a scenario that helped leaders understand the potential of mechanized warfare and how to integrate airpower over vast operational distances.

Large-scale exercises like the LaM provide an unmatched opportunity to fully understand the capabilities and limitations of experimental organizations and new systems. However, the larger the exercise, the greater the competition to prioritize exercise goals. Such goals might include validating a portion of a war plan, improving interoperability with regional partner forces, demonstrating a new capability as a deterrent to adversaries, or all the above. Sometimes, that does not leave much room for experimentation.

A more recent example of a large-scale experimental exercise is Millennium Challenge 2002 (MC02), sponsored by the then newly formed JFCOM. MC02 featured emerging doctrinal concepts such as "dominant battlespace knowledge" and "rapid decisive operations." It also introduced "leap ahead technologies" that were not yet fielded to the force, such as the V-22 Osprey. The director of the exercise said that it would be a key to military transformation. It cost approximately $250 million and involved over 13,000 servicemembers at nine live-force training sites and 17 simulation centers. To justify the expenditure and the commitment of so many forces, additional exercise objectives were added. Not surprisingly, the exercise was unable to fulfill all of them.

MC02 was supposed to be a free play exercise, but when red (enemy) asymmetric tactics inflicted unexpectedly heavy losses on blue (friendly) forces in the opening turn of the game, the director had to intervene. Most of the U.S. naval task force was "re-floated" so that the rest of the exercise could continue and achieve other objectives such as unit live-fire training. In other words, experimentation had to give way to training. Many lessons were learned from this experience, but perhaps the biggest is that it is difficult for large exercises to achieve every goal.[5]

Organizational Experimentation. This is not to say that large exercises are not useful for experimentation. Combatant Command (COCOM)–level exercises such as DEFENDER-Europe and Pacific Sentry have served as valuable opportunities for the development or validation of concepts and capabilities. For example, the Army created the Multi-Domain Task Force (MDTF) in the Pacific to test MDO doctrinal concepts. It combined units capable of long-range precision fires with a provisional Intelligence, Information, Cyber, Electronic Warfare, and Space (I2CEWS) Battalion. The MDTF then participated in the most recent Rim of the Pacific (RIMPAC) exercise. This went well enough that another MDTF is being created in Europe.

The services are experimenting with organizational designs in a variety of exercises, large and small. Each service has multiple examples, but two of them indicate their diversity and level of investment. The 88th Air Base Wing at Wright Patterson Air Force Base in Dayton, Ohio, is researching how the Air Force can best defend its strategic infrastructure—our homeland "forts and ports"—against attacks in the emergent domains of warfare. Meanwhile, the Navy's Surface Development Squadron ONE (SURFDEVRON ONE) will experiment with unmanned surface vessels and *Zumwalt*-class ships. Vice Admiral Richard Brown, Commander, Naval Surface Force, U.S. Pacific Fleet, described SURFDEVRON ONE's role as "developing warfighting capabilities and experimentation." It will also "[d]evelop material and technical solutions to tactical challenges" and "[c]oordinate doctrine, organization, training, material, logistics, personnel and facilities requirements for unmanned surface systems."[6]

Sometimes, an operational environment is the only way to stress test a concept or capability. Last year, the Navy embarked a full squadron of Marine F-35B Joint Strike Fighters on the amphibious assault ship USS *America*, converting it into a mini-aircraft carrier, or "Lightning Carrier," capable of conducting sea-control operations.

Service-Led Experimentation. After numerous unsuccessful attempts to find a solution to an experiment, Thomas Edison said, "I have gotten lots of results! I know several thousand things that won't work!"[7] Many live, virtual, and constructive exercises are conducted around the globe each year. They can and do

serve as laboratories; their results help us to find out more efficiently what will or will not work. Smaller-scale exercises sponsored by the services provide low-cost opportunities to generate feedback from lower echelons. Some of these are done primarily for training and readiness; others are intended as experiments with collateral training benefits. In either case, if the number of objectives is manageable, they can all generally be achieved.

For example, the Baltic Operations (BALTOPS) fleet exercises led by the recently reactivated U.S. Second Fleet have helped to iron out interoperability issues with allied navies and have enabled experimentation with concepts for Arctic operations and trans-Atlantic convoy tactics, among other benefits. Although these are not new types of operations, the Navy is learning how to conduct them in a multi-domain environment and in the more accessible Arctic Ocean.

Each year, the Air Force brings units from around the world to participate in its Red Flag Exercise at Nellis Air Force Base, Nevada. Against a tough, well-trained "aggressor" unit, the Blue forces learn how to employ space, cyberspace, and stealth to defeat integrated enemy air defenses such as those that characterize A2/AD environments. These exercises do a good job of combining training with concept development even though they are not specifically designed for the latter.

The Army conducts an annual exercise called the Joint Warfighting Assessment (JWA) that is designed specifically for experimentation. As the commander of 1st Armored Division at Fort Bliss, Texas, I have seen its value firsthand. JWAs are coordinated by the Joint Modernization Command, formerly known as the Brigade Modernization Command. As an aside, it is noteworthy that the word "Army" does not appear in the title of the exercise or its sponsoring agency. This makes sense, however. The purpose of the JWAs is to find solutions to multi-domain operational challenges in a joint context.

For several years, an entire Brigade Combat Team (BCT) was dedicated to experimentation, testing new equipment and doctrines in harsh field conditions at Fort Bliss and White Sands Missile Range. Cyber operations by and against a sophisticated and robust cyber opposing force were a recurring feature of these exercises. The cyber warriors tested the participants to their limits—and sometimes beyond them—because failure is often a better teacher than success. Although it was not the principal reason for the exercise, the rest of the division gained training value from supporting and participating in the JWAs, particularly because the Air Force, Marine Corps, and our allies were also involved. Today, the JWAs have moved from Fort Bliss and alternate between Europe and the Pacific and are now "coming to a theater near you" in order to test concepts and capabilities in possible theaters of operation against peer adversaries.

Even routine training exercises serve as opportunities for experimentation. As commander of the U.S. Army's III Corps at Fort Hood, Texas, I was able to test a concept during a major command post exercise and improve the corps' combat readiness at the same time. We employed a Stryker Brigade Combat Team that had been reorganized and retrained to perform in the role of a cavalry regiment in support of the corps during a Warfighter Exercise. The purpose of the exercise was to train corps-level and division-level staffs and prepare them for upcoming operations, which it did in full. The experimental objective did not hinder our training in the least. In fact, in some ways, it helped. Despite its focus on unit training, the exercise yielded important results by validating the requirement for restoring a corps-level reconnaissance and security brigade or regiment. It did not validate the Stryker Brigade solution, but like Edison, we did not fail; we just found out what did not work.

Collecting the insights from all of this exercise-based experimentation across the Joint Force and then applying them to the joint concept development process is a challenge. Although it is a good problem to have, the J7 has its work cut out for it, sorting through the results to find the golden nuggets. These

exercises are yielding a great deal of innovation, and it is important that this innovation is properly considered and exploited by the appropriate organization.

War Games as Experiments. Although exercises are becoming increasingly joint and have begun to explore cross-domain challenges, the models, simulations, and war gaming (MS&G) that support experimentation offer a better opportunity to test concepts and capabilities rapidly. MS&G is not without risk, however. Professor Robert Rubel of the Naval War College has identified several "wargaming pathologies" that are failures in purpose, politics (for example, preordained outcomes), design, assessment, and analysis.[8] Given the complexity and tempo of all-domain war games as well as what is at stake, it will take a significant effort to avoid such pathologies.

As the noted British statistician George Box put it, "[A]ll models are wrong, but some are useful." If the COVID pandemic has taught us anything, it is that Mr. Box knew what he was talking about. Naturally, the early predictions about how the virus would spread were off, but some of the most influential models were off by an order of magnitude, leading to governmental decisions that could have effects equal to or worse than the disease itself. The medical profession tries to live by the code "first, do no harm." Similarly, military doctrines need not be exactly right, but they must at least avoid being "too badly wrong," as British military historian Sir Michael Howard so memorably put it. As pandemics and military history have proven, failure by either medical or military professionals to heed these cautionary words can have fatal consequences.

Avoiding a joint warfighting doctrine that is "too badly wrong" requires useful models designed to replicate multi-domain conflict as accurately as possible. An apocryphal cautionary tale about the use of computer models circulated during the Vietnam War. In 1969, Pentagon staffers asked a computer when the United States would win based on all measurable military data. It quickly answered: "You won in 1964!"

An actual and well-documented example of the war-game design pathology occurred in 1990 when military models vastly overestimated the number of U.S. casualties during Operation Desert Storm. Once word leaked out, widespread concern led to some changes in the plan. A RAND paper published just before the Gulf War predicted the discrepancy, saying that "in many cases the models are built on a base of sand."[9] Unfortunately, despite significant DOD expenditures on models and simulations—nearly $300 million in 2017 alone—the problem persists.[10]

Some important simulations still rely on Lanchester equations to estimate combat losses. Frederick Lanchester, a British engineer, developed the equations in 1916 to conceptualize aerial combat and warned at the time that they were not applicable to ground combat.[11] Perhaps we should have listened to him. Although updated to account for the effects of modern weapons, Lanchester-derived equations used by pre–Desert Storm modelers failed to fully appreciate the dynamics of AirLand Battle and the use of precision-guided munitions in a desert environment. This led to a miscalculation of *multiple* orders of magnitude (fortunately, in our favor). Presumably, the equations' accuracy will not improve when applied to non-kinetic cross-domain effects against logistics or command and control functions.

Obviously, this is an area begging for research and development, and DOD is not blind to the need. In February 2015, then-Deputy Secretary of Defense Robert Work issued a memorandum titled "Wargaming and Innovation" in which he argued that war games can "spur innovation and provide a mechanism for addressing emerging challenges, exploiting new technologies, and shaping the future security environment."[12] Later that year, he coauthored an article with then-Vice Chairman of the Joint Chiefs of Staff (VCJCS) General Paul Selva titled "Revitalizing Wargaming Is Necessary to Be Prepared for Future Wars."[13] He also implemented some MS&G innovations, such as forming the Defense Wargame Alignment Group (DWAG), the Wargame

Repository, and the Wargame Incentive Fund (WIF), which was funded at $10 million. These initiatives helped to gain efficiencies across the enterprise, but the sort of fundamental changes required by all-domain joint warfighting will require a larger effort and a new way of doing business on the part of DOD.

Clearly, new MS&G software will be needed to address the challenges of all-domain joint warfare. Unfortunately, as current VCJCS General John Hyten said during his confirmation hearings, the process of developing military software is "a nightmare across the board" compared to the commercial process as practiced by American companies like Google, Amazon, and Microsoft.[14]

Spending money on new simulations is only half the battle, though. To achieve the best designs and avoid the other war-gaming pathologies, the MS&G community will need to be populated and led by a cadre of officers and civilians who fully understand the state of the art and the warfighter's requirements. The Naval Postgraduate School has created a field of study, in which classes in war-game design are exclusively electives, that can serve as a starting point for the rest of the Joint Professional Military Education (JPME) enterprise. Today, the Army is the only service with a career field dedicated to simulations, and Functional Area 57 (FA 57) officers are assigned to all major Army headquarters at the division level and above. This is a best practice that the other services should consider emulating while the Army assesses whether its FA 57 officers are getting the right training.

Ideally, in addition to learning the art of federating simulations for distributed exercises, MS&G leaders would also learn how to avoid or mitigate the other war-gaming pathologies. To do this, they must understand the capabilities and limitations of both software and wetware: that is, the human element. Seminar-style war games known as BOGSATTs (Bunch of Guys Sitting Around a Table Talking), in which a roll of the dice is used as the stochastic method to replicate uncertainty, can play a role in identifying novel concepts, but they are not well-suited to adjudicating (solving) them. The Army's Unified Quest (UQ) seminars have played an important part in helping to identify challenges related to Multi-Domain Operations (MDO), but they have not been used for adjudication. One of the key tasks throughout the UQ 2019 study year was how to operationalize artificial intelligence in support of MDO,[15] but adjudication of this automation-related question will require a more automated war game.

As Alexander Kott, chief scientist at the Army Research Laboratory, has observed, "[t]he actions of human actors teaming with robots and other intelligent agents will be pervasive in the complex operational environments of the future."[16] In other words, human–machine interaction will no longer be limited to training scenarios: We have reached the point at which we will need to use machines to help us learn how to use machines.

The Marine Corps may be leading the way toward this brave new world. War-gaming experts at Quantico, Virginia, are working on what they call the Next Generation Wargame (NGW). The NGW will attempt to leverage narrow applications of artificial intelligence for "in-stride adjudication," which would allow a war game to unfold without the traditional "turns." This would literally be a game changer, allowing war games to replicate the temporal aspects of conflict, which is increasingly relevant in an age of AI, hypersonics, and speed-of-light weapons.

The other services are taking steps in the right direction.

- The Army's Center for Army Analysis (CAA), the Army War College, and The Research and Analysis Center (TRAC) at Fort Leavenworth are leading the Army's war-game innovation efforts. They are incorporating all domains into the Army's models and evaluating various scenarios against potential adversaries.

- The Army Capabilities Integration Center (ARCIC) has been renamed the Futures

and Concepts Center and absorbed into a major new Army Futures Command. Supported by CAA and TRAC, the Futures and Concepts Center has been involved in selecting and war-gaming potential future technologies for ground combat. The results will be used to conduct additional, more detailed modeling.

- The Air Force Research Laboratory and LeMay Center are leading the charge for the Joint Force in the development of Joint All Domain Command and Control (JADC2).

- The Navy's Center for Naval Analysis (CNA) uses the same model as the one used by CAA, which is called the Joint Wargame Analysis Model (JWAM), another indicator of joint thinking among the services.

- The granddaddy of all war-gaming centers, the Naval War College Wargame Center, continues to refine its methods. While it has retained analysis of competing hypotheses as the core of its methodology, the Wargame Center is now using technology to enable joint, semi-autonomous forces.

Another step in the right direction is the Army's attempt to help bridge the gap between the military and industry by repurposing one if its reserve component training commands. The 75th Innovation Command's mission is to drive "operational innovation, concepts, and capabilities to enhance the readiness and lethality of the Future Force by leveraging the unique skills, agility, and private sector connectivity of America's Army Reserve."[17] These efforts can help to connect the civilian gaming "ecosystem" with the military's war-gaming ecosystem. The latter is a robust community of practice spread across the services, which are busily refining their models to include all six domains of warfare and applying themselves to the challenges of future conflict.

At the 2018 meeting of the National Training and Simulation Association, Tony Cerri, then Director of Data Science, Modeling and Simulation for the Army's Training and Doctrine Command G2, said that "if we can marry big data and AI with [modeling and simulation]...that's an unbeatable advantage."[18] Cerri is right, of course, but the converse of his statement is also true. Russia and China are investing vast amounts of money in AI with the aim of achieving superiority over the U.S. by 2030 in what they perceive to be a strategically important field. If our adversaries can experiment more realistically, faster, and less expensively than we can, there is no denying that we will be at a competitive disadvantage against them.

As stated previously, Russia has been joined by China as a peer threat to the United States, and we will need more sophisticated models if we are to understand the nature of the challenge that each poses. Chess, which requires the player to think multiple moves in advance to win, is a popular game in Russia. Not so in China, where a game called Go—based on deception and encirclement rather than direct attack—is preferred. In the early days of AI, IBM's Deep Blue learned to play chess well enough to defeat grandmaster Gary Kasparov in 1997. It took nearly two more decades before Google's AlphaGo was able to teach itself how to win against the world's top Go player, Lee Sedol of South Korea. In fact, it learned so well that Lee retired after the match.

Chris Nicholson, founder of a deep-learning startup, said at the time, "You can apply [this software] to any adversarial problem—anything that you can conceive of as a game where strategy matters. That includes war...."[19] It seems the Russians and Chinese have figured this out. We must as well.

A Guiding Hand

The MS&G community is spread across the Department of Defense. In some ways, this is a strength as it has led to a large and diverse community of interest, but it also hinders our ability to share information and act efficiently. Within OSD, the Office of Net Assessment

(ONA) conducts war games to see decades into the future, and Cost Assessment and Program Evaluation (CAPE) uses models to evaluate alternative capabilities and force structures. Responsibility for coordinating the development, validation, and verification of modeling and simulation software rests with a small organization called the Defense Modeling and Simulation Coordination Office (DMSCO). Within the Joint Staff, both the J7 and J8 conduct modeling and simulation. Naturally, each service has its own requirements and capabilities for MS&G.

Meanwhile, our closest allies are experimenting too. The European Defense Agency is studying the applications of AI and big data in training and simulations and using war gaming to analyze how to deal with complex scenarios such as hybrid warfare. There are many other examples.

Unfortunately, we no longer have JFCOM to bring all these efforts together to acquire the necessary resources and make the necessary changes to develop JADO. So who can coordinate interservice MS&G development to enable better, faster, and less expensive experimentation through war gaming? Who can ensure that we are taking full advantage of America's edge in commercial software innovation? Who can find the right applications for big data, artificial intelligence, and cloud computing for MS&G? And who will spearhead the joint DOTMLPF-P effort needed to implement JADO? Important changes that have been made indicate that the Joint Chiefs of Staff, supported by OSD and the services, could succeed in leading the charge. There are at least two reasons for optimism.

First, the J7 is not attempting to experiment alone. The Vice Chairman of the Joint Chiefs of Staff is an essential player in turning JADO into a fully developed and resourced joint warfighting doctrine. In his traditional role as chairman of the Joint Requirements Oversight Council (JROC), the VCJCS has embraced the original intent of the 1986 Goldwater–Nichols Act and is using his position to push more of a top-down acquisition process in support of JADO. General Hyten said that the JROC will set its attributes and "the services will build to those" attributes, flipping the current bottom-up acquisition approach to one in which the Joint Chiefs "send[] a 'demand signal' to the services."

> The service then will be responsible for building the pieces and coming back to us, and then we have to make sure it fits all together.... That's what the JROC is *supposed* to do, [but] that is something we haven't done yet....

The JROC tended to be a receiver of requirements from services, not a generator of requirements for the services to meet.... That's not what was intended by Congress when it was established, by the processes we put in place, but that's what we've come to. And so that's going to require some discipline at the senior level to make sure that we are actually putting the demand signal out.[20]

If General Hyten applies this thinking to MS&G research, design, and development, the U.S. will be able to develop the right capabilities to experiment with JADO concepts and systems.

Second, and just as important, General Hyten said that he will try to steer the JROC away from being overly prescriptive, which can increase program costs and cause delays. Rather, he sees the council's role as blessing "the attributes of the capabilities that we need to have and then monitor[ing] the service's ability to build that."[21]

This is an important acknowledgment, as no one solution fits all domains equally well. The Army and Marine Corps tend to operate in dirtier environments than do the Navy and Air Force, while the Army has the additional requirement that it be able to scale any solutions to accommodate a force that is much larger than the other services. A continuous flow of information and feedback through the JROC members is the only way these concerns can be resolved. The approach will also allow these MS&G capabilities to evolve more quickly.

That said, the VCJCS and J7 will need some help from OSD, the services, industry, and our allies. Recently, the U.S. Army created its first new four-star command in a generation, the Army Futures Command, to lead its modernization efforts. The reactivation of JFCOM is unrealistic and perhaps even unnecessary, but a joint counterpart for AFC, an all-domain experimentation joint task force (ADE JTF) led by a four-star general or admiral, would be able to focus exclusively on acquiring the resources and generating the momentum needed to realize JADO's full potential. It would be able to supervise the efforts of the JADO cross-functional team and the services' studies of its four "orphan" functions. It could address policy issues with interagency partners, collaborate with allies, and coordinate the efforts of OSD with those of the services. It could distribute experiments between exercises and war games, perhaps even sponsoring some of the latter, and serve as the repository for their results. The J7 is already doing much of this, and the purpose of the ADE JTF would not be to replicate its role, but rather to complement and support it.

Conclusion

A radically new approach to joint acquisition is already underway. If it is supported by an organization dedicated to joint experimentation with the necessary resources and authorities, perhaps the U.S. can avoid the multi-domain equivalent of the surprise we encountered at Okinawa. As Admiral Nimitz conceded, the Plan Orange war games failed to anticipate the Japanese kamikaze attacks that cost the U.S. Navy dearly at Okinawa, sinking 34 ships, damaging 368 others, killing 4,900 sailors, and wounding nearly 5,000 more.

Perhaps someday, a future American commander may be able not only to paraphrase Admiral Nimitz and say that our Joint All Domain Operation Doctrine and Plans were enacted in games and exercises throughout the Defense Department and around the world by so many people and in so many different ways that nothing that happened during the war was a surprise, but also to exceed Nimitz's boast and say that this *included* the enemy's asymmetric cross-domain tactics toward the end of the war. More important still, robust joint experimentation may allow the United States to avoid the Thucydides Trap entirely.

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