Air Force B-52 Stratofortress leads five other aircraft in formation above aircraft carrier USS *Theodore Roosevelt* during routine operations in Philippine Sea, February 24, 2024 (U.S. Navy/Thomas Gooley)

Taking Cues From Complexity

How Complex Adaptive Systems Prepare for All-Domain Operations

By Benjamin Selzer

Because of potential increased adversary military expenditures and technological advances, the U.S. military technological advantage that has benefited American interests since the end of World War II is dwindling. To adjust to the increasingly technical global competitive arena, the joint force continues to develop the joint all-domain operations (JADO) concept, mainly adapted from the U.S. Army's multidomain operations (MDO) concept. The Services are attempting to integrate military assets into a cohesive force that can detect, identify, fix, and engage with threats in an appropriate time frame, understanding that no single weapons platform, or even a lone military Service, will achieve success by acting individually. With such a monumental task, the question looms: How can a complex adaptive systems (CAS) model guide a Service when facing future challenges at the individual and Service/institutional levels? This article provides recommendations on how to address these challenges taken from the study of CAS. These studies can inform efforts to develop doctrine, education, training, planning, and eventual implementation of JADO doctrine.

The idea that warfare is complex is not new. For instance, by examining how the relationships changed between the "holy trinity" of an area's population, a

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governing politic, and the military and its commanders during war, Carl von Clausewitz describes warfare in terms of a comprehensive and paradoxical interacting system.[1] Despite previous examination of war's complexity, applying complexity theory to the JADO concept (and efforts to develop and implement it) has yet to be attempted. This article argues that insights from CAS can provide the joint force with an informed perspective on the broader phenomenon of complexity and how to address it in a way that makes for better strategizing and more nimble operations. A large majority of national security guidance describes the world as increasingly complex, so by using complexity science tools and a multidisciplinary approach, we can plan with much more specificity the actions needed to confront complex future competition and conflict. Extracting lessons learned from complexity research on how to survive and thrive in complex environments can illuminate next steps in JADO implementation and serve as a force multiplier when facing crisis and conflict.

This article begins by briefly describing the various domain operations concepts and CAS. The article then examines alternative planning methods that may be more time- and experience-appropriate in a JADO CAS, where traditionally Service-aligned assets are merged and the decisionmaking loop is both condensed and augmented with machine learning (ML) input. Finally, an analysis of current force structure and interoperability exercises suggests that some changes currently under way are improving readiness, but more is needed to break traditional Service-specific roles to fully operate in a future JADO CAS.

MDO/JADO Concepts and JADC2

Current doctrine development of multidomain operations is complex, existing at multiple levels. The Army developed the MDO concept over the past 5 years, transitioning from the AirLand Battle doctrine after the 2018 National Defense Strategy prompted a national security shift from defeating violent extremism to competing with and deterring revisionist powers.[2] The MDO concept set forth in Army Training and Doctrine Command Pamphlet 525-3-1[3] greatly influenced the development of the JADO concept, which acknowledges that future armed conflict will be won by militaries that can maneuver easily in and between all domains "in a synchronized manner at a speed which the opponent cannot match."[4]

Both concepts are nested in National Military Strategy guidance and aim to counter an increasing adversarial advantage, especially from China and Russia, by generating "rapid and continuous integration of all domains of warfare to deter and prevail . . . short of armed conflict."[5] Additionally, the Army's MDO concept supports the larger joint warfighting concept (JWC), which aims to synchronize fires coming from all domains and Services, essentially confusing and overwhelming an adversary in conflict.[6] Marine Corps Doctrinal Publication 6, *Command and Control*, may also have informed the JWC concept by robustly addressing command and control complexity.[7]

These concepts will be implemented through the development of the joint all-domain command and control (JADC2) system, which is envisioned to securely and reliably link sensors and fires from any friendly Service and support commanders' maneuver and engagement decisions.[8] The joint force is starting to integrate Service-specific command and control (C2) platforms into the JADC2 platform, which will be augmented by artificial intelligence (AI) and ML capabilities. Although the full JADC2 strategy is classified, the Army, Navy, and Air Force are contributing to JADC2 development through specific initiatives, including Project Convergence, Project Overmatch, and the Advanced Battle Management System, respectively. Each Service is striving to develop cross-functional platforms to increase interoperability, including U.S. networks as well as partner-nation assets. The common theme of these concepts at any level, therefore, is to use an integrated military network to identify, evaluate, and, if needed, neutralize any perceived threat that may possess technological parity with U.S. systems, across all domains in a more rapid and coordinated manner than an adversary can react.

Although it is heartening to see so much effort focused on combining our national assets to increase military potency, with so many levels of complexity involved, the risk for Service-specific bias, uncoordinated policy between and among Services, and general overall confusion among stakeholders increases. Combining Department of Defense resources in this new joint concept is also slow. For example, the Joint Staff started work on the JWC in 2019, but current joint doctrine publications still support land (Joint Publication [JP] 3-31), sea (JP 3-32), air (JP 3-30), space (JP 3-14), and cyber (JP 3-12) domains separately.[9] Additionally, the JADC2 strategy summary was published in March 2022, and although the Army, Navy, and Air Force are working to support JADC2 development through their respective programs, it is still unclear whether the Services will abandon projected Service-specific requirements to support future JWC/JADC2 integration when needed.

In essence, the joint force is trying to build a new force structure with its current assets, which are not adequately coordinated for a future conflict environment. To truly fuse Service assets together to work at the speed JADC2 requires to be effective, the system will need to be scrutinized and then adapted through a much more rapid and fluid development paradigm. Using CAS to critically assess JADO development will help sort through the menagerie of participants, doctrines, initiatives, and overall effort.

The Emergence Discipline

Complexity Science. As complex, difficult, and unique as integrating the entire assets of the U.S. military under JADC2 sounds, this type of coordination happens regularly in infinite CAS. Populations fight in coordinated ways for daily survival. Flocks of birds, panicked crowds, and even cockroaches gel together to fend off threats, produce unintentional group-jamming effects in contested

environments, or communicate and coordinate to find shelter.[10] Although several technological challenges are unique to the military, we can learn a great deal from studies of CAS that are applicable to efforts to develop JADO concepts.

Contradicting previous Newtonian or reductionist approaches to systems analysis, complexity science analyzes a system, arguing that a self-organizing system generates emergent properties that do not exist in or stem from any subcomponent.[11] Complexity science widens the aperture of a topic, helping to understand the system itself, as well as actors within a system (nodes), and generating influence on future outcomes. Exemplified through a military focus, a reductionist approach would analyze a specific weapons platform's effects on the battlefield or conduct effects of the efficacy of any military Service's projected expenditures. Going forward under a JADO concept supported by a JADC2 system, military analysts will need to understand not only the capabilities of each weapons system but also their cumulative effects and repercussions on the larger system within which the weapons operate.

Complex Adaptive Systems. As a subcomponent of complexity science, a CAS is one composed of multiple heterogeneous agents without centralized control that responds to and learns from stimuli over time, resulting in adaptation and perpetual novelty (nonlinearity) while the system remains cohesive under change.[12] As these self-organizing agents interact, they adapt, trying to turn events to their advantage to survive.[13] Feedback loops within the system inform decisionmaking processes that lead to adaptation. The interaction and adaptation of nodes result in unexpected, nonlinear outcomes that are more than the sum of individual parts, a process referred to as *emergence*. Emergence is unique to a given environment and is reliant on the agents' ability to interact with one another.

Conflict within a CAS produces patterns that are not entirely random or completely predictable.[14] The balance point where "components of a system never quite lock into place, and yet never quite dissolve into turbulence" is referred to as the *edge of chaos*.[15] The edge of chaos is the moment when a system teeters between action and stagnation. It is also where innovation and adaptation lean away from the status quo and toward change or potential system collapse. National security practitioners tend to avoid the edge of chaos if at all practical.

As multiple national security documents proclaim, Great Power players Russia and China have closed the military technology gap in recent years, increasing the probability of armed conflict to upset the geopolitical status quo. In fact, the Army's first operational environment publication in 2019 assessed Russia as our military pacing threat, with China surpassing Russia sometime near 2030.[16] Just 2 years later, the Army changed its assessment, declaring China the pacing threat and demonstrating the rapid fluidity of the edge of chaos for the Great Power competition CAS.[17]

A collapse of the current international system would not benefit American interests, so it should be assumed that the United States will strive to maintain this system (away from the edge of chaos) where it has a comparative advantage over other states and to avoid areas of uncertainty. Areas of military uncertainty are especially threatening because the current system is upheld in part by American military superiority and a network of alliances. However, several factors, outside of their own control, could nudge U.S. leaders nearer to the edge of military chaos, which may include a narrowing of U.S. technological advantages over adversaries, a decrease in democracy globally (as reported by Freedom House), and the demonstrated ambitions of contenders like China and Russia on multiple fronts.[18] The CAS model emphasizes sense-making of the world, the importance of institutional design, and force-structure agility in order to unleash the potential within the system.[19] Ultimately, a JADO CAS would attempt to maintain a military advantage over our adversaries by using capability-matched assets, but in a faster and comparably better way.

Previous applications of the CAS lens include a wide swath of topics, such as the human immune system, managerial practices within a corporation, and grains of sand on a beach. With regard to military subjects, prior CAS application falls into three general categories. First, war as an operation has been described as a CAS, with complexity increasing relative to elevated detail in terrain, unit composition, interaction with a civilian populace, and governments involved.[20] Second, military occupations, such as special operations, intelligence, and leadership roles, present a ripe opportunity for this type of analysis, as these actors often self-organize, react to information that is rarely complete and accurate, and interact in the system, sending ripple effects outward.[21] Finally, CAS analysis has been applied to doctrine and policy at the Service level with varying results. For example, the Marine Corps successfully applied the CAS concept to its command and control doctrine to reflect an agile and contemporary mindset,[22] whereas the Air Force failed to apply CAS to its force structure, leading to gaps in predictability when trying to counter a more dynamic threat.[23] As JADO concepts continue to gain traction, it is appropriate to apply a CAS lens to better understand all the complexity terminology currently used and usher in more structured analysis using complexity science as the discipline.

Applying CAS Insights and Lessons Learned to JADO

To maximize usefulness, this article applies a CAS lens to better understand how emergence, military structure, and decisionmaking (both human-based and machine-augmented) could be influenced to strengthen future JADO implementation. The following section discusses each of these in turn.

Emergence. In armed conflict, emergent results occur after first contact, almost always altering well-made plans, validating Dwight Eisenhower's and Helmuth von Moltke the Elder's sentiments that the plan is not as important as the planning process leading up to an engagement with an adversary. CAS demonstrate some type of collective group dynamic, even if personality types, existing skills, ambition toward group work, and levels of training differ within the group.[24] Thus, in addition to efforts to train individuals and units

Soldiers with Indiana Army National Guard conduct field artillery fire mission during exercise Bold Quest 20.2 at Camp Atterbury, Indiana, October 31, 2020 (U.S. Air Force/Joel Pfiester)

as independent decisionmakers, future training should recognize (and seek to leverage) the importance of group dynamics and collective behavior within complex operating environments. This training could develop more adaptive leaders who will face more flexible emergent future operating environments.

The same goes for weapons platforms. Instead of analyses primarily focused on a discrete weapons platform, such as the Army's next long-range fire platform or the Navy's next cruise missile carrier, complexity science suggests there is value in considering how these platforms can fit into a CAS—and how in turn this system could affect (for good or ill) efficacy in the JADC2 network. A greater non-Service–specific mindset would allow for more robust deterrence in depth, allowing the amalgamation of weapons systems availability to emerge.

Structure. Military structures are well known for their hierarchy, pyramid structure, and rigidity, allowing commanders to disseminate orders to subordinates in a controlled manner and optimize decisionmaking from several input sources. The main structure of the U.S. military revolves around the Army's Brigade Combat Team (BCT), the Navy's various battle force ships, the Marine Corps' Air-Ground Task Force (MAGTF), and the Air Force's Fixed-Wing Squadron.[25] Combining assets into joint task forces (JTFs), tailored for specific environments and adversaries, is traditionally seen as a force multiplier. But in a future JADO environment, sufficient time will not exist to form JTFs capable of thwarting near-peer adversaries. The United States must already be organized to minimize inter-Service confusion, bureaucracy, and distance.

Several CAS are organized like what Benoit Mandelbrot termed *fractal structures*, where objects of the same pattern occur repeatedly at different scales and sizes and appear to act as connective devices, linking parts of an integrated whole together.[26] No matter the magnification, the organism's pattern remains the same. Mandelbrot describes fractals "as being invariant under some suitable collection of smooth transformations."[27] Left unconstrained, humans tend to form fractal social groups.[28] Current military structures, however, from the smallest to largest formations, lack this scalable symmetry for a few reasons, including a greater requirement for information processing at higher levels and tactical engagement assets at lower levels.

Military communications channels are stovepiped because of their hierarchical structure. They are also not currently allowed to form fractals because of the structure imposed on their components. Vertical hierarchy tends to slow directives, as information often passes through multiple checkpoints before reaching its operational destination. This phenomenon, known as bureaucratic creep, can erode an

F-35C Lightning II assigned to "Argonauts" of Strike Fighter Squadron 147 prepares to launch off flight deck aboard *Nimitz*-class aircraft carrier USS *Carl Vinson*, Philippine Sea, September 17, 2021 (U.S. Navy/Isaiah Williams)

organization's talent base by driving away autonomous thinkers and replacing them with more compliant automatons, resulting in flourishing mediocrity.[29]

One way to combat bureaucratic creep is to reduce the distance between decisionmakers and the environment external to the military structure, distributing responsibility and ensuring accountability is widespread.[30] Zero-distance decisionmaking, therefore, could more closely model fractal CAS, expedite the military decisionmaking process, and improve interaction within military CAS.

Leader Decisionmaking. If time matters, then decisionmakers will increasingly be required to rely on what Daniel Kahneman describes as System I thinking, which operates automatically and rapidly, as opposed to System II, which is more deliberate and allocates rigor to mental processes.[31] Kahneman won the Nobel Prize for integrating psychological aspects into economic models and developed prospect theory, suggesting humans weigh loss more heavily than gain in decisionmaking processes. System I thinking is synonymous with intuition, whereas System II is more careful and methodical. When time is available, Kahneman favors System II thinking to avoid unrecognized bias in the decisionmaking process.

Gary Klein, a psychology contemporary of Kahneman and counterpoint on the virtues of intuition, suggests that expertise on a subject area arises by framing a situation from experience gained in the past and by identifying cues that intuitively lead to achieving appropriately selected goals. Klein developed his theory when researching how firefighters made decisions when confronting blazes.[32] The firefighters made their decisions quickly, with lives at stake, and in most cases successfully. Firefighting categorizes similarly to warfighting and CAS environments, as all teeter on the edge of chaos.

Klein argues that intuition is best applied when decisionmakers can use their knowledge, training, and experience to correctly assess a situation and develop an initial course of action, which they can submit to mental wargaming.[33] This process is called the Recognitional Planning Model (RPM). Starting with a "gut instinct," decisionmakers save time by going with the first viable course of action (COA). The COA's viability is determined by running it through mental wargaming. Wargaming could be done by the decisionmaker, as in the firefighter's case, or by a staff, which is more expected in military settings. If the COA is unable to overcome obstacles during the wargaming process, then it is discarded, and the next idea is challenged. This process repeats until a COA overcomes all obstacles. Higher levels of experience allow decisionmakers to generate more viable options faster and during earlier attempts.

What the firefighters did not do is generate a set of options, compare the strengths and weaknesses, and establish COA selection criteria based on a standard set of dimensions.[34] The second decision model exemplifies the military decisionmaking process (MDMP), which would prove too slow to fight fires.

Although these systems may look similar to practitioners, they are completely different mental processes because MDMP employs analytical procedures (System II thinking), whereas RPM builds on expertise and experience (System I).[35] If time is abundantly available or the situation is completely foreign during the planning process, analytical dissection of several options may produce a robust plan, with branches and sequels that can withstand nonlinear changes in initial expectations at engagement. However, in a time-constrained environment or if environmental conditions are familiar, the RPM model may be superior, both in speed and accuracy.

Planning Considerations

The foregoing analysis suggests several efforts to adapt to a future JADO CAS. First, the joint force could focus more on developing experience-based leader intuition at all levels. Second, future structures should increase zero-distance decisionmaking to decrease bureaucratic creep and decision delays. Finally, when no experience exists to inform leader intuition, establish ways to integrate AI/ML to increase sense-making, allowing decisionmakers to understand, relate, and eventually act.

Experience-Based Intuition. Conflict, or competition in the prelude to conflict, is time-competitive, and decisionmakers will increasingly need to rely on intuition to outpace their adversaries.[36] In a JADO CAS where quick and accurate decisionmaking determines the winner, intuition and System I thinking will be more beneficial than deliberating courses of action, branches, and sequels. Supporting a culture shift away from MDMP and replacing this tool with RPM allows for more rapid analysis and action.

Furthermore, in a CAS where feedback loops produce nonlinear or unexpected results, such as a financial disturbance instigating a mass migration—two effects that would not normally be connected—intuition, formalized through the RPM, could aid decisionmakers while framing rapidly changing, novel situations, but with much less certainty. However, intuition is most useful when the circumstances surrounding an event are well-known to the decisionmaker and they have had the ability to practice using their intuition, observing the feedback of their inputs. Therefore, in situations where the decisionmaker has little or no experience and little time to plan, objective algorithms may generate more reliable options.[37]

In his written statement to the House Armed Services Committee on April 1, 2022, then–Chairman of the Joint Chiefs of Staff General Mark A. Milley discussed coming changes to joint professional military education (JPME) for officers and enlisted personnel.[38] Future JPME will increase study of the changing character of warfare, provide greater focus on China and Russia, and include joint education at the mid-enlisted ranks. These are promising steps, but the current classroom-based structure—visited once every 4 to 7 years by students—is not sufficient to develop adequate intuition for a JADO CAS. Currently, only a fraction of officers attend other Service PME-III schools, and the first structured interaction within the JPME timeline is at the Joint and Combined Warfighting School, when officers are already mid-career. Joint experience could be better fostered by increasing exchange positions between Services during both educational and operational assignments. This would help close the inter-Service culture gap and make experienced-based intuition decisionmaking more robust.

Zero-Distance Decisionmaking. Another suggestion is to change the military hierarchy to allow for greater autonomy at lower levels. Mission command was successful at distributing decisionmaking authority, but when subordinates lack experience-based intuition, they will need to be reassured by more experienced leaders with immediate availability. Furthermore, although mission command increased subordinate decision power, the military structure can improve to accomplish the same.

Facing ever-increasing complex prospects for future conflicts, the Army (followed by the joint force) adopted the mission command doctrine from 2009 to 2014. *Mission command*, through distributed control, allowed military commanders to reduce the emphasis on providing all direction to units in a top-down fashion, increasing flexibility in subordinate maneuver while allowing the commander's intent to still be accomplished. As commanders and units were freed to collaborate more dynamically with adjacent mission partners, the joint force realized that inter-organizational and inter-unit collaboration could produce effects resonating beyond a single domain or area of responsibility "to enhance the effectiveness and compensate for the vulnerabilities of other domains."[39] Greater trust and responsibility could be placed in junior leaders if they enhanced their intuition skills, resulting in beneficial emergence.

Although the freedom for subordinates to explore how best to execute a commander's intent increased under mission command, collaborative flexibility will not improve until physical resources enjoy a similar level of freedom. With increased reliance on distributed sensors under the JADC2 platform, operational control will need to be more reactive and loosely defined than at present. Administrative control (that is, "care and feeding") may remain rigid to maintain accountability and serviceability of combat units and platforms, but the assets will need to be lent out to others much more rapidly to maintain their relevance and avoid bureaucratic creep. Thus, structural ownership will need to be more flexible to share resources across domains and military Services while still maintaining ownership ties to the Services and maintaining each asset.

While still complying with 2018 National Military Strategy guidance to maintain a competitive advantage against Great Power competitors, the Army provides an example with AimPoint Force. AimPoint Force initiated a change in headquarters structure above the BCT level (division, corps, and theater) to better confront near-peer adversaries by augmenting three field artillery brigades with intelligence, information operations, cyber, electronic warfare, and space assets, thus emulating higher echelon forces in a fractal manner.[40] However, in

January 2022, the Army announced that AimPoint Force will change into "Army 2030," essentially reverting the BCT-centric counterinsurgency structure back to a division-based structure consisting of the following types of divisions:

- standard light
- standard heavy
- penetration
- joint force entry air assault
- joint force entry airborne.[41]

Little is publicly known now as to whether the AimPoint initiative to combine other assets into an artillery headquarters will survive the Army 2030 transition. AimPoint appeared to be a step toward developing high-level fractal units, but now adjustments toward larger division structures increasingly distance the most experienced leaders from the edge of chaos.

AI/ML in the Absence of Experience. As technological capabilities among the world's Great Powers approach parity, effective options generated from robust and accurate data are crucial. Technological advances in AI and ML will aid the inexperienced in sense-making and the experienced in choice selection in the future. Aggregated information produced from an entire military's detection capability will overload decisionmakers who use current planning methodologies. AI and ML algorithms will condense information into more manageable nuggets, but at a possible tradeoff for transparency.

Kahneman generally favors algorithms over human judgment because human decisionmaking can be inconsistent, even when presented with the same data twice, subject to unconscious bias and susceptible to framing errors.[42] AI and ML play an emerging central role in the JADO CAS because they assist decisionmakers' sense-making of situations with numerous variables—too many for humans to interconnect—by building predictions based on programmer-defined parameters.

Despite ML's ability to connect several more data points than humans, the accuracy of its algorithms' predictions still suffers from bias because ML either relies on input constraints set in place by the original search query (information retrieval) or makes predictions based on past results (recommender). In either case, data that is considered or rejected is not randomly included in analysis, but rather is the consequence of previous choices.[43] ML results, therefore, could skew decisionmaking by omitting certain data sets, effectively blinding leaders to available and viable options.

With ubiquitous media reporting and government accountability upholding one of America's most trusted institutions, it is unacceptable for decisionmakers to claim ignorance on how they came to certain conclusions, especially if the JADO CAS is considered at scale and in terms of how many lives could be lost if poor decisions are made. Although some argue transparency is not important if a system's architects chose to include ML in the first place, a more responsible approach would be to focus on remaining transparent once actions are taken within a JADO CAS, both within the hierarchical C2 chain and with those outside, such as the citizenry, allies, and

Navy F/A-18 Super Hornet departs from Air Force KC-135 Stratotanker after receiving fuel over U.S. Central Command area of responsibility, December 2, 2023 (U.S. Air Force/Daniel Hernandez)

Marines with 1st Battalion, 2nd Marines, travel to landing zone in CH-53E Super Stallion during Stand-in Force exercise on Okinawa, Japan, December 7, 2022 (U.S. Marine Corps/Jerry Edlin)

adversaries.[44] It would be impractical for all decisionmakers to understand the computer science in advanced ML systems and be able to trace step-by-step the inputs that led to an ultimate decision. Instead, rationale transparency could be achieved by making information available that explains the decision and illuminates who is accountable.[45] Therefore, even with new technology guiding our decisionmaking process, we should not assume there will be any change in the responsibility placed on those making decisions, preventing ML capabilities from serving as a scapegoat if operational planning ends in tragedy.

Furthermore, Klein argues that the more we rely on ML tools to do our thinking, the more we lose our intuition skills.[46] A simple example: trying to recall friends' phone numbers. Now that most numbers are stored in phones, most individuals have lost their mental Rolodex. As ML takes over sense-making tasks by collecting and connecting information for us, we will need to purposefully strive to maintain our intuition skillset or risk losing the ability to recognize patterns and construct mental models.[47]

The Future Human Role in a CAS. AI and ML will outpace humans in decisionmaking and coordination in future military CAS. So where, then, should humans be placed in the decisionmaking loop to maximize control, efficiency, and responsiveness? Traditionally, humans "in the loop" exerted a high level of control over the system as the primary decisionmakers conducting most of the actions to produce results. As automation took over, decisionmakers had the option to sit "on the loop," allowing computers to do some actions autonomously but allowing humans to intervene when necessary. Some predict that as early as 2045, systems could be designed to function completely autonomously, with humans "out of the loop," which could lead to more humane warfighting as AI finds the most efficient ways to achieve objectives and limit the loss of lives, or could prolong warfighting as a result of technology's indefatigability.[48]

With current limitations, the out-of-the-loop structure holds the highest margin of error if the initial comprehension of preconditions for a given issue proves inaccurate. Therefore, if we are to move human decisionmaking out of the loop and allow AI/ML to function at its capacity, future work will need to focus on correctly framing situations to avoid ML bias and developing algorithms that do not reflect the biases of those developing the algorithms. Additionally, humans will still need training on how to best employ AI/ML tools to avoid algorithmic bias and when to avoid AI/ML use altogether.[49]

Promising Signs of Adaptation

On the joint front, signs of hope for fractal-like integration are emerging. Evidence supporting an integrated force structure arose in spring 2022 as the Army's I Corps conducted exercises with the Air Force and Navy in the Indo-Pacific region. With such a large geographical space to control, commanders realized that a distributed mission command approach, paired with multi-Service modular subunits that were geographically spaced out, reduced the risk to a central command footprint and sped the I Corps' ability to react and engage.[50] Additionally, since 2001, Bold Quest exercises incorporated the joint and multinational enterprise by developing capabilities, conducting analyses, and increasing interoperability between U.S. forces and partner nations.[51]

With a distributed control, mission command–style doctrine informing

decisionmakers at all levels, combined with both Service-specific and military-wide structural adjustments to traditional ownership hierarchies, the United States is moving toward a force that could be effective in a JADO CAS. Mission command minimizes bureaucratic creep by decreasing the distance between the decisionmaker and the edge of chaos, but this method is reliant on subordinates' intuition and experience to operate successfully. Therefore, the scope of current training should increase to include experience development and framing in conjunction with all military Services. Furthermore, additional fractal development at the BCT/MAGTF/squadron levels and below and increased clarification on ownership and employment authority across branches and military Services would increase nimbleness, reduce bureaucratic creep, and produce a more homogenized response to threats.

The rigid, hierarchical structure needed to command troops in combat has softened and become more agile from the days when fighting resided predominantly in land, sea, and air domains. Now that space and especially cyber domains are increasingly contested, and because there is much more fluidity when crossing between all domains, the military is slowly adapting both its structure and function to operate effectively in a JADO CAS. However, consolidation plans such as Army 2030 are concerning if structural change is addressed only at the division level and above. This type of consolidation limits the ability to engage a given threat with the most appropriate and effective countermeasure available in a timely manner because of the increased distance of the headquarters from the edge of chaos.

Conclusion

In a competitive world where potential adversaries have nearly reached technological parity across all domains, rapid and well-informed decisionmaking, as well as appropriate and coordinated application of available assets in a justifiable manner, will provide a U.S. advantage in a future JADO CAS. Although the military Services are taking steps at higher echelons to increase interoperability, more attention is needed to combine lower level multi-Service structures, update outdated planning methodologies, and discover appropriate ways for AI/ML to augment professional expertise in the military realm.

Complexity surges as the need to operate in multiple domains increases, requiring units to adapt to emerging, nonlinear outcomes. The strength of the military does not stem from BCTs, MAGTFs, squadrons, or battleships. Instead, the military's effectiveness is an emergent result of all Services working in unison, joined together through layered communications and skillset redundancies. Uncoordinated and isolated assets are left vulnerable, whereas robustly supported assets adequately equipped to face a given threat will project power. Applying a CAS framework to the JADO concept not only illuminates a new approach toward contemplating military doctrine but also could soon lead to novel modernization paths. **JFQ**

Notes

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