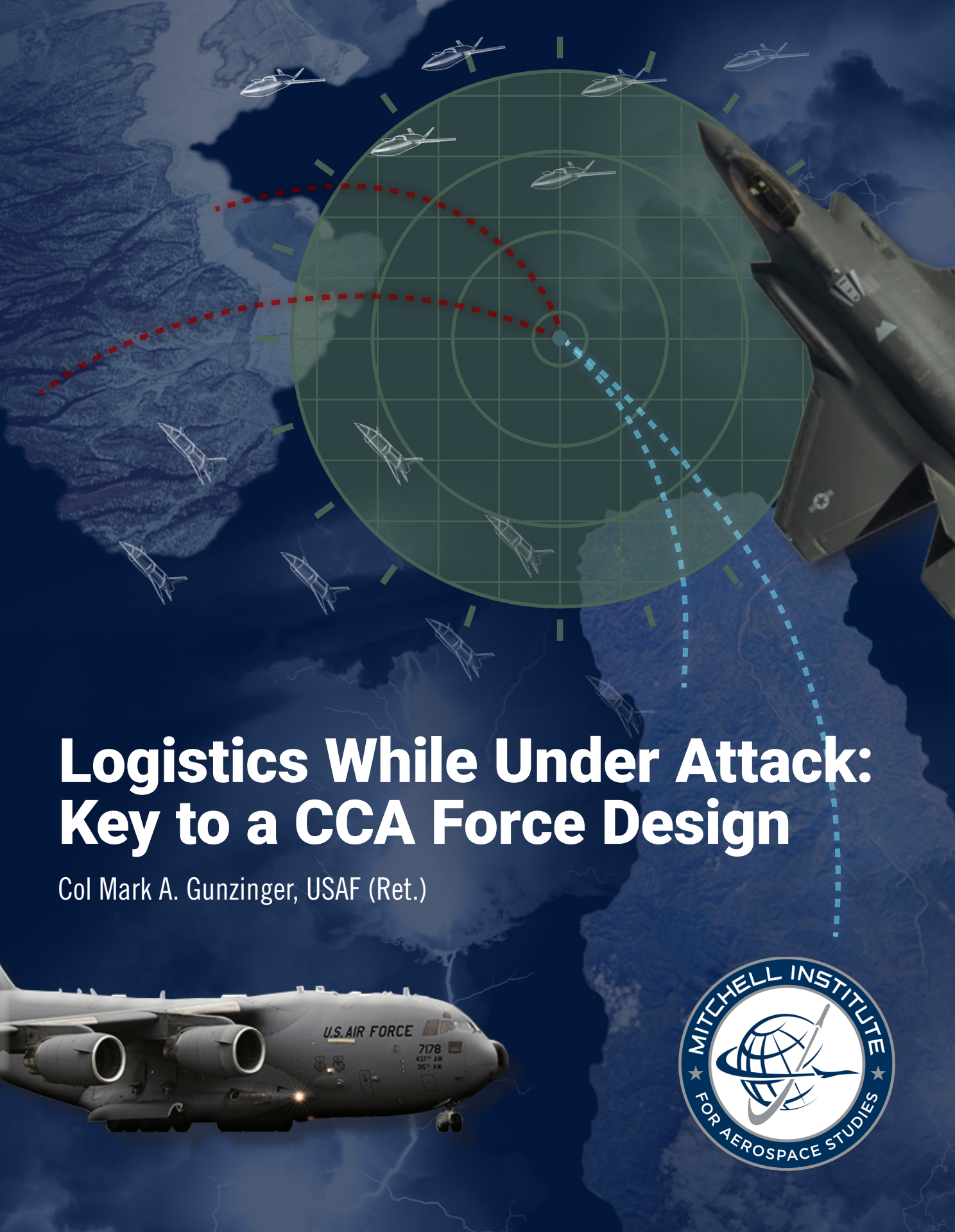

Logistics While Under Attack: Key to a CCA Force Design

Col Mark A. Gunzinger, USAF (Ret.)

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Contents

FOREWORD 1

EXECUTIVE SUMMARY 2

INTRODUCTION 8

THE IMPERATIVE TO INCREASE THE CAPACITY, SURVIVABILITY, & RANGE OF THE USAF'S COUNTERAIR FORCES 9

REALIGNING AIR SUPERIORITY FORCES WITH THE THREAT 14

ILLUSTRATING THE POTENTIAL FOR CCA TO SPEED THE TRANSITION 15

MINIMIZING CCA LOGISTICS IS AN OPERATIONAL ENABLER 24

CONCLUSION & RECOMMENDATIONS 26

Foreword

The U.S. Air Force is in a crisis. The service's combat aircraft inventory is far too small to meet its operational requirements, the average ages of its fighters and bombers have reached unprecedented highs, and its readiness to fight tonight remains at a historic low. This is the foreseeable result of decades of underfunding and delayed modernization, a trend that continues today. The Air Force must now size and shape its forces for peer-level conflict. This will require budget increases that fund the acquisition of a new generation of combat aircraft, munitions, and innovative technologies like uninhabited collaborative combat aircraft (CCA).

AI-enabled CCA, combined with 5th generation and beyond fighters and bombers, will form the core of the future Air Force. Advanced piloted combat aircraft and CCA are both needed in significant numbers—their combined operations will enable the Air Force's warfighters to disrupt a peer adversary's campaign and impose crippling costs on its forces. CCA are not "cheap fighters" that will replace the Air Force's F-22s, F-35s, or a new penetrating counter-air aircraft (PCA). But like piloted aircraft, simply acquiring significant numbers of CCA will not be enough. Combat air forces require logistics—personnel, fuel, munitions, ground handling equipment, and other materiel—to generate their sorties at scale. This is why Mitchell Institute's third in a series of exercises asked Air Force and industry operators, planners, and logisticians to assess potential CCA logistics requirements. Their top insight is that sustaining large-scale CCA operations in a Pacific conflict is feasible if the Air Force seeks to minimize the logistical requirements of its future CCA forces.

This is the focus of our latest report, *Logistics While Under Attack: Key to a CCA Force Design*. The report stresses the need for adequate munitions, prepositioned materials, and other logistics to generate hundreds of CCA sorties per day from a dispersed Pacific posture. In this way, CCA can help ensure the Air Force remains capable of generating decisive combat power as an "inside" force in the Pacific while under attack by China. Now is the time to field CCA, F-35s, PCA, B-21s, and the logistics needed to operate these forces at a winning scale to offset the PLA's combat mass advantage. This will require additional resources—budget and end strength. Without these increases, the Air Force will be forced to continue divesting its existing forces, delaying its modernization, and reducing its current readiness. This is a prescription for catastrophe in war that would cost far more than any perceived "savings" from continuing to under resource the Air Force.

Lt Gen David A. Deptula, USAF (Ret.)
Dean, The Mitchell Institute for Aerospace Studies

Executive Summary

The U.S. Air Force now lacks a counterair force that is adequately sized and shaped to achieve the degree of air superiority required to defeat China in a Pacific conflict—DOD's stated pacing challenge. After thirty years of force cuts and delayed recapitalization programs, there are no active component F-15C/Ds and only 120 F-22 combat-coded air superiority fighters in the service's inventory. These aircraft, complemented by 5th generation F-35s, cannot generate enough sorties to achieve the air superiority required to defeat Chinese aggression plus meet other concurrent operational demands for Air Force airpower.[1]

The Air Force is developing collaborative combat aircraft (CCA) and other novel capabilities to help offset its counterair mission deficits. This report summarizes insights from the third in a series of Mitchell Institute exercises that explored the potential for CCA with autonomous technologies to perform as counterair force multipliers. Its recommendations are derived from the assessments of teams of Air Force and industry planners, operational experts, and technologists on potential CCA use cases and logistics required to generate CCA sorties during a major Pacific conflict.

Understanding CCA

For the purposes of this report, CCA are UAVs with autonomous technologies that enable them to collaboratively operate with other UAVs and inhabited aircraft. CCA will provide "a distributed, mission-tailorable mix of sensors, weapons, and other mission equipment" that complement 5th generation and beyond fighters. CCA could cost a few million dollars to no more than low tens of millions of dollars each depending on their mission systems and intended use cases. These attributes will enable warfighters to use CCA as expendable or recoverable assets to meet mission needs and reduce risk to aircrews during high-intensity conflicts. For the purposes of this report, "recoverable" CCA can fly multiple sorties, and "expendable" CCA fly a single mission, much like a cruise missile. Warfighters can choose to attrit both types of CCA to achieve desired effects such as killing a threat or reducing risk to other forces.

Source: DAF Scientific Advisory Board FY 2022 Study: Collaborative Combat Aircraft for Next Generation Air Dominance

Air superiority will remain an essential condition for any form of successful military operations. Some observers of the conflict between Ukraine and Russia have questioned if air superiority remains an operational imperative in an era of drone and missile warfare.[2] This erroneous school of thought erodes support for the Air Force's core air superiority requirements, including the Next Generation Air Dominance (NGAD) family of systems, CCA that will be part of NGAD, and the need to retain all remaining F-22s and acquire F-35As at a faster pace. The U.S. military has gained valuable insights from the conflict, including the value of using small, weaponized drones to attrit enemy forces. However, extending these insights to question the need to achieve air superiority—especially in a war with a peer adversary such as China—is a gross overreach and fundamentally wrong. As multiple air warfare experts have pointed out, Russia and Ukraine's failure to achieve air superiority is a key reason for why they are now fighting a war of attrition that increasingly favors Russia because of its superior resources.[3]

CCA logistics should not be an afterthought, but a requirement that informs their key performance parameters, the mix of CCA the Air Force acquires, and how they are employed.

The same would be true in a high-intensity conflict with China—the lack of U.S. air superiority would give China's People's Liberation Army (PLA) a major, potentially decisive advantage.[4] China understands that air superiority is a critical center of gravity for U.S. joint force operations and has designed its integrated air defense system (IADS) to achieve the air superiority it believes will prevent the United States from effectively intervening against a PLA offensive in the South China Sea. China studied the 1991 U.S.-led Operation Desert Storm campaign against Iraq and concluded that "its military was ill-prepared to face a modern foe like the United States." [5] China has since developed a modern force that is on the cusp of achieving air superiority overmatch against the U.S. Air Force. The PLA now operates the world's most lethal IADS that includes 4th and 5th generation fighters, highly capable air-to-air missiles, and long-range kill chains enabled by airborne early warning and control aircraft. China is also developing its own 6th generation fighters and stealthy bomber force to pace the Air Force's NGAD.

The PLA will complement its air defense operations by launching offensive counterair strikes against the Air Force's theater airbases and logistics infrastructure.[6] While many consider achieving air superiority a matter of countering threats in the airborne realm, it is important to recognize that China will also seek to diminish U.S. air superiority forces by attacking them where and when they are most vulnerable—on the ground between sorties. These attacks will include salvos of missiles launched against the Pacific bases and logistics nodes the Air Force depends on to generate its combat sorties. Inadequate U.S. Army and Navy missile defenses in the Pacific theater will make this challenge especially problematic for all U.S. military forces operating in areas that are within range of the PLA's rocket forces.

Failing to achieve air superiority when and where needed by U.S. forces would be devastating. Without air superiority, the United States would, like Ukraine, be at risk of fighting a war of attrition that it cannot win against China. And failing to defend Taiwan against a Chinese invasion or defeat a PLA assault elsewhere in the South China Sea would fatally breach the security of the Pacific's First Island Chain. This would place China well down the path toward achieving its long-term goal of pushing U.S. forces out of the Western Pacific enroute to becoming the region's dominant power.

CCA are a Key to Sizing & Shaping the Air Force for Peer-Level Conflict

One of the Air Force's rebalancing priorities is to acquire a family of CCA with autonomous technologies capable of performing counterair missions.[7] This will require the Air Force and its industry partners to continue to mature technologies that are key to developing CCA that can operate in a highly collaborative fashion with other aircraft. According to General Kenneth Wilsbach, Commander of the Air Combat Command (ACC), this will help the Air Force to "present a multitude of dilemmas" that greatly complicate and adversary's counterair operations in the air and on the ground.[8] In the air, CCA will act as force multipliers that complement—but do not replace—the service's F-22s, F-35s, and NGAD's penetrating counter-air aircraft (PCA). This collaborative combination will pose a diverse threat that is more difficult for adversaries to accurately characterize and counter in highly dynamic, time-compressed operational environments. Air Force warfighters could exploit this uncertainty to disrupt an adversary's counterair operations and react in ways that increase the survivability and lethality of all U.S. forces. On the ground, a distributed CCA posture will complicate China's ability to effectively find, fix, target, and attack the Air Force's counterair forces and bases.

These advantages will not be realized without adequate personnel, fuel, theater airlift, and other logistics required to generate hundreds of CCA sorties per day. These logistics should not be an afterthought, but a requirement that informs their key performance parameters, the mix of CCA the Air Force acquires, and how they are employed. The Air Force is designing its CCA, including its Increment one (1) variants, to have smaller maintenance and logistics footprints on the ground compared to comparable numbers of piloted combat aircraft. They are also being designed to operate from shorter runways or even without runways for some variants. These attributes will help the Air Force generate air superiority sorties from a more distributed, relocatable, and resilient forward posture in the Western Pacific as envisioned by its Agile Combat Employment (ACE) concept.[9] Ground launching CCA from locations that are closer to the fight would increase the depth they can penetrate and the time they can persist in weapons engagement zones without aerial refueling. Again, reducing CCA logistics requirements, minimizing the detectable footprints of their launch locations, and improving the resiliency of CCA supply chains will be key to generating their sorties at scale from this forward posture while under attack.[10]

Major Insights from the Exercise

The Mitchell Institute for Aerospace Studies led a tabletop exercise (TTX) in 2024 that tasked teams of Air Force and industry operators, planners, and technologists to assess potential CCA force mixes, theater postures, and operating concepts for counterair missions during a campaign to defeat Chinese aggression. Experts from the Air Mobility Command and other Air Force organizations then assessed the logistics—fuel, munitions, airlift, and personnel—required to generate the team's proposed CCA sorties. Finally, the teams examined risks to their CCA logistics operations created by PLA missile attacks and developed recommendations for how the Air Force could reduce these risks.

Experts participating in the TTX determined that generating CCA sorties during a conflict with China is not an insurmountable challenge—**if the Air Force minimizes the logistics requirements of its CCA force design**. Without sufficient fuel, munitions, ground personnel, and launch and recovery infrastructure, the Air Force will not be able to generate CCA sorties in the numbers and at the tempos required by theater commanders. Experts also suggested that **CCA with reduced logistics requirements would help create a more distributed and resilient combat force capable of sustaining its sortie generation operations while under attack**. For instance, creating a CCA force that can employ the same kinds of munitions would significantly reduce their logistics requirements. Munitions commonality is critical to a resilient CCA force design. In their opinion, creating a resilient, distributed CCA basing posture in the Western Pacific is just as important as determining the right balance between the ranges, payload capacities, survivability, and costs of these uninhabited aircraft.

A third insight is closely related to the previous two: **CCA can help the Air Force to generate counterair sorties in contested areas that are located closer to the fight**.[11] TTX air superiority planning teams chose to deploy their CCA to sites in southern Japan and the northern Philippines that were located as close as possible to the Taiwan Strait despite the increased threat of PLA missile attacks.[12] The teams were willing to accept this risk because their CCA had smaller logistics footprints on the ground and cost significantly less than more complex and capable piloted aircraft. A close-in CCA force posture would enable ground-launched CCA to penetrate deeper into highly contested environments. This would help U.S. forces drive the timing and tempo of a conflict with the PLA and reduce the need to aerial refuel recoverable CCA to extend their ranges and mission endurance.

As in previous Mitchell TTXs, experts recommended that **the Air Force should not design its CCA and their operating concepts to marginally improve how it has fought in the past**. A new paradigm is possible. Experts placed a high priority on using large numbers of lower-cost, expendable and recoverable CCA to operate independently and in support of 5th generation fighters—but not controlled closely by their pilots—to absorb risk, disrupt China's counterair operations, and cause the PLA to expend its finite air defense resources.

A family of CCA should complement, but not replace, 5th generation fighters and NGAD PCA. All experts agreed that the U.S. Air Force needs both CCA and stealthy piloted aircraft to achieve air superiority against the PLA. The combination of inhabited and uninhabited aircraft will enable new operational concepts for counterair and other missions that cannot be achieved by piloted aircraft alone. In fact, eliminating 5th generation fighters and NGAD PCA would undermine the cost advantages and unique operational value of CCA. Not only would the Air Force have to transition technologies presently onboard its advanced piloted aircraft to CCA, thereby boosting their cost and complexity, but there are inherent advantages found in inhabited-uninhabited teaming operations. **Determining how best to combine the operations of piloted and uninhabited aircraft to create threats that adversaries must honor** is key to achieving a leap-ahead in warfighting capability.

Finally, **the Air Force could use CCA along with its 4th generation fighters to maintain pressure on the PLA's air defenses while the Air Force regenerates its strike forces**. Success demands stressing an adversary's forces with no reprieve. Allowing the PLA Air Force and other Chinese forces free reign in the battlespace between U.S. strikes is a recipe for defeat. The Air Force could launch CCA by air and from the ground to sustain a level of operations that induce the PLA to sortie its fighters, keep its KJ-500s airborne, and otherwise honor the threat in ways that will reduce the PLA's ability to regenerate its forces to surge against U.S. strikes.[13] Deploying waves of CCA could also enable the Air Force to use its 4th generation fighters with long-range air-to-air missiles to maintain pressure on China's IADS, both during and between U.S. strikes.

Recommendations

None of the advantages that CCA promise to provide can be realized without logistics to generate their sorties at scale while under attack. The case for CCA is clear—they are force multipliers with the potential to increase the resiliency of the Air Force's Pacific posture and perform in ways that disrupt and create dilemmas for an adversary. These kinds of attributes are exactly what the service desires for its future force. This will only be possible if the Air Force *develops a CCA force design that is informed by its logistics requirements*. Logistics considerations are fundamental to any new force development effort. Military operations depend on logistics, and designing new weapon systems in ways that reduce the resources needed to sustain their operations when it is most important—in combat—is crucial to mission success. Toward this end, the Mitchell Institute offers the following recommendations based on insights from its CCA exercises and related studies:

- **Minimize the logistics requirements of the Air Force's CCA force design**. Generating CCA sorties from Pacific operating sites located inside the PLA's missile threat envelope is a fundamental requirement. This is not an insurmountable challenge *if* the Air Force minimizes the logistics required to conduct these operations. This includes reducing requirements for fuel, spare parts, food, water, and other materiel needed to generate CCA

sorties at scale and sustain their forward units. To this end, the Air Force should engage its operators and logistics experts at every step of its CCA development process. The Air Force should likewise consider how the number of different CCA variants in its future force design could impact logistics. Too many unique CCA designs with different sustainment requirements could complicate their supporting logistics operations while under attack.

- **Develop innovative operating concepts for CCA.** The Air Force should design operating concepts for using lower-cost expendable and recoverable CCA independently and in collaboration with larger payload, highly survivable piloted aircraft to disrupt, create dilemmas, and impose costs on a peer adversary's air defense forces. Constraining CCA to performing as "loyal wingmen" to piloted fighters would limit the potential for CCA to create unique effects in contested and highly contested environments.

- **Employ CCA to help maintain pressure on adversary forces between U.S. piloted strike surges.** The Air Force should develop CCA and CCA use cases that will help maintain pressure on PLA air defenses between U.S. piloted strike surges. CCA launched from the air and the ground inside the First Island Chain with less reliance on runways could perform as primary forces supported by piloted aircraft to maintain continuous pressure on the PLA's surface action groups (SAGs), KJ-500s, and other air defense threats. This would help U.S. forces to drive the timing and tempo of a conflict, reduce the time available for the PLA to reset between the Air Force's strikes, and diminish the level of effort the PLA could concentrate against them.

- **Acquire lower-cost, expendable CCA to disrupt and impose costs.** The Air Force should acquire expendable CCA in significant numbers—high hundreds to low thousands—that it could use to absorb risk and disrupt adversary counterair operations in highly contested environments. The lower costs and reduced logistics requirements of expendable CCA increase the potential to acquire and use them at significantly greater rates compared to more complex and logistics-intensive fighter-like CCA designs. Additional cost-per-effect analysis—including the cost of logistics—is needed to determine the right mix of expendable and more capable reuseable CCA in the future force.

- **Prioritize the rapid funding and acquisition of CCA at scale—resiliency requires capacity.** Experts participating in Mitchell Institute's TTX exploited the combat utility of notional expendable and reuseable CCA, including variants with characteristics that are broadly aligned with known CCA Increment 1 requirements.[14] These CCA are designed to be manufactured at scale and maintain their combat readiness with reduced maintenance requirements compared to piloted aircraft. Delaying the acquisition of existing CCA designs for notional future solutions would extend the Air Force's air superiority capability and capacity gaps.

- **Do not trade 5th generation and beyond piloted fighters for CCA.** Success requires a team. The Air Force should design, acquire, and operate CCA to complement its 5th generation fighters, NGAD PCA, and possibly its future long-range strike family of systems. CCA will not reduce requirements for these advanced piloted aircraft as they do not possess the same levels of capabilities including survivability.[15] The stark reality is U.S. military has a severe shortfall in air superiority capabilities. Capacity growth for this mission in all areas—piloted and uninhabited—is imperative. Developing operating concepts that best combine the different attributes of these aircraft will be key to creating an asymmetric air superiority system of systems that offsets the PLA's numerical advantages.

- **Align the future CCA force mix with munitions inventories and prioritize the acquisition of CCA capable of creating non-kinetic effects.** Real-world shortfalls in air-to-air weapons and other munitions will constrain the combat effectiveness of weaponized CCA. This is also true for fighters and bombers. To mitigate this risk, the Air Force must consider the availability of munitions as it develops an optimum mix of CCA and determines the value of developing weapons suitable for CCA. Alternatives that could reduce munitions shortfalls include fielding electromagnetic warfare (EW) variants of CCA that are capable of non-kinetically disrupting, degrading, and destroying electronic systems that form the core of an adversary's IADS. These EW CCA variants could also help create more complex challenges for adversary forces and reduce the Air Force's air-to-air weapon expenditures in a long duration peer conflict. A CCA force design should also seek to maximize the commonality of munitions used by different CCA variants. This would significantly reduce their logistics sustainment requirements.

- **Assess logistics, battle management, and other requirements for a network of CCA forward operating sites.** CCA with reduced logistics footprints, including Increment 1 designs, could expand options to generate Air Force counterair sorties from launch sites that are within range of the PLA's missile forces. The Air Force should assess requirements to manage the operations of CCA dispersed across multiple launch and recovery sites in the Western Pacific, as well as the logistics needed to generate CCA sorties such as local fuel storage capacity and pumping equipment, ramp space, and access to bulk consumables. These assessments should be accompanied by actions to develop host nation agreements for local logistics support to CCA operations.

- **Assess the potential for uninhabited aircraft to provide CCA logistics.** Using the Air Force's C-130s and other airlift aircraft to provide logistics materiel to CCA bases inside areas covered by the PLA's long-range air defenses will not be without risk. Experts participating in Mitchell Institute's TTX recommended the Air Force assess the potential to reduce risk to its mobility aircrews by employing cargo carrying variants of CCA, equipping CCA with a cargo pod, or using uninhabited variants of small, commercially available aircraft to support CCA sortie generation operations.

- **Continue to develop a better understanding of CCA operational and logistics needs.** Mitchell Institute's TTXs are a start toward better understanding the logistics needed to generate CCA sorties from forward operating locations that will be at risk of air and missile attacks. The Air Force should continue to conduct threat modeling and campaign-level force structure assessments tied to realistic operational scenarios and operational concepts for CCA.

The Mitchell Institute's exercises and related research support the proposition that expendable and recoverable CCA will help mitigate the Air Force's air superiority capability and capacity shortfalls. When integrated with 5th generation and beyond fighters, CCA could create dilemmas that China's counterair forces cannot easily overcome. Operationalizing CCA as part of a hybrid air superiority force will require understanding the logistics that will be required to generate CCA sorties while at risk of attack. Engaging the Air Force's logisticians and mobility planners at every step of CCA development and fielding is a key to achieving this objective. CCA logistics cannot be an afterthought; they are a priority for rapidly fielding these uninhabited aircraft as part of the Air Force's efforts to size and shape its forces for peer conflict.

Introduction

The U.S. Air Force is still optimized for operations to defeat lesser regional militaries of the past. Because of insufficient budgets, the Air Force lacks the capabilities and capacity required to defeat aggression by China and simultaneously meet other global operational requirements.[16] Critical challenges the service is facing include the PLA's growing capacity to attack U.S. combat aircraft in the air and on the ground. These attacks will also target the logistics forces and infrastructure on which the Air Force depends to sustain its combat operations. Countering these challenges will require the Air Force to develop and field the next generation of piloted combat aircraft and uninhabited capabilities like CCA. Fielding a force of CCA with autonomous technologies would expand the Air Force's options to conduct air superiority missions in the air and disperse its counterair forces in forward areas. But to be combat effective, this CCA force must receive sufficient fuel, munitions, and other logistics materiel required to generate their sorties while their operating locations are at risk of attack.

This report assesses logistics requirements that should inform the Air Force's development of a family of CCA. Its recommendations are the product of a series of tabletop exercises and studies led by the Mitchell Institute over the last three years. Mitchell's latest tabletop exercise convened more than 60 Air Force warfighters, operational planners, technologists, and industry experts to gain a better understanding of how logistics should shape the kinds of CCA the Air Force acquires, how it operates them, and where they should be postured during a conflict with China.[17] Mitchell Institute designed this TTX to scope material and non-material solutions to likely logistics challenges, such as how to resupply with acceptable risk CCA operating sites in the Pacific that are within range of the PLA's strike forces. A second TTX objective was to assess how U.S. warfighters could use CCA to maintain pressure on the PLA's IADS between the Air Force's strike surges in a defense of Taiwan scenario.

The Mitchell Institute's TTX explored how innovative concepts for using AI-enabled CCA in collaboration with 4th and 5th generation fighters and bombers can help the U.S. Air Force achieve air superiority in a high-intensity conflict with China. Three TTX air superiority mission planning teams independently proposed concepts for using CCA in ways that would disrupt the PLA's counterair operations and create multiple dilemmas to offset the PLA's advantages in combat mass and proximity to the Taiwan Strait. Aside from these concepts of operation, the TTX produced insights on how and why logistics requirements should inform the development of a CCA force that complements—but not replaces—the Air Force's 5th generation and beyond air superiority aircraft. Developing a better understanding of these logistical requirements is a critical step toward acquiring a combat-credible CCA force for the U.S. Air Force.

The Imperative to Increase the Capacity, Survivability, & Range of the USAF's Counterair Forces

Decades of force cuts driven by inadequate budgets and assumptions that future wars would be limited in scale and scope reduced the Air Force's combat aircraft inventory to less than half the force available to fight Operation Desert Storm in 1991.[18] This diminished force is now marginally capable of achieving the degree of air superiority required to defeat Chinese aggression in the Pacific and meet the Air Force's other global operational commitments. Given the growing alignment between China, Russia, Iran, and North Korea, it is likely the Air Force will be required to concurrently engage in multiple theaters during a major peer conflict. This is a new normal that will stress the Air Force's undersized forces to their breaking point.

China is aware of the U.S. Air Force's diminished state and is preparing to decisively attack the entire life cycle of the service's combat operations, including its ability to generate air superiority sorties and complete counterair kill chains in highly contested environments. Collectively, these challenges create the imperative to increase the Air Force's combat capacity, improve the resiliency of its forces on the ground as well as in the air, and operate in ways that pose insurmountable dilemmas to adversaries. Acquiring CCA as part of an NGAD family of systems will help create a force design with these characteristics. It all comes down to developing credible capacity and capability to deter Chinese aggression and, should that fail, win in combat. CCA are part of that new paradigm.

Air Superiority Remains a Core Requirement

According to U.S. military doctrine, air superiority is "that degree of dominance in the air battle by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats."[19] This is different from air dominance, which is a more enduring condition, as explained by former ACC Commander General C. Michael Hostage: "Fundamentally, air dominance is the ability to operate unchallenged or at least unprohibited [from the air]."[20] The former is an essential precondition for successful military operations, and the latter is a welcome, but historically unusual condition. For illustrative purposes, consider that throughout World War II, the U.S. Army Air Forces (USAAF) routinely worked to secure air superiority—temporal windows during which U.S. and allied forces could successfully project power—in Europe and the Pacific. Even as victory neared in 1945, USAAF pilots were flying and fighting to secure air superiority every day. Decades later, U.S. and Allied forces in Afghanistan and Iraq had the advantage of rapidly achieving air dominance largely because their adversaries lacked effective counterair capabilities.

Confusion over the difference between air superiority—a temporary condition needed to achieve mission success—and air dominance may help explain why some commentators have argued that air superiority is no longer necessary or even possible in an era of drone and missile warfare. The reality is that air superiority remains a fundamental requirement for prevailing in a high-intensity conflict with a peer adversary or any sort of military operation. Despite those who proclaim otherwise, the inability of Russia or Ukraine

to establish air superiority is a major reason that the largest conflict in Europe since World War II has devolved into a wasting war of attrition. According to Desert Storm air campaign planner retired Air Force Lt General David Deptula and former Air Force strategic planner Christopher Bowie, "Without the advantages that air superiority ensures—namely freedom from attack and freedom to attack—this attrition-based conflict will be won by the side with the most warfighting personnel and materiel—Russia."[21]

Gaining air superiority is also a requirement for China, a fact that is not lost upon its military. The PLA believes it must achieve air superiority over the Taiwan Strait as a precursor to a successful combined amphibious and air assault on Taiwan. China's perception that it could not achieve air superiority over the Taiwan Strait would likely forestall a decision to launch its forces against Taiwan. This is the essence of deterrence. The Mitchell Institute has led multiple research efforts to better understand how a family of AI-enabled CCA could increase the Air Force's air superiority capacity this decade, when the need to deter Chinese aggression may reach a peak. This is a national issue, since the Air Force is the only U.S. force provider that is responsible for achieving air superiority for all joint force operations. While the Navy and Marine Corps also have fighters and other counterair systems, they are primarily dedicated to performing their service-specific missions, and they cannot provide combat commanders with the essential combat mass they require to achieve theater-wide air superiority.

China Seeks Air Superiority Overmatch

The U.S. Air Force's diminishing air superiority forces increasingly lack the range, survivability, and weapons capacity needed to defeat Chinese aggression. Mass retirements of combat aircraft, combined with curtailed or cancelled modernization programs and deferred large-scale buys of next-generation aircraft like the F-35, have left America's air superiority quiver in a precarious condition. Conversely, China is moving in the opposite direction, growing the size and lethality of its air defenses and its capacity to conduct offensive counterair strikes on the U.S. Air Force's Pacific bases and logistics.

The Air Force's direction: divestiture with little recapitalization. The Air Force last recapitalized most of its combat aircraft inventories during President Reagan's administration. An increase in defense spending during the 1980s allowed the Air Force to acquire new combat aircraft like the F-15, F-16, A-10, and B-1 in high volumes. Increased defense budgets also allowed the service to operationalize a new generation of technology in the form of stealthy combat aircraft, advanced sensors, munitions like the AIM-120 advanced medium-range air-to-air missile (AMRAAM), and battle management command and control (BMC2) networks. These and other weapon systems gave the Air Force a decisive edge in conflicts with regional adversaries in the 1990s and 2000s. Many of these aircraft and munitions still represent the preponderance of the Air Force's combat capacity.

After the fall of the Soviet Union, multiple U.S. administrations and Congress believed that no foreign military could mount a serious challenge to the Air Force's ability to achieve air dominance. This belief, combined with a desire to reduce defense spending, resulted in decisions to cut the Air Force's size and forego many of its planned modernization programs. Most notably, in 2009, then-Secretary of Defense Robert Gates capped the Air Force's acquisition of 5th generation F-22s at 187 aircraft, the service's replacement for its non-stealthy, aging F-15C/Ds. Gates rationalized his decision by claiming F-22s were a "niche silver-bullet solution

Figure 1: Rendering of a J-31 fighter launching a PL-15 beyond-visual-range air-to-air missile.

Source: Peter Wood, David Yang, and Roger Cliff, *Air-to-Air Missiles: Capabilities and Developments In China* (China Aerospace Studies Institute, November 2020), p. 39.

for one or two potential scenarios" that were unlikely to occur.[22] The Air Force's airborne warning and control system (AWACS) force followed a similar path. Until recently, the Air Force lacked the funding needed to recapitalize its aging E-3s that are based on 1950s-era commercial derivative airframes.

Subsequent world events, particularly the rapid rise of China, combined with an increasingly aggressive Russia supported by Iran and North Korea, clearly demonstrate these benign projections were dangerously incorrect. Three decades of budget-driven force cuts and flat modernization budgets have created a hollow force that is incapable of meeting the Air Force's global operational requirements in a world that is growing increasingly dangerous. As General Wilsbach and other Air Force leaders have said, "The nation has more missions for the United States Air Force than the Air Force has forces."[23] This is directly linked to America's fundamental ability to fight and win, it is not just a problem for the Air Force.

These force cuts and delayed modernization are the primary reasons for why the Air Force now operates its smallest, oldest, and least ready air superiority force in its history. A small inventory of F-22s and dwindling number of Air National Guard F-15C/Ds remain the core of the Air Force's air superiority force decades after these aircraft were first fielded. Due to insufficient resources, dwindling parts manufacturers, and aircraft age, DOD's FY 2025 budget proposed retiring 92 of the Air National Guard's remaining F-15C/Ds through FY 2029 without replacements on the horizon.[24] The same budget proposed retiring 32 of the service's stealthy F-22s in FY 2025, again due to resource constraints.[25] The Air Force also delayed developing an NGAD penetrating combat aircraft that it long maintained was critical to keeping pace with China. The primary reason for this delay is the same old story: not enough budget and the urgent need to fund other priorities, including programs to recapitalize the two legs of the nuclear triad the Air Force is responsible for. According to then-Secretary of the Air Force Frank Kendall, the lack of funding to acquire NGAD PCA, modernize the service's nuclear-capable bomber and ICBM forces, and field other Air Force capabilities the nation needs is "what I worry about most."[26]

The Air Force's few remaining F-22s and Air National Guard F-15s are augmented by a force of 5th generation F-35s that is growing at less than half its originally planned rate, again due in large part to the service's insufficient acquisition budgets. The Air Force is considering closing some fighter units because the older aircraft they fly are structurally exhausted and the service lacks enough resources to replace them with new aircraft.[27] This occurred in 2023 with the retirement of the last Air Force active duty F-15C/Ds that were stationed at Kadena Air Force Base—in the heart of the Pacific theater—without direct replacements.[28] At the very time the security situation demands more fighters, the Air Force finds itself in a capacity collapse. Its remaining aircraft cannot generate enough air superiority sorties, and its decades-old 4th generation F-15C/Ds—now used solely for continental air defense—lack the survivability needed

to operate in contested environments of the kind that would exist hundreds of miles from China's coastline. These fighters are supported by aging E-3B/G AWACS that will be eventually replaced by E-7 aircraft. However, largely driven by insufficient budgets, the Air Force is dramatically downsizing its E-3 inventory by about half before the E-7 will be available in operationally relevant numbers.[29] This capability gap portends serious risk.

The same trend applies to the Air Force's air-to-air weapons. The Air Force relies on upgraded versions of the short-range AIM-9 Sidewinder and medium-range AIM-120 as its mainstay air-to-air weapons. These munitions will soon be upgraded and augmented by new beyond-visual-range AIM-260 Joint Advanced Tactical Missiles (JATM) and other weapons that are needed to keep pace with China's long-range air-to-air kill chains. Weapon stocks of all types are significantly undersized for what would be required to sustain a major theater conflict. As combat operations in Ukraine have proven, regenerating munitions stocks is a complex, time-intensive process—especially for stocks of technologically advanced missiles.

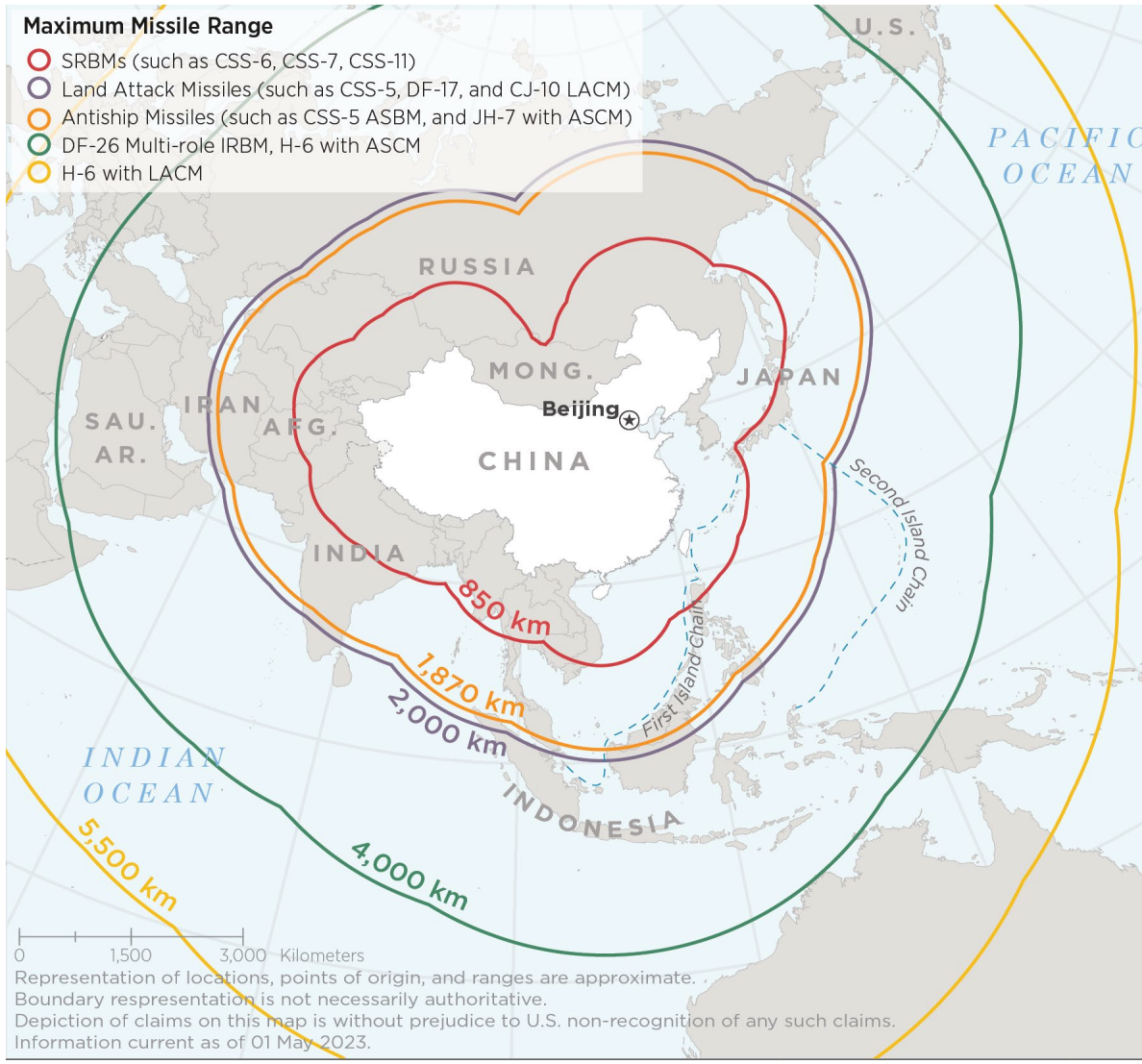


Figure 2: China's fielded conventional strike capabilities.

Source: *2024 Military and Security Developments Involving the People's Republic of China* (Arlington, VA: DOD, 2024), p. 67.

China's military is moving in the opposite direction. China took a very different approach for developing its air superiority forces over the last 30 years. From China's perspective, the U.S. success during Operation Desert Storm signaled a profound shift in modern warfare that revealed how ill-prepared the PLA was for a fight with a modernized adversary.[30] This realization caused China to initiate a sweeping effort to transform the PLA from a continental army to a joint military capable of denying U.S. forces freedom of action in all warfighting domains in the Western Pacific.

China's efforts have succeeded, aided in part by its decision to decrease its total number of ground forces to accommodate the modernization and expansion of its air, maritime, and rocket forces.[31] According to intelligence expert J. Michael Dahm, the PLA is now a joint force that features "a substantially improved air force and navy; precision-strike capabilities; and a modern command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) system."[32] Admiral Aquilino, Commander of the U.S. Indo-Pacific Command, has testified to Congress that China continues to fund "the largest, fastest, most comprehensive military buildup since World War II in both the conventional and strategic nuclear domains."[33] Aquilino added the PLA had increased its fighter inventory by more than 400 aircraft, including the J-16 and stealthy J-20, between 2021 and March 2023 alone.[34] According to the U.S. Indo-Pacific Command, the PLA Air Force and PLA Navy Aviation now "constitute the largest aviation force in the Indo-Pacific."[35] Many of China's newest air superiority fighters are equipped with long-range sensors and advanced long-range air-to-air missiles like the PL-15 and PL-17. These air-to-air threats are complemented by the world's most lethal long-range surface-to-air missiles that can be launched by the PLA's ground and naval forces. These weapons can receive target cues from a network of air, land, and sea-based sensor platforms, including KJ-500 airborne early warning and control (AEW&C) aircraft that are key to closing the PLA's long-range counterair kill chains against U.S. high-value airborne assets (HVAA). In combination, the PLA's air, sea, and ground-based long-range air defenses will create a highly contested environment that extends hundreds of miles out from China's coastline.

Missile attacks against U.S. theater airbases and logistics is another part of China's strategy to gain air superiority. U.S. Air Force doctrine acknowledges the PLA understands that "the best place to kill an enemy's air force is on the ground," especially if the enemy operates from a handful of airbases that lack missile defenses, as is presently the case for the Air Force in the Pacific.[36] China can now strike every Indo-Pacific base on which U.S. forces depend. The PLA Rocket Force's (PLARF) long-range surface-to-surface ballistic missiles and hypersonic weapons can reach airbase and other targets located in northern Australia, Guam, and elsewhere in the Pacific. China's DF-26 "Aircraft Carrier killer" intermediate range ballistic missile has a range that exceeds 2,000 nautical miles and can carry conventional and nuclear payloads.[37] China's nascent fractional orbital bombardment system will extend its ability to attack bases in Alaska and the West Coast of the United States.[38] The United States has underinvested in capabilities and associated capacity to defend against these threats. Solutions are possible, but will take time and investment to manifest.

Treating CCA as replacements for 5th generation fighters and NGAD PCA requirements would be tantamount to continuing the budget-driven tradeoff practices that hollowed out the Air Force over the last 30 years.

Realigning Air Superiority Forces with the Threat

The Air Force is at the beginning of a process that will rebalance its forces to deter and, if necessary, defeat aggression by a peer adversary. This once-in-a-generation, enterprise-wide endeavor will field new military technologies, create operating concepts that combine the advantages of novel and existing capabilities, and possibly change the Air Force's organizational structures. Broadly characterized, these innovations must size and shape the Air Force to perform its core missions in a conflict with a peer adversary, including achieving air superiority against IADS and other anti-access/area-denial systems that threaten U.S. power-projection operations.

Maintaining the advantage over China's IADS will require the Air Force to field an NGAD family of systems and equip other long-range aircraft to perform air-to-air missions. The unmatched stealth, long unrefueled ranges, and large payload capacities of NGAD PCA and B-21 will help the Air Force to overcome the tyranny of distance in the Indo-Pacific and increase the density of counterair weapons it can project into highly contested areas. The U.S. Air Force could increase the lethality and survivability of these next-generation aircraft by teaming them with uninhabited CCA to compel adversaries to react in ways that are advantageous to U.S. forces. But none of these capabilities will be effective in the air if they cannot survive while they are on the ground, which is why the Air Force must also improve the resiliency of the bases and logistics that are the foundation for generating its air superiority combat power. Designing CCA in ways that reduce their logistics requirements would help create this resiliency. CCA with small logistics footprints would improve the Air Force's ability to periodically change their operating locations as part of a shell game to complicate China's missile targeting. Combined with active and passive airbase defenses, a resilient CCA force would help ensure the Air Force remains an "inside force" that generates decisive combat airpower alongside America's allies. Remaining an inside force is critical to maintaining a credible deterrent in the Pacific, and if necessary, fight tonight without long deployment times to defeat Chinese aggression.[39]

A balanced force is also needed. Air Force and industry experts who participated in Mitchell Institute's exercises agreed that the service should rapidly acquire CCA as it realigns its forces for a far more challenging threat environment. Concurrently, the Air Force must create a force design that achieves the right balance between CCA and higher-end air superiority aircraft. In other words, CCA should be considered as complementary and additive capabilities, not as substitutes for F-35A and NGAD PCA requirements. Believing these advanced aircraft could be replaced with a more homogenous force composition of cheaper, less capable drones would be tantamount to continuing the budget-driven tradeoff practices that hollowed out the Air Force over the last 30 years. The fact is that piloted aircraft can deliver capabilities that uninhabited aircraft cannot—both are needed in greater numbers to meet the Air Force's global operational requirements.

The Air Force does not have time to waste as it creates a balanced force design to prepare for peer conflict. Given the growing threat of Chinese aggression this decade, the Air Force must prioritize capabilities that enhance deterrence and create a more resilient force within the FYDP. Increased lethality, greater resiliency, and the potential to create challenging dilemmas that adversaries must solve—these are the capabilities that CCA can bring to the force in this timeframe.

Illustrating the Potential for CCA to Speed the Transition

Air Force and industry experts developed the operating concepts described in this section during Mitchell Institute's 2024 TTX. The concepts illustrate how CCA could perform as force multipliers for piloted fighters *and* as primary forces to maintain pressure on the PLA between U.S. pulsed airstrikes. Overall, the concepts substantiate the potential for CCA to increase the Air Force's capacity to project affordable mass into contested environments and create dilemmas for adversaries that help achieve air superiority for all U.S. forces.

Why the Need for CCA to Disrupt, Detonate, & Create Dilemmas?

According to experts participating in Mitchell Institute's exercises, using AI-enabled CCA in asymmetric ways would have a greater impact on the Air Force's ability to achieve air superiority against China than just limiting them to performing as missile-carrying adjuncts to fighters. This is the true meaning of achieving affordable mass, which is different than simply generating more kit to conduct force-on-force attrition warfare. The Air Force cannot afford to adhere to industrial age warfighting approaches in an era where it must remain prepared to defeat peer level aggression. Instead, achieving affordable mass is about using cost-effective capabilities in asymmetric ways to *disrupt* China's campaign, *impose costs* on its forces, and *create doubt* in the minds of China's leadership that its military can achieve the air superiority necessary for its operations to succeed.

Mitchell Institute's 2024 CCA TTX methodology. The Mitchell Institute designed its 2024 TTX to assess how CCA could help achieve the Air Force's reoptimization objectives. During the TTX, Mitchell asked three teams of experts to independently propose operating concepts and choose a mix of CCA and crewed combat aircraft to achieve air superiority in support of Air Force maritime strikes. The teams were also asked to develop concepts for using CCA to maintain pressure on the PLA's air defenses between Air Force strike surges. The teams' initial plans were unconstrained by logistics to create a baseline to assess the fuel, munitions, personnel, and theater lift required to support their CCA sorties over the first week of conflict.

Figure 3 illustrates a notional Air Force maritime strike used as a baseline for the teams' planning. For TTX purposes, it was assumed the Air Force would have sufficient in-theater forces to conduct two major strikes per day during the opening stage of conflict with the intent to prevent PLA forces from achieving a decisive lodgment on the shores of Taiwan.

The three TTX planning teams independently selected forces for their missions using inventories of Air Force fighters, bombers, electronic attack aircraft, and eleven notional CCA designs provided by the Mitchell Institute. Operational and technological experts participating in previous Mitchell Institute TTXs developed and iterated the performance characteristics of these CCA variants (see Table 1). The teams also used a menu of U.S. and allied airfields and potential operating sites located along the First and Second Island Chains to determine where to disperse their CCA.

Examples of disruptive CCA operating concepts for three counterair missions. The following examples summarize operating concepts developed during the TTX. One team planned to conduct counterair "sweep" missions to suppress airborne threats including the PLA's KJ-500 aircraft and stealthy J-20 fighters. A second team was tasked to protect U.S. high-value airborne assets (HVAA) like E-7A and air refueling tankers lacking organic defenses. The team planned to attack the airborne KJ-500 the PLA's counterair forces depend on to complete many of their long-range kill chains against U.S. HVAA.[40] A third team planned to suppress enemy air defenses (SEAD) using kinetic and non-kinetic (electromagnetic warfare) capabilities to disrupt, degrade, and destroy PLA SAG air defenses and coastal SAMs screening access to the Taiwan Strait.

Table 1: TTX teams chose from these notional CCA designs to plan their counterair missions. "LO" and "VLO" refer to low observable and very low observable, respectively. Sensors include low-cost active electronically scanned array radars (AESA), infrared search and track (IRST) systems, and electro-optical/infrared (EO/IR) systems. These CCA are also equipped with line-of-sight (LOS) communication systems and, with exceptions, beyond-line-of-sight (BLOS) communications.

	CCA-1	CCA-2	CCA-3	CCA-4	CCA-5	CCA-6	CCA-7	CCA-8	CCA-9	CCA-10	CCA-11
Mission	Counterair	Counterair	Counterair	Counterair	Counterair	Counterair	Strike	Strike	Strike	ISR	Electronic Attack
Type	Recoverable	Recoverable	Recoverable	Recoverable	Expendable	Recoverable	Recoverable	Expendable (loitering PGM)	Expendable (loitering PGM)	Recoverable	Expendable
ROM Cost Band	> $40 M	> $40 M	$30-40 M	$20-40 M	$2-6 M	$2-15 M	$20-40 M	$2-15 M	$2-15 M	$2-15 M	$3-9 M
Empty Weight (lb)	35,000	35,000	10,000	15,000	1,500	2,500	16,200	Each UAS 50 lb	1,000	1,500	1,500
Fuel Load (lb)	30,800	9,231	3,500	7,000	1,000	3,000	12,088	0 (battery)	1,269	1,500	1,000
Payload Weight (lb)	7,000	7,000	3,000	5,000	500	1,500	5,400	Each UAS 5 lb	500	400	500
Gross Weight (lb)	72,769	51,231	16,500	27,000	3,000	3,300	33,688	55 lb per UAS, 20 UAS per dispenser	2,769	3,400	3,000
Speed	Supersonic capable	Supersonic capable	Subsonic	Subsonic	Subsonic	Subsonic	Subsonic	Rocket: Supersonic	Subsonic	Subsonic	Subsonic
Range (nm)	2,000	3,000	2,000	3,000	1,000 + host range	1,200 + host range	3,000	Rocket: 1,000 Loitering PGM: 1 hour search, 20 nm radius	600	2,000	1,000
Air Refueling	Optional	No	No	No	CCA no, launch host yes	CCA no, launch host yes	No	No	CCA no, launch host yes	No	CCA no, launch host yes
Engines	2	2	2	1	1	1	1	Battery	1	1	1
Launch	Runway (at least 10,000')	Runway (8,000 ft)	Runway (5,000 ft)	Runway (5,000 ft)	Ground or air-launched	Ground or air-launched	Runway (8,000 ft)	Air launched, rocket delivers dispenser	Air-launched B-2, B-21	Road, rail, runway (2,500 ft)	Ground or air-launched
Recovery	Runway (5,000 ft)	Runway (5,000 ft)	Runway (5,000 ft)	Runway (5,000 ft)	No	Potential parachute recovery	Runway (8,000 ft)	No	No	Road, runway (2,500 ft)	No
Survivability	VLO (fighter decoy)	VLO	VLO	VLO	LO	LO	Not LO	Not LO but small form factor	VLO	LO	VLO
Weapons	2 x SiAW 4 x AMRAAM	2 x SIAW 2 x JATM	6 x AMRAAM	6 x SiAW or 12 SDB)	2 x AMRAAM or 4 x SDB	2 x AMRAAM or 4 x SDB	2 x LRASM	Loitering	Loitering	No	No
Sensors	AESA, IRST	AESA, IRST	AESA, IRST	SAR, ATR	EO/IR, RF	EO/IR, RF	No	Low-cost EO/IR	Low-cost SAR	SAR	No
EW	High cost	High cost	Moderate cost	Moderate cost	No	No	No	No	No	Moderate	ELINT, SIGINT, EA
Comms	LOS + BLOS	LOS + BLOS	LOS + BLOS	LOS + BLOS	LOS + BLOS	LOS + BLOS	LOS	LOS	LOS	LOS	LOS + BLOS

Source: Mitchell Institute

As in previous Mitchell Institute exercises, these teams independently determined that fielding CCA at scale would help create a force with increased ranges, greater weapons capacity, and the lethality and survivability needed to achieve air superiority in a peer conflict. The teams also chose to posture their CCA as close as possible to the Taiwan Strait to increase the depth to which they could penetrate and time they could persist in weapons engagement zones. In large part, this choice was based on team assessments that expendable and recoverable CCA would have smaller logistics footprints on the ground compared to piloted fighters.

Example 1—CCA for Counterair Sweeps to Disrupt & Suppress PLA Air Defenses

Using CCA to disrupt and destroy in advance of Air Force strike surges. The Mitchell Institute tasked one TTX team to develop a plan to suppress PLA fighters and KJ-500 in advance of the Air Force's maritime strikes. The team's operating concept organized significant numbers of expendable CCA into three lines of attack that would probe the PLA's air defenses, cause these defenses to react in ways that reveal their locations and expend their resources on lower-cost CCA, and improve air-to-air shot geometries for U.S. fighters and CCA. As Figure 4 depicts, one of these lines of attack would be followed by F-22 and F-35 aircraft launching air-to-air weapons to counter PLA fighters responding to the CCA. These F-22s and F-35s would passively receive target cues from penetrating CCA and E-7A Wedgetails operating at the fringe of the weapons engagement zone.

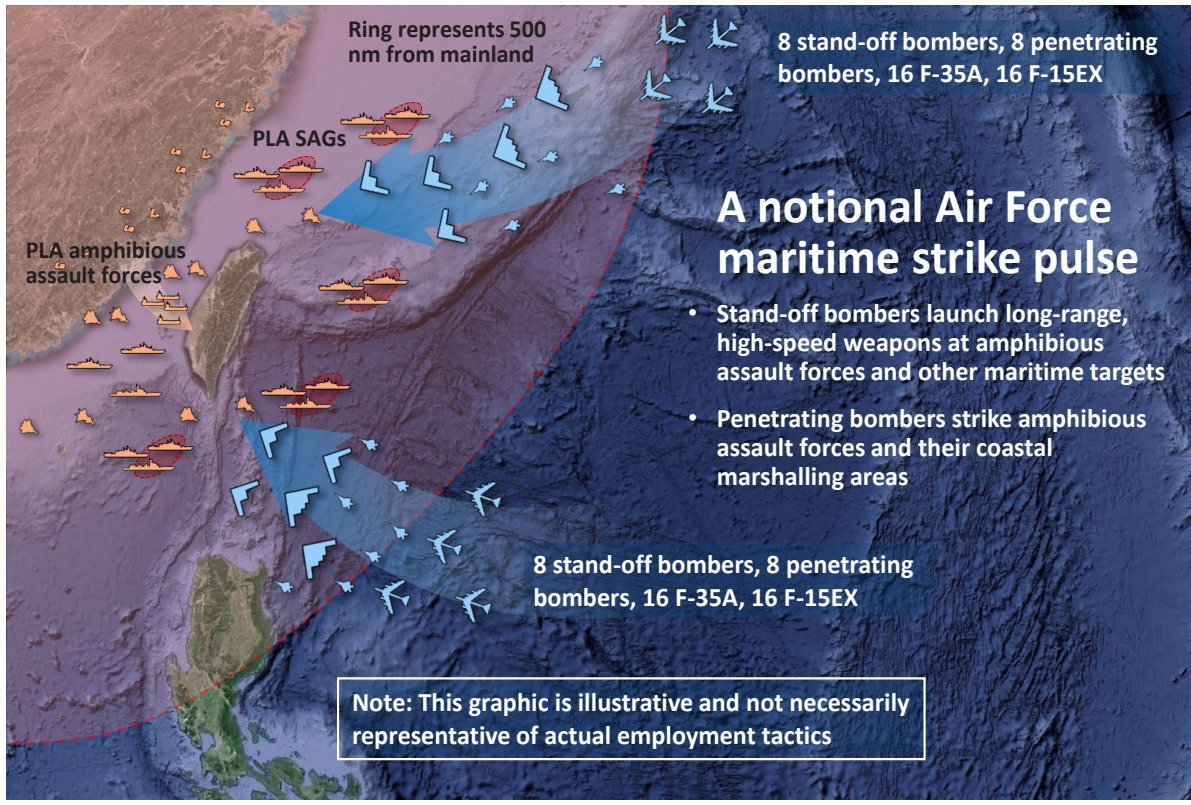


Figure 3: Illustration of a notional Air Force airstrike against PLA naval forces as part of a campaign to defeat a Chinese assault on Taiwan. For the purposes of Mitchell Institute's TTX, it was assumed the Air Force would have sufficient forces and resources during the first few days of conflict to launch two maritime strike pulses per day.

Source: Mitchell Institute.

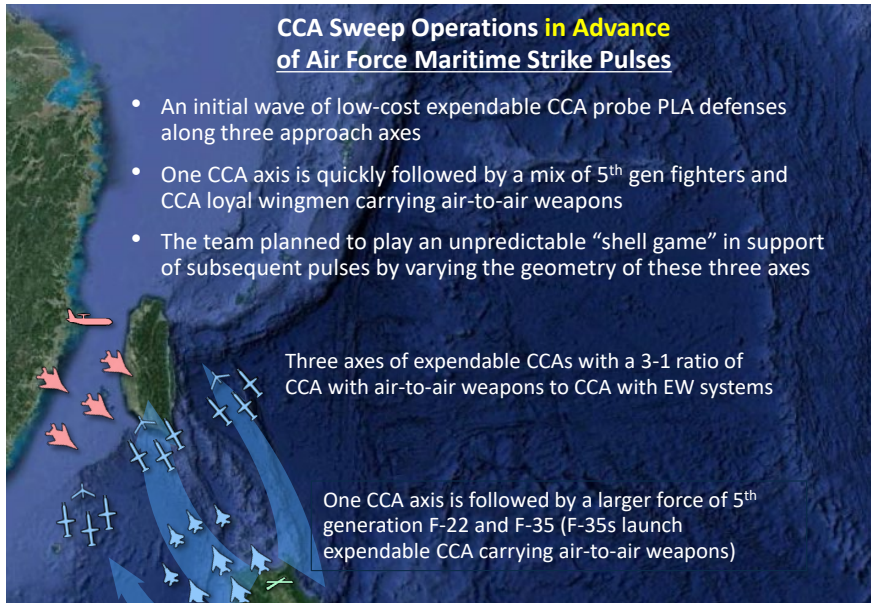


Figure 4: Illustration of a notional counterair sweep that combines CCA with F-22s and F-35s to suppress PLA fighters and KJ-500s in advance of an Air Force maritime strike. The sweep team's plan used expendable CCA carrying AMRAAMs and EW systems to create uncertainty and cause PLA air defense forces to react and expend their weapons. This would reduce risk to follow-on fighters. The team planned to synchronize their three-pronged operations to avoid warning the PLA of an attack and varied their geometry from mission to mission to avoid a "gorilla up the middle" predictability problem.

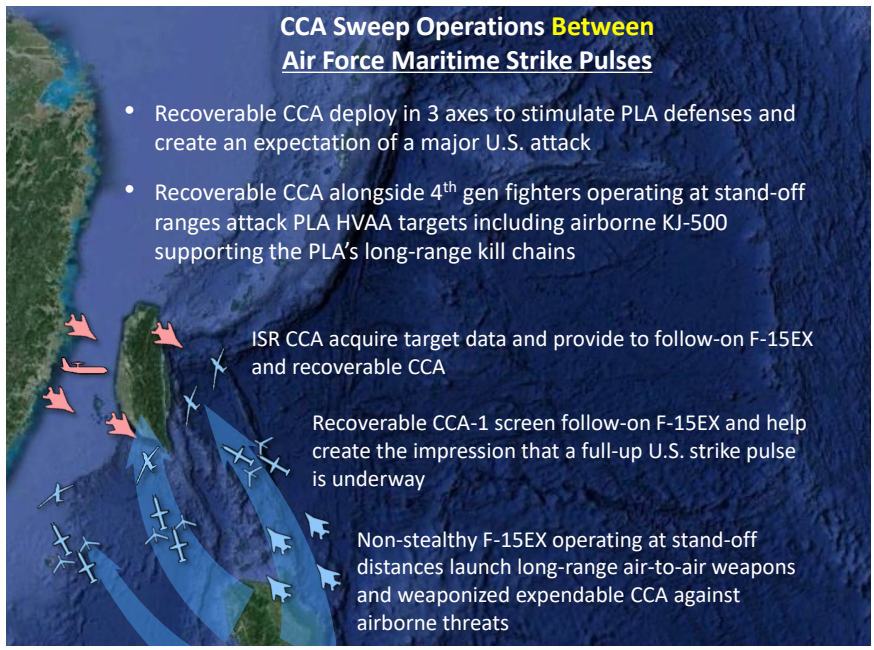
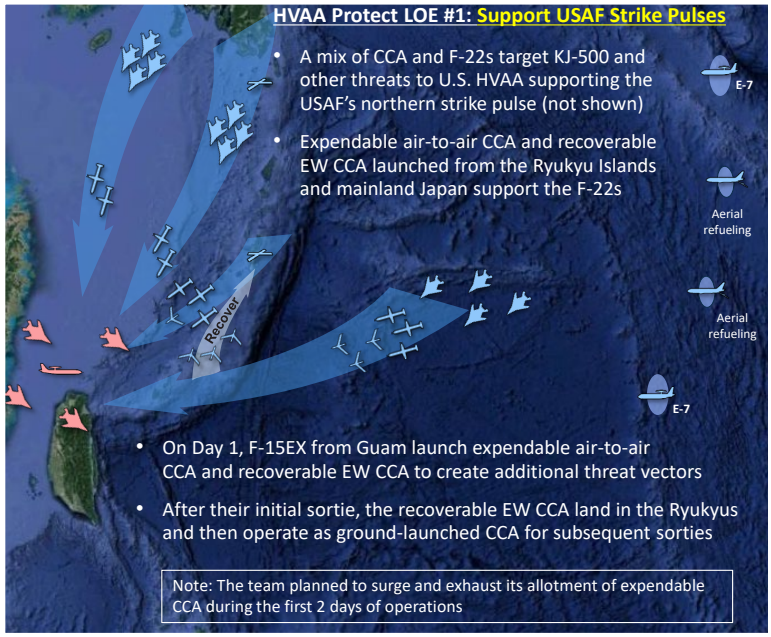
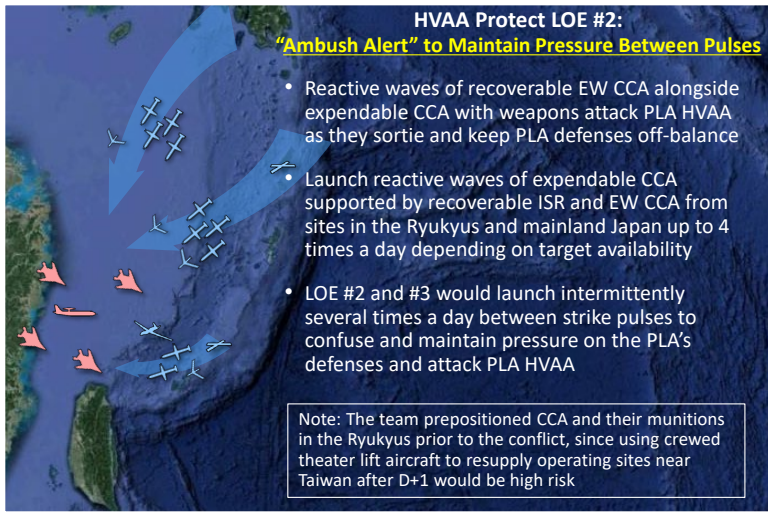


Figure 5: The sweep team planned to use recoverable and expendable CCA with 4th generation fighters to maintain pressure on the PLA's air defenses and cause them to continuously expend its resources between U.S. strikes.

Source: Mitchell Institute.

Maintaining pressure on the PLA between strikes. The sweep team also planned to use recoverable and expendable CCA along with F-15EX to maintain pressure on the PLA and deny its air defenses the time to reconstitute between the Air Force's pulsed strikes. The team deployed recoverable CCA-1—a higher-end, fighter-like uninhabited aircraft—as defensive screens well out in front of F-15EX that would remain outside the most lethal threat areas (see Figure 5). These CCA-1 would launch their weapons at airborne targets or pass target information to cue F-15EX carrying long-range air-to-air missiles or CCA-5 missile trucks. The sweep team noted that using CCA in this way would create opportunities for the Air Force to "get its 4th generation fighters into the fight" for air superiority. It would also free some of the service's limited number of F-22 and F-35 to perform missions that required 5th generation fighters elsewhere in the theater of operations. This is part of what experts on the sweep team meant when they described using CCA as force multipliers.





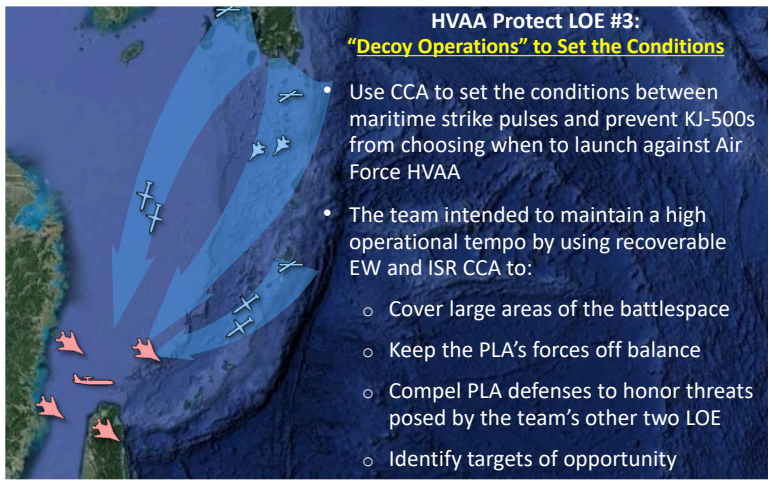


Figure 6 (top): CCA and 5th generation fighters could operate as a first line of effort to counter long-range threats to the Air Force's HVAA. Figure 7 (middle) and Figure 8 (bottom): The HVAA protect team designed its second and third LOEs to keep the PLA's air defenses off balance, cause them to expend their resources, and increase the survivability of HVAA supporting U.S. maritime strikes.

Source: Mitchell Institute.

Example 2—CCA to Defend U.S. HVAA & Degrade Adversary Long-Range Kill Chains

Another team of experts developed a concept to use CCA and 5th generation fighters in three lines of effort (LOE) to suppress PLA long-range kill chains that threatened the Air Force's E-7A Wedgetails, air refueling tankers, and other HVAA. The team determined the Air Force could not conduct these lines of effort at acceptable levels of risk using piloted aircraft only. All three LOEs are examples of how CCA combined with a smaller number of stealthy fighters could create multiple fronts inside China's IADS that disrupt the PLA's operational timing, create confusion, and cause the PLA's defenses to respond to multiple threats across the battlespace. The first line of effort—called "pulse support" by the team—used CCA as screens in front of the Air Force's strike pulses to attack KJ-500s and soak up risk by engaging J-17 and J-20 carrying long-range air-to-air weapons (see Figure 6).

The HVAA protect team planned a second line of effort the team called an "ambush alert" to maintain pressure on the PLA's air defenses between strikes (see Figure 7). This LOE employed CCA to launch air-to-air weapons against KJ-500 whenever these AEW&C aircraft sortied and large numbers of lower-cost, expendable CCA to create threats that would be difficult for the PLA to accurately characterize. In a third, complementary line of effort, the team planned to use CCA as decoys representing higher end fighters that would cause the PLA to sortie its aircraft and degrade their ability to respond to the Air Force's actual strikes (see Figure 8). Both the second and third LOEs were intended to create uncertainty that would cause the PLA to expend its long-range weapons against lower-cost CCA instead of U.S. HVAA.

Example 3—CCA for the Suppression of Enemy Air Defenses (SEAD) Missions

A third planning team adopted operational objectives for CCA that mirrored the objectives defined by the sweep and HVAA protect teams: use CCA to maintain pressure on China's air defenses, cause the PLA to expend its resources, harass and desynchronize SAG air defense operations, and screen the U.S. Air Force's strikes. The team's priority targets included China's mobile coastal SAM launchers and SAGs with long-range sensors and surface-to-air missiles screening the Taiwan Straits. As illustrated by Figure 9, the SEAD team organized their operations into four phases that would cover a 24-hour period. This phased approach was designed to reduce risk to the Air Force's fighters and bombers and "broaden" in time and space their strikes.

- During **Phase 1,** three orbits of CCA-10 and EA-37B Compass Call aircraft and a single orbit of RC-135 Rivet Joint reconnaissance aircraft are deployed to maintain continuous ISR coverage over the SEAD team's assigned operating area.

- In **Phase 2,** expendable CCA-9, CCA-11, and CCA-12 would stimulate the PLA's air defenses, act as decoys to cause the PLA's SAGs to react and break their emissions control (EMCON) procedures, and then jam their communications links and other IADS electronic systems.[41] The SEAD team modified the ground-launched CCA-8 described in Table 1 to create a new loitering munition they called a CCA-12. The team believed using this type of CCA at scale would dramatically increase targets the PLA's SAGs must track and engage, and at the same time help minimize logistics required to deploy and launch the team's CCA. And because CCA-12 would roughly cost about $50,000 each to procure, the team requested 2,000 of them, a number that far exceeded the Mitchell Institute's projected CCA inventory.

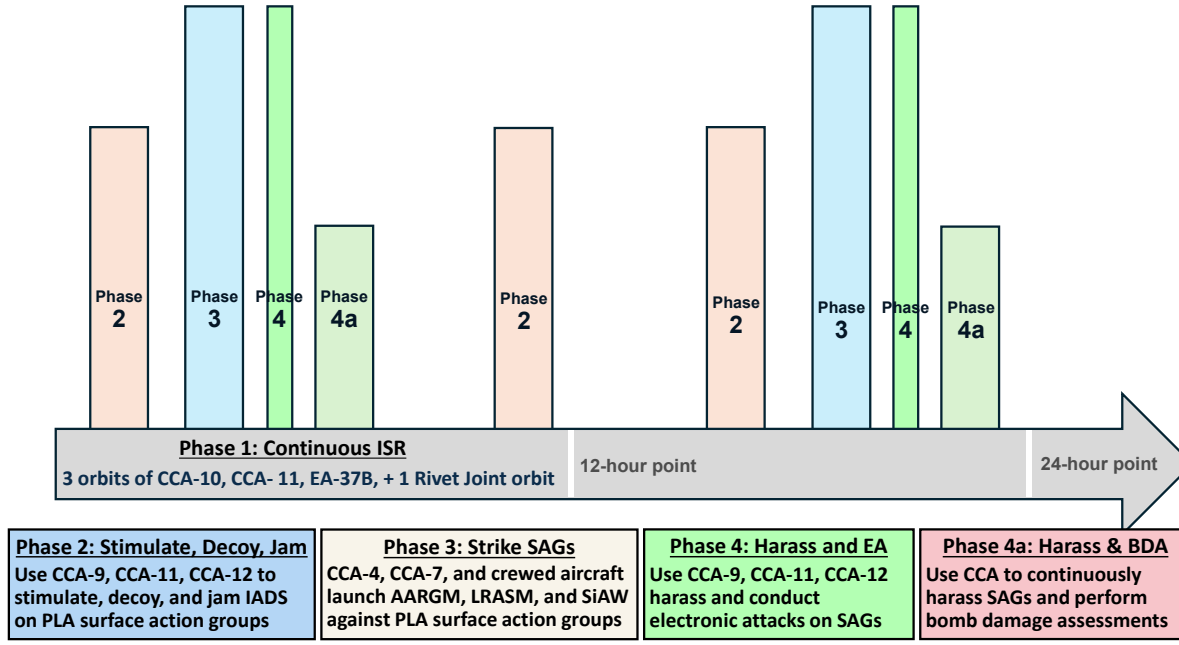


Figure 9: The SEAD team's four-phased approach to maintain continuous pressure, disrupt, and create dilemmas for the PLA's air defense forces between and in support of U.S. strikes. The team planned to vary the timing and areas targeted by its phased operations to create uncertainty and confuse the PLA.

Source: Mitchell Institute.

- For **Phase 3**, Advanced Anti-Radiation Guided Missiles (AARGM), Long Range Anti-Ship Missiles (LRASM), and Stand-in Attack Weapons (SiAW) launched by CCA-4, CCA-7, and penetrating and stand-off piloted aircraft would strike PLA SAGs screening the Taiwan Strait. These strikes were intended to degrade the sea-based component of China's IADS and cause it to expend their weapons against lower-cost CCA instead of the Air Force's strikes.

- In **Phase 4**, the team intended to launch episodic waves of expendable CCA-9, CCA-11, and CCA-12 to harass the PLA's SAGs between the Air Force's strikes.

Overall, the SEAD team planned to launch large numbers of expendable CCA-9, CCA-11, and CCA-12 during the first seven days of operations to continuously pressure China's SAGs, disrupt and destroy their sensors and other IADS capabilities, and potentially cause the SAGs to "go Winchester"—or deplete—their on-board air defense missile magazines. This mirrored the high use rates of expendable CCA planned by the other TTX teams.

Key Operational Take-Aways

While teams of Air Force and industry experts independently developed their CCA counterair operating concepts, their plans all serve to illustrate how CCA could perform as both a primary force and a collaborative force with piloted aircraft to disrupt and impose costs on the PLA. Moreover, the teams' key insights, summarized below, mirror insights developed by similar teams of experts during Mitchell Institute's previous CCA exercises.[42]

Figure 10: Illustration of an EA-37B Compass Call. The aircraft's stats sheet describes the EA-37B as an electromagnetic attack aircraft that "denies, degrades and disrupts adversary command, control, communications, radars, and navigation systems to restrict enemy electromagnetic-based battlespace coordination. The weapon system neutralizes enemy air defenses by preventing the transmission of essential information between sensors, weapon systems and control networks."

Source: Gulfstream Aerospace illustration published in Air & Space Forces Magazine.

CCA can increase the Air Force's capacity to disrupt and create dilemmas that help achieve air superiority in a peer conflict. The Air Force's air superiority force is too small and too old to conduct the kind of disruptive operations in highly contested airspaces explored during Mitchell Institute's TTXs. Air Force and industry experts agreed that hundreds and potentially thousands of CCA may be needed in the Indo-Pacific theater, as are additional F-35s and a new penetrating counterair aircraft. The key to achieving the affordable mass the Air Force envisions will be combining these weapon systems to *create unpredictable threats that adversaries determine they must honor.* This will offer new options for theater commanders to achieve air superiority and deny a Chinese offensive. No other mix of forces in the U.S. military will have the same disruptive potential.

Teams created innovative CCA use cases. The same experts also suggested that realizing the full potential of AI-enabled CCA will require innovative concepts for their use that challenge current orthodoxy. For instance, CCA could also perform as a primary force that is *supported* by fighters and bombers to disrupt, cause dilemmas, and exhaust the PLA's air defenses, as well as a loyal wingman force that supports piloted aircraft.

The TTX teams prioritized using lower-cost, expendable CCA to absorb risk. Two of the three TTX teams planned to exhaust all their allocated lower-cost expendable CCA to keep the PLA's air defenses off balance and soak up risk to U.S. fighters and HVAA in the first few days of operations. Cumulatively, the three teams requested more than 145 percent of the expendable CCA in Mitchell Institute's notional 2030 inventory (see Figure 11). Insufficient expendable CCA was the most significant limiting factor for using them at the scale the teams desired to disrupt, detonate, and impose costs on the PLA.

CCA with realistic levels of autonomy can help maintain pressure on adversary forces between U.S. strike surges. All three TTX air superiority mission teams determined they must manage the tempo of their expendable CCA launched from the ground and air to sustain attacks 24/7 on emerging targets during a campaign to blunt a PLA offensive. The Air Force currently lacks the capacity to do this using its piloted combat aircraft alone. TTX teams employed upwards of 100 CCA-6, CCA-7, and CCA-10 in support of complex HVAA protect and SEAD mission sets, finding advantages in their capabilities, cost, and logistics requirements in comparison to both piloted fighters and expendable CCAs. CCA-6, CCA-7, and CCA-10 are roughly aligned with the known mission sets and cost targets for Increment 1 CCA.[43]

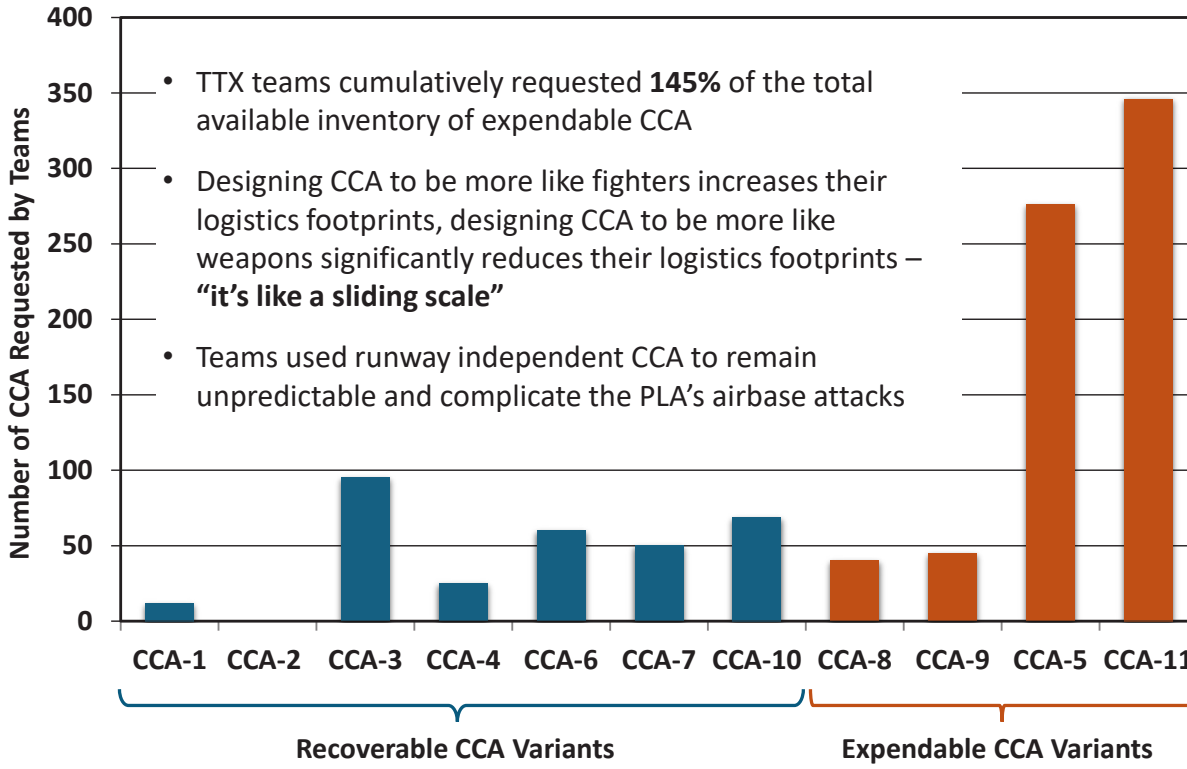


Figure 11: Total number of CCA requested by three teams of experts during Mitchell Institute's 2024 CCA TTX. For the purposes of the TTX, the Mitchell Institute limited the number of CCA that might be available to the planning teams in the 2030 timeframe. The teams' combined requests for expendable CCA exceeded this limitation by 45 percent. Limited quantities of expendable CCA and air-to-air munitions were the two most significant constraints that affected the teams' mission planning.

Source: Mitchell Institute.

Finally, **the Air Force could use air-launched CCA carrying air-to-air weapons or other mission systems to enable 4th generation fighter long-range kill chains** against PLA aircraft. These long-range kill chains could help maintain continuous pressure on China's air defenses during and between the Air Force's strike pulses. In this sense, CCA would perform as force multipliers that help get the Air Force's 4th generation fighters—which still constitute more than 70 percent of the Air Force's combat-coded fighter inventory—back into the fight for air superiority.

Minimizing CCA Logistics is an Operational Enabler

Planners from the Air Force's Air Mobility Command, other Major Commands, the Air Staff, and industry assessed key logistics—fuel, munitions, ground personnel, and theater lift—that would be needed to generate and launch the CCA sorties proposed during Mitchell Institute's TTX. The following insights are based on their assessments of the Air Force's ability to provide these resources and the risks of doing so while under attack. The TTX teams then proposed material and non-material solutions to help reduce these risks and ensure mission success.

Insights on CCA Logistics Risks & Potential Mitigation Actions

Generating CCA sorties while under attack. During Mitchell Institute's TTX, three planning teams took advantage of the reduced logistics requirements of CCA to mitigate the impact of PLA missile attacks on the Air Force's Pacific theater sortie generation operations. For the same reason, the teams prioritized using CCA that could launch from non-traditional surfaces, including roads, and, for some CCA variants, launch by rocket without the need for runways. The teams determined the combination of smaller logistics footprints and ability to operate off airbases expanded their options to posture CCA in southern Japan and the northern Philippines. Disaggregating CCA forces in this way would dilute the PLA's missile attacks by complicating its targeting and denying it the ability to concentrate its attacks on a small number of U.S. operating bases.[44]

Mitigating munitions shortfalls. Shortfalls of AMRAAMs and other munitions were the most significant logistics risk to executing the CCA CONOPs proposed during Mitchell's TTX. Experts determined the initial unconstrained logistics plans developed by the sweep, SEAD, and HVAA protect teams could exhaust the Air Force's entire in-theater inventory of air-to-air missiles in less than a week of operations. The teams partially mitigated this logistics risk by shifting toward using more CCA equipped with electromagnetic warfare systems (see Figure 12). Instead of creating kinetic effects, these EW CCA would use their electronic mission systems to mimic piloted aircraft, decoy the PLA's defenses to expend their weapons and fuel against CCA, and otherwise "desynchronize the PLA's sorties with our maritime strike pulses." All three TTX teams recommended expanding the kinds of non-kinetic effects future CCA can create, possibly by acquiring modular CCA that can change their mission systems in a "Lego-like" fashion to meet rapidly changing operational requirements.

Risk to theater airlift constrains operations to replace CCA expended or lost in combat. A limited inventory of expendable CCA was the single greatest constraint to using them in the numbers proposed by the TTX planning teams. Moreover, the teams concluded that using C-130s to replenish CCA operating sites in the Ryukyu Islands and other areas that were located close to the battlespace would be a high-risk endeavor.[45] To reduce these risks, the teams chose to preposition replacement CCA at these forward locations and shift toward using a greater number of expendable CCA that could be launched by the Air Force's bombers. These air-launched CCA would be co-located with B-52s deployed to airbases in northern Australia, Diego Garcia, and other areas that would be at less risk of receiving high density missile attacks. The TTX teams also proposed using uninhabited "collaborative mobility aircraft" and MQ-9 UAVs to replenish CCA munitions stores and reduce the number of C-130 missions required to resupply CCA sites located inside the PLA's IADS threat envelope.

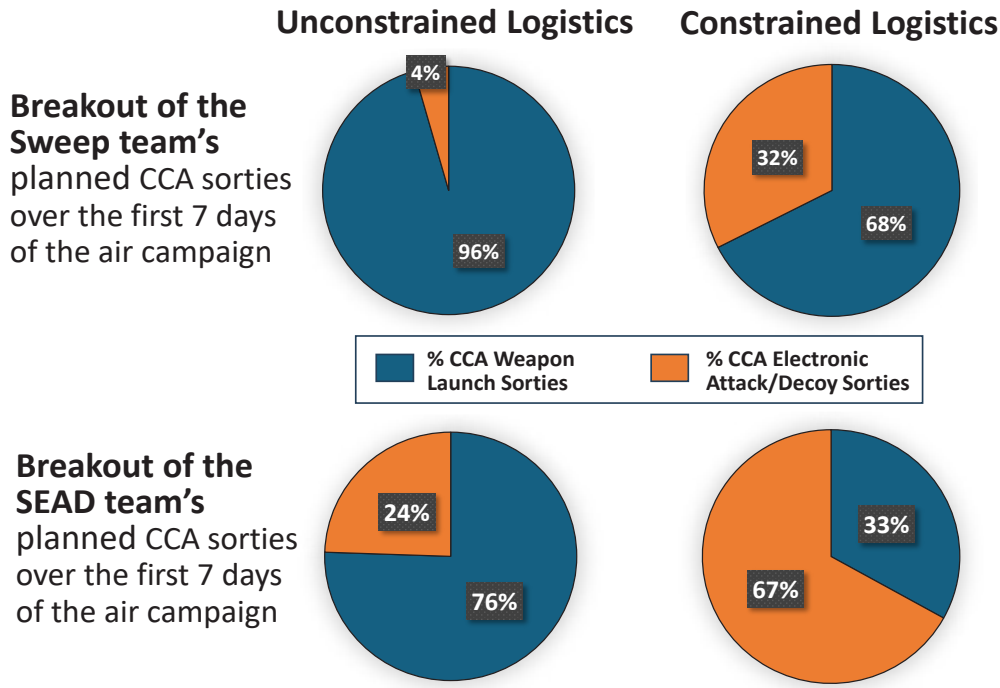


Figure 12: Two of the three TTX teams reduced their planned number of CCA weapon launch sorties in favor of creating non-kinetic effects using recoverable and expendable CCA equipped with EW systems.

Source: Mitchell Institute.

CCA fuel and bulk stores replenishment. The TTX planning teams were moderately concerned with the potential to obtain sufficient fuel to generate their recoverable CCA sorties. The teams stressed the Air Force must determine requirements for refueling equipment, fuel pump rates, and fuel storage capacity for austere CCA operating locations prior to the onset of a crisis in the Pacific. The same is true for host nation support. All teams heavily relied on the local economies of host nations to provide fuel, water, food, and other material support to their CCA forces. If available, this support would further reduce CCA logistics footprints on the ground and airlift required to resupply them. The lack of host nation support could significantly reduce the Air Force's ability to generate CCA sorties. To address this risk, the TTX teams recommended the Air Force work with other U.S. Government organizations to develop appropriate host nation agreements for CCA logistics support as part of its reoptimization effort. Obtaining host nation support should not be a "pick-up game" that is pursued after the start of a crisis.

Other CCA basing requirements. The TTX planning teams believed basing requirements for the Air Force's piloted combat aircraft far exceed what will be required for CCA. For instance, because CCA are lower cost aircraft—especially expendable variants—the Air Force would not need to acquire hardened shelters to defend them against missile attacks when they are dispersed to their operating locations. The teams also agreed that the Air Force's current logistics personnel could generate and recover CCA at the scale proposed by their plans, assuming CCA would have significantly fewer maintenance and material requirements compared to piloted aircraft. The teams were more concerned that the Air Force's materiel handlers, bomb loaders, and other ground support equipment may be too large and specialized for small teams deployed to austere locations to support CCA forces. The Air Force should assess these requirements to determine if it should develop equipment that is tailored for ACE-like distributed, agile CCA sortie generation operations.

Conclusion & Recommendations

The scale and scope of challenges now facing the U.S. Air Force are unprecedented. Since the end of the Cold War, decisions to cut the size of the Air Force and discontinue its practice of continuously modernizing to keep pace with emerging threats have hollowed out its combat air inventories. The Air Force is now older, smaller, and less ready than it has ever been. In 1991, U.S. combatant commanders could rely on 134 Air Force squadrons to defend the U.S. homeland, deter forward, and defeat regional aggression in multiple theaters simultaneously. Today, the Air Force's 55 fighter squadrons are less than a one-war force. As the Air Force strains to meet its global operational requirements, it must rebalance and grow the size of its forces to prepare for conflict with peer adversaries. The world is a far more dangerous place, and the nation is asking its airmen to deliver in ways we have not seen since the Cold War. It is imperative that we give them the tools they require to meet these objectives—existential U.S. national interests are at stake.

This will not be an easy task. China, DOD's pacing threat, has modernized its military to prevent U.S. forces from intervening against a campaign to extend China's dominance in the South China Sea and eventually beyond the First Island Chain. The PLA operates the world's most lethal IADS and can attack U.S. forces at their Pacific bases. To address these threats, the Air Force requires new aircraft and munitions with longer ranges to overcome the Pacific's tyranny of distance, capabilities that are optimized for highly contested environments, and more capacity to create decisive effects at range. The Air Force's combat forces must also survive China's attacks while they are on the ground as well as in the air. This will be a formidable challenge given projections that the Air Force's budgets will remain flat at best.

Resolving the Air Force's requirements-budget mismatch will require additional resources—funding and end strength— for the service. It will also require an Air Force force design strategy that prioritizes new asymmetric capabilities and concepts for warfighting instead of attempting to match the PLA aircraft-for-aircraft and weapon-for-weapon. A family of CCA should be part of this asymmetrical mix. During Mitchell Institute's exercises, Air Force and industry experts proposed concepts for using CCA to disrupt, impose cost, and create dilemmas for the PLA's counterair forces. And because of their reduced logistics requirements, the experts agreed that CCA will also help create a more dispersed, resilient force posture for generating combat sorties from the Pacific's First Island Chain. This will help ensure the Air Force remains an inside force capable of fighting with and alongside America's Pacific allies.

Finally, some forget that 5th generation combat aircraft—and soon NGAD PCA—are also asymmetric capabilities for achieving air superiority, without which the success of all U.S. joint force operations will be in doubt. This is why the Air Force should develop CCA and their operating concepts to complement, not replace, its 5th generation and beyond combat aircraft. Former Chief of Staff of the Air Force General T. Michael Moseley (Ret.) recently stressed the need for this synergy:

> Fighters like the F-35 and F-22 secure air superiority over enemy territory and U.S. forces while adding to strike capacity. The NGAD PCA advanced stealth fighter working in conjunction with uninhabited CCA will take these mission capabilities to new heights.[46]

Recommendations

Uninhabited vehicle technologies are maturing at a pace that will support the fielding of several generations of CCA this decade when the risk of Chinese aggression in the Indo-Pacific may be greatest. A family of reuseable and expendable CCA will absorb risk and increase the survivability of the Air Force's counterair forces in highly contested environments and HVAA that support them. Based on Mitchell Institute wargames and related studies, the Air Force should field a mix of CCA as quickly as possible and prepare to use them as asymmetric, force multiplying capabilities in concert with piloted bombers and fighters to achieve the air superiority on which all joint force operations depend. To this end, the Mitchell Institute offers the following recommendations that are based on insights from its wargames and related studies:

- **Minimize the logistics requirements of the Air Force's CCA force design**. Generating CCA sorties from Pacific operating sites located inside the PLA's missile threat envelope is a fundamental requirement. This is not an insurmountable challenge *if* the Air Force minimizes the logistics required to conduct these operations. This includes reducing requirements for fuel, spare parts, food, water, and other materiel needed to generate CCA sorties at scale and sustain their forward units. To this end, the Air Force should engage its operators and logistics experts at every step of its CCA development process. The Air Force should likewise consider how the number of different CCA variants in its future force design could impact logistics. For instance, too many unique CCA designs with different sustainment requirements could complicate their supporting logistics operations while under attack.

- **Develop innovative operating concepts for CCA.** The Air Force should design operating concepts for using lower-cost expendable and recoverable CCA independently and in collaboration with larger payload, highly survivable piloted aircraft to disrupt, create dilemmas, and impose costs on a peer adversary's air defense forces. Constraining CCA to performing as "loyal wingmen" to piloted fighters would limit the potential for CCA to create unique effects in contested and highly contested environments.

- **Employ CCA to help maintain pressure on adversary forces between U.S. strike surges.** The Air Force should develop CCA and CCA use cases that will help maintain pressure on PLA air defenses between U.S. strike surges. CCA launched from the air and the ground inside the First Island Chain with less reliance on runways could perform as primary forces supported by piloted aircraft to maintain continuous pressure on the PLA's surface action groups (SAGs), KJ-500s, and other threats. This would help U.S. forces to drive the timing and tempo of a conflict, reduce the time available for the PLA to reset between the Air Force's strikes, and diminish the level of effort the PLA could concentrate against them.

- **Acquire lower-cost, expendable CCA to disrupt and impose costs.** The Air Force should acquire expendable CCA in significant numbers—high hundreds to low thousands—that it could use to absorb risk and disrupt adversary counterair operations in highly contested environments. The lower costs and reduced logistics requirements of expendable CCA increase the potential to acquire and use them at significantly greater rates compared to more complex and logistics-intensive fighter-like CCA designs. Additional cost-per-effect analysis—including the cost of logistics—is needed to determine the right mix of expendable and more capable reuseable CCA in the future force.

- **Prioritize the rapid funding and acquisition of CCA at scale—resiliency requires capacity.** Experts participating in Mitchell Institute's TTX exploited the combat utility of notional expendable and reuseable CCA, including variants with characteristics that are broadly aligned with known CCA Increment 1 requirements. These CCA are designed to be manufactured at scale and maintain their combat readiness with reduced maintenance requirements compared to piloted aircraft. Delaying the acquisition of existing CCA designs for notional future solutions would extend the Air Force's air superiority capability and capacity gaps.

- **Do not trade 5th generation and beyond piloted fighters for CCA.** Success requires a team. The Air Force should design, acquire, and operate CCA to complement its 5th generation fighters, NGAD PCA, and possibly its future long-range strike family of systems. CCA will not reduce requirements for these advanced piloted aircraft as they do not possess the same levels of capabilities including survivability.[47] The stark reality is U.S. military has a severe shortfall in air superiority capabilities. Capacity growth for this mission in all areas—piloted and uninhabited—is imperative. Developing operating concepts that best combine the different attributes of these aircraft will be key to creating an asymmetric air superiority system of systems that offsets the PLA's numerical advantages.

- **Align the future CCA force mix with munitions inventories and prioritize the acquisition of CCA capable of creating non-kinetic effects.** Real-world shortfalls in air-to-air weapons and other munitions will constrain the combat effectiveness of weaponized CCA. This is also true for fighters and bombers. To mitigate this risk, the Air Force must consider the availability of munitions as it develops an optimum mix of CCA and determines the value of developing weapons suitable for CCA. Alternatives that could reduce munitions shortfalls include fielding electromagnetic warfare (EW) variants of CCA that are capable of non-kinetically disrupting, degrading, and destroying electronic systems that form the core of an adversary's IADS. These EW CCA variants could also help create more complex challenges for adversary forces and reduce the Air Force's air-to-air weapon expenditures in a long duration peer conflict. A CCA force design should also seek to maximize the commonality of munitions used by different CCA variants. This could significantly reduce their logistics sustainment requirements.

- **Assess logistics, battle management, and other requirements for a network of CCA forward operating sites.** CCA with reduced logistics footprints, including Increment 1 designs, could expand options to generate Air Force counterair sorties from launch sites that are within range of the PLA's missile forces. The Air Force should assess requirements to manage the operations of CCA dispersed across multiple launch and recovery sites in the Western Pacific, as well as the logistics needed to generate CCA sorties such as local fuel storage capacity and pumping equipment, ramp space, and access to bulk consumables. These assessments should be accompanied by actions to develop host nation agreements for local logistics support to CCA operations.

- **Assess the potential for uninhabited aircraft to provide CCA logistics.** Using the Air Force's C-130s and other airlift aircraft to provide logistics materiel to CCA bases inside areas covered by the PLA's long-range air defenses will not be without risk. Experts participating in Mitchell Institute's TTX recommended the Air Force assess the potential to reduce risk to its mobility aircrews by employing cargo carrying variants of CCA, equipping CCA with a cargo pod, or using uninhabited variants of small, commercially available aircraft to support CCA sortie generation operations.

- **Continue to develop a better understanding of CCA operational and logistics needs.** Mitchell Institute's TTXs are a start toward understanding the logistics needed to generate CCA sorties from forward operating locations that will be at risk of air and missile attacks. The Air Force should continue to conduct threat modeling and campaign-level force structure assessments tied to realistic operational scenarios and operational concepts for CCA.

The U.S. Air Force is facing a daunting array of challenges. Its forces are too small to meet growing operational demand, its current budget will not allow it to modernize fast enough to keep pace with China, and its need to change its force design is immediate. These shortfalls are not just about one military service, they cut to the nation's core security requirements. Maintaining a force that can achieve air superiority—a core Air Force function—over the PLA will be as effective a deterrent as the ability to deny a PLA lodgment on the shores of Taiwan. Composite forces of recoverable and expendable CCA, 5th generation fighters, and eventually NGAD PCA will provide warfighters with new options to disrupt, create dilemmas, and impose costs on the PLA's counterair forces. The Air Force could also use CCA to create counterair effects that it cannot achieve with its piloted aircraft alone. The reduced footprints of CCA—including TTX CCA designs that were broadly aligned with Increment 1 requirements—would help the Air Force to remain an "inside force" capable of generating combat sorties in forward areas that are within range of an adversary's missile forces.

None of these advantages will be realized without sufficient logistics. This is why logistics should inform the entire development cycle of the Air Force's CCA forces—it cannot be an afterthought. In the words of one Air Force planner participating in Mitchell Institute's TTX, "We must go fast, [but] we also shouldn't overburden CCA designs with so many capabilities that we must support them like fighters."

Creating this balanced CCA force will require additional resources. Business-as-usual budget allocation practices that underfund the Air Force would leave it with no choice but to continue to decrement its other modernization programs to acquire CCA. This is a prescription for failure. The need is too great, the timing is too urgent, and failing to prevail over Chinese or Russian aggression would prove far costlier than fully funding the Air Force's efforts to size and shape its forces for peer conflict. A loss at this level would have an existential impact on the United States—and that is not an option. ✪

Endnotes

1 The Air Force defines air superiority as "that degree of dominance in the air battle by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats." U.S. Air Force, *Counterair Operations Air Force Doctrine Publication 3-01* (U.S. Air Force, June 15, 2023), p. 2. According to General Kenneth Wilsbach, Commander of the Air Combat Command, "Without air superiority you cannot do anything else." The Mitchell Institute for Aerospace Studies, "Aerospace Nation: Gen Kenneth S. Wilsbach," July 10, 2024.

2 For example, see David Barno and Nora Bensahel, "Drones, the Air Littoral, and the Looming Irrelevance of the U.S. Air Force," *War On The Rocks*, March 7, 2024.

3 David A. Deptula and Christopher J. Bowie, *The Significance of Air Superiority: The Ukraine-Russia War* (Arlington, VA: The Mitchell Institute for Aerospace Studies, July 2024).

4 For instance, see remarks by a panel featuring Air Marshal Allan Marshall, Air & Space Commander of the Royal Air Force; Lt Gen Dave A. Deptula, USAF (Ret.), Dean of AFA's Mitchell Institute for Aerospace Studies; Gen Jeffrey L. Harrigian, USAF (Ret.), former Commander of U.S. Air Forces in Europe-Air Forces Africa; and Maj Gen Charles Corcoran, USAF (Ret.), former Assistant Deputy Chief of Staff for Operations: "Ukraine, Russia War: A Prelude to Future Conflict," Air Force Association 2024 Air, Space & Cyber Conference, September 2024.

5 According to China expert J. Michael Dahm, "The 1991 Gulf War was a harbinger of change for the Chinese military. In just 42 days, a United States–led coalition eviscerated the Iraqi military and expelled it from Kuwait. Before Operation Desert Storm, the Chinese People's Liberation Army (PLA) was aware of its shortcomings relative to the West, but the war underscored the magnitude of the problem. The similarities between the PLA and the vanquished Iraqi military—an army-centric force organized for a defensive campaign—created a sense of urgency, as Beijing realized its military was ill-prepared to face a modern foe like the United States. The transformations in Chinese military strategy, technology, and force structure born out of the Gulf War have been seismic, shifting the balance of power in East Asia and portending global challenges for the U.S. military." J. Michael Dahm, "China's Desert Storm Education," *Proceedings*, March 2021.

6 See J. Michael Dahm, *Fighting the Air Base: Ensuring Decisive Combat Sortie Generation Under Fire* (Arlington, VA: Mitchell Institute for Air and Space Studies, July 2024).

7 For a recent Mitchell assessment on the potential of CCA in a conflict with China, see Mark A. Gunzinger, *The Need for Collaborative Combat Aircraft for Disruptive Air Warfare* (Arlington, VA: Mitchell Institute for Aerospace Studies, February 2024).

8 The Mitchell Institute for Aerospace Studies, "Aerospace Nation: Gen Kenneth S. Wilsbach," July 10, 2024, 27:00 and 43:00.

9 Agile Combat Employment is an Air Force concept for distributing its forces across hub and spoke airbases and forward operating sites to increase their survivability in areas that will be subject to adversary air and missile attacks. "When applied correctly, ACE complicates the enemy's targeting process, creates political and operational dilemmas for the enemy, and creates flexibility for friendly forces." U.S. Air Force, *Agile Combat Employment*, Air Force Doctrine Note 1-21 (Maxwell AFB, AL: Curtis E. LeMay Center for Doctrine Development and Education, Air University, August 23, 2022), p. 1.

10 This includes reducing the detectable emissions in the electromagnetic spectrum of CCA launch locations.

11 The Mitchell Institute classified its notional CCA designs as "expendable" or "recoverable." Recoverable means CCA have the potential to land after missions to rearm, refuel, and then fly additional sorties. An expendable CCA is designed to fly a single mission only and does not recover, much like a cruise missile. Both types of CCA can be attritted in combat to achieve effects like reducing risk to aircrews.

12 To quote one Air Force planner participating in Mitchell's TTX, CCA "bought us opportunities to generate sorties closer to the fight."

13 Because of its lack of combat capacity, the Air Force envisions using periodic "pulses" of forces to conduct precision strikes and other missions in a campaign to defeat a peer adversary. This episodic operational approach risks creating breathing spaces in time between pulses for enemy forces to reconstitute and regain the initiative.

14 For more information on the Air Force's Increment 1 CCA, see Jennifer DiMascio, *U.S. Air Force Collaborative Combat Aircraft* (Washington DC: Congressional Research Service, January 22, 2025).

15 While Mitchell Institute's TTXs addressed the warfighting potential of CCA operating with 4th and 5th generation fighter aircraft, there is similar potential for teaming them with penetrating bombers like the B-21. According to Major General Jason R. Armagost, Commander of the 8th Air Force, "The B-21 is meant to fly in coordination with uncrewed air vehicles like Collaborative Combat Aircraft … a large aircraft, like a bomber, has many apertures and many radios, and in many cases, more crew members to be able to manage things like that." John A. Tirpak, "8th Air Force Commander: B-1 and B-2 Fleet Retirements Will Be Conditions Based." *Air & Space Forces Magazine*, December 4, 2024.

16 See Mark A. Gunzinger and Lukas Autenried, *Building a Force That Wins: Recommendations for the 2022 National Defense Strategy* (Arlington, VA: the Mitchell Institute for Aerospace Studies, June 2021); and David A. Deptula and Mark A. Gunzinger, *Decades of Air Force Underfunding Threaten America's Ability to Win* (Arlington, VA: the Mitchell Institute for Aerospace Studies, September 2022).

17 The Mitchell Institute also designed its exercises to promote the crossflow of information between Air Force and industry experts on CCA technologies, their potential operating concepts, and logistics requirements.

18 See Deptula and Gunzinger, *Decades of Air Force Underfunding Threaten America's Ability to Win*.

19 According to Joint Publication 1-02, air superiority is "that degree of dominance in the air battle by one force that permits the conduct of its operations at a given time and place without prohibitive interference from air and missile threats," *Department of Defense Dictionary of Military and Associated Terms* (Arlington, VA: Joint Chiefs of Staff, February 15,2016), p. 10.

20 Marc V. Schanz, "Rethinking Air Dominance," *Air & Space Forces Magazine*, July 1, 2013.

21 David A. Deptula and Christopher J. Bowie, *The Significance of Air Superiority: The Ukraine-Russia War* (Arlington, VA: the Mitchell Institute for Aerospace Studies, July 2024), p. 1.

22 Samantha L. Quigley, "Defense Department Must End Business As Usual," *American Forces Press Service*, July 17, 2009. Secretary Gates also cancelled the Next Generation Bomber, which led to a nearly ten-year delay in fielding a new stealthy bomber, now known as the B-21 Raider.

23 From a transcript of comments by General Wilsbach during a 2024 interview with the Mitchell Institute, "Q&A: Creating Dilemmas," *Air & Space Forces Magazine*, July 26, 2024.

24 See Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer (OUSD[C]/CFO), *Department of Defense Report on Force Structure Changes for the Fiscal Year (FY) 2025 Defense Budget* (Arlington, VA: DOD, April 2024), p. 23. As of early calendar year 2024, the Air Force had 154 F-15C/Ds in its Total Aircraft Inventory (TAI). This includes test, training, and backup aircraft as well as F-15C/D that are assigned to squadrons for the performance of their assigned combat missions.

25 The Air Force's FY2025 budget submission proposed retiring its Block 20 F-22s primarily due to budget constraints, not declining operational requirements. During a Mitchell Institute event, General Wilsbach reinforced this point, noting that Block 20 F-22s "give us a lot of training value, and even if we had to in an emergency use the Block 20s in a combat situation, they're very capable." The Mitchell Institute for Aerospace Studies, "Aerospace Nation: Gen Kenneth S. Wilsbach," July 10, 2024.

26 John A. Tirpak, "Kendall: USAF Can't Afford Next-Gen Fighter, Tanker, and Wingman Drones All at Once," *Air & Space Forces Magazine*, November 5, 2024.

27 The Air Force intends to retire squadrons of aging A-10 and F-15C/D fighters without replacements to fund some of its modernization requirements. This budget-driven action would increase the size of the service's combat capacity shortfall. David Rosa, "National Guard Boss Warns of Potential 'Critical' Fighter Shortage," *Air & Space Forces Magazine*, May 1, 2024.

28 See Chris Gordon, "As Kadena Hosts a Farewell Ceremony to the F-15, Lawmakers Question Force Size in Pacific," *Air & Space Forces Magazine*, April 21, 2023.

29 Greg Hadley, "Boneyard-Bound: USAF Retires First of 13 AWACS," *Air & Space Forces Magazine*, April 12, 2023.

30 Dahm, "China's Desert Storm Education."

31 OUSD, *2023 Military and Security Developments Involving the People's Republic of China*, annual report to Congress (Arlington, VA: DOD, 2033), p. 47.

32 Dahm, "China's Desert Storm Education."

33 Admiral John C. Aquilino, Commander, U.S. Indo-Pacific Command, "U.S. Indo-Pacific Command Posture Statement to the House Armed Services Committee," April 18, 2023, p. 5.

34 Aquilino, "U.S. Indo-Pacific Command Posture Statement to the House Armed Services Committee," p. 6.

35 Aquilino, "U.S. Indo-Pacific Command Posture Statement to the House Armed Services Committee," p. 7.

36 U.S. Air Force, *Agile Combat Employment*, p. 2.

37 Mike Dahm quoted in Unshin Harpley, "How to Save Guam from Chinese Missiles," *Air & Space Forces Magazine*, August 1, 2024.

38 For more on China's growing missile inventory, see Dahm, *Fighting the Air Base*. In 2021, China tested a fractional orbital bombardment system (FOBS) that deployed a maneuverable hypersonic glide vehicle. An operational FOBS with conventional or nuclear warheads would have the potential to reach targets globally.

39 Dahm, *Fighting the Air Base*.

40 For descriptions of the Air Force's offensive and defensive counterair missions including sweeps, SEAD, and HVAA defense, see *Counterair Operations*, Air Force Doctrine Publication 3-01 (U.S. Air Force, June 15, 2023).

41 EMCON is a common tactic practiced by the world's naval forces for reducing risk to ships in contested operating environments. EMCON procedures "greatly reduce or mask the ship's electronic footprint, making it harder to detect by electronic means." For a layman's description of EMCON, see Patrick A. Goldman, "In the Digital Age, Make Ships Go Dark," *Proceedings*, August 2022.

42 On Mitchell Institute's previous CCA studies, see Gunzinger, *The Need for Collaborative Combat Aircraft for Disruptive Air Warfare*; and Caitlin Lee and Mark A. Gunzinger, *The Next Frontier: UAVs for Great Power Conflict* (Arlington, VA: the Mitchell Institute for Aerospace Studies, 2022).

43 See Joseph Trevithick, "Everything New We Just Learned About The Collaborative Combat Aircraft Program," *The Warzone*, February 23, 2024.

44 Creating a distributed CCA posture would also help "depressurize" operations at the Air Force's Pacific's main operating bases.

45 Several TTX teams distributed their expendable CCA-9, CCA-11, and CCA-12 to sites in the Ryukyu Islands and northern Philippines that were within 300 nm of PLA SAGs screening the Taiwan Strait.

46 T. Michael Moseley, "Fighters and bombers are what America needs to win—not quadcopters," *Defense News*, November 1, 2024.

47 While Mitchell Institute's TTXs addressed the warfighting potential of CCA operating with 4th and 5th generation fighter aircraft, there is similar potential for teaming them with penetrating bombers like the B-21. According to Major General Jason R. Armagost, Commander of the 8th Air Force, "The B-21 is meant to fly in coordination with uncrewed air vehicles like Collaborative Combat Aircraft … a large aircraft, like a bomber, has many apertures and many radios, and in many cases, more crew members to be able to manage things like that." Tirpak, "8th Air Force Commander: B-1 and B-2 Fleet Retirements Will Be Conditions Based."

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