

SHAPING THE FUTURE OF AIRPOWER:

INTEGRATION, INNOVATION, AND
INSTITUTIONAL TRANSFORMATION

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INTRODUCTION

This report examines five interconnected developments that collectively reveal how American and allied airpower stands at a critical inflection point.

Rather than awaiting revolutionary new platforms, the path to sixth-generation capabilities runs through the systematic evolution of existing fifth-generation systems, the integration of autonomous collaborative aircraft, and fundamental transformation in how combat pilots are trained to operate within persistent complexity.

These developments demonstrate that generational transitions in military aviation are increasingly defined by operational behavior and networked integration rather than platform characteristics alone.

THE DESERT STORM BLUEPRINT AND ITS ABANDONMENT

The report opens with a sobering assessment of how the United States has systematically unlearned the lessons that enabled its last decisive military victory. Lieutenant General David Deptula's analysis of Desert Storm's 35th anniversary

reveals an institutional failure extending far beyond operational doctrine. The 1991 campaign succeeded through an effects-based, systems approach to warfare that targeted Iraq's ability to function as a coherent military entity rather than pursuing traditional attrition. Precision-guided munitions, stealth technology, and strategic discipline converged to achieve unprecedented results: coalition forces attacked more discrete targets in the opening 24 hours than the Eighth Air Force struck over two years in Europe during World War II.

Yet this proven approach was abandoned for prolonged counterinsurgency campaigns that consumed vast resources without achieving strategic objectives. Over twenty years following 9/11, the Army received \$1.3 trillion more than the Air Force to fund ground campaigns in Afghanistan and Iraq that ultimately failed, while Air Force combat forces shrank to 40 percent of their Desert Storm size. This reflects strategic incoherence: the United States optimized for conflicts it chose to fight rather than conflicts it needs to win against peer adversaries.

The connection between Desert Storm's operational success and contemporary training challenges proves crucial. The campaign demonstrated the power of attacking adversaries as integrated systems, but this requires pilots who think in terms of effects and networks rather than platforms and sorties.

Modern fifth-generation aircraft provide the tools to execute such approaches at unprecedented scale, yet traditional training methods designed for earlier eras actively inhibit the cognitive development necessary to employ these capabilities effectively. When student pilots exhaust their mental capacity simply keeping difficult-to-fly training aircraft stable, they have insufficient cognitive bandwidth remaining for learning mission systems, information management, and tactical thinking.

Italy's International Flight Training School represents the

alternative: a facility designed from inception around Live-Virtual-Constructive training that integrates live aircraft, high-fidelity simulators, and computer-generated forces into seamless environments. This produces tactical thinkers who happen to fly aircraft rather than exceptional stick-and-rudder pilots who must later learn tactical employment. The paradigm shift in combat pilot training is not a luxury but a prerequisite for the warfare that Desert Storm previewed and fifth-generation aircraft now enable.

COLLABORATIVE COMBAT AIRCRAFT: FROM CONCEPT TO OPERATIONAL REALITY

The transformation of Collaborative Combat Aircraft from conceptual "loyal wingman" proposals to concrete prototypes achieving first flight demonstrates how rapidly the defense establishment can move when institutional consensus emerges around operational requirements.

By 2025-2026, CCAs evolved into a family of large, jet-powered uncrewed systems tightly linked to manned platforms and backed by growing budgets, incremental acquisition strategies, and intensive experimentation with autonomy and manned-unmanned teaming.

The Air Force's program pacing reflects this urgency. General Atomics' YFQ-42A achieved first flight in August 2025, less than two years after program start, while Anduril's YFQ-44A followed in October. These prototypes are not being treated as purely experimental demonstrators but as the core of operational learning efforts linking early flight results directly to tactics development and future requirement refinement. The service's decision to select Beale Air Force Base as the preferred location for a CCA Aircraft Readiness Unit signals commitment to standing up real-world support and

deployment infrastructure rather than keeping capabilities locked inside test ranges.

Financially, CCA has become central to future combat air budgets, with the broader NGAD family of systems receiving nearly \$28.5 billion over five years. The promise of achieving step changes in numbers at a fraction of crewed fighter costs drives this investment: Increment 1 CCAs target roughly \$30 million per aircraft compared with multiple hundreds of millions for sixth-generation NGAD fighters, allowing planners to envision each crewed aircraft operating alongside several uncrewed teammates.

What proves most significant is the spread of CCA concepts across all services. By late 2025, the Navy, Marine Corps, and Army had all launched programs aimed at fielding capabilities around 2030, building on Air Force experience while tailoring designs and employment concepts to maritime and expeditionary missions. This transformation from Air Force niche project to joint expectation indicates that CCA-style systems have passed their initial credibility test and entered a decisive phase where key questions shift from "can it be built?" to "can it be fielded at scale and integrated into real operations?"

COMBAT VALIDATION: ISRAEL'S OPERATION RISING LION

The theoretical promise of fifth-generation capabilities received decisive validation through Israel's June 2025 Operation Rising Lion against Iran. Over twelve days, Israeli aircraft flew more than 1,400 sorties against targets over 1,000 miles away without losing a single manned aircraft, sustaining battle damage, or suffering major mechanical failures. At the operational heart of this unprecedented achievement stood the F-35, performing so essentially that Israeli

pilots refused to enter Iranian airspace without F-35s leading the way.

The Jewish Institute for National Security of America's comprehensive analysis reveals capabilities that exceeded even optimistic expectations. The F-35's sensor fusion and information-sharing allowed F-16s and F-15Is to engage targets detected by F-35s without ever activating their own radars, a critical advantage against sophisticated air defenses.

Even more significantly, the aircraft's ability to detect air defense systems operating in survivability mode and remaining invisible to standard intelligence collection proved decisive. When Iranian radar or missile sites activated, F-35s immediately spotted them, relayed targeting information to other aircraft, and enabled rapid precision strikes against defenses that would otherwise have gone unnoticed.

This integration fundamentally shaped Israeli operational doctrine. No aircraft entered Iranian airspace unless F-35s were present, whether leading formations directly or escorting packages from dozens of miles away. Israeli military leaders told researchers this wasn't hyperbole but operational reality: the F-35's sensor capabilities, survivability features, and real-time electronic warfare adaptations were essential for operating in contested airspace.

The aircraft's combination of multi-role capabilities, intelligence sharing, and networked combat effectiveness established it as the critical centerpiece enabling Israel to achieve air superiority rapidly and maintain it throughout the campaign.

The strategic implications extend beyond Israeli defense. Operation Rising Lion validated decades of American investment in the F-35 program and demonstrated capabilities that reinforce deterrence across multiple theaters. It also revealed critical lessons about how sensor fusion and networked operations represent fundamental shifts in how air campaigns can be conducted.

The F-35's ability to serve simultaneously as strike platform, electronic warfare asset, intelligence collection system, and command-and-control node created operational possibilities that simply did not exist with previous aircraft generations.

THE BEHAVIORAL PATH TO SIXTH GENERATION

These operational realities enable reconceptualization of what defines generational transitions in air warfare. Former Secretary of the Air Force Michael Wynne provided clear articulation of fifth-generation concepts during the F-35's early development: a fundamental shift from platform-centric thinking to network-centric operations where stealth, sensor fusion, and information dominance define combat effectiveness.

In contrast, sixth-generation concepts have remained frustratingly opaque, with various characteristics proposed but no equivalent clarity about what fundamentally distinguishes this generation.

However, one element has emerged with increasing clarity: the crewed fighter operating in wolfpack configuration with Collaborative Combat Aircraft. This human-machine teaming represents genuinely revolutionary operational shifts. Yet the critical insight that defense planners are beginning to recognize is that the F-35 itself can be reworked to serve as quarterback in such formations.

Rather than waiting for entirely new airframes to deliver sixth-generation capabilities, we are witnessing hybrid transitions where existing fifth-generation platforms evolve to exhibit sixth-generation behavior through integration with autonomous systems.

This realization forces reconceptualization of generational transitions. Previous generations were defined primarily by

platform characteristics: fourth-generation fighters introduced fly-by-wire controls and beyond-visual-range missiles; fifth-generation platforms added stealth and sensor fusion.

The leap to sixth generation, however, is better understood as behavioral rather than platform-based transition, defined by how forces operate rather than what individual platforms can do.

An F-35 operating alone exhibits fifth-generation behavior. The same F-35, upgraded with enhanced processing and communications and operating as quarterback for a formation of four CCAs, exhibits sixth-generation behavior. The platform itself evolves incrementally, but operational capability transforms fundamentally.

This represents practical application of force multiplier integration concepts where the whole exceeds the sum of its parts. The F-35 becomes more capable when paired with CCAs than it could ever be through internal upgrades alone; the CCAs become exponentially more effective under human direction than they could be operating autonomously.

ITALY'S STRATEGIC POSITIONING: TRAINING AS FORCE MULTIPLIER

Italy's €112.6 million investment in establishing the Lightning Training Center at Trapani-Birgi represents far more than conventional infrastructure development. As the first F-35 pilot training center outside the United States, scheduled to achieve initial capability by December 2028, this facility positions Italy as a permanent European node within the global F-35 training network while revealing how training ecosystems built on proven methodologies serve as foundational architecture for sixth-generation demands.

The Lightning Training Center builds directly on success at Italy's International Flight Training School at Decimomannu, where synergy between the Italian Air Force and

Leonardo has demonstrated capacity to deliver world-class advanced aviation training. The IFTS represents revolutionary shifts from traditional stick-and-rudder instruction to cognitive-focused education emphasizing information management and network-centric operations.

This training methodology prioritizes building mental models over mechanical skill acquisition, using Live-Virtual-Constructive environments where students develop cognitive capacity to manage information flow, prioritize threats, and execute decisions within compressed timelines.

This architecture proves particularly relevant to F-35 preparation because it addresses fundamental challenges: the aircraft's capabilities far exceed traditional pilot workload management paradigms. F-35 pilots operate not as individual platform commanders but as nodes within distributed kill webs, synthesizing data from multiple sensors, sharing targeting information across formations, and coordinating effects with both manned and unmanned assets.

The cognitive skills developed through IFTS's methodology provide precisely the foundation required for this transition.

The facility's strategic positioning extends beyond national requirements to enable collective capabilities essential for allied operations. Italy, the Netherlands, Norway, Denmark, the United Kingdom, Poland, Finland, Switzerland, the Czech Republic, Germany, and Belgium have all committed to F-35s, creating demand for qualified pilots exceeding Luke Air Force Base's finite capacity.

A European training hub reduces costs, eliminates transatlantic personnel rotations, and creates opportunities for tactical standardization and interoperability training essential for coalition operations.

CONCLUSION: THE TRANSFORMATION IMPERATIVE

Taken together, these developments reveal airpower transformation occurring not through revolutionary new platforms but through systematic integration of existing systems with emerging autonomous capabilities, enabled by training methodologies that develop cognitive capacity to operate within persistent complexity.

The path to sixth-generation warfare runs through the F-35 evolved into a quarterback commanding autonomous teammates, validated by operational success in combat, and enabled by training ecosystems that produce tactical thinkers capable of managing distributed networks rather than simply flying aircraft.

This transformation reflects pragmatic recognition that strategic competition with peer adversaries does not allow the luxury of waiting for perfect solutions. It demands fielding effective capabilities rapidly using available platforms.

The hybrid transition approach leverages existing industrial capacity, preserves international partnerships, and allows incremental risk reduction through rapid iteration of autonomous systems while avoiding the decades of cost growth and schedule delays that characterized previous revolutionary programs.

The urgency is real. China studied Desert Storm's lessons and built military capabilities designed to counter the advantages it revealed. Meanwhile, the United States military risked forgetting how to execute effects-based, systems approaches while distracted by unwinnable counterinsurgency campaigns.

Future conflicts will be fast, intense, multi-domain contests against adversaries who can contest all domains from the outset. Success will require intelligent application of military power through effects-based approaches, exactly what

Desert Storm demonstrated and what fifth-generation aircraft enable when properly employed within kill webs rather than as individual platforms.

The transformation from platform-centric to network-centric warfare, from kill chains to kill webs, from crisis management to chaos management—these are cognitive transformations that must be embedded in training from the first day. The paradigm shift in combat pilot training is not luxury but prerequisite for the warfare that emerging threats demand and advanced aircraft enable.

Italy's strategic positioning demonstrates that training constitutes strategic architecture as critical as aircraft design or manufacturing capacity, with methodologies applicable across generational transitions and transferable to sixth-generation operations.

This report ultimately argues that sixth-generation warfare is achievable today through behavioral transformation rather than awaiting distant revolutionary platforms. The conceptual clarity that defined fifth-generation capabilities has been absent from sixth-generation discussions perhaps because we've been looking in the wrong place: in platform specifications rather than operational behavior.

Once we recognize that sixth-generation warfare is fundamentally about the wolfpack, the path forward becomes clear: evolve the F-35 into the quarterback it was designed to become and pair it with autonomous teammates that technology now makes possible.

CHAPTER 1

FROM VICTORY FORGOTTEN TO LESSONS UNLEARNED: DESERT STORM, STRATEGIC DRIFT, AND THE COMBAT PILOT TRAINING REVOLUTION

Lieutenant General David Deptula's *Forbes* piece marking the 35th anniversary of Operation Desert Storm examines how the United States abandoned a proven approach to warfare in favor of prolonged campaigns that failed to achieve strategic objectives.

It reveals the institutional resistance to internalizing lessons from success and the persistent tendency to substitute activity for outcome.

Desert Storm remains "the last major regional war fought and decisively won by the United States." For three and a half decades, the most technologically advanced military in history has been unable to replicate that decisive victory.

The answer, as Deptula demonstrates, is deeply troubling.

But beyond operational lessons lies an equally critical insight: fifth-generation aircraft demand a paradigm shift in the training of combat pilots to fight in a kill web force.

What made Desert Storm successful was not, as Deptula emphasizes, technological superiority alone, nor numerical advantage, nor favorable geography. It was the application of what he terms an "effects-based, systems approach to warfare", a methodology that targeted not individual plat-

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forms or tactical formations but the integrated system that enabled Saddam Hussein to wage war. This represented a fundamental shift from traditional attrition-based warfare to strategic disruption.

Three elements converged to enable this approach.

- First, precision-guided munitions allowed small numbers of aircraft to achieve effects previously requiring massive formations.
- Second, stealth technology permitted operations deep within defended airspace without the supporting armada traditionally required.
- Third, and most important, was a planning philosophy that valued outputs over inputs, effects over effort.

The results speak for themselves. In the opening 24 hours of Desert Storm, coalition forces attacked more discrete targets than the Eighth Air Force struck in Europe over two years of World War II. Thirty-six F-117 stealth fighters attacked more targets in that first day than the entire non-stealth air and missile force of six aircraft carrier battle groups. Over the campaign's duration, the F-117, flying just two percent of combat sorties, struck over 40 percent of Iraq's fixed strategic targets.

This was not efficiency improvement. It was operational transformation.

Yet this transformation required not just new technology but new ways of thinking about air combat, a cognitive shift that would become even more critical with the advent of fifth-generation aircraft.

Deptula identifies another crucial element: strategic discipline at the national leadership level.

The mission was finite, to restore the status quo ante by expelling Iraqi forces from Kuwait. No mandate for regime change, no mission to remake Iraqi society, no open-ended commitment untethered from military means. This clarity

prevented the mission creep that plagued Vietnam and later undermined Afghanistan and Iraq.

In Afghanistan, initial objectives were rapidly achieved, but American strategy shifted to transforming “a deeply tribal society into a modern democracy”, a non-military task pursued through military means for two decades. Desert Storm treated a crisis as a crisis: identified the problem, applied decisive force, withdrew. Post-9/11 campaigns treated crises as opportunities for permanent engagement.

Perhaps the most significant innovation of Desert Storm and the one most thoroughly abandoned in subsequent conflicts was the employment of airpower not as a supporting arm but as the primary instrument of strategy. As Deptula explains, this reversed traditional military logic. Rather than beginning with ground maneuver and using airpower to support it, General Schwarzkopf made airpower the main effort, with ground forces initially employed as a blocking force.

This was not merely tactical adjustment. It represented a fundamental reconceptualization of how to achieve strategic objectives. The air campaign was designed to attack Iraq as a system, targeting leadership, command and control, critical infrastructure, and fielded forces simultaneously. The goal was not to destroy things but to negate Iraq’s ability to function as a coherent military entity.

The results validated the approach. By the time coalition ground forces advanced, airpower had destroyed or disabled more than 4,200 Iraqi tanks, armored vehicles, and artillery pieces. Iraqi heavy divisions were so paralyzed that they retained little ability to maneuver, reinforce, or conduct coordinated operations. The ground campaign that followed was not a hard-fought contest. It was, as Deptula observes, “the physical confirmation of a defeat already delivered.”

Compare this to the counterinsurgency campaigns that dominated American military thinking after 9/11.

Airpower became relegated to supporting ground operations rather than serving as the primary instrument of strategy. In some cases, as Deptula notes, air component commanders were “intentionally cut out from critical operational planning”, such as in Operation Anaconda in Afghanistan, Operation Inherent Resolve against ISIS in Syria, and Operation Rough Rider in Yemen. The military learned to win decisively in 1991, then systematically unlearned those lessons over the subsequent three decades.

During the 20 years after 9/11, the Army was allocated \$1.3 trillion more than the Air Force, \$65 billion per year, to fund ground campaigns that failed to achieve strategic objectives. Meanwhile, Air Force combat forces shrank to 40 percent of their Desert Storm size. The F-22 program was canceled at less than half its requirement. The Air Force now flies ten major aircraft types that first flew over 50 years ago, constituting over two-thirds of inventory.

As Deptula observes, “The U.S. Air Force has become a truly geriatric force.”

Yet this diminished force is in greater demand than ever, revealing the disconnect between American strategic commitments and resources allocated.

This reflects strategic incoherence: the United States spent three decades optimizing for conflicts it chose to fight rather than conflicts it needs to win.

Nowhere is this more evident than in combat pilot training.

The paradox of fifth-generation aircraft like the F-35 is captured in a phrase I have encountered repeatedly in my research: they are “the easiest aircraft to fly and the hardest to employ.” Modern fighters essentially fly themselves, with flight control systems handling the aerodynamic complexities that once consumed pilot attention.

But they demand sophisticated cognitive management of

sensor fusion, weapons employment, and tactical decision-making based on overwhelming data streams.

This creates the “hidden cost” of traditional training approaches. When students train on older, difficult-to-fly aircraft, they exhaust their cognitive capacity just keeping the aircraft stable and on parameters. Little mental energy remains for learning mission systems, information management, and tactical thinking. Worse, they develop deeply ingrained habits and mental models that must be unlearned when transitioning to fifth-generation fighters.

The problem is fundamental: you cannot prepare pilots for effects-based, systems warfare using platform-centric training methods designed for an earlier era. Desert Storm demonstrated the power of attacking adversaries as integrated systems. Fifth-generation aircraft provide the tools to execute such approaches at unprecedented scale.

What is required as part of the shift Deptula is discussing is what I have analyzed as the paradigm shift in pilot training. The connection to Desert Storm is direct. That campaign succeeded because planners thought in terms of effects and systems, not platforms and sorties. Modern combat pilot training must produce aviators who think the same way, who understand their aircraft as information nodes in larger networks, who can synthesize data from multiple sources to support decision-making across the force, and who can shift seamlessly from individual tactical problems to strategic effects.

While American pilot training has been slow to adapt, allies have been innovating. Italy’s International Flight Training School (IFTS), established in 2022, represents the first air combat training facility designed from inception around Live-Virtual-Constructive (LVC) training, the integration of live aircraft, high-fidelity simulators, and computer-generated forces into seamless training environments.

As I documented in my book “Training for the High End Fight: The Paradigm Shift for Combat Pilot Training,” this represents more than technological advancement. It reflects a fundamental reconceptualization of what combat pilot training must achieve. The goal is not to produce exceptional stick-and-rudder pilots who then learn tactical employment. The goal is to produce tactical thinkers who happen to fly aircraft, pilots who can manage information flows, make rapid decisions in contested environments, and operate as nodes in distributed kill webs rather than as individual hunters.

Yet the USAF is still training pilots the old way and creating the “hidden cost of flying yesterday’s trainers.” I discussed this in detail in my book and underscored in discussions with **senior USAF officers** who clearly understood what IFTS has created and what is missing in the United States.

General Brian S. Robinson when he was Commander of Air Education and Training Command (AETC), United States Air Force described the agreement allowing USAF pilot trainees to attend Italy’s International Flight Training School (IFTS) as a historic milestone in transatlantic military cooperation and a strategic innovation for the Air Force’s training pipeline. He highlighted that this initiative responds to urgent needs, such as delays in the T-7 Red Hawk program and growing demand for fighter pilots, by leveraging the proven capabilities of the T-346A at IFTS.

Robinson emphasized that American student pilots will undergo nine months of intensive, jointly developed training using the “Multiphase Jet Training Integrated Syllabus,” which enables them to earn a Military Pilot License on the T-346A and prepares them for advanced fighter operations.

Robinson has publicly stated that the decision to send American pilots to a NATO-partnered foreign training center reflects a commitment to strengthening interoperability and innovation in NATO airpower development. By collaborating

with the Italian Air Force and industry partners like Leonardo, the agreement is positioned as a way to accelerate USAF readiness and deepen allied ties in next-generation aircrew training and force development.

This is the shift from operating in kill chains to operating in kill webs. Kill chains are brittle; breaking a single link collapses the sequence. Kill webs are adaptive and redundant, with multiple sensors feeding multiple shooters across all domains. As one Navy strategist put it bluntly: “We only win if we fight as an interoperable, networked and distributed force.”

While American defense thinking drifted toward counterinsurgency, China studied what worked. China “carefully analyzed the Desert Storm air campaign and built a military designed to counter the advantages it revealed.” Chinese doctrine now emphasizes precision strike, information dominance, and systemic disruption, precisely the elements that defined Desert Storm’s success.

As Deputla underscored: “The challenge the United States now faces in the Indo-Pacific is the result of the U.S. military ignoring lessons that China internalized. Desert Storm showed how to defeat a large, modern military without fighting it symmetrically. China has been working hard to learn how to counter that approach. It established its paradigm of anti-access/area-denial as a result. Meanwhile, the United States military risked forgetting how to execute it while distracted by un-winnable wars in Iraq and Afghanistan and firing leaders for advocating preparing for war with China—Air Force Chief of Staff, General T. Michael Moseley and Air Force Secretary Mike Wynne.”

Future conflicts will be “fast, intense, multi-domain contests” against adversaries who can contest all domains from the outset. Success will require intelligent application of military power through effects-based, systems approaches, exactly what Desert Storm demonstrated.

But it will also require pilots trained to think and operate fundamentally differently. The lessons are urgent: acknowledging that technological superiority alone does not guarantee success, recognizing that prolonged presence is not strategic achievement, accepting that the United States cannot afford another three decades of drift.

This applies equally to how we fight and how we train. Desert Storm at 35 is a blueprint for how America can win wars against capable adversaries, a blueprint we abandoned as potential adversaries began preparing to face us. General Deptula's article is a call to strategic seriousness that must extend to how we prepare the next generation of combat pilots.

The transformation from platform-centric to network-centric warfare, from kill chains to kill webs, from crisis management to chaos management, these are cognitive transformations that must be embedded in training from day one. The paradigm shift in combat pilot training is not a luxury. It is a prerequisite for the warfare that Desert Storm previewed and fifth-generation aircraft now enable.

January 19, 2026

CHAPTER 2

AN UPDATE ON COLLABORATIVE COMBAT AIRCRAFT: JANUARY 2026

Collaborative Combat Aircraft (CCA) have moved in just a few years from a conceptual “loyal wingman” idea to concrete flight testing, down-selects, and multi-service adoption, with 2025–2026 shaping up as the period where the United States proves whether it can actually field affordable combat mass at speed. Across the Air Force, Navy, Marine Corps, and now the Army, CCAs are evolving into a family of large, jet-powered uncrewed systems, tightly linked to manned platforms and backed by a growing budget, a more incremental acquisition strategy, and intensive experimentation with autonomy and manned-unmanned teaming.

The U.S. Air Force remains the pacing service in the United States for CCA development, having launched the first formal program in 2023 and moved it into early operational prototyping during 2025. In August 2025, General Atomics’ YFQ-42A achieved a key milestone with its first flight at a California test location, occurring less than two years after program start and providing data on airworthiness, flight autonomy, and mission-system integration. Anduril’s competing YFQ-44A “Fury” followed with initial flight tests

in October 2025, marking a second jet-powered CCA prototype entering the air and validating the rapid-prototyping approach that underpins the program.

These prototypes are not being treated as purely experimental demonstrators but as the core of an “operational learning” effort. Both aircraft are undergoing developmental testing in California while also feeding into assessments run through an Experimental Operations Unit at Nellis Air Force Base, designed to link early flight results directly to tactics development and future requirement refinement. The Air Force has also selected Beale Air Force Base as the preferred location for a CCA Aircraft Readiness Unit, signaling a commitment to standing up a real-world support and deployment infrastructure rather than keeping CCA locked inside test ranges.

The Air Force’s Collaborative Combat Aircraft program has been structured around increments, with Increment 1 focused on delivering a first “minimum viable” capability suited for teaming with NGAD and F-35 in contested environments. Defense insight assessments indicate that between roughly 100 and 150 Increment 1 CCAs are expected to be procured, with the broader program potentially reaching into the low thousands of airframes as additional increments are launched. Critical design reviews for the initial prototypes concluded in late 2024, and ground testing began in early 2025, aligning with a forecast of prototype flights in 2025 and first operational deliveries toward the end of the decade.

A key shift in recent messaging has been the decision not to treat Increment 2 as a radical leap into an exotic, ultra-stealthy design, but as an iterative step driven by lessons from Increment 1 flight operations and experimentation. This approach implies a focus on refining survivability, payload options, and cost rather than starting over with an entirely new platform, supporting the broader “affordable mass” concept central to the NGAD family of systems.

Congress has taken note of this shift; a Congressional Research Service brief from January 2025 describes CCA as having moved “decisively from concept and experimentation into early operational prototyping,” highlighting emerging oversight questions around autonomy, scale, storage, and sustainment for potentially hundreds of large uncrewed aircraft.

Financially, CCA has become a central pillar of the Air Force’s future combat air budget. In March 2024, Air and Space Forces Magazine reported that the service planned nearly \$28.5 billion over five years for the broader NGAD family, with CCA accounting for a significant share of RDT&E and later procurement as it moves toward production. The FY2026 request singled out CCA RDT&E at just over \$111 million in discretionary funding in one line, but that figure is nested within larger NGAD-related efforts and is supplemented by separate funding for autonomy, networking, and related experimentation. More recent reporting notes that CCA-related requests for FY2026 across accounts are on the order of hundreds of millions of dollars, underscoring an upward trend as prototyping transitions to preparation for production.

The budget trajectory is driven in part by the promise of achieving a step change in numbers at a fraction of the cost of crewed fighters. Open-source assessments describe a target unit cost for Increment 1 CCAs of roughly \$30 million per aircraft, compared with “multiple hundreds of millions” for a sixth-generation NGAD fighter, allowing planners to envision each crewed aircraft operating alongside several uncrewed teammates. At the same time, CRS has flagged congressional questions about whether the Air Force has adequately planned for storing, transporting, and maintaining such large fleets of big uncrewed aircraft and how it will integrate National Guard and Reserve units and F-35 squadrons into CCA operations. These oversight issues suggest that the polit-

ical test for CCA will be less about the technology's feasibility and more about demonstrating scalable logistics and credible concepts of employment.

Even as airframes move into flight test, autonomy remains the decisive variable for CCAs. The Air Force and its industry partners are working toward large, jet-powered uncrewed aircraft equipped with AI-driven software capable of missions ranging from air-to-air and air-to-ground combat to electronic warfare, targeting, and ISR. Public reporting indicates that mission autonomy software stacks are being developed and integrated somewhat independently of specific airframes, with vendors such as RTX (Raytheon) announced as providing autonomy suites for at least one of the prototypes, though formal selections remain largely undisclosed.

An important doctrinal shift lies in treating CCA as part of an "autonomous collaborative" ecosystem rather than as remotely piloted platforms in the traditional sense. Air Force descriptions highlight CCAs as able to operate as teammates to manned aircraft, as individual autonomous platforms, or as members of swarms without continuous human supervision, with operators setting mission objectives and engagement parameters rather than manually flying each aircraft. This aligns with the Congressional Research Service's observation that CCAs may be able to adapt to battlefield changes more quickly than human operators, even as lawmakers weigh the risks and ethical implications of increased reliance on autonomy in lethal missions. The near-term flight profiles being demonstrated—pre-planned semi-autonomous routes with push-button takeoff and landing—are designed to build trust and experience on the way to more sophisticated collaborative tactics.

One of the most significant developments in 2025 was the spread of CCA-like concepts across the other services. By late 2025, both the U.S. Navy and Marine Corps had launched their own programs aimed at fielding CCA capabilities by

around 2030, building on Air Force experience but tailoring designs and concepts of employment to maritime and expeditionary missions. The Navy's efforts are nested inside its own Next Generation Air Dominance approach, with CCAs envisioned as carrier-capable or carrier-compatible uncrewed aircraft working alongside F/A-18, F-35C, and future manned platforms, and the service has signaled plans to use exercises with Australia to explore manned-unmanned teaming in realistic operational contexts.

The Marine Corps, for its part, has taken an incremental approach, awarding an Increment 1 contract to a Northrop-Kratos team to begin developing an expeditionary CCA and emphasizing a stepwise build-up of capabilities in command and control, electronic warfare, mission computing, and datalinks. Budget documents and public statements frame each minimum viable increment as a tool for real training and tactics development with operational units rather than a purely lab-based technology experiment. This approach mirrors the Air Force's "learning while fielding" strategy and reflects a broader institutional recognition that only operational forces, not test organizations alone, can validate how CCAs should be used in complex, distributed operations.

By late 2025, the U.S. Army had also publicly confirmed that it is pursuing a CCA-like capability, making it the last of the four services to formally move toward manned-unmanned teaming in a structured way. Rather than immediately launching a full program of record, Army aviation leadership has used 2025 to study Air Force and Navy efforts and conduct its own experiments, looking at how a CCA concept might support land-centric operations and Future Vertical Lift platforms. Brig. Gen. Cain Baker, who leads the Army's Future Vertical Lift Cross Functional Team, indicated that the service is targeting an initial capability within "the next couple of years," contingent on continued experimentation and refined requirements.

The Army has been testing relevant technologies in its annual aviation experimentation events and through market-outreach activities assessing industry offerings in the Group 4 and Group 5 unmanned aircraft space. This more cautious and iterative posture reflects both the Army's distinct operational needs and a desire to avoid locking in requirements before the service fully understands how CCAs should interact with helicopters, long-range fires, and distributed ground formations. In practice, the Army's move signals that CCA-style systems are becoming a joint expectation rather than a niche Air Force project.

Taken together, these developments suggest that the CCA concept has passed its initial credibility test and is now entering a decisive phase where the key questions shift from "can it be built?" to "can it be fielded at scale and integrated into real operations?". For the Air Force, 2026 will be about continuing flight tests of the YFQ-42A and YFQ-44A, awarding further design work for Increment 2 to a broader pool of industry participants, and convincing Congress that logistics, basing, and sustainment plans are robust enough to support hundreds of large uncrewed aircraft. Across the Navy, Marine Corps, and Army, 2026 will test whether their emerging programs can convert paper roadmaps into executable increments that produce usable capabilities for frontline units rather than endlessly deferred science projects.

At the operational level, CCAs are central to restoring mass and resilience to U.S. combat air power in the face of sophisticated Chinese and Russian air defenses. The combination of relatively lower unit cost, modular payloads, and AI-enabled autonomy promises to extend the reach, sensing, and striking power of a shrinking fleet of manned aircraft, provided the services can solve the challenges of command and control, data links, and cross-domain integration. The next two to three years, therefore, will not simply determine the fate of a single program; they will indicate whether the

U.S. can establish a repeatable pattern for rapidly fielding autonomous collaborative platforms across domains, turning CCA from a promising prototype into a durable pillar of future force design.

January 19, 2026

CHAPTER 3

THE F-35'S DEFINING ROLE IN ISRAEL'S HISTORIC CAMPAIGN AGAINST IRAN

NJune 2025, Israel executed the most ambitious air campaign in its history, Operation Rising Lion, striking targets over 1,000 miles away across a nation 75 times its size.

Over twelve days, Israeli aircraft flew more than 1,400 sorties against Iran's nuclear facilities, ballistic missile infrastructure, and military leadership without losing a single manned aircraft.

At the heart of this unprecedented achievement was a weapons system that fundamentally transformed how Israel could project power: the F-35 "flying combat system" wolf-pack fighter.

According to a **comprehensive new report** from the Jewish Institute for National Security of America (JINSA), the F-35's role went far beyond simply participating in the campaign.

Israeli pilots and commanders described the aircraft as so essential that they refused to enter Iranian airspace without F-35s leading the way.

This integration of America's most advanced fighter into Israel's operational doctrine not only enabled the June 2025

strikes but demonstrated capabilities that exceeded even optimistic expectations and set new standards for modern air warfare.

To understand the significance of Operation Rising Lion, one must first grasp the strategic context. This wasn't simply a "12-Day War" that erupted without warning, as American media often portrayed it. Israeli officials told JINSA researchers that the operation represented the culmination of Iran's three-decade pursuit of Israel's elimination through three coordinated lines of effort: developing nuclear weapons capability, building massive ballistic missile arsenals, and creating a "ring of fire" of terrorist proxies surrounding Israel.

By late 2024, Iran had made alarming progress on all three fronts. Its nuclear program had advanced to the point where U.S. intelligence assessed Iran could produce enough weapons-grade uranium for multiple bombs within weeks of a decision to do so. Its ballistic missile stockpile had grown to approximately 2,500 missiles capable of reaching Israel, with plans to triple that number within two years. And its proxy network, Hamas, Hezbollah, Palestinian Islamic Jihad, the Houthis, and various militias, had become a formidable deterrent force.

Hamas's October 7, 2023 terrorist attack proved to be the catalyst. Israeli leadership realized that so long as Iran, the "head of the octopus", remained untouched, there would always be another tentacle ready to strike.

Over the following months, Israel systematically dismantled Iran's proxy network: degrading Hamas in Gaza, devastating Hezbollah's leadership and capabilities in Lebanon, and eliminating Syrian air defenses after Assad's fall. By June 2025, Israel had created both the opportunity and the necessity to strike Iran directly.

Initially, Israeli planners conceived of their Iran operation as a series of pinpoint surgical strikes targeting only the enrichment facilities at Natanz and Fordow.

However, as Iran accelerated both its nuclear weapons research and its ballistic missile production following an October 2024 exchange of fire, Israeli military leaders fundamentally reimagined their approach.

The expanded operational plan required something Israel had never attempted: conducting sustained operations over a major regional power more than a thousand kilometers from its borders.

More targets meant more sorties.

The Israel Air Force undertook the ambitious task of preparing its entire fleet for extended, long-range missions.

Initially, planners didn't envision using F-16s, given their more limited range and payload compared to the F-15I.

However, as the campaign's scope expanded, F-16s were added to strike packages to provide additional flexibility and sortie capacity.

Yet even with this expansion, no Israeli aircraft would enter Iranian airspace at any point unless F-35s led the way and Israeli pilots made clear they wouldn't have wanted to fly in Iran without the F-35s there.

Israel's confidence in the F-35 wasn't theoretical.

By June 2025, Israeli pilots had accumulated more combat flight hours in the F-35 than any other air force in the world. Israel became the first nation to use the F-35 in combat operations back in May 2018, and in March 2025 became the first to fly it in "beast mode" or carrying external underwing munitions that sacrifice some stealth for increased payload capacity.

This operational experience translated into concrete capability improvements.

Since October 7, 2023, the average flight hours per Israeli F-35 had soared from 440 to 2,250 hours, reflecting the intense pace and critical role of these advanced fighters in Israel's ongoing conflicts. Israel had built a fleet of 44 F-35 jets orga-

nized into two full squadrons plus a flight trainer, with five additional jets expected within two to three years.

But quantity alone doesn't explain the F-35's decisive impact.

What made the aircraft indispensable was its revolutionary sensor fusion and information-sharing capabilities, combined with Israeli innovations and real-time adaptations that kept the fleet perpetually one tactical step ahead of Iranian defenses.

The F-35's advanced sensor suite and data-sharing capabilities fundamentally changed how Israeli strike packages operated.

The aircraft could transmit sensor data instantly to other Israeli jets, which could "lock on" to F-35 radars for synchronized attacks.

This meant F-16s and F-15Is could engage targets detected by F-35s without those aircraft ever needing to activate their own radars, a critical advantage when operating in contested airspace with sophisticated air defenses.

Even more importantly, the F-35's extended detection range allowed for broader coverage and eliminated the need for tight formation flying.

Rather than relying on visual contact or closely coordinated flight patterns traditional to air operations, F-35s could guide and direct other aircraft across the battlespace from dozens of miles away, maximizing both survivability and strike effectiveness.

Israel's capacity to update F-35 electronic warfare systems in real time, drawing directly from recent combat experience in Lebanon and Syria, ensured that the fleet was always adapted to the latest threat environment.

When the campaign began, Israeli F-35s were specifically configured to counter Iranian air defense systems based on the most current intelligence available.

Initially, Israeli planners were uncertain about the profiles

and operational characteristics of many indigenous Iranian surface-to-air missile systems, which stood in contrast to Russian systems that Israel had previously studied and operated against in Syria. Some Iranian systems relied solely on optical tracking, complicating detection and countermeasures. Israeli intelligence also recognized that Iran had demonstrated an ability to adapt, especially in its responses to Israeli strikes in April and October 2024.

This is where the F-35's unique capabilities proved decisive.

The aircraft possessed the ability to detect air defense systems even when those defenses operated in survivability mode and remained invisible to standard intelligence collection.

When Iranian radar or missile sites activated, F-35s could immediately spot them, effectively serving as an airborne early warning or electronic warfare aircraft.

The F-35 would then relay targeting information to other jets, such as F-16s and F-15s, enabling rapid and precise strikes against defenses that would otherwise have gone unnoticed.

Israeli commanders told JINSA researchers that this capability exceeded expectations. The F-35s detected and targeted surface-to-air missile sites with remarkable ease, and their sophisticated targeting systems performed flawlessly in the dynamic battlespace.

By the middle of the conflict, Iranian SAM systems between the Iraq border and Tehran had mostly stopped operating due to coordinated air defense suppression missions that the F-35 made possible.

The integration of F-35s into Israeli operations wasn't merely supportive. It was foundational to the entire campaign.

Israeli military doctrine for Operation Rising Lion mandated that no aircraft entered Iranian airspace unless F-

35s were present, whether leading formations directly or escorting packages of F-15s and F-16s from dozens of miles away.

One Israeli pilot told JINSA researchers directly: they would not have wanted to fly in Iran without the F-35s there. This wasn't hyperbole or marketing speak. It reflected the stark operational reality that the F-35's sensor capabilities, survivability features, and real-time electronic warfare adaptations were essential for operating in Iran's contested airspace.

The aircraft's combination of multi-role capabilities, real-time intelligence sharing, and networked combat effectiveness established the F-35 as the critical centerpiece of Israeli air operations. Its ability to detect threats, coordinate strikes, suppress air defenses, and survive in contested environments enabled Israel to achieve air superiority rapidly and maintain it throughout the twelve-day campaign.

The results speak for themselves. Over twelve days, the IAF flew more than 1,400 long-range sorties, each lasting roughly four to four-and-a-half hours—against targets up to 1,000 miles away without losing a single manned aircraft, sustaining battle damage, or suffering a major mechanical failure. Israeli pilots dropped 3,709 bombs on 2,879 Iranian targets, with F-35s playing a central role in target identification, air defense suppression, and strike coordination.

Iran managed to launch only two surface-to-air missiles against manned Israeli aircraft during the entire campaign, and neither came close to hitting their targets. This extraordinary defensive success operating deep in hostile territory against a nation that had invested heavily in air defenses demonstrated not just tactical proficiency but fundamental technological and operational superiority enabled by the F-35.

The aircraft's success also facilitated U.S. Operation Midnight Hammer. Israeli F-35s and other aircraft cleared

ingress routes for American B-2 bombers, struck additional targets specifically requested by U.S. CENTCOM, and provided battle damage assessments that confirmed conditions for U.S. strikes on Iranian nuclear facilities. Israel's air superiority, achieved largely through F-35-enabled operations, ensured that U.S. warplanes could deliver their weapons uncontested.

The F-35's performance during Operation Rising Lion has profound implications for U.S.-Israeli defense cooperation and regional security architecture.

The aircraft validated the billions of dollars invested in its development and demonstrated capabilities that few analysts fully anticipated.

For Israel, it proved that distance and sophisticated defenses are no longer insurmountable obstacles to holding adversary targets at risk.

Yet JNSA's report also identifies critical gaps and future requirements. While the F-35 performed brilliantly, Israel's aging fleet of Boeing 707-based "Ram" refueling tankers proved precarious to operate and maintain. Israeli pilots told researchers they felt safer flying over Tehran than trying to keep the aging tankers airborne. The report strongly recommends that the United States expedite delivery of KC-46 aerial refueling tankers, currently scheduled for 2026, to address this critical vulnerability.

The report also emphasizes that ensuring Israel maintains the capabilities demonstrated in June 2025 serves American interests. Israel's ability to independently defend itself and U.S. security interests against Iranian threats reduces the need for direct U.S. military intervention while demonstrating to allies and adversaries alike the credibility of American security commitments.

Operation Rising Lion offers several lessons for military planners and strategists.

- First, sensor fusion and networked operations aren't

merely technical improvements. They represent fundamental shifts in how air campaigns can be conducted. The F-35's ability to serve simultaneously as a strike platform, electronic warfare asset, intelligence collection system, and command-and-control node created operational possibilities that didn't exist with previous generations of aircraft.

- Second, persistent training and combat experience matter enormously. Israel's eight years of F-35 combat operations, accumulated through thousands of sorties across multiple conflicts, created institutional knowledge and tactical innovations that generic training exercises cannot replicate. The Israeli Air Force's ability to rapidly update electronic warfare systems based on recent combat lessons gave them crucial advantages against Iranian defenses.

- Third, technological superiority can offset numerical and geographical disadvantages but only when properly integrated into operational doctrine. The F-35 wasn't simply added to Israeli strike packages; it fundamentally shaped how those packages were organized, how missions were planned, and how operations unfolded. This level of integration requires years of doctrinal development, training, and organizational adaptation.

As Iran works to rebuild its degraded capabilities, the F-35 will remain central to Israeli deterrence and, if necessary, future operations.

The aircraft's demonstrated ability to penetrate advanced air defenses, detect hidden threats, coordinate complex strike packages, and enable other aircraft to operate safely in contested environments makes it irreplaceable in Israel's strategic toolkit.

JINSA's report emphasizes that maintaining Israel's qualitative military edge, symbolized perhaps most clearly by F-35 capabilities, serves broader American strategic interests. As Iran potentially seeks to reconstitute its nuclear program, rebuild its missile arsenals, and restore its proxy networks,

Israel's ability to hold these capabilities at risk, enabled by the F-35, provides crucial deterrence against Iranian aggression.

The June 2025 campaign demonstrated that modern air warfare has entered a new era where sensor fusion, stealth, electronic warfare, and networked operations combine to create decisive advantages.

At the center of this transformation stands the F-35, not just as another fighter aircraft, but as a system that fundamentally changes what's possible in modern military operations.

For Israel, the F-35 transformed Operation Rising Lion from an audacious gamble into a calculated success.

For the United States, it validated decades of investment and demonstrated capabilities that reinforce deterrence across multiple theaters. And for future conflicts, it established new standards for what advanced air forces can achieve when cutting-edge technology meets operational excellence and strategic necessity.

November 30, 2025

CHAPTER 4

F-35 QUARTERBACKS AND CCAS: THE BEHAVIORAL PATH TO SIXTH- GENERATION AIRPOWER

The concept of fifth-generation air warfare was clearly articulated by former Secretary of the Air Force Michael Wynne during the early development of the F-35 Joint Strike Fighter program. Wynne emphasized a fundamental shift from platform-centric thinking to network-centric operations, where stealth, sensor fusion, and information dominance would define a new era of air combat. The aircraft itself became a flying information node, integrating data from multiple sources and distributing targeting information across the battlespace. This clear conceptual framework guided procurement, training, and operational integration for nearly two decades.

In contrast, the sixth-generation concept remains frustratingly opaque. While the Air Force's Next Generation Air Dominance (NGAD) program and the Navy's F/A-XX effort have generated significant discussion, there is no equivalent to Wynne's clear articulation of what defines this next generation. Various characteristics have been proposed, adaptive cycle engines, enhanced range, advanced materials, open architecture, but these represent incremental improvements rather than a transformative operational concept.

However, one element has emerged with increasing clarity: the crewed fighter operating in a "wolfpack" configuration with Collaborative Combat Aircraft (CCAs). This human-machine teaming approach represents a genuinely revolutionary shift in how air power is generated and applied.

Yet here is the critical insight that defense planners are beginning to recognize: the F-35 itself can be reworked to serve as the quarterback in such wolfpack formations. Rather than waiting for an entirely new airframe to deliver sixth-generation capabilities, we are witnessing a hybrid transition where existing fifth-generation platforms evolve to exhibit sixth-generation behavior through integration with autonomous systems.

THE F-35 AS AN EVOLVING PLATFORM

The F-35's design philosophy, rooted in Wynne's vision, incorporated open architecture and continuous software upgrades from its inception. Unlike legacy platforms where capabilities were essentially frozen at delivery, the F-35 was conceived as a constantly evolving system. This approach, though criticized for creating sustainment challenges, positioned the platform for adaptation to collaborative combat operations.

The aircraft's sensor fusion capabilities, integrating data from its AN/APG-81 AESA radar, electro-optical targeting system, distributed aperture system, and electronic warfare suite, create a comprehensive battlespace picture that exceeds what any single pilot can fully exploit. This information richness, initially designed to enhance situational awareness for the pilot, becomes the foundation for commanding autonomous loyal wingmen. The F-35 already processes and distributes more information than a single human can utilize; extending that processing to coordinate unmanned systems

represents an expansion of existing capability rather than a fundamental redesign.

Recent developments in the F-35 program demonstrate this evolution. Block 4 upgrades include enhanced computing power, increased data storage, and improved communications architecture, all essential for managing multiple CCAs simultaneously. The Technology Refresh 3 (TR-3) initiative, despite its delays, fundamentally increases the aircraft's processing capacity, enabling it to serve as a command node for distributed operations. These are not merely incremental improvements; they represent the technical foundation for sixth-generation operational concepts.

THE COLLABORATIVE COMBAT AIRCRAFT REVOLUTION

The CCA concept emerged from recognition that exquisite manned platforms, operating alone, cannot achieve the mass necessary for high-intensity conflict against peer adversaries. The economics are straightforward: a single F-35 costs approximately \$85 million; a CCA is projected to cost between \$20-30 million. This cost differential enables force multiplication, instead of four F-35s operating independently, imagine four F-35s each commanding two to four CCAs, creating a force of 12-20 platforms with substantially greater capability than the original four.

But CCAs represent more than simple force multiplication through numbers. They enable entirely new tactical approaches by accepting risk that cannot be imposed on crewed aircraft. CCAs can penetrate dense air defense networks to serve as forward sensors, suppress enemy air defenses through saturation attacks, or provide deceptive electronic warfare signatures, all missions where the loss of an unmanned platform is acceptable but the loss of a pilot is not.

The wolfpack concept leverages this risk calculus. The

crewed F-35 operates at standoff range, preserving the irreplaceable human pilot while orchestrating autonomous systems that engage more directly with enemy defenses. The human provides strategic judgment, ethical oversight, and adaptive decision-making; the CCAs provide mass, forward presence, and expendable persistence. This division of labor represents a fundamentally different operational model than either fifth-generation platform-centric operations or traditional unmanned aircraft employment.

FROM FIFTH TO SIXTH: A BEHAVIORAL RATHER THAN PLATFORM TRANSITION

This realization forces a reconceptualization of generational transitions in air warfare. Previous generations were defined primarily by platform characteristics: fourth-generation fighters introduced fly-by-wire controls and beyond-visual-range missiles; fifth-generation platforms added stealth and sensor fusion. The leap to sixth generation, however, is better understood as behavioral or capability enhanced rather than platform-based transition. It's defined by how forces operate, not what individual platforms can do.

An F-35 operating alone in 2024 exhibits fifth-generation behavior. The same F-35, upgraded with enhanced processing and communications, operating as the quarterback for a formation of four CCAs in 2028, exhibits sixth-generation behavior. The platform itself has evolved incrementally, but the operational capability has transformed fundamentally.

This represents a practical application of the force multiplier integration concept I have developed in my recent work on naval transformation. Rather than hybrid fleets where different platform types operate in parallel, we see genuine integration where the whole exceeds the sum of its parts. The F-35 becomes more capable when paired with CCAs than it

could ever be through internal upgrades alone; the CCAs become exponentially more effective under human direction than they could be operating autonomously.

THE ECONOMIC AND STRATEGIC LOGIC

The hybrid transition approach offers compelling advantages over waiting for a clean-sheet sixth-generation platform. The F-35 production line is mature, with over 1,000 aircraft delivered and production rates approaching 150-180 per year. The industrial base exists, the training pipeline is established, and international partnerships are solidified. Pivoting entirely to a new platform would sacrifice these advantages and create a dangerous capability gap during transition.

Moreover, the F-35's development history decades of cost growth and schedule delays should instill caution about betting everything on a new program. The NGAD program encountered major turbulence in 2024, when Air Force Secretary Frank Kendall pressed 'pause' on the fighter segment for several months to reassess the design concept amid projected unit costs on the order of \$300 million per aircraft. In an era of constrained budgets and rising peer competition, the risk-adjusted approach favors evolving existing platforms rather than pursuing revolutionary new ones. Just calling it an F-47 will not solve the problem.

The CCA development approach reflects this pragmatism. Rather than specifying detailed requirements and pursuing a single solution, the Air Force has embraced an incremental approach with multiple contractors developing competing designs across different capability increments.

Internationally, this approach leverages the F-35's unique position as the most widely adopted fighter aircraft in history. With partners including the UK, Italy, Japan, Australia, and many others operating F-35s, the wolfpack concept can prolif-

erate globally through CCA integration rather than requiring these nations to develop entirely new platforms. The interoperability advantages are substantial. Allied forces could integrate their CCAs with partner nation F-35s, creating flexible coalitions that share the burden of developing autonomous systems while maintaining commonality in the crewed quarterback platform.

TRAINING AND CULTURAL TRANSFORMATION

The shift to wolfpack operations requires fundamental changes in how pilots are trained and how air warfare is conceptualized. As my recent research at Italy's International Flight Training School demonstrates, fifth-generation pilot training has already moved beyond traditional stick-and-rudder skills to emphasize information management and decision-making within complex networks. The transition to commanding autonomous wingmen accelerates this cognitive transformation.

Pilots must develop new skills in delegation, trust calibration with autonomous systems, and management of distributed forces. The traditional fighter pilot ethos, individual mastery of the aircraft, must expand to encompass orchestration of multiple platforms. This is not a diminishment of the pilot's role but an expansion into command responsibilities previously reserved for more senior officers. The lieutenant flying an F-35 with four CCAs is effectively commanding a formation, making tactical decisions that previously would have been made by a flight lead or mission commander.

This cultural shift presents challenges, particularly for air forces steeped in traditions of individual aerial combat. Yet it also creates opportunities for innovation in tactics, techniques, and procedures that would be impossible with

crewed aircraft alone. The Live-Virtual-Constructive training environments that I observed at IFTS provide the ideal laboratory for developing these new approaches, allowing pilots to experiment with wolfpack tactics in simulation before risking actual CCAs in flight.

THE PATH FORWARD

The hybrid transition is already underway, though it has not been officially recognized as the primary path to sixth-generation capability. The Air Force's CCA program aims to field initial operational capability with F-35s and potentially upgraded F-15EXs serving as the command platforms. Software upgrades to the F-35 continue to enhance its ability to integrate off-board sensors and direct autonomous systems. Industry partners are developing the enabling technologies from AI-enabled mission planning to secure datalinks to human-machine interfaces.

What remains is official acknowledgment that this represents the sixth-generation transition, not merely a bridge to some future clean-sheet platform. Such recognition would have practical implications for resource allocation, requirements development, and strategic planning. Rather than hedging between F-35 evolution and NGAD development, the Department of Defense could commit fully to the wolfpack concept, accelerating both CCA development and the F-35 upgrades necessary to command them effectively.

This approach does not preclude eventual development of a new crewed platform. But it recognizes that sixth-generation behavior, human-machine teaming in distributed operations, can be achieved through evolution of existing systems paired with revolutionary autonomous platforms. The urgency of strategic competition with China does not allow the luxury of waiting for perfect solutions; it demands

fielding effective capabilities rapidly using available platforms.

CONCLUSION

Secretary Wynne's clarity about fifth-generation warfare centered on the operational concept: it was about how aircraft operated within networks, not merely what the individual platforms could do. The sixth generation should be understood through the same lens. It is defined by the wolfpack behavior, crewed platforms commanding autonomous systems to achieve effects impossible for either alone, not by any particular airframe configuration or technology.

The F-35, continuously upgraded and paired with increasingly capable CCAs, can exhibit sixth-generation behavior. This hybrid transition offers the most pragmatic path to fielding the capabilities necessary for high-end conflict in the 2030s. It leverages existing industrial capacity, preserves international partnerships, and allows incremental risk reduction through rapid iteration of autonomous systems.

The conceptual clarity that defined the fifth generation has been absent from sixth-generation discussions. Perhaps that is because we have been looking for it in the wrong place, in platform specifications rather than operational behavior. Once we recognize that sixth-generation warfare is about the wolfpack, the path forward becomes clear: evolve the F-35 into the quarterback it was always designed to become, and pair it with the autonomous teammates that technology now makes possible. That is sixth-generation warfare, and it is achievable today, not in some distant future.

January 26, 2026

CHAPTER 5

ITALY'S STRATEGIC LEAP: FROM F-35 TRAINING HUB TO SIXTH-GENERATION INTEGRATION

Italy's recent approval to invest €112.6 million in establishing the Lightning Training Center at Trapani-Birgi Air Base represents far more than a conventional infrastructure project. This facility, scheduled to achieve initial training capability by December 2028 and full operational status by July 2029, marks the first F-35 pilot training center outside the United States and signals a fundamental transformation in how European air forces prepare for fifth-generation operations.

More importantly, it reveals how training ecosystems built on proven methodologies can serve as foundational architecture for the even more complex demands of sixth-generation warfare.

The selection of Trapani-Birgi in northwestern Sicily carries strategic weight that extends well beyond geography. Currently home to the Italian Air Force's 37th Wing operating Eurofighter Typhoons, the base will host both an Italian operational F-35 squadron and an international training squadron, creating a unique convergence of daily combat operations and multinational pilot preparation.

This dual-use model positions Italy as a permanent

European node within the global F-35 training network, reducing dependence on transatlantic deployments to Luke Air Force Base in Arizona while accelerating pilot production timelines for NATO and partner nations.

THE IFTS FOUNDATION: PROVEN TRAINING ARCHITECTURE

The establishment of the Lightning Training Center builds directly on the success of Italy's International Flight Training School at Decimomannu, Sardinia, where the synergy between the Italian Air Force and Leonardo has already demonstrated the capacity to deliver world-class advanced aviation training. The IFTS, centered on Leonardo's M-346 platform, represents a revolutionary shift from traditional "stick-and-rudder" instruction to cognitive-focused education emphasizing information management and network-centric operations.

Field research at IFTS reveals a training methodology that prioritizes building mental models over mechanical skill acquisition. The Live-Virtual-Constructive training environment allows students to operate simultaneously in physical cockpits, networked simulators, and synthetic threat scenarios, creating a seamless continuum where pilots develop the cognitive capacity to manage information flow, prioritize threats, and execute decisions within compressed timelines.

Italian Air Force instructors at IFTS emphasize that modern fighter pilots must function as "information managers" first and aviators second, a philosophy that applies even more acutely to fifth-generation operations where sensor fusion and multi-platform coordination define combat effectiveness.

This training architecture proves particularly relevant to F-35 preparation because it addresses the fundamental chal-

lenges of fifth-generation aviation: the aircraft's capabilities far exceed traditional pilot workload management paradigms.

An F-35 pilot operates not as an individual platform commander but as a node within a distributed kill web, synthesizing data from multiple sensors, sharing targeting information across formations, and coordinating effects with both manned and unmanned assets. The cognitive skills developed through IFTS's Live-Virtual-Constructive methodology provide precisely the foundation required for this transition.

FROM CRISIS MANAGEMENT TO CHAOS MANAGEMENT: TRAINING FOR PERSISTENT COMPLEXITY

The Lightning Training Center's curriculum must address a more fundamental shift in operational philosophy that transcends traditional crisis management frameworks. Contemporary military operations no longer follow predictable cycles of stability punctuated by discrete crises requiring resolution. Instead, forces must operate effectively within persistent complexity, where multiple overlapping challenges create continuous chaos that cannot be "managed" back to stability but must be navigated as an enduring condition.

This transition from crisis management to chaos management reflects battlefield realities observed across multiple theaters, from Ukraine's demonstration of drone warfare innovation to contested operations in the Indo-Pacific.

Fifth-generation pilots require training that develops comfort with ambiguity, rapid decision-making under incomplete information, and the cognitive flexibility to adapt tactics in real-time as situations evolve. The F-35's advanced sensor suite and network integration capabilities enable pilots to perceive this complexity, but only proper training transforms perception into effective action.

The Lightning Training Center's two Full Mission Simulators and associated Pilot Training Devices will provide essential infrastructure for building these capabilities, but the curriculum design must go beyond traditional scenario-based training. Students require exposure to dynamic, multi-domain scenarios where adversaries adapt, friendly forces pursue conflicting objectives, and information environments include both accurate intelligence and deliberate deception.

This approach mirrors best practices already established at IFTS, where synthetic training environments create complexity that matches or exceeds operational reality.

STRATEGIC POSITIONING: ITALY AS A EUROPEAN DEFENSE HUB

Italy's investment in the Lightning Training Center reinforces a broader strategic positioning within European defense architecture that extends well beyond F-35 operations. The Final Assembly and Check-Out facility at Cameri already establishes Italy as a manufacturing and sustainment hub for European F-35 fleets, having assembled aircraft for both Italy and the Netherlands while providing maintenance for Italian, Norwegian, Dutch, and British jets. The addition of multinational training capability creates a complete lifecycle presence from production through pilot preparation to operational sustainment.

This positioning carries particular significance as European air forces expand their F-35 fleets. Italy, the Netherlands, Norway, Denmark, the United Kingdom, Poland, Finland, Switzerland, the Czech Republic, Germany, and Belgium have all committed to the platform, creating demand for qualified pilots that far exceeds Luke Air Force Base's finite capacity.

A European training hub reduces ferry costs, eliminates transatlantic personnel rotations, and allows national instruc-

tors to cycle through common curricula while respecting sovereignty requirements. More importantly, it creates opportunities for tactical standardization and interoperability training that proves essential for coalition operations.

The facility's location along the Mediterranean seam line between Europe, North Africa, and the Levant provides additional operational value. Students train in airspace characteristics and threat environments that match actual deployment conditions more closely than Arizona desert operations, developing tactics appropriate for the contested littorals and complex electromagnetic environments they will encounter in operational assignments.

NETWORK-CENTRIC TRAINING: BUILDING MULTI- PLATFORM COMPETENCE

The Lightning Training Center's curriculum design must address network-centric operations as a core competency rather than an advanced skill. F-35 pilots operate within a Multi-Function Advanced Data Link environment where aircraft share targeting data automatically, creating a common operational picture that transcends individual platform sensors.

Training scenarios must develop pilots' capacity to leverage this networked awareness while maintaining the cognitive flexibility to operate independently when network connectivity degrades or adversaries employ electronic warfare.

This requirement connects directly to 6th generation development priorities, where autonomous collaborative platforms will require operators to manage networks that include both manned fighters and unmanned effectors.

The F-35 provides an essential developmental platform for these capabilities, allowing pilots to build fundamental skills

in managing information flow across distributed formations before transitioning to the more complex human-machine teaming required by sixth-generation operations.

Field research at IFTS demonstrates that effective network-centric training requires more than simply connecting multiple simulators. Students must develop mental models that incorporate wingmen, support assets, and threat systems as dynamic participants in an evolving tactical problem rather than static elements in a predetermined scenario.

Instructors at Decimomannu emphasize that students initially struggle with the cognitive load of managing these multiple information streams but develop capacity through progressive exposure to realistic complexity.

The Lightning Training Center's Special Access Program Facility will enable classified training that incorporates actual F-35 mission systems and operational methods, providing realism impossible to achieve through non-classified simulation. This capability proves essential for developing proficiency with advanced electronic warfare techniques, low-probability-of-intercept communications, and fusion algorithms that synthesize data across multiple sensor types and platforms.

ECONOMIC AND INDUSTRIAL IMPLICATIONS

Beyond operational considerations, the Lightning Training Center carries significant economic implications for European defense industrial capacity. The project's €112.6 million investment creates immediate construction and equipment procurement opportunities while generating long-term sustainment revenue from training system maintenance, software updates, and courseware development. Lockheed Martin's exclusive supply rights for simulation technology ensure American industrial participation, but

Leonardo's partnership role preserves Italian expertise and employment.

More strategically, the facility strengthens Italy's position within the F-35 enterprise as a nation providing added value beyond simple aircraft operation. Training capability creates dependencies that extend beyond hardware procurement cycles, as pilot preparation requires continuous access to simulation systems, threat libraries, and instructional expertise.

Nations sending pilots to Trapani-Birgi for training establish relationships with Italian instructors, Leonardo engineers, and Lockheed Martin representatives that facilitate knowledge transfer and promote interoperability across the program's lifecycle.

This model proves particularly relevant as European nations consider their engagement in 6th generation aircraft development. The ability to contribute training expertise alongside manufacturing capacity provides multiple pathways for industrial engagement beyond traditional work-share negotiations over airframe assembly or avionics integration. Italy's demonstrated success with both IFTS and the Lightning Training Center establishes credibility for similar contributions to GCAP training architecture development.

INTEGRATION CHALLENGES: BRIDGING FIFTH AND SIXTH GENERATIONS

The transition from fifth to sixth-generation aviation presents training challenges that extend beyond simple platform differences. Training pilots for adaptive platforms requires curricula that develop learning agility rather than procedural mastery. Students must understand system architectures well enough to rapidly incorporate new capabilities as they

become available, a requirement that challenges traditional aviation training paradigms focused on standardization and procedural compliance.

The Lightning Training Center's curriculum development must anticipate this transition, preparing F-35 pilots who will eventually operate GCAP aircraft to function as continuous learners rather than certified technicians executing predetermined tasks.

Field research at IFTS suggests that younger students adapt more readily to this learning paradigm than pilots transitioning from earlier generations. The Live-Virtual-Constructive environment's ability to modify scenarios in real-time creates natural opportunities for students to develop cognitive flexibility, as instructors can inject new threat systems or modify mission parameters mid-exercise, requiring rapid tactical adaptation.

This approach mirrors the operational reality of platforms whose capabilities evolve through software updates rather than remaining static.

CONCLUSION: TRAINING AS STRATEGIC ARCHITECTURE

Italy's establishment of the Lightning Training Center at Trapani-Birgi represents far more than infrastructure investment or industrial policy. The facility embodies recognition that pilot training constitutes strategic architecture as critical as aircraft design or manufacturing capacity.

The methodologies developed at IFTS and now extending to F-35 preparation provide foundational capabilities applicable to sixth-generation aircraft operations, creating continuity across platform generations while preserving flexibility to adapt as requirements evolve.

The convergence of proven training ecosystems, fifth-generation operations, and sixth-generation development

creates opportunities for Europe to build competitive advantages in domains beyond traditional industrial metrics.

Cognitive training that develops information managers capable of operating within persistent complexity rather than resolving discrete crises provides capabilities applicable across military operations beyond aviation.

The chaos management paradigm developed through advanced aviation training translates directly to joint operations, multi-domain coordination, and the strategic competition environment that defines contemporary security challenges.

Italy's investment demonstrates understanding that technological superiority alone proves insufficient without the human capital to employ complex systems effectively. The Lightning Training Center's success will ultimately be measured not by simulator fidelity or facility construction quality but by the combat effectiveness of pilots prepared there.

Early indicators suggest Italy has positioned itself to succeed, building on IFTS's proven methodologies while adapting to F-35's unique requirements and anticipating 6th generation aircraft's even greater demands.

The facility establishes Italy as a European defense hub whose contributions extend well beyond national requirements to enable collective capabilities essential for allied operations in an increasingly contested strategic environment.

February 2, 2026

CHAPTER 6

THE EVOLUTION OF AIRPOWER: THE 2025 BOOKS

In 2025, four significant books emerged that collectively chronicle the transformation of airpower from its industrial-age roots to its current form as a networked, information-centric enterprise. These volumes, *Training for the High-End Fight*, *Remembering the B-17 and Its Role in World War II, Italy and the F-35*, and the second edition of *My Fifth Generation Journey*, together provide a comprehensive narrative arc that spans from the strategic bombing campaigns of World War II to the software-defined combat systems shaping contemporary warfare.

What makes this collection particularly valuable is not simply its chronological sweep, but its demonstration of how the fundamental nature of airpower has evolved from platform-centric operations to integrated, coalition-enabled kill webs.

FROM PLATFORM TO NETWORK: THE CENTRAL TRANSFORMATION

The most striking theme across these four books is the transition from viewing aircraft as individual combat platforms to

understanding them as nodes within larger networks. This transformation represents nothing less than a revolution in how we conceive of airpower itself. The B-17 Flying Fortress, documented in *Remembering the B-17*, exemplified the industrial-age approach to air warfare. Success depended on building enough aircraft, training enough crews, and accepting devastating losses as the price of strategic effect. The bomber formations over Europe operated in coordinated patterns, but each aircraft remained fundamentally autonomous once airborne, its crew making decisions based on limited information and visual contact with the enemy.

Training for the High-End Fight captures the endpoint of this transformation, describing a combat environment where fifth-generation aircraft like the F-35 function as "information supercomputers" rather than merely improved fighters. The book's central insight is that modern pilots must be "intellectual athletes" and "digital connectors" capable of managing vast flows of real-time data across air, land, sea, space, and cyber domains. This is not simply an upgrade in capability; it represents a categorical shift in what airpower means. Where the B-17 crew focused on navigation, bomb delivery, and defensive gunnery, today's F-35 pilot operates as a collaborative manager of network power, processing information from sensors distributed across the battlespace and coordinating strikes executed by platforms they may never see.

The book on Italy's F-35 program reinforces this networked perspective by demonstrating how a mid-tier power leveraged the Lightning II to transform itself into a global force multiplier. Italy's approach, building the Cameri facility as a strategic nerve center for F-35 production and sustainment, shows understanding that influence in modern airpower derives not from platform count but from position within the international defense network. By making itself indispensable to F-35 operations across Europe and beyond,

Italy achieved strategic weight disproportionate to its traditional military ranking.

THE COGNITIVE REVOLUTION IN PILOT TRAINING

Training for the High-End Fight makes perhaps its most important contribution in documenting what it terms the "cognitive revolution" in pilot preparation. The book argues forcefully that yesterday's training paradigms are not merely outdated but actively detrimental to developing the mental agility required for modern combat. Traditional training emphasized mastery of aircraft systems and tactical procedures—essentially preparing pilots to execute known solutions to anticipated problems. The high-end fight demands something entirely different: the ability to thrive amid ambiguity, rapidly shifting circumstances, and scenarios requiring creative, on-the-fly problem solving.

This cognitive shift finds its practical expression in the "live-virtual-constructive" training ecosystem pioneered at facilities like Italy's International Flight Training School. By blurring the boundaries between actual flight and advanced simulation, these systems expose trainees to the intensity and complexity of true combat, complete with electronic warfare, joint operations, and adaptive adversaries, without the expense and risk of live exercises. More importantly, instructors can inject constant friction, forcing pilots to develop adaptive thinking rather than procedural response.

The second edition of *My Fifth Generation Journey* reinforces this point through its documentation of how F-35 pilots discovered that the aircraft demanded fundamentally different cognitive approaches than legacy fighters. As one section notes, the F-35 represents a "software-upgradeable aircraft" designed for continuous evolution rather than periodic major upgrades. This means pilots must develop not just

proficiency with current systems, but the intellectual flexibility to rapidly assimilate new capabilities as they emerge through software updates. The traditional model of mastering a static weapons system has given way to permanent learning and adaptation.

KILL CHAINS TO KILL WEBS: THE OPERATIONAL PARADIGM

The evolution from "kill chains" to "kill webs" provides the operational framework that unites these books. The kill chain concept, identify, fix, track, target, engage, assess, emerged from the Cold War emphasis on linear processes and centralized control. It worked well enough when the pace of conflict allowed sequential decision-making and adversaries lacked sophisticated sensors and weapons. *Training for the High-End Fight* documents why this approach has become obsolete. Modern adversaries operate with machine-speed sensor and weapons systems. Single points of failure, inherent in linear kill chains, have become fatal liabilities.

Kill webs represent the alternative: flexible, distributed networks where every sensor, shooter, and platform plays overlapping roles. No single node's failure breaks the system. Information flows omni-directionally, allowing the fastest decision-maker to coordinate strikes regardless of formal command hierarchy. This operational approach demands the cognitive agility and networked thinking that the training revolution seeks to develop.

Italy's F-35 program demonstrates kill web concepts in practice through what Lt. General Pasquale Preziosa termed the "double transition"—simultaneously modernizing legacy platforms like the Eurofighter Typhoon while pioneering F-35 integration. This creates a fully networked air force where KC-767A tankers, E-550 CAEW command aircraft, Typhoons, and Lightning IIs form a coherent system rather than a collec-

tion of platforms. Each element extends the others' capabilities through shared situational awareness and distributed decision-making.

THE HISTORICAL MIRROR: LESSONS FROM THE B-17

Remembering the B-17 and Its Role in World War II might seem the outlier in this collection, a historical work among studies of contemporary transformation. Yet it serves crucial purposes in the overall narrative.

- First, it provides the baseline against which we measure transformation. The industrial-age airpower represented by the Flying Fortress, mass production, accepted attrition, linear tactics, stands in sharp contrast to today's network-centric, information-dominant approach. Understanding what has changed requires knowing where we started.
- Second, the B-17 story illuminates timeless challenges in military aviation. The book's examination of procurement decisions, crew training imperatives, and the balance between cost and capability resonates directly with current defense debates. How do you build the right aircraft? How do you train crews fast enough? How do you maintain readiness while managing resources? These questions haunted Pentagon planners in 1943 and remain central to defense strategy today. The context changes, but the fundamental tensions persist.
- Third, the book's focus on Franco-American bonds forged through shared sacrifice during World War II provides essential context for understanding

coalition operations today. The modern emphasis on coalition readiness documented in *Training for the High-End Fight*, where allies train together from the outset, forging common mental frameworks and tactical habits, has deep roots in relationships built during earlier conflicts. The ceremonies on Noirmoutier Island honoring B-17 crews seventy years after their crash demonstrate how historical memory sustains alliance relationships that underpin contemporary coalition airpower.

Italy as Case Study: Strategic Transformation Through Airpower

Italy and the F-35 serves as the detailed case study demonstrating how a nation can leverage airpower transformation to elevate its strategic position. Italy's approach offers several instructive elements. First, the Cameri facility represents strategic thinking about manufacturing as power projection. By positioning itself as the European hub for F-35 production and sustainment, Italy ensured its voice carries weight in program decisions affecting dozens of partner nations. This is influence through indispensability rather than traditional military mass.

Second, the integration of F-35B fighters aboard the carrier Cavour demonstrates how new capabilities enable new strategic options. Italy's expeditionary strike capability extends its influence into contested waters worldwide, transforming its role from regional Mediterranean player to global naval power. The book documents how Italian carrier strike groups have deployed to the Pacific, participating in exercises that demonstrate interoperability with partners from Japan to Australia.

Third, Italy's "double transition" strategy shows sophisticated understanding of the relationship between legacy and advanced systems. Rather than viewing Typhoon moderniza-

tion and F-35 integration as competing priorities, Italy treats them as complementary elements of a networked force. The Typhoon provides sensor coverage and weapons capacity that extends F-35 effectiveness, while the Lightning II's information dominance amplifies legacy platform capabilities. This integrated approach creates combat power exceeding the sum of individual platforms.

THE CONTINUOUS EVOLUTION MODEL

My Fifth Generation Journey introduces a concept with profound implications: the software-defined aircraft designed for continuous evolution. Traditional fighters received periodic major upgrades—perhaps three or four major capability blocks over a thirty-year service life. The F-35 represents something fundamentally different: a platform that "never will be truly finished." Each software block delivers combat-ready additive capabilities without the extensive redesign and testing required for legacy upgrades.

This model transforms the relationship between operators and developers. Instead of defining requirements, developing solutions, and fielding static systems, the process becomes iterative and responsive. Frontline operators identify capability gaps; software developers create solutions; new capabilities flow to the fleet within months rather than years. *Training for the High-End Fight* documents how training programs have adopted similar continuous adaptation models, updating curricula based on operational lessons rather than waiting for scheduled reviews.

The continuous evolution model also creates new dependencies and vulnerabilities. Software-defined systems require robust cybersecurity, resilient data links, and stable international cooperation to maintain upgrade pipelines. These

requirements explain the emphasis throughout these books on coalition integration. The F-35 global enterprise depends on partner nations maintaining compatible systems, training standards, and security protocols. National decisions to modify or restrict systems can disrupt the collective capability.

MAN-MACHINE TEAMING: THE NEXT FRONTIER

Several of these books point toward the next transformation: the evolution from piloted aircraft to man-machine teams where manned fighters command autonomous systems. *My Fifth Generation Journey* explicitly discusses plans for F-35s to serve as command nodes for "man-robotic wolf packs," directing swarms of sensors, weapons, and support platforms. This concept bridges current fifth-generation operations and emerging sixth-generation approaches.

Training for the High-End Fight implicitly prepares for this future through its emphasis on cognitive development and decision-making under uncertainty. Managing autonomous systems in contested environments will demand the same mental agility, rapid assessment, and adaptive thinking required for modern kill web operations. The pilot's role continues shifting from direct platform control toward information management and decision coordination, a trajectory that could eventually lead to manned aircraft becoming mobile command centers for largely autonomous forces.

This evolution raises questions these books acknowledge but do not fully resolve:

- What cognitive skills must pilots develop to effectively command autonomous wingmen?
- How do training systems prepare humans for delegation of lethal decision-making to machines?

- What new vulnerabilities emerge when combat effectiveness depends on maintaining network connections between manned controllers and unmanned systems?

The 2025 books document transformation in progress, not transformation complete.

COALITION AS IMPERATIVE, NOT OPTION

Perhaps the most consistent theme across these four volumes is the centrality of coalition operations to modern airpower. This represents a fundamental shift from earlier eras when coalition warfare was viewed as a complicating factor, something that reduced efficiency through the need to coordinate different systems, procedures, and languages. Today's approach, documented throughout *Training for the High-End Fight* and the Italy book, treats coalition integration as the baseline assumption.

Training together from initial qualification rather than attempting interoperability later creates shared mental models and tactical habits. When Italian F-35 pilots deploy to exercises in Australia or Norwegian Lightning IIs train with American squadrons, they operate with pre-established procedures and common understanding developed through joint training. This is not cobbled-together cooperation under crisis but designed-in interoperability from the beginning.

The strategic logic is compelling. No single nation can maintain the full spectrum of capabilities required for high-end conflict across all domains. By specializing and integrating, coalition partners achieve collective capability exceeding what any member could field independently. Italy's Cameri facility, Norway's Arctic expertise, Australia's Pacific presence, and American force projection create an integrated

system more powerful than its components. This makes coalition not merely politically desirable but operationally necessary.

CONCLUSION: ADAPTATION AS STRATEGY

These four books, read together, reveal airpower transformation as an ongoing process rather than a completed revolution. From the B-17's industrial-age mass to the F-35's networked information dominance represents not the end of evolution but rather one particularly dramatic phase. The continuous adaptation model documented in *My Fifth Generation Journey*, the cognitive development emphasized in *Training for the High-End Fight*, and the coalition integration demonstrated in the Italy book all point toward a future where competitive advantage derives from the speed of adaptation rather than static capability advantages.

The most valuable weapon, as *Training for the High-End Fight* insists, is not the airframe but the mind in the cockpit—and the coalition of nations willing to continuously reinvent how they develop, train, and employ airpower. This demands institutional cultures comfortable with perpetual change, training systems that prioritize cognitive agility over procedural mastery, and international partnerships resilient enough to sustain cooperation through technological and operational turbulence.

The B-17 story reminds us that transformation always builds on accumulated experience and sustained relationships. Italy's strategic positioning demonstrates that smart thinking can multiply influence beyond raw capability counts. The F-35 global enterprise proves that software-defined, continuously evolving systems can deliver unprecedented operational flexibility when backed by international cooperation. The training revolution shows that cognitive

development and mental agility have become as crucial as aircraft performance.

Together, these 2025 books document how airpower has evolved from industrial production of autonomous platforms into a sophisticated international enterprise where networked information dominance, coalition integration, and continuous adaptation define competitive advantage.

The evolution continues, but its trajectory is clear: success belongs to those who adapt fastest, think most clearly under pressure, and build partnerships that multiply individual national capabilities into collective power. In this transformation, the questions that matter are not about which aircraft to build, but about how to develop the minds that will employ them and the coalitions that will sustain them.