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An ISR Perspective on Fusion Warfare

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About the Forum

The Mitchell Forum exists to give an open venue to authors with ideas and thoughts on national defense and aerospace power. The series features topics and issues of broad interest and significant impact on current and emerging policy debates. The views expressed in this series are those of the author, and not necessarily those of the Mitchell Institute.

By 2030, the threats facing the United States around the world will be formidable. They will have twice, if not three times, the lethality and range of today's threats. Imagine a nation roughly 300 nautical miles (nmi) by 300 nmi in size, with a coastline bristling with anti-access/area-denial (A2/AD) weaponry. Such capabilities could include modern weapons such as hypersonic cruise missiles, fifth generation fighters, air-to-air missiles with 150 nmi ranges, digital adaptive electronic warfare waveforms, and perhaps long-range (300 nmi plus) and ultra-long-range (500 nmi) surface-to-air missiles (SAMs). Potential adversaries could enhance traditional ground-based-radar detection methods with advanced passive detection systems and possibly further augment them by acoustic detection means and advanced cyber abilities. These advances would contribute to an adversary's primary goal of attacking and disabling our capabilities before we employ them.

The Air Force's mission is to fly, fight, and win today and tomorrow's wars. How we accomplish this must undergo a paradigm shift. This change is an imperative not only for the Air Force, but also for all the US armed services and elements of the Intelligence Community (IC). A review of open source literature on fifth generation weapon systems (e.g., B-2A Spirit, F-22 Raptor, F-35 Lightning II) presents a common theme: near real-time information sharing on threats, targets, onboard payloads, aircraft flight dynamics, and command and control (C2) activities.[1]

"The Air Force's ability to continue to adapt and respond faster than our potential adversaries is the greatest challenge we face over the next 30 years."

Air Force Chief of Staff Gen Mark A. Welsh III

America's Air Force: A Call to The Future, July 2014.

The pilots in those stealth platforms act as the central nervous system in the cockpit to integrate disparate types of data and make decisions. Simultaneously on the ground, intelligence, surveillance, and reconnaissance (ISR) Airmen serve as the central nerve center in intelligence squadrons to process information coming in from airborne, space, cyber, and terrestrial collection sources. These Airmen must fuse multiple types of data from numerous sources in a fast-paced environment to produce analysis and empower decision makers at various Air Force command and control nodes.

These C2 nodes may include air and space operations centers (AOCs), the common ground system (CGS) core sites, unit-level intelligence flights, or even the pilot in the cockpit. Harnessing the information available from each of these elements in a coherent, collaborative, and cohesive manner will provide decision advantage and success in tomorrow's conflicts. This paper defines and explores a concept we call "fusion warfare" — and provides a perspective on what tomorrow's war fighting will mean for Air Force ISR professionals.

The Fusion Warfare Concept

In fusion warfare, tactical, operational, and strategic leaders enjoy an asymmetric decision advantage via the integration and synchronization of information from multiple sources and domains into analysis within a specific time and space parameter. Ideally, fusion warfare shapes the battlespace in advance of real time. To illustrate this advantage, we will use the Observe, Orient, Decide, and Act (OODA) Loop model created by the late Col John Boyd. Boyd originally designed the model using air-to-air combat engagements as a point of departure for explaining winning and losing in conflict. As a result, military officials have widely adopted it for various C2 decision-making processes.

Boyd's model is much richer than the simple, sequential OODA Loop familiar to most readers (see Figure 1). His thoughts included several variables and feedback mechanisms that have applicability within fusion warfare. However, at the OODA Loop's core, time is the key variable that determines victory or death. In other words, the fastest OODA Loop wins.[2]

The difference today's technology introduces to this construct is compression of the time variable, along with the amount and diversity of data available. Specifically for ISR, analysis in its basic form is just as central to this concept as collection, fusion, integration, and speed. Analysis allows for the best judgment of a given scenario, considering what we know and what we don't know, and assessing what dangers and opportunities exist in this void. Analysis is how we mitigate deception, provide improved warning about threats we haven't yet discovered, and identify the targets we have yet to find. Additionally, observables now come from multiple domains simultaneously, not just the air domain. This essentially eliminates a sequential C2 OODA Loop process.

In fusion warfare, multiple OODA loops occur simultaneously across different domains, C2 nodes, and mission sets (see Figure 2). There can also be complications caused by multi-service, coalition, and IC processes, which impact the ability to maneuver throughout multiple OODA loops.

In future conflicts, the victor may not necessarily be the one with the quickest OODA Loop. Rather, the prevailing side may be the one which can harness the power of multiple OODA loops, utilize the vast amounts of data in them, and provide enhanced battlefield situational awareness—all fused into decision-making analysis—to achieve multi-domain freedom of action.

This alignment occurs in a time and place of the victor's choosing, which leads to battlespace superiority. Using fusion, the victor will be able to observe and orient himself in a conflict more accurately and faster than his opponent, thereby deciding and acting more rapidly and precisely.

Fusion warfare tactics, techniques, and procedures (TTPs) will focus on integrating and synchronizing these OODA loops to present a coherent, cohesive, and fully informed characterization of the battlespace from the tactical to the operational level.

The Power of Fusion Warfare

As recently as Operation Iraqi Freedom in 2003, a standard 72-hour air tasking order (ATO) cycle consisted of multiple ISR platforms and exploitation units collecting (the OODA Loop's observe leg), an air intelligence squadron analyzing (orient), and a combined forces air component commander receiving vital intelligence for C2 (decide) and then using this information to order target solutions (act).

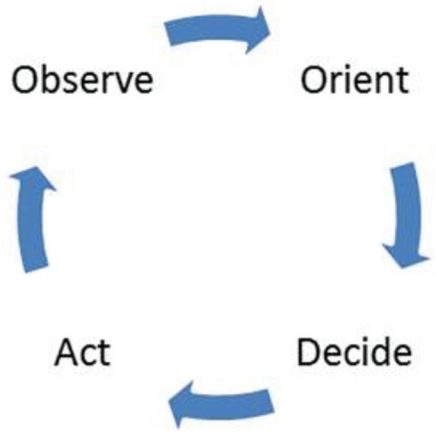

Figure 1. Traditional OODA Loop

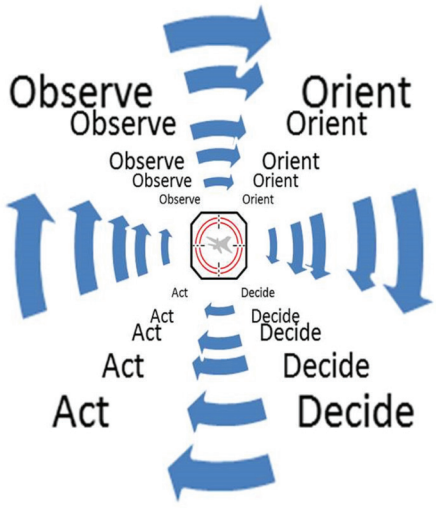

Figure 2. Multi-Domain Fusion Warfare OODA Loops With Decision-Making Analysis

However, the advent of ISR operations within multiple domains, along with the growing capability of the Air Force Distributed Common Ground System (AF-DCGS) weapon system architecture, increased space-based surveillance, and unprecedented cyber and signals intelligence (SIGINT) capabilities now mean multiple OODA loops are a fixture of modern war.

Each of these capabilities can individually deliver vital information to the warfighter, but a true capability leap lies in the ability to fuse the information together in a time and space of our choosing to deliver actionable intelligence to decision makers.

At the tactical edge, tasking multi-mission aircraft with various air-to-air, strike, and operational reconnaissance roles, or retasking aircraft multiple times with differing objectives on a single sortie during combat operations will become the norm instead of flying a specific mission.

A fifth generation platform can equally perform as a strike fighter, a bomber escort (e.g., counter air missions), a dynamic C2 relay node, and an ISR collector in current and future operations. These missions create multiple opportunities to feed and receive tactical and operational OODA loop processes within the cockpit. A pilot able to fuse the information flowing from these weapon systems can deliver unmatched and potentially devastating effects across the battlespace.

Taking this concept a step further, integrating and synchronizing information available to, and sent from, the cockpit of fifth generation weapon systems along with information available from other ISR sources provide the Air Force the ability to go well beyond the air domain using the fusion warfare approach.

In the past, separate specialized aircraft performed ISR functions; in the future, multiple sensors on multiple aircraft with multiple capabilities will provide these same functions — connected via a "combat cloud" which synthesizes and integrates them.[3] Integrating and correlating battlespace management command and control (BMC2) track-level data with this multi-source, multi-domain ISR sensor "take" at the tactical level of war will demonstrate fusion warfare's practical application. The victor can act decisively during execu-

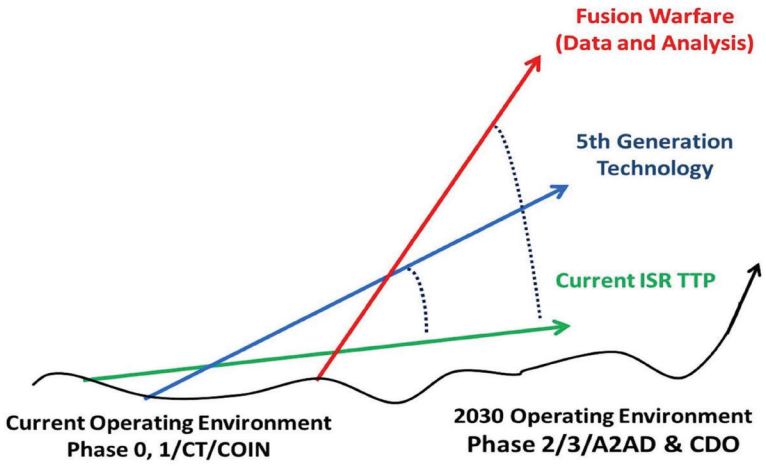

Figure 3. Growing Gap Between Intelligence TTP, Technology, and Fusion Warfare Analysis

tion of a single day's ATO in a dynamic manner. This enables effective control of the present environment and, more importantly, the ability to pre emptively shape future environments.

Acting decisively during execution of a single ATO in a dynamic manner while simultaneously affecting scenarios before they unfold will assure the Air Force can achieve battlespace superiority in a time and domain of our choosing—leaving potential adversaries attempting to catch up.

Some refer to the mindset needed for fusion warfare's success via employment of fifth generation weapon systems as an operational "rupture" — affecting how current air operations are perceived and conducted in future conflicts.[4] We must start thinking about a fusion warfare vision from the perspective of both blue (i.e., friendly) and red (i.e., enemy) intelligence operations, not business as usual. Otherwise, our thinking will stagnate and be overtaken by our adversaries' advances, as systems and threats grow more potent and capable. Left unchecked, the gap between ISR TTPs, fifth generation capabilities, and future fusion warfare analysis will continue to grow (see Figure 3).

The Need For a New ISR Approach

There are Airmen who understand what is needed to empower the tactical edge of operations with national capabilities via multi-domain and multi-level security gateways by utilizing fusion warfare. However, the vast majority of ISR professionals, both junior and senior, are largely unprepared for the tidal wave of synthesized information fusion warfare will demand in the years to come.

In the past, a pilot could be satisfied with basic intelligence information, such as knowing a current SAM disposition and a brief on adversary air-to-air tactics, or perhaps just having a recent image outlining a target.

Fusion warfare demands a different ISR approach rooted in our experiences with low-observable (LO) platforms. Beginning with Operation Desert Storm in 1991, a select group of Airmen began integrating advanced warfighting capabilities by maximizing stealth technology's advantages, better harnessing the electromagnetic (EM) spectrum, and redefining associated intelligence support.

Specifically, the introduction of the F-117A Nighthawk changed the way unit level personnel engaged and supported the stealth fighter, and subsequent LO platforms. Intelligence personnel worked tirelessly with electronic warfare officers (EWOs) to ensure the translation of signatures, wavelengths, and returns into new TTPs for stealth employment. This approach became known as "flying the black line."

Despite revolutionary advancements in stealth application, non-LO unit-level intelligence maintained threat knowledge and aircrew tactics training without the aid of consistent access to national capabilities. We must take the intelligence lessons learned from the F-117 and multiply them in order to advance fusion warfare.

We must merge the capabilities inherent within our space, cyber, distributed ground system, and SIGINT communities and integrate them into tomorrow's mission planning. We must better manage "big data" and prepare our multi-domain operators for the roles we will ask them to carry out within a fusion warfare construct.[5]

Integrating Fifth Generation Weapon Systems

Our fifth generation weapon systems are the eyes, ears, and teeth of war today, and likely for tomorrow's conflicts. They act as a fusion hub by integrating legacy systems, C2, air and space sensors, strike elements, cyber capabilities, and near real-time ISR feeds across domains.

These fusion warfare capabilities strengthen a mission mindset at the operational level that is focused on delivering simultaneous effects at a much faster pace, and providing decision-quality analysis earlier than the traditional ATO construct.

Fifth generation pilots are pushing this state of the art today, and are seeing firsthand what the B-2, F-22, and F-35 are capable of. Intelligence professionals are somewhat more limited in their knowledge, due to the clearance accesses involved, and varying experience levels ISR Airmen have with these new capabilities.

But in order to provide decision advantage, the ISR professional engaging these "hubs" must know how to access the data, share the data, integrate the data, and, of course, fuse the data with remaining legacy national and tactical intelligence at our disposal. As such, the approach to supporting and engaging with fifth generation weapon systems is far different from how ISR airmen have engaged other platforms and systems in the past. We will no longer be satisfied with just geospatial imagery (GEOINT) and what we used to be known as "threat intelligence" on systems such as advanced SAMs.

Fusion warfare is all about characterizing threats through multiple lenses, including understanding signature management to an advanced degree; applying multi-"INT" fusion to inform tactical, operational, and strategic consumers in a near real-time operating environment; and developing counter-tactics based on an operational-level "package" concept rather than a tactical flight concept. We will no longer be able to define counter-tactics just in terms of "flying the black line."

Improving Signatures Management Knowledge

Gen Herbert "Hawk" Carlisle, head of Air Combat Command, described in June 2015 how the F-22 is providing critical and versatile support to major strikes in Syria in support of Operation Inherent Resolve.[6] On one sortie, an F-22 completed an 11.5-hour strike mission against the ISIL terrorist organization. The mission report outlines why advanced warfighting is such a change from the status quo, and why the ISR enterprise must evolve to anticipate future intelligence demands required for successful employment.

During the sortie, the F-22 flew its primary strike mission in Syria, with the pilot then receiving multiple new taskings. F-22 pilots also tracked individual ISIL fighters on the ground, used the aircraft's advanced sensors to redirect other aircraft, called for additional strikes, relayed important data, and escorted bombers to targets.

Characterizing the threat and operating environment for aircrew in this sort of scenario takes a well-trained and experienced ISR professional to fully grasp what data are available and what collaboration is required to effectively train aircrew, inform decision makers, and disseminate near real-time intelligence to our C2 nodes to influence future actions.

What this means, at the most basic level, is we must revamp and update today's ISR training and mission planning. For example, we must derive threat-of-the-day (TOD) briefings from an advanced electronic warfare (EW) knowledge base. Signature management is no longer just about radar cross sections—it includes acoustic signatures, infrared signatures, visual signatures, and emission signatures (to include cyber). As such, TODs cannot merely represent maximum effective range threat rings. Instead, they must illustrate an evaluation of four-dimensional avenues of attack (yaw, pitch, roll, and the cyber avenue) in tomorrow's fight as well as the adversary's use of the EM spectrum. Those who can effectively analyze and harness the EM spectrum with speed and agility will own fusion warfare's advantages, and attain superiority in any future conflict domain.

Squadron-level intelligence briefers/planners must also consider potential disruptions to their assigned weapon system's mission, including all types of jamming (electronic attack), "spoofing" of C2/data links, and denial and deception techniques, to name a few. During mission planning, aircrews will want to know specifically how adversaries will react if presented with certain signature profiles; if their information can be shared with other US (i.e., blue) and coalition (i.e., green) platforms; what information they will be able to receive from other blue and green platforms; and what the national and tactical intelligence enterprise may be able to provide them while in flight to enhance situational awareness.

They will also want to know where vulnerabilities exist, which afford adversaries an advantage. Understanding the adversary's intent and capability requires agile and innovative analysis coupled with effective crypto-linguist tools to respond across the range of potential military operations around the world.

Integrating Multi-"INT" Fusion

Collaboration across the ISR enterprise is the key to effective multi-"INT" fusion. The 70th ISR Wing at Fort Meade, Md., brings space, cyber, and national cryptologic data to fifth generation weapon systems via National-Tactical Integration (NTI) and Cyber Mission Force (CMF) cells, for example.

The 480th ISR Wing at JB Langley-Eustis, Va., brings tactical GEOINT, SIGINT, and multi-source, multi-"INT" time-sensitive fusion capabilities to bear, as part of its global around-the-clock operations. The 363rd ISR Wing, also at Langley, provides content-driven analysis that combines information from other ISR wings with targeting and special operations ISR data to affect find, fix, track, target, engage, and assess (F2T2EA) operations.

The airborne ISR capabilities of the 55th Wing at Offutt AFB, Neb., 9th Reconnaissance Wing at Beale AFB, Calif., 461st Air Control Wing at Robins AFB, Ga., 552nd ACW at Tinker AFB, Okla., and numerous fighter wings are also critical for realtime bridging of dynamic threat changes and fusion in the battlespace.

Flying unit personnel across the combat air forces bring a specific understanding of weapon system capabilities and platform intelligence requirements. At the operational level, National Air and Space Intelligence Center (NASIC) analysts, intelligence division personnel at Air Combat Command, and ISR experts assigned throughout the AOC use intelligence from all aspects of the enterprise to provide operational-level planners assessments, updates, and recommendations needed to synchronize an air campaign.

The analytic advancement of junior noncommissioned officers and company grade officers must be a continuous stair-step method vice a mid-level career update. This training will apply to warfighting through the tactical, operational, and strategic levels. Airmen entering the career field now will likely understand data access and application, but will require fifth generation scientific and technical acumen. This will help them fully operationalize collection, fusion, integration, and build speed to develop critical analysis to inform good decision making.

The Air Force's ISR wings must set new standards for collaboration, information sharing, and mission understanding between Airmen in order to import and export intelligence directly with fifth generation weapon systems. The ability to work complementarily, harmoniously, and simultaneously with one another and alongside C2 nodes will serve as the bedrock for the success of fusion warfare.

Advancing Operational Level Counter-tactics

Keep in mind, the enemy always gets a vote, and we must make every effort to stay ahead of potential adversaries. The days of "just perform a defensive maneuver" are now gone. Our adversaries can manipulate the EM spectrum, wield modern long-range SAMs, and are developing their own fifth generation aircraft as well as anti-satellite systems. Potential rivals have also conducted cyber attacks against the Defense Department as well as defense contractor databases and social media networks — and use these methods to counter our advances.

Air Force planners must also exploit the electromagnetic environment and develop counter-tactics from a holistic package approach, rather than a flight approach, to conduct successful fusion warfare in denied areas.

Our approach to intelligence support and mission planning must change in order to conduct operations and develop counter-tactics faster. Fusion warfare mindset examples which could ensure access in a degraded environment include: 1) an analysis that an acoustic signature detection of an LO aircraft will occur at the tactical level, leading to an operational-level synchronized diversion by kinetic or non-kinetic means; 2) during mission planning, multi-"INT" fusion identifies an adversary's C2 vulnerability, leading to a strike package comprised of aircrew, ISR, and cyber operators to disrupt this C2 node via non-kinetic means.

As you can see, counter-tactics within fusion warfare become less of a tactical decision and more of an operational art. We will be able to influence and choose the time and space for operations performed by professionals across multiple domains by multiple platforms.

The Way Forward

Changing the way we do business within ISR must start with a framework to determine the best way forward. The standard approach of doctrine, organization, training, materiel, leadership, personnel, facilities, and policy (DOTMLPF-P) is well understood and we should utilize it. Commanders and ISR professionals at all levels need to identify where shortfalls exist.

Questions need to be asked such as: "Do we need a geospatial analyst in my unit? Do we need SIGINT analysts, electronic intelligence analysts, cyber analysts, electronic attack experts, or do we need these Airmen in a new federated organization? What training do we need to understand the EM spectrum and to conduct advanced analysis? What equipment do we need to ensure we can access, integrate, and share data across communities (e.g., ISR, C2, air superiority, global precision attack, personnel recovery) in multiple domains?"

We are past the point of contemplating the development of better tools. By 2018, all unit-level intelligence Airmen must be able to employ fusion warfare capabilities. These advancements must include: interoperability with the IC to allow seamless data flow between all national and tactical-level sensors; automated multi-level security interfaces; incorporating multi-"INT" fusion tools into mission planning systems; and standardizing mapping interfaces to reduce time spent reproducing information rather than analyzing.

This will require the Air Force ISR career field to refine and write requirements for true long-term advancement, instead of short-term gain. In some cases, it may lead the Air Force and IC to adjust institutional processes to better fit a fusion warfare approach.

Fusion warfare requires our youngest tacticians at the Airman and company grade officer level to talk, debate, and write lessons learned on TTPs. Field grade officers need to leverage corporate processes to organize, train, and equip units as well as lead the development of better operational mindsets. And senior leaders must trust, guide, and empower Airmen conducting tactical operations, often accepting risk in an information age where we cannot guarantee 100 percent situational awareness.

Air Combat Command will develop a fusion warfare concept of operations to lay out and address the integration of fifth generation, fourth to fifth generation, AOC, DGS, and unit-level functions. Additionally, it will outline roles and responsibilities, data flow, analytic tradecraft, and key decision points for advancing fusion warfare.

Air Force major commands will need to evaluate their respective areas of expertise and determine how they can assist. For example, Air Force Materiel Command must take validated and prioritized requirements and translate them into material developments. Air Education and Training Command must re-evaluate initial and continuing ISR training. Air Force Space Command must evaluate opportunities to integrate space and cyber knowledge, capabilities, and planning with flying units. And Air Force Special Operations Command must evaluate the applicability of fusion warfare in confronting future counterterrorism/counterinsurgency (CT/COIN) challenges.

The ISR enterprise as a whole must ensure continued partnership between future threat analysts and science and technology development. Often ISR concerns are raised late in development, when we could have addressed issues with earlier involvement. We no longer have the luxury of trying to build weapon system-related ISR tools after fielding the system.

We must foster a renewed sense of focus and purpose for the Air Force on advancing fusion warfare. Organizing, training, and equipping our ISR professionals to better understand signature management, multi-"INT" fusion, and counter-tactics for our fifth generation weapon systems, in conjunction with advancing the synchronization and integration of information to conduct fusion warfare, are paramount to success.

This change in mindset, combined with empowering Airmen to adapt, will ensure superiority and success across the domains of future conflicts, in a time and space of our choosing. ✪

Footnotes

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The Mitchell Institute educates about aerospace power's contribution to America's global interests, informs policy and budget deliberations, and cultivates the next generation of thought leaders to exploit the advantages of operating in air, space and cyberspace.

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