# THREE-DIMENSIONAL WARRIORS


A PUBLICATION OF SECOND LINE OF DEFENSE

# FOREWORD

The interviews and essays in this booklet have appeared in earlier versions on the web site Second Line of Defense (http://www.sldinfo.com/). SLDinfo.com focuses on the creation and sustainment of military and security capability and the crucial role of the support community (military logistics community, industrial players, civilian contractors, etc.) along with evolving public-private partnerships among democracies in crafting real military strength. SLDinfo.com is updated every Tuesday; articles, photos and videos are posted on a weekly basis.

Some of the interviews and articles in *Three-Dimensional Warriors* are excerpted from the longer pieces on SLDinfo.com as indicated at the beginning of the article. The original pieces on the web site often include photos and graphics which are not included in this publication.

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# PREFACE

**Dr. Robbin F. Laird**

*Three-Dimensional Warriors* provides an overview of how United States Marine Corps (USMC) aviation shapes their capabilities and directs how they operate. Aviation allows the USMC to be "three dimensional warriors" in fighting the "three block war." Not only does aviation provide for 360-degree situational awareness, but aviation leverages the ground warrior against the "hybrid" enemies he faces today. As a former Commandant of the USMC characterized the challenge, the Marines have to be prepared to fight the "three block war." For then-Commandant General Krulak, Marines had to be prepared to operate over the spectrum of warfare within confined space. USMC aviation provides the essential glue for such capability.

The new elements being added to the USMC—the V-22 and the F-35B—provide a significant advancement in capability to support these concepts of operations. The role of the air element for the USMC is essential to its future. One can have a police force that wears military uniforms or one can have a flexible military force enabled by full spectrum capability. The choice depends upon the central role provided by an integrated air element for USMC operations and options. The air element enables diversified, decentralized, and flexible USMC operations.

The aviation element within the USMC force structure plays a number of crucial functions. Because of the integrated nature of air and ground elements, it would be difficult to conceive of effective distributed operations without the air element.

First, the air component provides crucial strike capabilities in support of the ground commander. Because the USMC lacks the organic ground firepower of US Army forces, the air component provides the ground commander with essential strike support. From this standpoint, both fixed and rotary wing aircraft operate as flying gunships.

Second, the unmanned and manned elements of USMC aviation provide essential ISR and C2 capabilities for the ground commander. Indeed, because of USMC doctrine and training, USMC pilots think like the ground forces and consider themselves as part of any ground operation.

Third, the USMC is an expeditionary force. As such, the air components enable the strike and C4ISR capabilities to facilitate a rapid advance against adversaries on the battlefield or to operate in a distributed manner to change the very character of the battlefield or of military operations. Furthermore, air is an enabler for operations from the seabase, which figures prominently in USMC and USN strategic planning for the future.

With regard to rapid advance, the USMC in the assault on Baghdad was able to use its fixed wing fighters for close air support without its ground forces waiting for the movement of artillery pieces. The KC-130s operated off of highways to support flexible ground and air operations. Bringing the tankers along with the troops is an essential element, and protection of the tankers as well as the ground forces is a crucial role for USMC tactical air.

But tac air does not simply play a close air support (CAS) role in any traditional sense. It is an enabler for distributed operations when such operations are essential to either conventional strike or counter-insurgency warfare. USMC aviation has allowed the USMC ground forces to operate with greater confidence in deploying

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within the civilian population in Iraq. Aviation's roles in both non-kinetic and kinetic operations have allowed the USMC to avoid operating within "green zones" so as to facilitate greater civil-military relations. Aviation has also provided an integrated asset working with the ground forces in joint counter-IED operations.

Battlefields of the future will require the USMC to operate simultaneously upon many axes of attack. Such an operation is impossible without a USMC aviation element.

Another aspect of the expeditionary focus of the USMC is the central role of the seabase. In a famous moment in the initial Afghanistan operation, the USMC operated from ships to move deep inland to operate against the Taliban. Task Force 58 (TF-58) was in essence a seabasing operation and a prime example of what the USMC needs to be prepared and supported to do in the years ahead. TF-58's combat operations in Afghanistan during Operation Enduring Freedom (OEF) in 2001 covered 450 nm to establish Camp "Rhino" and then operated over 750 nm to Kabul—unimaginable without integrated airpower.

The new air platforms fit into the overall approach taken by the USMC. The *Osprey* provides unique capabilities, which allow the "ground" forces to engage in envelopment operations that Napoleon could only have dreamed about. The F-35 will be a "first-generation flying combat system" which will enable air-ground communication and ISR exchanges unprecedented in military history.

The pilot will be a full member of the ground team; the ground commanders will have ears and eyes able to operate in a wide swath of three-dimensional space. New unmanned air vehicles will be added to enhance, not supplant, the new manned aircraft, operating as "extenders" of USMC capabilities and part of the integrated air-ground solutions sought by the USMC to support their concepts of distributed operations. In short, the new technology will fit within the operational envelope already evolved by the USMC. This operational approach will provide invaluable assets for the evolving integration of air and ground capabilities required by the U.S. effort to transform the overall joint force structure.

*Three-Dimensional Warriors* outlines the evolution of the future of USMC aviation, especially as shaped by the contribution of the F-35B. But given the centrality of integrated air and ground capabilities to the evolution of 21st-century warfare, the USMC case is definitional and not unique to the service. ✪



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# INTRODUCTION: THE F-35B IN THE PERSPECTIVE OF AVIATION HISTORY

**Ed Timperlake**

Former Commanding Officer, VMFA-321 "Hells Angels"

In the opening days of U.S. combat in World War II, extremely courageous Navy and Marine pilots went up against the Imperial Japanese Navy in inferior aircraft. For the Marines, the Brewster F2-A *Buffalo* was woefully inadequate at the Battle of Midway. An entire Navy torpedo squadron, Torpedo-8, except for a single pilot, was killed in combat.

With the entire world in combat and nations fighting for their very existence, aircraft design teams pressed ahead with all the resources and intellectual vision they could bring to the design table. The U.S. air forces introduced a steady stream of type, model, and series (T/M/S) of always improving airborne killing machines.

From the Brewster F2-A *Buffalo* to the F-4F and F-4U to the F-6 and, at war's end, the F-8 *Bearcat*, the Navy had a series of prop-driven fighters that mastered the Japanese Zero. The Army Air Corps went from P-39 to P-38 *Lightning*, P-47 *Thunderbolt* to the P-51 *Mustang*, with its wonderful bubble canopy, to carry the fight to the heart of Germany.

Along the way, emphasis was placed on pilot survivability by putting armor plates in the cockpit and installing self-sealing fuel tanks. Since the entire objective was to get first "tally" and then out-maneuver and kill the enemy, the design focus was on an improved blend of speed, range, and maneuverability—in essence, better engines and smarter airframe designs.

While the main effort was producing enough "motors and gun sights," industry and research labs were working on the technology of the air fight.

The P-61 *Black Widow* was an early attempt to put radar on a night fighter, and the Germans tried a rocket plane against B-17 formations. The Italians, Germans, Brits and, ultimately, Americans experimented with early jet engines. But it was the German ME-262 that changed the dynamics of combat, although the Germans employed it in an inefficient manner by following Hitler's call for it to be committed to an air to ground role.

After WWII, the jet engines saw improved airframe system performance by improving speed, range, and maneuverability. But two new dynamics were added—both related to payload.

For a fighter in WWII, the payload was simple—what caliber and how many machine guns or cannons fit the design to give the pilot enough "deadly bursts" to kill several of his opponents?

In the jet age, the complexities of adding airborne systems and improving the weapons on board changed the technology vectors of design considerations and introduced two more synergistic, but relatively independent, research and development paths.

Airborne radar and sensors were added to fighters. Those systems helped the payload—guns and early infrared (IR) "fire and forget" missiles became more efficient with the AIM 9 sidewinder series. But then, concurrently, independent performance was put into the payload by improving missiles and linking long-range (BVR) missile shots to radar technology. At first, radar guided missiles needed continuous guidance from the fighter but eventually even radar guided missiles became BVR self-contained "fire and forget."

Unlike WWII research and development, where research on airframes and engines was the mantra, the jet age involved two other major design factors. The first was always a continuous quest for improved radar systems and, second, as technology allowed, improved weapons. Yet again, the art of aeronautical design had to work in partnership with the science of military R&D.

Along the way, survivability concerns shifted from armor, speed, and a good canopy to electronic warfare and the incorporation of stealth characteristics through design, composite materials, and paint chemistry.

Stealth is a survivability factor and multiplies the effectiveness of the fighter. Stealth isn't just *added*, it is *incorporated* into the fighter. Being a multiplying factor means it is sensitive and can drive the entire performance of the airframe and combat system.

At the end of the 20th-century the complexities of fielding the best fighter were a much bigger challenge because of three synergistic but independent factors—basic airframe performance improvements, internal system R&D, and constantly improving weapons.

However, with the computer revolution moving at light speed, a fourth design dynamic is now at work—the man-machine interface.

With the capability of three-dimensional sensing and the ability to distribute information to other warfighters—airborne, on the ground, or at sea—the relationship of the individual pilot to the entire air battle offers a truly revolutionary shift that will continue to evolve.

For example, one of the most important capabilities of the F-35B, not yet exploited, is the distributed information capability. All pilots, regardless of experience, will fly into the air battle with the same knowledge and situational awareness.

Consequently, in the formation, if one pilot gets inside the opponent's OODA loop (observe orient decide act) all are capable of having that same joint knowledge. The revolutionary aspect is that the enemy can "splash" an individual F-35B but they can't kill the knowledge gained by all—a truly unique 21st-century technology brought to an air battle.

Conversely, on the offensive, if one F-35B picks up an enemy's airborne vulnerability, such as an aircraft system, weapon frequency emission, or stealth breakdown—it can be sent to all. Every *Lightning II* is a real time intelligence collection system. The entire engagement is also captured electronically for immediate and direct refinements to tactics and analysis at the Marine Air Weapons Training Squadron during the air battle. Fleet-wide information sharing among services and allies will be a huge factor in winning an air campaign.

In WWII the *Buffalo* was a "grape" and the design teams worked with wartime efficiency to follow a single path to improve airframe performance. After WWII the technology vectors of improving internal systems and weapons carried were added to the mix. In this new century, the concept of each pilot being a three-dimensional warrior with superior knowledge is being pioneered by the USMC aviation community.

The F-35 is not designed for the early century's concept of the knife fight, and it has the growth potential for internal changes to its systems to always incorporate the best weapons while expanding empowerment of combat pilots to have three-dimensional knowledge and elevate the fight to a new level.

In other words, the F-35 may actually be its own follow-on. Instead of the old paradigm of needing to completely build another fighter to move from the F-2A "Grape" to F-4U "Whistling Death," the Marines can just change and update the F-35B system, sensors, and weapons. The Marines flying the F-35B with a pre-planned product improvement design philosophy to pull and replace or add system capabilities will in the future have total flexibility to add new sensors and the improved AA missiles currently being designed.

Exploiting man-machine, three-dimensional knowledge is truly a brave new world. Consequently, the F-35B is capable of constantly updating the next generation of U.S. fighters, but not by building a new airframe, by staying inside the F-35B basic airframe and adding the next generation of systems and weapons. The American arsenal of democracy is shifting from an industrial production line to a "clean room" and a computer lab as key shapers of our competitive advantage.

It is a bold concept and only history will tell us if this is indeed the best way ahead. In addition, the USMC combat flexibility of basing mode enabled by V/STOL adds a revolutionary capability for the integrated air-ground battle.

# SLAPING

THE CONCEPTS OF OPERATIONS

# 21ST-CENTURY CONCEPTS OF AIR OPERATIONS

**Dr. Robbin F. Laird**

[Excerpted from "A 21st-Century Concept of Air and Military Operations."]

The limited numbers of the F-22 will ensure that the F-35 will be the dominant fifth-generation aircraft in both numbers and availability in a coalition environment. From the standpoint of thinking through 21st-century air operations, the ability of the F-22 and F-35 to work together and lead a strike force will be central to U.S. core capabilities for projecting power. The F-35 will be flown from Air Force airfields, allied airfields, Navy carriers, and, in the case of the F-35B (the vertical lift version of the F-35), virtually anywhere close to the action.

The F-22 and F-35 will work together in supporting air dominance, kicking in the door, and supporting insertion of a joint power projection force. The F-22 provides the initial strike and guides the initial air dominance operations; the F-35 and fourth-generation aircraft support the effort. The F-35, because of its stealth and sensor capabilities, will be able to operate in a distributed network to provide strike, ISR, and air defense suppression, as well as attack shore defenses against maritime projection forces.

The F-35 is more than a fifth-generation fighter; it is a first-generation flying combat system. The effects that the F-35 can deliver within the battlespace are flexible, synergistic, and multidimensional (air, ground, maritime). The F-35's open architecture allows this flying combat system to become the focal point of three core activities: air-to-air, air-to-ground, and air-to-maritime roles and missions. The F-35 will be defined by how its open architecture is customized by national militaries in meeting their perceived priority needs and mix of air, ground, and maritime missions. Its combat capabilities will be defined in part by "CONOPS customization."

One example of an opportunity for CONOPS customization derives from the F-35's multimodal/multi-mission capability, which includes the ability to deliver non-kinetic as well as kinetic effects, offering decision-makers many options. The F-35 is central to operationalizing the networked battle management environment. It can provide services (communications, intelligence, and electronic support) to others in the battlespace in ways that are transparent to its pilot.

**Large platforms that used to provide battle management will be supplanted by a force mix of the F-35 and unmanned vehicles, shaping a 21st-century approach to air operations.**

CONOPS customization is the reason that the F-35B is of special interest to the Marine Corps, Royal Air Force, Italian navy, and other forces. The F-35B's short takeoff and vertical landing (STOVL) capability will make possible a different approach to ground-air integration and CONOPS than with that of the F-35 conventional takeoff version. Almost certainly, weaponization and ISR requirements will be modified to work with the STOVL-enabled CONOPS.

An additional aspect in developing joint or coalition CONOPS for the F-35 will revolve around its interaction with other manned and unmanned assets (UAS). With regard to manned assets, a key challenge will be to work an effective connectivity battlespace with other manned aircraft, such as the Eurofighter *Typhoon* and legacy U.S. aircraft. Here, the advantages of each platform in contributing to the air battle and to the type of flexible military force packages that 21st-century air capabilities provide will be the focus of a joint concept of operations.

In addition to the core dynamic of working with a variety of manned aircraft across the joint and coalition battlespace, the F-35 will be highly interactive with the evolution of robotic elements. UAS are not well designed for self-defense. For early entry UAS to stay alive, they need to be part of a wolf pack built around the protective functions of the manned aircraft. As air dominance and air superiority operations succeed, their significance can recede during an operation, allowing the role of unmanned aircraft to increase significantly and, over the course of the operation, supplant manned aircraft in ISR and C2 roles.

The man-machine attributes and computational capabilities of the F-35 provide a significant opportunity to evolve the robotic elements within airspace to provide for data storage, transmission, collection, weapon emplacement, and loitering strike elements, all of which can be directed by the manned aircraft as the centerpiece of a manned-robotic strike or situational awareness wolf pack. Rather than focusing on robotic vehicles as self-contained units with proprietary interfaces and ground stations, the F-35 can be useful in generating common linkages and solutions to combine into a core wolf pack capability.

# AN INTERVIEW WITH BRIGADIER GENERAL WALSH ON THE USMC USE OF AIRPOWER IN IRAQ: FROM PRECISION-STRIKE TO PRESENCE

[Excerpted from a November 2009 interview with Brigadier General Robert Walsh, USMC in which he discussed his recent experiences in Iraq.]

In December 2008, General Walsh became the Commanding General of the 2nd Marine Aircraft Wing (Forward). He deployed to Operation Iraqi Freedom on November 3, 2009. 2nd MAW (Fwd) was deactivated on Thursday November 19, 2009. General Walsh served in Washington with the Deputy Commandant for Aviation as the principal deputy, and in this position developed significant familiarity with the latest USMC aviation platforms, including the F35-B. He has extensive experience in dealing with the USAF and is very knowledgeable with regard to the USAF's approach to air-battle management, so his comments on how the USMC has used aviation in Iraq, and the growing requirement for integration between air and ground elements is significant for the USAF and its relationship with the U.S. Army as well. He was an instructor at the U.S. Navy Fighter Weapons School (Top Gun) and is a decorated Marine Corps Aviator.

During Walsh's time in Iraq, there was a double transition underway. The first transition was the acceleration of stability operations. The second was the growing collaboration with the Iraqis in shaping their evolving capability to provide for their own internal security.

This meant that the air element for the USMC had two crucial tasks: to support U.S. forces as they began to withdraw and prepare for their exit role as Iraqi advisors and to assist the Iraqis in shaping operations to provide for their own security.

As such, the core role of the USMC air was largely non-kinetic but with a residual kinetic role. But the non-kinetic role needs to be understood as a presence and support role. The presence role was robust and significant; and Walsh argued that the metrics for this significant airpower role are not well understood. "One can measure the effects of kinetic strike; it is more difficult to measure the effects of presence."

Walsh provided a core understanding of the strategic shift in the use of manned air in the counter insurgency (COIN) environment. The shift is from shaping air around precision-strike to shaping air to provide collaborative presence.

**We are living among the people. The enemy is living among the people. The challenge is to get the people on our side.**

At the heart of the challenge, according to Walsh, is that "you are not dealing with one large formation on attack; the forces are very decentralized and very distributed. You are dealing with a very large area and with a dispersed force. You are dealing with little formations all over Anbar province, which is 250 miles by 150 miles in area. You have companies and platoons split over a large territory, which you have to support with limited assets. There is no rear area; there is no safe area."



Walsh went on to characterize the situation facing the COIN military force. "The enemy can hit you anywhere; the enemy gets a vote is how I characterize it. We are not on the offensive; we are on the defensive.

If they are on our side they will give us credible information upon which we can act. But to know that level of detail you have to be distributed or dispersed."

The challenge is simply this according to Walsh: "How does aviation provide support in such a chaotic environment? Just like the guy on the ground who is not certain of what is about to happen, the pilot who is trying to support those ground elements also has to deal with managing uncertainty."

His answer revolved around the shift from precision strike to presence. Air presence was significant on three major levels for the USMC during this period in Iraq.

First, presence was crucial to support the Marine on the ground. This could be lift, it could be overwatch, it could be an ability to provide fire support, it could be to fly low to demonstrate to the population that the ground element had significant firepower available, it could be to deal with the disparate strikes to which the ground forces were still subject from a dispersed enemy. "A lot of times, Marines on the ground would ask us to come down lower so that they could see us. *How do you measure that effect?"*

**Walsh characterized this concept as "no Marine walks alone." When a Marine is operating "outside of the wire," the role of airpower is to provide protection and support to that Marine.**

He gave an example of dealing with an IED-event. "When you have a vehicle blow with an IED and have the road divided now into two slow moving small lanes of vehicles, how do you know who is in those vehicles? How do you know what they are going to do? You can wait a long time for the clearing vehicles to show up. A request would come in: Please bring in a fighter for presence to show you are there. *How do you measure that effect?"*

Second, it could be reassurance to the population. As the Iraqi leadership began to perform more functions, there was a remaining need to reassure the population that support could be provided throughout the country to the Iraqi allies.

"For example, when the provincial government was to be seated in Al Anbar in June 2009, there was an Al Qaeda threat to Ramadi. The Governor asked us to fly our F-18s at 5000 feet to reassure the population and to deter any threats."

Third, it could be presence to deter attacks from a dispersed adversary. The pop-up capability of an adversary blended into a civilian population meant that air assets were in demand to come in and to support the ground elements on an ad hoc, and on-call role.

As an example of the challenge of confronting attacks in a dispersed environment, Walsh offered this example. "I was on the ground; we were stopped at a check point and the check point came under motor fire. Several vehicles in front of us were destroyed. All hell was breaking loose with mortars coming in every few seconds. We did not know where the things were coming from. We of course had no battery radar. We called in some F-18s and the minute the planes showed up the firing stopped; the enemy figured out that the F-18s would know where they were with the obvious consequences. *How do you measure this effect?"*

Indeed, Walsh underscored that as the US forces withdrew there was demand for more, not less airpower. This happened on several levels.

On one level, this was due to the drawdown of the number of combat posts, which supported operations in Iraq. American forces continued to work with Iraq forces but now had to commute from distance to do their work, rather than being in close proximity to combat posts. This meant that airpower had to provide regular support to the transit of US forces working with Iraqis.



"At one point we had 140 combat posts; while we were there we went from 36 to 4 combat posts; so air was relied on more frequently for convoy protection. As we drew down combat posts and associated capabilities, air was relied on for capabilities which had earlier been largely provided by the ground forces."

On another level, this was due to the need to protect the convoys moving equipment out of Iraq. "As you close down and do retrograde, you have to move further out in road miles and that requires air support."

On another level, transport needs increased demands to move support elements to work with Iraqis. "We were increasingly asked to provide support for partnering operations."

Walsh underscored that the CONOPS for doing presence missions is considerably different from doing strike-oriented, offensive operations. With an offensive operation, air power can be tasked in advance, targets are identified, and air battle management focus is on tempo of operations. With a presence-focus, which characterizes counter-insurgency (COIN) operations, tasking is "on the fly" and is not orchestrated 48-72 hours in advance.

To do the "on the fly" mission planning, the ground and air elements would work with common mission planning software to identify the ground element's day-to-day tasks. The pilots would go airborne with a set of four to five taskings for the support of the ground forces, and would shift among these taskings as the ground forces would demand. The ground forces would identify the day's schedule and intentions in the mission software and web-based communication system. These intentions drove the taskings for the air element.

In effect, a *push concept* for air operations was adopted. In the push concept, air elements would be launched in support of the ground forces, and the selection of the taskings would be taken from the pre-planned presence support list and adjusted as challenges emerged. The USMC aviators worked with the ground elements *before* launching to determine the range of needs likely to be required based on the ground forces intent.

A key technology highlighted by the push concept is blue force tracking (BFT). Because BFT identifies where the ground elements are located in real time and provides a texting tool, BFT can be a crucial tool for the air element.

Walsh stated, "I can do my operations with real knowledge of where the ground elements are located to support them. It goes from being a tool to reduce fratricide in a fast moving offensive operation to becoming a key tool to allow me to do collaborative support and operations. Frankly, all of our fixed wing aircraft should have BFT on them and I hope the F-35 will have as well ...."

The presence role, which Walsh sees as central to COIN operations, is facilitated by the institutional investment, which the USMC has put into air-ground integration.

**"When we have the F-35, we will have a very significant flying combat system overhead which can work with this distributed command element."**

"The processing power of the aircraft and the software on board which will allow us to support directly overhead our ground forces will be an exponential increase in capability. But this capability will be built upon the organizational investment and the habitual relationship we have between the ground and air elements...."

Walsh emphasized the central role of the manned element in playing the presence role within COIN. "The ability of the ground and air elements to work together to shape presence in a COIN environment is central to reassurance of the Marine on the ground, to the population you are trying to reassure, and to the ability to strike an adversary who can pop up without warning."

# V/STOL AIRCRAFT AND EXPEDITIONARY OPERATIONS: SHAPING FLEXIBLE CONCEPTS OF OPERATIONS

[Excerpted from an April 2010 interview with Brigadier General Robert Walsh, USMC concerning USMC experience in operating *Harrier* aircraft]

As the F-35B comes to the USMC and replaces, in part, the *Harrier*, the concepts of operations introduced by the *Harrier* over the past thirty years will be extended and transformed. In this interview, BGen Walsh provides a better understanding of the concept of operations facilitated by the *Harrier* as a V/STOL aircraft.

**BGen Walsh:** The *Harrier* enables the MAGTF to have flexible expeditionary basing, and that's key. The *Harrier* provides the expeditionary basing capability from a fixed-wing standpoint. Obviously, we've got helicopters that can live in the dirt just like the Grunts do, and we support the Grunts right up front and close with our helicopters, but from a fixed-wing standpoint, the *Harrier* is the only aircraft that can do that.

The A-10 can do some of the things the *Harrier* does, but cannot operate off the small strips like the *Harrier* can—diminishing its expeditionary role.

Marines in the Marine Air-Ground Task Force (MAGTF) view ourselves as the Nation's 9-1-1 Force. We look at ourselves as the First Responders to any type of crises or event.

**SLD: The point is that you have to go where the crisis is: you cannot go only where a fixed-wing aircraft could go. Is this correct?**

**BGen Walsh:** That's right, and to be those First Responders, we have to be agile, light, and quick to the fight. We can't go with all the heavy gear and firepower that the United States Army brings. They have a different mission, they bring a lot more. So to be light we bring less. In order to bring less, our firepower, the organic firepower we bring with ourselves is really our fixed-wing aviation, or heavy firepower. Now if the firepower can't go where the Grunts are, then they're not going to have the firepower with them. We need to carry the aircraft to the fight as we move, and our expeditionary air basing capabilities and the *Harrier*— or AV-8—as a STOVL [Short Take Off/Vertical Landing] aircraft facilitates that.

**If you look at today's global operating environment, the threats are hybrid. It's a mix of conventional warfare, it's irregular warfare, it's terrorism, it's criminal activity; but, today's battlefield is a chaotic ever-changing environment that requires rapid decision making.**

One of the things that we like to do because we're light—and this goes all the way in our history, all the way back into World War II—is that we like to control the tempo of operations in these chaotic environments. We want to operate very quickly, make decisions fast, maneuver very quickly, and use maneuverable warfare as our ability to outmaneuver the enemy.

So to do that, we've got to be able to drive the fight, control the tempo of the fight. So, if we had to sit and wait for external air support to come from long ranges away from fixed operating bases, then we couldn't drive that fight. We couldn't drive that tempo because the ground combat element, without organic fire power, is waiting for our air to be there to provide that fire power. Tempo is key to the way the Marine Corps fights.

The *Harriers* allow us to do so not only in conventional ops, but in regards to this hybrid type of warfare, by bringing all assets to bear, all technology to bear. The AV-8 gives us that capability to bring that advantage to the battlefield.

The Marines on the ground in Afghanistan, operating against the Taliban, may not have a lot of advantages; if you consider the gear and equipment they're traveling with; knowing the terrain and the environment that the Taliban have lived in all their lives, it's a fairly equal footing that they're on.

You bring *Harriers* in there—and the technology that *Harrier* brings into that fight—then you do bring in that advantage. The key thing to remember about the *Harrier* is that it is a flexible basing piece we can operate virtually anywhere. We can operate off of major operating bases; we can operate off of damaged airstrips, as well as austere sites like we're doing in Afghanistan right now; we can operate off of major conventional aircraft carriers, or we can work off of smaller amphibious ships.

Among the conventional aircraft carriers that we've worked off of are the *USS John F. Kennedy*, as well as, in the past, the *USS Teddy Roosevelt*.

**We've also loaded up large-deck amphibious ships with *Harriers*: we have put, say, 24 *Harriers* on an amphib and treated them as, what we call, "*Harrier* Carriers."**

Marine Expeditionary Units (MEUs) go out with those on large-deck carriers. Along with the normal complement of their combat element capabilities, they also bring six AV-8s out there on every MEU afloat. In Desert Storm, we located three squadrons at King Abdul Aziz air base. That air base was basically an abandoned, unserviceable 6,000-foot airstrip where conventional aircraft couldn't have worked off of, but we were able to use them to forward-base 60 AV-8s. Initially, the *Harriers* were operating out of Bahrain and it was taking 45 minutes to get them to the battlefield—that's a lot of time. By forward-basing them, we cut all that "drive time" away to get to the fight by basing them at that King Abdul Aziz airfield.

In Desert Storm we were able to move the *Harriers* that were operating off of the *USS Nassau* ashore at a place called FARP Tanajob, an Aramco helo field. We moved them forward as a forward arming and refueling site off the ship, where their mission was to fly, refuel, rearm, and then eventually go back to the ship. This FARP site—Forward Arming and Refueling Point—allowed them to arm, refuel, and operate right there on the battlefield, instead of having to drive all the way back to the ship and use a tanker.

That's a key benefit of being close to the fight. You reduce the requirement for tankers and you free up tankers for other conventional operating aircraft. Plus you allow the *Harriers* to carry more ordnance, because they don't have to worry about going long distances to get home or find a tanker to be able to meet their bingo profiles to get back to the ship.

Those were some of the things we did in *Desert Storm*.



If you look at Afghanistan in the early operations of *Operation Enduring Freedom*, our AV-8s were operating off of *USS Peleliu* and *USS Bataan*. They were some of the first aircraft to fly over Afghanistan and operate well inland off of the coast of Pakistan, operating deep in Afghanistan and actually using Kandahar Airfield, which was a badly damaged airfield that really only had about 2,000 feet of usable runway.

Again, the *Harrier* in this case could come off the ship and use those runways to rearm/refuel, even though it wasn't a fully operational conventional operating runway. In 2002 and 2003, we had our *Harriers* operate out of Baghram Airfield in the northern central part of Afghanistan. In fact, CENTCOM put a Frag Order out that would only allow AV-8s and A-10s to fly out of Baghram because the airfield—a former Soviet airfield—was in such terrible condition.

In the first stages of *Operation Iraqi Freedom* we started to look for places where we could put aircraft. We were not able to rely on some of the places that we previously depended on, like Saudi Arabia. As we started looking at bringing in conventional aircraft, we quickly ran out of room ashore.

As a result, we came up with this concept of using our large-deck amphibs to move the helos ashore and use those large deck amphibs, instead of a normal MEU air combat element capability. We cleared the helos off and used them for what we called "*Harrier* Carriers." Using those 750-foot flight decks that the *Harriers* could operate from—the *USS Bataan* and the *USS Bonhomme Richard*—we could operate in the Gulf by putting 24 AV-8s on each.

Along with that, we also had two MEUs operating on *Tarawa* and *Nassau*, so we had a total of 60 AV-8s that were operating out at sea. That allowed shore-based ramp space to be opened up to other coalition and U.S. aircraft.

Because those ships were parked right off the coast of Kuwait, there was only a 15 minute transit to the battlefield. That's a whole other piece of this basing concept; because the *Harrier* could work off the ships, we didn't have to put them ashore, allowing other aircraft to come in and use the limited amount of basing that we did have. So it plussed-up the amount of aircraft that could go into the initial stages of OIF-1.

**SLD: So the point is that the aircraft allows you to operate in initial insertion operations and to operate off of seabases, or land bases as needed and appropriate. It can be used in a moving COIN operation, so to speak, as you currently do in Afghanistan. Or it can operate off of a sea base of a variety of platforms to support insertion, high-intensity warfare, mid-intensity operations, or low-intensity operations. So it's really an important piece on the chessboard that gives the decision maker a lot more flexibility than he would otherwise have.**

**BGen Walsh:** I've seen numbers anywhere from five to eight times the number of runways that an AV-8 could use across the world, as opposed to a conventional aircraft. That means there are five to eight times as many fields that they could fly off of, if you picked a country in the world that we were going to go in and operate from. There are only so many airfields that have the 8,000+ foot runways that conventional aircraft need.

FA-18s can fly off 11 carriers, but our 11 large-deck amphibs are available as well for the AV-8s.

**SLD: Could you describe the approach to using the *Harrier* in the current Afghan situation?**

**BGen Walsh:** Right now in the operation that we've got going on in Marjah in Afghanistan and Helmand Province is another indicator of how we can use the aircraft, the AV-8, in its capability as a V/STOL or STOVL aircraft. This really proves the expeditionary capability of the aircraft in support of the MAGTF and the Joint Force. In Marjah

right now, we had been operating out of Kandahar Airfield. It was about 100 miles from Kandahar to where this Marjah operation was going to take place.

The key leadership in Afghanistan had made it very clear that we were going to Marjah and we were going to take on the enemy in Marjah, and they were going to either leave or they were going to die there; but we were going to take Marjah back and give it back to the people that once lived there. So I don't think there was any doubt that we were coming there. We told them we were coming

there, and in order to provide the best support we could from an AV-8 standpoint, we decided to build a runway called Dwyer 20 miles away from Marjah. We built that thing right in the middle of the enemy's battlespace, right there in the Helmand River Valley and, like I said, 20 miles away from where this major operation was going to take place.

By doing that, we put AV-8s 20 miles away from where the ground combat element was going to be operating. And it was, again, a Marine Wing Support Squadron that was able to build this austere 4,000 foot runway which the *Harriers* were able to operate out of—in the middle of the enemy's battlespace. Since then, we've grown that runway to 6,000 feet. The enemy is probably watching this thing get built. Lo and behold, what they don't know is that AV-8s are going to show up here, and that's what we're building that airfield for. So now in the Marjah operations, we've got AV-8s operating off of Dwyer, an airstrip that we carved out of the desert.

*Harriers* are dropping laser-guided bombs and using their 25mm cannon to kill the enemy and support our Marines right there on the ground. The AV-8 can take off in about a 1,000 to 2,000 foot ground run and can come back and land, with its ordnance, and stop at about 2,200 feet without using arresting gear.

We're then able to generate a lot of sorties that way—a lot of sorties and a lot of time on station. They're flying out of Kandahar, they'll fly a mission, they'll come down and land at Dwyer. They'll rearm, refuel, fly another mission, come back in and land again at Dwyer; rearm, refuel, go back up, fly again over the battlespace over Marjah; and then eventually return back to Kandahar at the end of their third mission. Dwyer is also the Regimental Combat Team-7's combat outpost, their combat operations center. Our pilots are rearming and refueling at the same field in direct radio contact with the Regimental Combat Team's command operations center, talking directly to the air officers, getting the latest battlefield updates, the latest operations intentions and what requirements they're going to be needing on their next mission.

So, unlike other aircraft that are flying long distances from another major operating base miles and miles away, or from an aircraft carrier hundreds of miles away, reading the Air Tasking Order (ATO) in the morning and flying the mission, then finding out everything on the ground has changed since they took off—these guys are right there on the ground getting real-time updates from the command center or the ground combat element that's conducting the operation.

Going back to the current Afghan operations, if the ground element is moving to Marjah, we want to move with them. If it's moving deep towards Baghdad, we want to move with them. If it's off the Coast of Iraq, we want to be on ships or austere sites close to them so we can support them.

Responsive fire support is necessary because, as you know, the battlefield does not go as scheduled. Often you find yourself launching 500 miles away off an air-tasking order, thinking you know what you're going to do, then 180 miles out you find out that the battle wasn't going as you planned. To be flexible in that situation, air has to change as ground changes.



**When we move those sea-based platforms ashore, move our airfields to a shore expeditionary site, we can decrease our response time by 75% and increase the on-station time by about 50%.**

It is key to understand the presence piece. If you're right there, you can respond quickly, which gives you that presence piece so you can react and support that ground commander more effectively than if you're parked an hour or two hours away from his location. The presence factor has an impact on the friendly forces, the enemy forces, and the civilian population.

When we were designing the original AV-8A, the options we had were to buy lots of aircraft and blacken the skies with aircraft, which would not be affordable, or develop an aircraft that could be based close to the fight.

So this presence concept, though we're using it differently today, was something we looked at many years ago when we developed the STOVL concept, mainly because we couldn't buy the number of aircraft that we would have liked. By moving them closer to the fight we could afford to get that presence.

**Within four to five minutes of taking off from Dwyer, they are operating over the tactical area of operations over Marjah.**

This is enough time for the pilot to get the gear up, to get his weapons armed, to talk to the FAC (Forward Air Controller) on the ground. Then he's there. There's none of this putting the airplane on auto-pilot and smoking a cigarette as you drive an hour and a half to get to the battlespace from the aircraft carrier.

**SLD: Is the STOVL concept central to COIN, hybrid warfare, and insertion of force in the spectrum of warfare?**

**BGen Walsh:** Because the world is so chaotic and we don't know where we're going to go, it's not necessarily going to be at the Fulda Gap in the airfields that we set up at Spangdalem, and Bitburg, and Ramstein, and those places. We don't know where we're going to end up. It could be the South Pacific, off the Coast of Africa, or Central America. Who knows?

Being close to the battlefield minimizes time to go to the refueling tanker. If you look at the fixed-wing aircraft that are operating over Iraq and Afghanistan, they're always having to save gas to get to the tanker and be on their bingo profile to get to an airbase where they can get gas in case the tanker's fouled, the tanker goes down, the weather's bad, or they can't get in the basket; but they're always saving mission time to get to the tanker.

With the STOVL aircraft, it's parked right there on the bow, but you don't have to worry about getting to the tanker, either pre-mission or post-mission, to get gas to get home or to increase time over stations; the STOVL aircraft is already there on-station requiring less tanker requirements and less time to operate.

**SLD: So it changes the logistics needs from a refueling point of view. You can play this game differently and more effectively and allow your tankers to go support the fixed-wing assets that might need them for other missions as well.**

**BGen Walsh:** Another piece is strip alert. If you've got your aircraft parked right near the battlefield, there are times where you may not want to have them airborne all the time in a presence mission. You might want to have them on strip alert as alert aircraft that are ready to launch at a moment's notice. When you can be airborne and over the battlespace in five minutes, you can allow your aircraft to sit on the ground waiting. You can't do that when you're four or five hundred miles away.

The STOVL allows you to set your aircraft down and use less gas in a strip alert standpoint. So again, the responsiveness of being close to the battlefield gives us the operational agility that we like.

They haven't turned Dwyer into a major operating base. They could in the future if they want to, and then eventually you could bring in the conventional aircraft. But somebody's got to make a decision that you want to bring in all that logistic support and all those resources.

Right now, what they're using it for is a Forward Army and a Refueling Point at that Forward Operating Base. And they're rearming, refueling, and doing three missions; and at the end of the three missions heading back to the major operating base at Kandahar, 100 miles away, for long-term heavy maintenance and daily turnaround inspections.

**SLD: What about the time on station aspect which shapes the presence availability percentage as well?**

**BGen Walsh:** You can't predict today's fight— when the enemy's going to attack, where they're going to operate. Like you said, these guys don't wear uniforms, they blend in. We don't have the greatest intelligence all the time on when they're going to attack, or operate, or come out of their holes.

So the presence capability with increased time on station to be able to observe, pounce, provide presence where they don't come out; whatever the effect is you're looking for, the STOVL being closely based not only gives you the response time, but also gives you that increased time on station by being closer to the battlefield.

But time on station in these presence rules, because this isn't a deliberate attack, this isn't driving forward on conventional operations what we're doing today. It's a lot of times just waiting for the ground force to say that they need an effect.

And it may be the enemy reacting to what we're doing that drives that reaction. So it's not that we're developing a plan 72 hours out on when to attack targets, and launch into a 10 minute window to drop your ordnance and get out of there—that all works fine and good.

We may not drop any ordnance. But it's that presence piece, that loiter time, that's critical. You can loiter much longer over the area you need to loiter if you're parked right next to it.

**SLD: So the time on station is the critical measure of success, if we're trying to look for a metric, a metric for the presence capability.**

**BGen Walsh:** Presence may be the driving force. Troops may not go outside the wire if they don't have that capability overhead. That could be a driving point in triggering their operations, dictating whether or not to send convoys based on if they have fixed-wing presence overhead. Just like they may not go outside the wire if they don't have MEDEVAC support available. The more time you've got on station, the better off you're going to be able to provide that presence capability.

**SLD: Obviously, you are discussing sortie generation rates as well.**

**BGen Walsh:** Let's look at it from a conventional standpoint like we did in Desert Storm or OIF-1, where that proximity to the objective area, the target area, allowed us to go out, drop ordnance, rapidly get back a short distance, rearm, get back out there, and drop more ordnance again.

We're able to service more targets and hit more targets because we're closer. So if I'm ten minutes away from the target area and I can go out there and drop my ordnance and then come back in ten minutes, I'm already in the refueling mode or rearming mode in ten minutes. The guy that's driving back 500 miles to his major operating base or to the aircraft carrier is not even thinking about rearming. He's just trying to get back home, and we've already generated another sortie by the time he lands.

Hitting more targets goes back to the *Harrier* providing our aviation fire, or a great portion of our aviation fires, for the ground combat element because they're able to be closely-based and provide that capability.

Then again, it ties into the tanker piece. We're not sucking up those tankers. It's go hit your target, come back, and, in some cases, not refuel. We're just rearming. We don't have to get more gas.

**SLD: Can you summarize the STOVL impact on CONOPS for the USMC?**

**BGen Walsh:** The biggest benefit we see in the AV-8 and V/STOL is its expeditionary nature. It allows flexible basing, and in today's war or tomorrow's fight there are a lot of unknowns out there. We could be operating on bombed-out runways, highway strips, FARPS, and austere runways, or working off of amphibs and large-deck carriers. This isn't just a theory that the Marines of many years ago dreamed up and never used.

**This is a proven concept that we've been using — with the Brits in the Falklands, in Desert Storm, with the Marines in Iraq and OIF, in Afghanistan. . .**

and today in the operations out of Marjah and Kandahar in support of the Marjah operations. It goes right with our ethos of being expeditionary as a MAGTF, being light and quick to the fight, and the aviation piece has to be right there with us. It's a natural bridge right to the F-35B. I look at the AV-8 as that bridging aircraft to get us to that fifth-generation capability, which is going to give us what we all want, but allows us the MAGTF to maintain that expeditionary capability so we can be that 9-1-1 Force.

We can be those First Responders because we can get there lighter and quicker with our ground combat elements. Because it's really your ground forces that take up all the weight and all the cube that goes aboard shipping and aircraft lift. If we can reduce that down and bring a lot of that firepower in our aviation combat element, that reduces what the ground force has to bring. ✪

# THE F-35B AND USMC CONOPS

[In a March 2010 interview with SLD, former USMC aviator, Robert Fitzgerald, discusses how the F-35B will replace multiple assets for the USMC.]

**SLD: Bob, could you tell our readers about your background so that they have a sense of the experiential base from which you are viewing the introduction of the F-35B within the USMC?**

**Fitzgerald:** I retired about two years ago. I was the director of aviation plans and policy inside HQMC Aviation, so was responsible for crafting the Marine Corps aviation vision, which is parallel and complementary to, but not the same as, the Marine aviation transition strategy.

I have been a *Harrier* pilot for about 25 years with almost 3,000 hours in a *Harrier*. I also had an opportunity to fly the *Prowler* as the CO of MAG-14. So I have unique experience with the transition from AV-8A to AV-8B, being involved in its growth from Day Attack to Night Attack to the AV-8B II+ radar jet and the introduction of the lighting pod and the integrated capabilities of the *Harrier*, but also with the electromagnetic spectrum exploitation of the *Prowler*.

And in fact, that's what we want to do with the F-35B. The JSF is really a fusion of the EA-6's extraordinary EM capabilities, and the *Hornet's* long-range afterburning, supersonic, fourth-generation capabilities, with the ground attack, STOVL capabilities of the *Harrier*…all combined into a single cockpit.

**SLD: So, from your point of view, the experiences you've had with the transition within the *Harrier* force and transition within the *Prowler* force are important operational experiences that you've taken forward to the new aircraft.**

**Fitzgerald:** As we pace the threat and as we understand the evolving national security environment and the engagement responsibilities our Corps has in the littorals, the F-35 is going to embody all of the unique characteristics and capabilities of our integrated TacAir force into a single platform.

**SLD: So the F-35B is not simply replacing the *Harrier* as many claim. It's a much broader replacement effort.**

**Fitzgerald:** It's certainly understandable why they would think that, because the focus is again, on a fifth-generation afterburning capable aircraft that can take off and land vertically. And so the natural tendency is to describe it in its STOVL attributes. But it's much more than that.

In fact, this is an EC-130, F-18 and *Harrier*, all rolled up into one. So what you have is a supersonic, fifth-generation, EC-130-*Prowler-Hornet-Harrier* all rolled up into one. It's the computing processing power, it's the sensors, it's the integrated weapons suites and communication systems, combined with the stealth technology that enables persistent presence on the battlefield. To do all the things we do across all six functions in marine aviation, and all six warfighting functions of the MAGTF. And it brings the expeditionary flexibility of STOVL operations, which doubles the number of airfields and decks that we can take off, land, and operate from.

**SLD: What's the impact of the Distributed Aperture System (DAS)?**

**Fitzgerald:** The DAS is an incredible leap in technology. While it was initially designed for protection of the aircraft—and it will certainly do that—we're able to extend that capability across the battlespace, truly integrating the MAGTF in the single battle.



That will allow us to identify threats to the aircraft plus we'll be able to see threats to other elements of the MAGTF. The system will allow us quickly to identify and pinpoint threats to those locations, and highlight Point of Origin and Expected Point of Impact to the MAGTF. We'll have an unprecedented opportunity to counter a strike from assets across the MAGTF. F-35 can self-engage, or we can transfer that target off to another aircraft or assign that target to another firing element inside the MAGTF…with incredible speed.

By fusing that kind of capability across the MAGTF in the single battle—the rear, the deep, and the close fight—we can connect all the elements of the MAGTF, not only for force protection, but for precision engagement, intelligence, surveillance, and reconnaissance. The battlefield becomes very dangerous for the bad guys, immediately, while giving great confidence to our friends and allies.

**SLD: Could you talk to the machine-to-machine aspect of the DAS and associated systems—what that really means to future procurement and future operations?**

**Fitzgerald:** That machine-to-machine piece is what's going to provide the decisive engagement capability we're looking for: bringing strategic agility, operational flexibility, and tactical supremacy to the single battle. The speed of intel-sharing, threat-data processing, and decision making will allow us to rapidly and accurately complete the kill-chain, and the target-to-weapon system pairing. The F-35 is not a traditional intel-consumer or intel-dependent weapon but an intel-generator and battlespace manager for the MAGTF.

We're transitioning from platform-centric operations to network-centric operations, and the F-35B is the key node in our integrated MAGTF system of systems. Not only can we Right-Configure our force protection posture real-time, across the MAGTF, but we can engage threats as they're presenting themselves or before, in some cases, to engage them with the appropriate weapons system across the MAGTF. And we'll do it at unprecedented speeds because it will be machine-to-machine interaction with all Blue Forces linked on the network, as opposed to identifying and prosecuting a threat—the way we've done it for the last 30 years.

This response time is critical when considering a future battlefield with sophisticated hybrid threats that are dangerous, elusive, and can blend in with noncombatants and hide themselves amongst the civilian population, where collateral damage is extremely important. This is where speed, precision, and proportionality are critical to strategic success—where protecting the population is equally, if not more important than engaging the threat, just as we're seeing in Afghanistan.

This machine-to-machine interface with F-35 is going to allow us to outpace the threat and engage the adversary with precision, with the right weapon, with very specific yield, from very specific quadrants. And at the same time limiting, if not eliminating collateral damage and civilian casualties, which is extremely important when we're trying to separate the threat from the population and bring stability and security to the region.

**SLD: Can you speak to the difference that an integrated capability brings to your ability to rethink operational capabilities as opposed to sequential upgrades which are not integrated inherently into the legacy tactical aircraft?**

**Fitzgerald:** This is going to fundamentally change the way we conduct operations across all phases of combat operations. Modernizing legacy platforms, while important, limits you to just accelerating traditional tactics because you're limited by your technology. With these next-generation capabilities and the machine-to-machine interface, which exponentially increases our tempo and our ability to influence actions across the electromagnetic spectrum, we can influence the battlespace in ways we've never seen before.

**SLD: Rather than relying on specialized aircraft that may or may not be there?**

**Fitzgerald:** Expeditionary means being able to execute and sustain with organic capabilities. While we expect to integrate with out-of-theater, national, and joint/coalition partners and platforms, we don't want to put operations or our Marines at risk by being limited due to other priority tasking or bandwidth limitations or physical locations of critical assets. So if the bad guys are operating anywhere in the battlespace, not only will we know it, not only can we influence that, but we expect to have unfettered access on our own, which gives us

unprecedented non-kinetic capabilities, which we've only begun starting to explore. We can finally fuse the non-kinetics with the kinetics in a time and place of our choosing.

**SLD: The fact that you're subsuming multiple platforms will have a significant impact on the logistics problems; you're now supporting one aircraft. Does bringing the *Osprey* plus the F-35 give you a much smaller footprint and a greater capability?**

**Fitzgerald:** It certainly does. That's part of the key performance parameters for the F-35—the ability to generate sorties. You hit the nail on the head when you talk about our logistics sustainability, and our ability to conduct and sustain and surge operations for extended periods because of the smaller footprint over legacy platforms. And this will be coupled with increased system reliability. We're expecting to see component Time Between Failures to be reduced by 30% and Combat Turn Around Times to increase by another 30%.

We're also going to have unprecedented connectivity with joint and coalition forces.

Nine countries and 13 services will be operating the same basic airframe. We will have the unprecedented ability to train, operate, integrate, and reduce the footprint across the joint and coalition force.

**SLD: Is shaping joint and coalition mental furniture a key part of 21st-century operations?**

**Fitzgerald:** We've always had exchange officers. And they've always been critical to sharing ideas and tactics and building long-term partnerships. In this case, we're taking it to a next logical step in that we're flying the same aircraft. So, not only do we share tactics across tactical airframes, but now we're flying the same airframe. So that when we form the coalition in response to crises, we expect our combat power, our response force to be able to respond faster and more appropriately because we will have procedures, processes, tactics, systems, and logistic support processes that all fall in on each other and accelerate our ability to respond to threats.

This will facilitate our ability to respond to crises before they become conflicts and shape the battlespace, because even with a small initial shaping force, such as a MEU, you bring a tremendous range and depth of combat power from an integrated MAGTF with F-35Bs that shape the battlespace with next-generation technologies.

**SLD: The *Osprey*'s a good example of new systems being ahead of CONOPS. I think we're having the same problem with F-35; the DAS will generate way too much information to handle for our current needs. Does that mean that we then go backwards and buy something that fits our current mental furniture? Or do we take advantage of what the new technology can provide us?**

**Fitzgerald:** We're tackling that issue across the force. The F-35B will be no different, in that the new capabilities…such as the DAS…will generate much more information than our current system is equipped to manage and exploit. The answer does not lie in muting the capabilities so that they conform to legacy systems and our current integrated operations. We have bright young Marines crafting next-generation concepts and intend on taking advantage of what the new technology can provide us. You can't stay in place in this business. You're either moving forward or going backwards…and I'm pleased to say that I've served in an organization with a history of innovation and fresh ideas.


We're generating the support systems, the computers, the meta tagging, the data recalling, the ability to manipulate and share, and the machine-to-machine interface that is essential to exploiting all of this combat power, and all of this information sharing. We cannot overlay a manual process over this high technology information exchange system. This is an unprecedented computerized capability, and we'll need the support infrastructure that exploits that. That's what we're in the process of doing.

**SLD: Does the built-in integrative capability of the aircraft coupled with shaping new CONOPS provide the ability to shape a smaller footprint for the deployed force?**

**Fitzgerald:** We've never had the kind of operational flexibility in such a small footprint before. A much smaller force now brings exponential growth in combat power through integration: data sharing, technology sharing, speed of decision making, and precision weapons. It is not commonly realized that the F-35B has 400 percent of the EA-6 *Prowler's* processing capability.

You can deploy large-deck carrier capability to a significant extent from an amphibious L-Class ship. And that enhances our ability to shape and influence the battlespace across the littorals, across the naval battle force, and deep inland. And this kind of combat power isn't resident in only discreet areas, but rather it's spread across the areas.

Now you're just adding this enhanced capacity to the force for the CoCom, and its resident from the smallest force up to the largest force. So you're not signaling your strategic intent with force size, rather you have the full spectrum at your disposal at any force size. You can shape and influence operations at the lowest level as well as the highest level.

**SLD: You've had a lot of *Harrier* experience. Because folks often insist on seeing the F-35B as a *Harrier* replacement, can you discuss the difference between flying a *Harrier* and an F-35B?**

**Fitzgerald:** Mostly in cockpit management. The *Harrier* is a combat-proven, but first-generation STOVL platform; a manual, mechanical aircraft that requires a great deal of hands-on flying from the pilot. As the aircraft matured we added more sophisticated capabilities, but it's a third-generation aircraft with limited growth potential.

The F-35, because of the enhanced technologies and unprecedented reliability of the systems in the aircraft, you are less of a mechanical pilot and more of a battlefield operating systems manager. And…you can do it at 8.5Gs, at supersonic speeds, through persistent presence on a sophisticated battlefield.

You are truly a fully networked, battlespace integrator. You are able to develop the combat situation and push real-time situational awareness (SA)…imagery, data, threat communications…directly from your aircraft into the network, and can directly engage threats or direct engagement from others with a full range of non-kinetic to kinetic options.

# GOING TO AFGHANISTAN: THE *OSPREY* SQUADRON PREPARES

[Excerpts from an interview with several members of the *Osprey* squadron just prior to the deployment of the squadron from North Carolina to Afghanistan in November 2009.]

The *Osprey* team discussed their preparation, some of their expectations and some of their thinking about how the *Osprey* could be used to benefit the MAGTF and the joint and allied forces.

Above all, the core view was that the unique capabilities of this aircraft would provide some tools which the MAGTF commander would be able to use in the context of the topography of Afghanistan and the demands of shifting strategy. The speed and range of the aircraft and its ability to support MAGTF team members, widely dispersed in Afghanistan, were often cited in the interview. Also, underscored was the ability of the *Osprey* to fly at a much greater height than traditional rotorcraft to which it is often compared, and to be able to use "vertical sanctuary" by operating at higher altitudes.

The Afghan deployment is the second for the *Osprey*. The *Osprey* was first used in Iraq, and its "baptism" has been drawn upon for lessons learned in preparing for the new deployment. When asked whether the Marines had drawn such lessons, one squadron member commented: "Absolutely, we're the Marine Corps. We pass it on."

Specifically, the Marines underscored that some members had previous *Osprey* experience in Iraq, many had Iraq combat experience and some had Afghan combat experience. Also emphasized was the wide-range of backgrounds of members of the squadron in working air issues within the MAGTF. As the squad leader commented: "We have guys from every background: *Hornets*, *Prowlers*, CH-46s, CH-53s, you name it...."

With regard to operations, the Marines discussed the challenge of getting folks to understand the impact of the new machine on operations. A common point is that "…we are not a rotorcraft; we are operating a tiltrotor craft. As such, we can do the operations of a CH-46 but we are not simply a CH-46. Do not confuse our abilities to mimic the CH-46 with the much more limited capabilities of the CH-46 when compared to the *Osprey*."

As one Marine put it: "…you can call it a rotorcraft, it's a form of rotorcraft, but it's a tiltrotor; that's the distinction that gives you the speed and the altitude that a normal rotorcraft doesn't have."

Another Marine underscored that getting folks to understand the difference is essential to understanding how to use it differently from a rotorcraft:

"Let me give you a practical example in CONUS. When we land in the DC area, we challenge the FAA controllers to understand how we operate. We surprised the Washington Terminal area controllers because…why can't I get in the pattern with that guy up there? I'm moving at the same speed. Because then you have to take the runway. Well, no, I don't need to take the runway, I can get off and fly helo route, too, if you want me to do that. And that just blew their minds, and we couldn't find a way to work that out. So it is not just us, the military, that are challenged to understand the unique characteristics of the *Osprey*, it's FAA controllers as well. We're going to have to figure out this tiltrotor piece because it is far more versatile and gives you a lot more options, and there are no rules written for it."

Bringing the unique qualities of the *Osprey* to the fight is especially important in Afghanistan. This



is true for several reasons. First, the adversary has decades of experience of tracking and combating rotorcraft. The CONOPS of the *Osprey* are different and can provide a counter to the years of experience of the adversary in countering rotorcraft. Second, the combat operations in Afghanistan will be able to draw upon the unique capabilities of the *Osprey*. Third, the ability of the *Osprey* to support ground forces not near its base will be a significant advantage.

The aircraft can move in areas not covered by traditional rotorcraft without using multiple forward operating bases (FOB), and moving in the directions of relatively direct flight which rotorcraft need to use. As one Marine commented on the critics of *Osprey*,

**"They simply do not take into account the operational advantages of the ability to skip a refueling or its ability to carry it all in one load."**

Another Marine emphasized the joint impact of enhanced security for the force and increased ability to surprise the enemy. "If you're flying a helicopter, you pretty much have to take a straight line in a lot of situations, but we can come from any direction, which offers a big surprise factor."

The range of the aircraft means you can cover the entire theater. When VIPs came to Iraq and wanted to get around Iraq in a day, one Marine underscored:

"The minute they got there and everybody realized that you can cap all six FOBs in less than six hours if you've got the speed and the legs to do it, the next thing you know you've become the VIP platform. Why? Because I have to get to these places before the sun sets today. And no other machine can do that for you except the V-22."

The infrastructure piece is key to the *Osprey* advantage. The *Osprey* can operate from a single base, but its ability to operate all over the area of operations (AOR) means that it can go where it is needed. As one Marine put it:

"We're not married to the base and ground infrastructure the same way as traditional aircraft and the mission in Afghanistan requires that that not be the case. You can't do it. You couldn't…you wouldn't be able effectively to maintain aircraft and maintain the maintenance or the operation of infrastructure for a relatively small air element in so many different locations and FOBs from the company level, in some cases down to platoon level. But if you put them all in one place with their ability to quickly dash out and get to that guy and

do whatever he needs you to do, then return to that same central base, we're in effect doing distributed operations."

The ability of the *Osprey* to move rapidly to support dispersed forces is central to tempo-setting. As one Marine noted:

"The mission of support, which people often lose sight of, isn't just to move things around the battlefield in a circulatory motion like we've seen in Iraq, it is the ability to provide mobility to the MAGTF Commander anywhere, anytime, anyplace, any payload; that's the key. I can be wherever the enemy is, and I can be there faster than the enemy can respond to me. That's tempo-generating. That's basic maneuver warfare. I can move faster, farther, with more stuff than you can, and you can't get away from me; and you can't catch me."

The ability to quickly move ground forces from one area where they are not needed to reinforce in areas under attack is essential in the Afghan theater. One Marine underscored the significance of the *Osprey* contribution to this CONOPS capability:

"I see V-22 as a real combat multiplier with its ability to reinforce ground forces over great distances. So right now, in the traditional deal that we're in where we have platoon-sized elements spread over hundreds of miles, it's likely to be very quiet in one area, and there will be a tic in another area. At the ground commander's request, we could take troops from a regionally quiet area to an area where something's going on, and that's a real combat multiplier, the ability to do that with the speed that of which the *Osprey* is capable. That is the crux of it all. We can reinforce, cover great distances in very short periods of time, and then return those troops to their base, which might be 200 miles away, at the conclusion of an operation."

Another key aspect is the ability to fly higher and quicker as a means of providing enhanced security and greater capability to execute envelopment operations. As one Marine encapsulated the *Osprey* advantage:

"Obviously Afghanistan's got terrain that we're all familiar with. *Osprey's* got the highest altitude capability of any vertical lift aircraft. It's the only vertical lift aircraft that has an oxygen system onboard. Our ability to fly more than 20,000 feet does a lot for us. Obviously, we can't carry passengers at our highest altitudes, but we can carry cargo. We can retrieve passengers and we can carry passengers at lower altitudes. But flying at higher altitudes makes you a whole lot faster. I see that glossed over when this airplane is briefed. The average ground person, or someone who's not a pilot, or even a rotary pilot, may not fully understand it. At higher altitudes, you're about a hundred knots faster than you are on the surface, in any airplane, tiltrotor or otherwise.

The ability to go higher definitely makes you faster, too. You get vertical sanctuary. The ability of the enemy to shoot you or channelize you through some terrain is reduced. So you may have a helicopter that can fly at 13- or 14,000 feet, a very powerful lightly loaded helicopter; but, he's still going to have to fly through passes where the enemy could establish a threat system. Our ability to fly at more than 20,000 feet empty, or 13,000 feet when full of people, gives us the ability to fly in straight lines from Point A to Point B without having to go around mountain ranges in certain cases, and gives us vertical sanctuary and speed while doing so. That's often not captured in discussions about the airplane...." ✪



# THE *OSPREY* IN AFGHANISTAN: A SITUATION REPORT

[In February 2010, *Second Line of Defense* followed up its interview with the *Osprey* squadron, just before their deployment to Afghanistan, with an interview with Lieutenant Colonel "Buddy" Bianca, USMC.]

The most compelling point underscored by the squadron commander is how, in effect, the *Osprey* has inverted infrastructure and platform. Normally, the infrastructure shapes what the platform can do; a rotorcraft or a fixed wing aircraft can operate under specific circumstances. *Osprey's* range and speed shapes an overarching infrastructure allowing the ground forces to range over all of Afghanistan or to be supported where there are no airfields or where distributed forces need support. The *Osprey's* envelopment role in Afghanistan is evident as well as it can provide the other end of the operational blow for the ground forces or rotorcrafts in hot pursuit of Taliban. The *Osprey* can move seamlessly in front of the land forces and allow different lines of attack to be pursued. The envelopment role was not the focus of the interview because of security considerations, but anecdotal evidence suggests the role.

**SLD: What is the nature of the environment in which you've had to operate and what kind of challenges have you faced as a Marine supporting the ground forces?**

**LtCol Bianca:** The nature of this particular environment is distributed operations, which the V-22 excels at. We operate primarily in the Helmand province, but we do fly to the far reaches of the country. The forces and the leadership want to go places where there is no runway, and the V-22 can get you there.

Distributed operations are mostly at outlying bases, living with the people in their villages and townships. One of the advantages of the V-22 is that we can land at dozens of these places in a single day—move mail, food, water, in some cases building equipment. We have run the whole gamut of support operations. We've done external lift operations; we've done deliberate actions for assault insert looking to kick in the door.

Day-to-day, we circulate and circumscribe the battlefield. And we do that in concert with the H-53s. Typically the H-53s or the other aircraft will work closer to Camp Leatherneck and the V-22s will range out to the far reaches.

The environment is challenging for several reasons. First and foremost is the fact that we're not at an airport; we live in tents. The airplanes are hangared in tents, and we only have one. For the most part they live outside in the dust and the mud and the crud on expeditionary airfield matting. We don't take off from a concrete runway. We typically lift to and from river rock pad, open desert, and things of that nature.

We're trying to do some pretty sophisticated maintenance on some precision parts. These are

actuators, hydraulic actuators, electrical motors, things of that nature, and even the electronics of the aircraft, the flight control computers, mission computers and things. They have to live in this dusty environment. That's been a challenge. But the airplanes have held up to it.

In some cases, we learned a trick or two to ease things and make the aircraft last a little longer—keeping the electronics from overheating, keeping the actuators so they could last longer on wing. Things of that nature.

I'd say the biggest challenge has been the environment and the fact that there is no factory you can go to, no depot level maintenance facility you can go to; we fix it right here underneath the sun or the rain or the clouds.

In terms of flying the airplane in the dust, the V-22 is potentially the best airplane to do that. We are very comfortable with landing in a brownout; we do it daily. The pilots are very good at it, and the airplane systems allow us to do that.

**SLD: Can you speak to how the V-22 is providing a very different kind of infrastructure than a classic rotorcraft or a fast jet can provide for the operational commander?**

**LtCol Bianca:** This is true not just for pure military operations but also in support of the political process closely associated with the military and security operation. For example, when a Shura or tribal council is to be held, a big issue is getting everyone together in a timely fashion to reduce the security risk to the council from Taliban attacks. The *Osprey* can uniquely bring folks together and move them after the meeting in a very timely manner.

There have been one or two times where we had to go get a guy, literally, on the border with Iran and another guy from the other end of the country from the border of Pakistan. If we didn't have V-22s, we could not have done that without taking several days to transport these guys.

**SLD: Are you highlighting how the V-22 fits the political context of Afghanistan?**

**LtCol Bianca:** We're trying to put people and policy makers together in certain places at certain times. The nature of mobility is characterized by three things: speed, range, and payload. If you need mobility, hey, I just got here in Kandahar, and I need to go see this place and this place and this place, so I can get this non-government agency eyes-on, well then, we're your platform, and I guarantee you, we're going to get that mission.

It's the same with the VIPs that come from America: the undersecretaries for agriculture, the various service committee members or representatives. If you need to see a lot of things, then we're going to put you on a V-22, because that's the only way you're going to see everything in this province in a day. We'll get you there and back in a day. There are no airports; we carry the airport with us.

**SLD: A recent press piece focused on the role of the V-22 in Afghanistan as "ferrying around" troops. Given what you are saying, this phrase probably should be modified to suggest the impact you have in shaping operational capabilities, not just doing something akin to classic rotorcraft transport.**




**LtCol Bianca:** Here's something that nobody ever thinks about until they get here. It's one thing for me to do an assault support mission where I insert troops to a location. It's quite another to talk about distributed operations.

So, I'm here at this airport, the troops I have to move are way over there, and the place I need to get them to is way over that way. So, if you want to do this in one cycle of darkness, you're going to have to put some speed on it or you're going to have to make this a two-day evolution. So, even if it was to be characterized as "ferrying" of troops, there's the speed component.

**Football's a game of inches; combat is a game of minutes or even seconds.**

Never forget that it's not like the troops just get on the airplane here at Camp Leatherneck. They're not here at Camp Leatherneck, they're somewhere else. We have to go get them first and then move them to wherever the operation's going to go. Regardless of how you characterize an operation, whether it's an assault or it's a town meeting, it's time urgent mobility.

We are moving folks to places in this country that you just can't get to in a timely manner any other way. You can't get in a car and drive there. You can get in a helicopter and fly there, but that's going to take two and a half or three hours.

Your only option if you need to get somewhere quickly is to get into a V-22.

AUGMENTING THE CAPABILITY OF THE AMPHIB:

# A KEY ELEMENT IN THE EVOLUTION OF THE SEABASE

[Excerpted from a March 2010 SLD interview with Jim Strock, Director, Seabasing Integration Division, Capabilities Development Directorate, U.S. Marine Corps Combat Development and Integration.]

Jim Strock is one of the nation's leading experts on seabasing and an innovative thinker with regard to the evolution of U.S. Naval and Marine Corps forces. In excerpts from this interview, Strock highlights innovations in the decade ahead in augmenting the capability of the seabase, notably under the impact of the *Osprey* and the F-35B.

**SLD: Let's turn to the question of the evolution over the decade ahead; what new capabilities could be added to the seabasing effort?**

**Strock:** The capabilities that we need in the seabase are the ability to conduct at-sea transfer of personnel, equipment, and supplies between large vessels and maneuver those capabilities ashore via all forms of surface craft. The last time we talked, we talked about the MPF future program and how we were going to have the LMSR, the large, medium-speed, roll-on/roll-off ship coupled with a fully functional mobile landing platform. With such platforms in the seabase, you'd be able to transport troops to the seabase by aircraft and the Joint High-Speed Vessel and conduct at-sea arrival and assembly of troops, equipment, and supplies—transforming them into an operationally capable unit able to maneuver ashore by both aviation and surface landing craft.

We're clearly heading in that direction, but we're not getting there as fast as we want. The answer comes in three parts.

First, the Marine Corps fortuitously acquired three LMSRs from the U.S Transportation Command (TRANSCOM) to replace some aging MPS ships. While those LMSRs are not outfitted with the MPF Future enhancements we were seeking, they are LMSRs nonetheless, and they are extraordinarily capable ships. The Marine Corps went to TRANSCOM and said we would like to acquire the operating rights of three of those ships and put them in our MPS program. The LMSRs are nearly a thousand feet long with three to four hundred thousand square feet of rolling cargo space. They were built in the mid 90s as part of the Army's overall strategic mobility program. That's a story unto itself, but we wound up acquiring 19—half of them are the *Bob Hope*-class, the other half are the *Watson*-class. The vessels are very good utility infielders, capable of going 24 knots and carrying substantial amounts of cargo. Those ships were one of the principal means for getting combat equipment in theater for OIF (Operation Iraqi Freedom) and OEF (Operation Enduring Freedom). We still have the AMSEA and *Waterman*-class dense-pack ships in our MPS program, but with the addition of three LMSRs we now have the beginnings of at-sea transfer capabilities.

Second, the Navy's Fiscal Year 2011 shipbuilding budget contains funding for three revised Mobile Landing Platforms. These MLPs will initially have two basic seabasing capabilities: at-sea, sea-state three transfer of personnel, cargo, and equipment between the MLP and the LMSR, and the ability to transfer those assets from the MLP to LCACs for maneuver ashore.

Third, the original MPF Future program called for three T-AKE supply ships, carbon copies of the T-AKEs that are being acquired for the Navy's Combat Logistics Force. The MPF Future T-AKEs were funded in Fiscal Years 2009 and 2010, and we were able to retain the commitment for those ships to become part of our MPS program. By adding one T-AKE to each of our three MPS squadrons, we'll be able to convert 20-25 percent of supply stocks, previously packaged in 20-foot containers, into pallet-level stowage configuration, thereby enabling selective offload of small-unit sustainment packages for pinpoint delivery ashore by aircraft for surface craft.

Put all that together, the MPS squadrons operating in the seabase becomes a very credible new node within a much larger theatre operations and distribution network. With those enhancements to today's MPS, we will have far greater seabasing capabilities—at-sea transfer, maneuver ashore, and selective offload—that will enable our Navy and Marine Corps operating forces to employ our afloat prepositioning capabilities across a far greater array of military operations in support of Combatant Commander mission assignments.

**SLD: It seems to me that given your focus on the seabase, that the amphibious fleet becomes more important as the capabilities onboard are enhanced, namely, the *Osprey* and the F35-B which enable a three-dimensional capability for the seabase that it currently doesn't have. Could you speak a little bit to the question about how these new aviation assets interact with the surface assets?**

**Strock:** I think what the nation needs to know about amphibious ships and amphibious forces is, number one, that out of all the ships in the fleet—all the ships in the fleet—the only ships that can truly extend the full range of seapower ashore are amphibious ships. Aircraft carriers and surface warfare ships have tremendous strike capabilities, and the upcoming Littoral Combat Ships will provide enhancements to our surface combat, anti-submarine warfare, and mine warfare capabilities. But amphibious ships are armed with operationally ready Marine Air-Ground Task Forces (MAGTFs). Those ships can project and sustain those forces ashore, and can recover them to the seabase when and where required. That's a degree of operational flexibility that significantly increases the range of options available to the Combatant Commander. That's very important in today's security environment.

Equally important is the fact that amphibious ships can loiter virtually indefinitely with those operationally ready forces fully capable of operating on a rheostat. Other ships can't do that, or they can't do it to the extent amphib ships can. The amphib ship with its onboard ability to care and feed and train and refresh and resupply those troops, and house and maintain their aviation and landing craft, those are critical capabilities necessary to support today's national security strategy.

With the V-22, you now have a geometric increase in your operational reach and speed of extending those forces ashore. With a CH-53 kilo's key performance parameter of 27,000 pounds traveling 110 nautical miles on a high hot day, that's a level of operational reach we have never seen before. With that elongated operational reach, you could go farther inland; you can enable that seabase to stand off a little bit more that enhances your force protection.

With respect to the F-35B, we're talking about a fifth-generation aircraft with greatly expanded capabilities over its predecessors. It's a multi-mission aircraft. I'm not an aviator, but it's clear that this aircraft will bring far more than improved kinetic strike to the battle space. It will give the commander on the ground vastly improved eyes and ears. It's an incredible aircraft.

We have a whole lot of ship integration work to do to get that aircraft onboard the amphibs and have it operate from the amphibs. The flexibility of what our amphibious ships can do across the full spectrum of military operations is lost on the nation. They are exceptionally versatile platforms, and they're always in high demand.

# AN INTERVIEW WITH LIEUTENANT GENERAL GEORGE J. TRAUTMAN, III, USMC, DEPUTY COMMANDANT FOR USMC AVIATION ON THE IMPACT OF USMC AVIATION ON THE EVOLVING CAPABILITIES FOR THE U.S. WARFIGHTER

**SLD: The Commandant has referred to the F-35 as the centerpiece for the future of the MAGTF. Why is that so?**

**LtGen Trautman:** The Marine Corps is by nature a light force. We don't have the luxury of traveling with a lot of heavily mechanized forces. Because of our naval character, we often go by sea and because of our expeditionary nature we often find ourselves in austere locations early in a campaign. In order to get there early in a campaign, we need to deal with an increasingly inaccessible world.

At the forefront of the ability to operate in this environment is the very low observable capability that the F-35 brings to the fight, as well as the capabilities that STOVL will bring to the fight with regard to close proximity to our expeditionary forces.



The Marine Corps depends on TacAir probably more than some of the other services because of the light nature of our force and the dependency that we have on TacAir to ensure that we can take risk in maneuver. You can only take risk in maneuver if you have adequate intelligence surveillance and reconnaissance, dissemination of information and the firepower that comes with it that will enable you to move about the battlespace without the heavy firepower that, for example, an Army heavy corps would bring to the fight.

So TacAir is essential to our ability to maneuver in the battlespace. F-35 is going to be an incredible contributor because of the sensing and computing power that this machine is going to bring to us. We are going to find ways to better disseminate that information across the entire battlespace and all the way down to our platoon and fire team leaders at the right time and in the right way.

And so in many ways, F-35 will lead us to the next generation of warfighting, if you will, in which information exchange is going to become more and more important, and the F-35 is ideally suited for that kind of operation.

**SLD: The F-35 is going to replace several aircraft for the Marine Corps. What contributions does simplification of your fleet bring to the fight?**

**LtGen Trautman:** The tangible benefit of replacing our *Hornets*, our AV-8s, and our EA-6B *Prowlers* with a single type model series is going to be huge. From the perspective of the logistics footprint, from the training perspective, from things like peculiar support equipment, ground support equipment, the training of individual Marines and aviators, we're going to take more than a threefold increase in effectiveness, efficiency and resource savings by transitioning to this single type model series.

**We're going to take more than a threefold increase in effectiveness, efficiency and resource savings by transitioning to this single type model series.**

We learned this when we, for example, transitioned our H-1 helicopters to two airplanes, the AH-1 *Zulu* and UH-1 *Yankee*, which have 84 percent commonality. We're already reaping the benefits. We anticipate the same result with the F-35.

It's absolutely essential that a machine that is going to do everything that our STOVL AV-8s, F/A-18 fighter attack airplanes, and EA-6B electronic warfare airplanes do for us today be a "pilot-friendly" machine. If it's not a pilot-friendly machine, built from the ground up with fused systems, we're not going to be able to perform all of those functions.

We're actually quite optimistic in what we've seen in the simulator and what we've seen through various studies of the systems that are already being built by the contractor that we're going to be able to train to this range of mission sets. We may have to have specialization of some of our aircrew. It remains to be seen as we build our concepts of operation and our tactics, whether we have to evolve into a specialized approach or not. At this juncture, we're actually fairly confident that the enhanced capabilities of the F-35 are going to enable us to avoid building specialized aircrews.

**SLD: The USMC has introduced the *Osprey,* which is certainly a transformational product, and the F-35B is coming online. Those two together should give you more integrated capability to certainly provide a leapfrogging capability for your amphib fleets for example.**

**LtGen Trautman:** The range and speed that the *Osprey* brings to the fight is very much transformational, and the ability to connect *Osprey* to F-35 and then to the rest of the joint force is going to open up potentialities that just have not existed in warfighting to date.

I think by the time F-35 comes to the forefront here in the next four to five years and by the time we figure out how to connect the two in the battlespace, we're going to bring to the fight something that is going to be very much a game changer. It's going to be a game changer from the perspective of the kinds of things that commanders can choose to do should they choose to do them.

Combined with the improved intelligence surveillance and reconnaissance capabilities that our nation already has, we're going to be able to exploit our asymmetrical advantage which will be in the combination of the F-35B in the STOVL mode and the V-22 with the range and speed that it contributes to the fight.

**SLD: The combined capabilities that you are crafting will be an essential contributor to dealing with hybrid threats. How do you view the multi-mission capability of the F-35 in dealing with hybrid threats?**

**LtGen Trautman:** Some people like to paint the fifth-generation strike fighter, the F-35, as only essential in a state versus state endeavor where a near peer competitor has decided to build a sophisticated integrated air defense system or has decided to spend a lot of money on sophisticated aircraft that can conduct a near peer aerial warfare fight.

I think that's flawed thinking because even in a low end fight, it's possible that you can encounter very sophisticated enemy scenarios with radar guided air defense systems and even double-digit surface-to-air missiles in localized areas that preclude your ability to operate freely. In other words, you can encounter an integrated air defense system on a local level right in the midst of another kind of fight.

So in a single day—much like the Three Block War that General Krulak talked about; much like the hybrid war that we saw the Israelis and Hezbollah involved in—you can find yourself in a COIN fight in one part of the battlespace quickly evolving into a very different threat scenario in another part of the battlespace. This might happen all within the range of maybe 100 miles or 200 miles. You have to be ready and prepared to evolve from one type of threat scenario to another, even at the lower scale, on a daily basis.

Consider, for example, if someone had introduced sophisticated double-digit SAMs into Iraq at some point in the recent past or in the near future; it would change the whole nature of the fight. You have to be prepared to swing across the range of military operations, not just in the broadest strategic sense, but at the tactical level in the context of something like the current fight that we find ourselves in in Afghanistan or previously in Iraq.

## Transitioning from Legacy Aircraft to the

# THREE-DIMENSIONAL WARRIOR

# ENABLING

## THREE-DIMENSIONAL WARRIORS

# ENABLING THE F-35 PILOT

[Excerpted from a January 2010 SLD interview with Chris Sheppard, manager of the USAF programs for Northrop Grumman Corporation's government relations group.]

SLD sat down with Chris Sheppard, a manager of USAF programs for Northrop Grumman Corporation's government relations group, to discuss the interaction between the F-16 and F-35 as the U.S. Air Force builds its capabilities into the 21st century. We asked Chris to share his personal experience as an F-16 pilot, his work on the F-35, and how the two compared.

Chris works at the Fighter Demonstration Center in Arlington, Virginia, a facility shared by Lockheed Martin, Northrop Grumman, and Pratt and Whitney that was set up to showcase the fifth-generation fighter capabilities. Chris Sheppard has flown all F-16 blocks, "A through D," he says, and has closely followed the fighter's evolution from block to block in his current line of work at Northrop Grumman.

A graduate of the Air Force Academy, Chris Sheppard is now an Air National Guard F-16 pilot and has flown F-16s operationally on active duty and with the reserve component, and participated in a number of combat exercises including Operation Northern Watch, Operation Southern Watch, and Operation Iraqi Freedom.

The F-35 is intended as the replacement for the F-16. Excerpts from this interview explore how the new fighter will execute future missions differently, as well as how the two fighters may work together during the transition. We also discussed with Chris Sheppard how customers can get greater connectivity between the two aircraft.

**SLD: You referred to the F-35 pilot as a tactical decision maker, but doesn't the F-35 play a much more strategic role in the new paradigm?**

**Sheppard:** Fighter pilots are typically thought of as being tacticians in the Air Force construct of operations. Although they will continue to be front-line tacticians, having an asset like the F-35 provides the capability to have much more situational awareness and have a much more strategic impact on decisions made in the battlespace. Part of the paradigm shift is viewing flying forces—in this case the fighter community—as part of the strategic versus the tactical picture. This is similar to the concept you spoke of previously regarding the situations our ground forces find themselves in in today's fight—their decisions and subsequent actions can have significant strategic ramifications.

In the current fight, we're continuing to appreciate the value of leadership and critical decision making at every level.

**The F-35's ability to gather data and present it puts this platform on a new level with regard to the strategic importance of real-time decision making.**

When time isn't as critical, some decisions can be passed back to the rear echelons to be analyzed and then proceed with the proper response. Many times decisions need to be made in real time—not only on the ground but in the air as well. The ability to have that information there and make the




right decision is invaluable. I'm sure the "strategic corporal" to whom you referred earlier didn't anticipate the time he or she would be expected to make a decision that could have battlefield effects larger than they ever dreamed possible. But that's what we're facing now with this type of threat.

**SLD: How does stealth change Concepts of Operations?**

**Sheppard:** Stealth provides the ability for true first-look, first-shot in a traditional kinetic effect, force-on-force type application. One has to ask, "With the evolution of enemy weaponry and the projected evolution of threat aircraft by other countries building fifth-generation-like aircraft, will they be of the caliber of fifth generation aircraft that we see in the United States and with her allies?" Perhaps not.

Will they be built in vast quantities? I think there's general agreement that will be the case. Having the benefit of very low observable stealth on these aircraft does require that weapons be carried internally. This provides the aircraft the opportunity to have a much decreased chance of detection to not have to go into those force-on-force types of scenarios, depending on the situation.

Pilots have to be mindful of ground threats as well. With today's precision-guided weapons, the aircraft is like a truck that's carrying weapons into a combat envelope where they can be deployed and then returned to base. That's a fairly typical mission.

One benefit of the F-35 is the ability to reconfigure and carry even more weapons externally when the threat environment is assessed to be permissible to this type of configuration. This enables the benefit of internal and external stores to carry more ordnance to service more targets if called upon to do so. The F-35A can carry approximately 18,000 pounds of ordnance when fully loaded internally and externally, far exceeding the payload of the F-16 and F-18.

**SLD: What does DAS (Distributed Aperture System) do for your air-to-air combat and what's the potential for DAS to contribute to the Army and the Marine Corps on the ground?**

**Sheppard:** The Northrop Grumman Distributed Aperture System (DAS) is truly one of the game-changing capabilities on the F-35, and we're already seeing interest in its application on rotary wing aircraft and other assets for missions and roles such as missile defense.

DAS offers multiple capabilities. First, there's no need to fly with night vision goggles, which we do now when conducting combat operations at night. The night vision goggles that we currently fly with are dependent upon the amplification of ambient light. In a sense, your night vision goggles are just another sensor. They don't simply turn night into day. One must look and analyze before acting—much like a radar or a targeting pod.

The DAS provides an EO/IR picture in a different spectrum than night vision goggles, such that it's not dependent on ambient light. As a result, flying below cloud decks and flying anywhere there's an overcast sky or where ambient light's not present is possible.

Second, its ability to detect and accurately locate firing points of missiles and anti-aircraft artillery is key to getting other sensors locked on to where that threat came from, so the appropriate action can be taken—whether it's kinetic or non-kinetic. I think we're only on the cusp of understanding what the true value of DAS will be to the warfighter.

**I think we're only on the cusp of understanding what the true value of DAS will be to the warfighter.**

DAS has a situational awareness mode that simultaneously tracks all aircraft within range, spherically around the F-35. This capability will have significant implications in air combat maneuvering, for launching off-boresight weapons, and for overall survivability.

There are also growth modes for the Distributed Aperture System which will significantly enhance the platform's networking capability. DAS works in a spherical context and is always on, all the time… always detecting. Perhaps our biggest challenge is that DAS taking in so much information that the next step will be to figure out how to manage and distribute all the data it can provide.

**SLD: In the manned-to-unmanned evolution, what do you think about the possibility of off-loading data from the F-35 to an unmanned flying data recovery system?**

**Sheppard:** There are multiple options. One of the concerns of combatant commanders that is consistently articulated is the need to hand off data in a usable format. It's about turning data into actionable intelligence. Our challenge is to devise the most efficient manner to manage the data and make the intelligence actionable.

**SLD: So the F-35 can help manage data choke points for leaders who have to make real-time decisions in a tight time frame?**

**Sheppard:** The F-35 could aid by gathering and assimilating data from others in some circumstances, or acting as a data provider to other systems. If the objective is to get the data off board to preserve the processing power on the jet for other functions, it can be a data provider. Perhaps in other circumstances the best option is to utilize on-board fusion capacity, then relay. We're now evolving into a system-of-systems construct, and we can readily see how such a "flying combat system"—when integrated with the ground forces—provides important new capabilities from which to develop the future of air as well as ground and sea operations.



# THE DISTRIBUTED APERTURE SYSTEM AND 360-DEGREE SITUATIONAL AWARENESS

[An interview with Mark Rossi, Northrop Grumman Electronic Systems.]

SLD talked with Northrop Grumman Electronic Systems' Mark Rossi about the Distributed Aperture System (DAS) on the F-35, which together with the helmet provides 360-degree situational awareness for the F-35 pilot.

Mark has served as the Director of the AN/AAQ-37 Electro-Optical Distributed Aperture System (EO DAS) for the F-35 platform, having management responsibility for the product development and production of the EO DAS hardware and software. He joined Northrop Grumman in 1984 and has held numerous positions of increasing responsibility in Technical Subcontract Management, Business Development and Program Management.

**SLD: The Distributed Aperture System (DAS) is one of the reasons why the development of the F-35 is about the next 30 years of military aviation, not the past 30 years. Yet folks have not really wrapped their heads around what DAS is or can and will do for the warfighter.**

**Rossi:** The biggest problem with DAS is that it's completely unknown to most people. We think of it as revolutionary. If you consider radars, it's evolutionary. Everything since WWII has been equipped with a radar, they just keep getting better. We keep building on it. People are used to what it brings to the fight. They've never had the capability provided by DAS. So we wow them with imagery, we wow them with performance data, and so forth. But I think everybody who listens to our story, especially at a classified level, can imagine what they might do with this thing. But they have no idea what they're getting.

The number one thing that DAS brings to JSF is 360-degree spherical situational awareness. We create this bubble around the airplane where we're just seeing everywhere all the time, we're always on, we never stop. We don't interleave. We do it 100 percent, all the time.

**SLD: Is this a man-machine interface we're talking about?**

**Rossi:** From a situational awareness point of view, the pilot does absolutely nothing. We are monitoring the world around us all the time and then differentiating things that occur that are important to that pilot—classifying them for him. It's only when we determine there's something important that he'll even know anything's going on.

**SLD: DAS provides 360-degree situational awareness for the individual pilot on the F-35, but is there any reason that we couldn't take that fused data and share it?**

**Rossi:** There's no reason we couldn't do it short of limitations of those sharing channels.

**SLD: But the point is that you're standing up a basic capability on the first production aircraft and there's the opportunity to take this capability, which is unprecedented, and figure out new ways to share data and new ways to battle manage. In other words, you're investing in the future by buying this capability.**

**Rossi:** Absolutely, absolutely, absolutely. All of it's there. What you do with it beyond ownership is all in the realm of possibility.

**SLD: So the point—focusing on the individual aircraft now and the pilot managing the aircraft—this allows him to have capabilities to see 360 degrees and understand the threat envelope around him.**

**Rossi:** The pilot gets this situational awareness, and obviously we're providing an IR situational awareness of the world. It's not individual. It's in the IR band and it is completely passive so it's on all the time and it doesn't hurt the LO capability of the aircraft.

Within that situational awareness, another mode that we were asked to develop was a missile targeted at the plane. So we have to know what all those manmade airborne objects are and classify them, and then if we believe that one of those happens to be a missile that's targeted at the plane, we have to actually tell them that.

**SLD: So this is a key tool to de-clutter the battlespace so that the pilot can focus on the most important priorities.**

**Rossi:** Absolutely. So the pilot keeps track of the world, but we classify the world into things that the pilot would care about that are manmade. Obviously, this includes missiles and airplanes, both air-to-air and air-to-ground, so if there happens to be something coming from the ground, not only do we need to know that it's something coming from the ground, we need to know that it's coming from the ground and it's targeted at you and we have to tell you where it came from too.

**SLD: Why is DAS so misunderstood or underestimated?**

**Rossi:** I think number one, they don't really understand what it's going to do for them. And number two, the few systems out there that try to do this, never try to this degree. The missile warning systems that exist out there are just fraught with error. The reliability of the DAS ensures a whole new level of trust and confidence for the pilot in operating the aircraft.

**The reliability of the DAS ensures a whole new level of trust and confidence for the pilot in operating the aircraft.**

**SLD: How does the new helmet for the F-35 interact with the DAS?**

**Rossi:** The DAS provides 360-degree NAFLIR (Navigation Forward Looking Infrared) capability. So if you think about it we're out there staring at the world. We have all this information. We can then take and post-process where the pilot is looking on his helmet. We also have an auxiliary channel where he can dial in any particular sector that he wants to keep track of and we can give him near 20/20 IR imagery of the world about him.

So now night landings on carriers are fully enabled. We show this stuff to Navy pilots and they're just awestruck that they can even see the horizon, let alone the boat out there and the wake.



**It's going to revolutionize night landings on aircraft carriers.**

FLIR is an archaic term because FLIR stands for forward looking infrared. We're not *forward* looking; we're *everywhere* looking. But it's a term that people have created so we stick with it. But anywhere the pilot can turn his head—through his legs, through the floor of the airplane—he can look because we're looking everywhere.

**SLD: You mentioned fusion. The fact that this data is fused… can you tell me a little bit about what advantage that brings?**

**Rossi:** We take and collect all that information and we, for lack of a better term, we fuse that data and create a global theme within our processor. From that we produce the NAFLIR imagery. We're watching everything and then we're classifying everything by order of importance. So we do all of that, that fusion, ourselves and then the output is per the Lockheed defined interface control drawing as to what messages we send and the streaming video that we also send.

Then that information is fused with other weapon systems on the aircraft and then presented to the pilot. We actually don't determine what gets presented to the pilot, they do. So if we see something and they want to put another weapon system on it to verify it, they might do that. We don't know exactly what they intend to do with all the information we send them. That's a Lockheed fusion job. You don't directly interface with the pilot, other than our imagery on their helmet and the declaration of a plane-targeted missile.

We do a lot of fusion at our level because we have to integrate six sensors into a singular unit that does not lose track of things across sector boundaries and camera boundaries. A lot of systems in the past, even with multiple sensors, were challenged by fusing those into a singular global seam that is impervious to the boundaries relative to tracking things of interest across them. Being able to seam to the point that we don't have a loss of track across the camera or the sector boundaries in inertial space is critical.

**SLD: Lockheed is addressing the broader air integration issues, but there's a significant difference between an F-18 or F-16—where you're doing iterative additions to the aircraft—versus what you're doing with the F-35—where you're coming on with an integrated sensor capability—and the DAS—where it can work on a man-machine basis. That is very, very different than just incrementally adding capabilities.**

**Rossi:** That's the whole fifth-generation concept. The F-22 is a fused airplane and so is the F-35, and they can use these other weapon systems to enhance their overall integrative capability. The beauty about DAS is that we're seeing everything all the time in places on a 360-degree basis. Radar's a phenomenal system but it has a cone, right? It's never looking behind you and most of the time it's not looking to the side of you unless you have side arrays.

So we look everywhere and we can let the pilot know that there may be a problem. The pilot may need to turn around and look to see if there is a need for other weapon systems, where in the past you would have nothing in those coverage areas.

And then we have to work in all clutter environments. Think about it, we're looking everywhere. In the daytime, at all times in the daytime, one of our cameras, at least, is looking at the sun. So think of the challenges associated with an IR system that's staring at the sun. We obviously can't bloom on it; we can't bleed over.

Think about those challenges. There are all kinds of things associated with looking everywhere. We're looking at cold sky at the same time as we're looking at a very highly cluttered mountainous range, and we're looking off to the side at backlit clouds all at the exact same time in this 360-degree world. So we can't be tuned to one or the other, we have to be tuned to all of them in order to provide this performance. When you get into the details you realize the challenge associated with doing this because we're looking everywhere all the time in all conditions day and night, and we have to address all those conditions or else we're not a capable system.

**SLD: You're providing technologies, tools that really allow the pilot to act very differently, function very differently.**

**Rossi:** Absolutely. We provide a whole lot more situational awareness around the pilot. We project imagery into the helmet to a defined field of view based on where the pilot is looking. All that's mapped, and we predict where the pilot's going to move his head. We have post-processed that region of imagery to provide the near 20/20 quality. We could do it everywhere, but it would just be a processor hog so we post-process the spot where he's looking and the region around where he's looking so to minimize latency as he moves, and then present him that near 20/20 quality visual wherever he moves his head.

And again, he can go pick an area and if he wants to just watch that area all the time, he can just dial that in and he'll stare at that thing. But remember, we're not slewing anything. We're not moving anything. It's all just picking a spot in a virtual global sea. We're doing this in the processor.

**SLD: How do you think they'll experience this because it's going to be a very different experience and will drive new battle tactics and operational foci?**

**The young kids who are going to be flying these airplanes will have grown up playing video games.**

**Rossi:** This will not be foreign to them. We're providing that technology now so that when the next generation of fighters get in that cockpit, it's not going to be unlike what they're used to back home playing they're videogames. If you consider the mentality of the kids that are going to be sitting in those seats, they would be very disappointed if they didn't have that kind of capability. That's just my take on the world. I'm 50 and I didn't grow up that way, but my 13-year-old knows a lot more about it than I do.

The next generation of pilots is going to expect that speed. They're going to expect that image quality to be given to them, and I think that they'll already know how to use it because they will have been trained all their life by playing video games. With this kind of capability, the F-35's mission can be increased.

The missions JSF can do can expand the operational envelope. You don't want to make JSF a drone, but if he's up there anyway and they're everywhere and they're linked, your mind starts to think of the possibilities of what they could do with this kind of 360-degree, fused information.

Also, think about the additional information that we could provide. We're seeing everything so we're seeing ground activity, all of which, right now, we completely suppress. We throw it away because—guess what—it's not an airborne object and right now we don't care about it. But what if with a simple algorithm change you could direct other weapon systems to, say, "Hey, something's moving right there!" Then you point your "soda straws" and, wow, you're not scanning and searching like you do today with your traditional "soda straw" systems.

Even radar is in volume search a lot. DAS is looking everywhere, seeing everything, maybe not with the clarity of a targeting system, but if I see something here, all I have to do is tell my radar or my EOIS to go look, and bingo. There are capabilities limited only by our imaginations!



# THE F-35 PILOT

[An interview with Lieutenant Colonel M.G. "Squirt" Kelly, F-35 Flight Operations Lead, VX-23, Patuxent River, Maryland.]

The pilot on the F-35B is really a centerpiece of what we are calling the three-dimensional warrior. The new helmet and the interactions between the pilot and the systems on the new aircraft provide the hub for new operational capabilities.

SLD went to Patuxent River in April 2010 to interview several members of the Patuxent River test team and spoke with test pilot "Squirt" Kelly about his thoughts on the F-35 experience.

**SLD: You've been testing the helmet and the plane. What's the synergy between the helmet and the plane?**

**LtCol Kelly:** Well, it is quite a nice synergy, actually. The helmet becomes very natural to the pilot, because it mimics what we have in legacy systems, but it presents it in a way that's clean and easy to understand, and is the building block for the DAS system, for the night camera, and all of the situational awareness that can be provided to the pilot.

**SLD: And you don't need night vision goggles?**

**LtCol Kelly:** You don't need night vision goggles; it's all built into the helmet. So, depending on the conditions—the light levels, environmental factors, and cultural lighting—you may choose to use the night camera or your DAS system, depending on what gives you the best situational awareness.

**SLD: Do you have better peripheral vision as a result?**

**LtCol Kelly:** Yes. The night vision goggle—the Legacy Night Vision Goggle—is just a sensor. It doesn't provide you with an integrated picture. The F-35 night camera as it's projected in the helmet is really more like using your own vision, rather than looking through a narrow sensor, or soda straw, so to speak.

**SLD: Do you foresee a significant adjustment when you start using this in the airplane?**

**LtCol Kelly:** We think there will be a building block approach as we integrate more of the capabilities into the aircraft and the helmet. We saw the same jump in tactics development in the simulator when we first added the helmet capability. We had to take a step back and rethink some of the ways we were performing the mission, because now we had more information, better information, more situational awareness. We could be even more efficient and effective at performing the mission with this helmet.

**SLD: Can you give me an example of the difference this makes?**

**LtCol Kelly:** With the F-35, if my wingman finds a target on the ground, he can data-link that information to me and now my helmet will tell me where to look on the ground to find that target and I know we are looking at the exact same target.

**SLD: So, in other words, it's shared information?**

**LtCol Kelly:** Yes. It's shared information and the helmet will tell the pilot where to employ sensors and weapons while providing threat information.

You get more awareness, throughout your flight, on friendly and enemy positions. So you have shared situational awareness across the board to understand who the "friendlies" are, who the "hostiles" are, what the order of battle is, and what the current situation on the ground is in real time.

**You have shared situational awareness across the board to understand who the "friendlies" are, who the "hostiles" are, what the order of battle is, and what the current situation on the ground is in real time.**

**SLD: Are you also building a consensus between you and your mate on what you think you're seeing?**

**LtCol Kelly:** Absolutely.

**SLD: So you have confidence that you're looking at the same thing?**

**LtCol Kelly:** Absolutely. Between you, your wingmen, and the ground. That consensus allows for a safer, more rapid employment of weapons with less potential for collateral damage.

**SLD: So situational awareness offers a higher sense of confidence in the decision you're about to make. Is one of the advantages going to be your ability to share this information rapidly with a ground decision-maker?**

**LtCol Kelly:** Yes, based on the information you and your wingmen obtain, you can make timely decisions more effectively as a team, and rapidly pass that information to the ground without relying on other assets.

As you add the F-35, you are going to reshape other capabilities on the battlefield as well, and provide the foundation for managing battlefield assets, UAVs, intelligence, and other tactical information. The F-35 will change the way we think about the role of tactical aviation.

**SLD: Is there a cultural challenge to learn how to maximize the impact of the F-35 and to adjust CONOPS?**

**LtCol Kelly:** Yes, but one of the things we made sure of with the F-35 was that it is and will be compatible with legacy systems, like Link 16. Legacy platforms of the United States and various nations are going to be around for quite a number of years. The F-35 will have the ability to interact with those platforms in a large force coalition CAOC environment where there are multiple platforms and multiple services. And then also provide the ability to have a separate communication system that's designed for low observable aircraft, which provides the flexibility to operate differently and more independently.



**SLD: I assume that the F-35 will be able to operate more effectively in airspace from the pilot's point of view?**

**LtCol Kelly:** One of the other great things about the F-35 is that it is a first day of the war airplane, but not just a first day of the war airplane. So in those situations where we are supporting Marines on the ground in a rapidly changing environment, the F-35 will be able to safely operate in that environment because of its sensors and the threat information that is presented to the pilot.

In a high-threat, close air support environment, the F-35, through the helmet, will enable the pilot to focus on employing weapons on time, on target, while providing the information to avoid threats where that's possible, or defeat those threats where that's necessary to perform the mission. And the helmet is the key to getting the pilot looking in the right direction. We all know a picture is worth a thousand words, so, hearing something is nice, but being able to see it on the ground in relation to the battlefield really builds the pilot's knowledge and awareness.

**SLD: So you are enhancing the probability of looking at the right thing?**

**LtCol Kelly:** Yes, whether it's friendly or hostile, and then having the aircraft, through the helmet, alert the pilot to what action he needs to take in a particular scenario, to either avoid or defeat that threat, and then perform the mission. In a legacy aircraft, depending on what that threat is, you may have to abort your mission. You wouldn't have the real time situational awareness of all the threats, so there could be confusion about whether you can still perform the mission … how safe is it to continue.

**I would have to abort missions in a legacy aircraft that I will now be able to continue in an F-35.**

**SLD: Tactically, the big deal used to be to get your opponent to jettison his ordnance. To react to you, he punches everything off, and you're fighting and you want to kill him if you can't get the silver star, but at least you've stopped your opponent from doing something ugly to your guys. And they're telling you, basically, you're not going to throw anything over the side, you're going to press on with the fight, with enough confidence that you survive a fight and get the mission done.**

**LtCol Kelly:** With this aircraft, I could take off, and after employing weapons on my primary target, my wingmen or someone on the ground can say okay, I've got another threat over here, can you provide me some information. Instantly, you can become a flying ISR platform, and adjust to provide the context for that ground commander. So even after employing your weapons, which was your initial goal, you can continue maximizing your capabilities.

# EVOLVING MANNED AND UNMANNED CONOPS: AN INTERVIEW WITH LIEUTENANT GENERAL DAVID A. DEPTULA, USAF

[In April 2010, SLD interviewed Lieutenant General David A. Deptula, USAF to discuss the evolving interactions between the new manned aircraft and next-generation unmanned air vehicles.]

General David A. Deptula is Deputy Chief of Staff for Intelligence, Surveillance, and Reconnaissance at Headquarters, U.S. Air Force in Washington, D.C. He is currently responsible to the Secretary and Chief of Staff of the Air Force for policy formulation, planning, evaluation, oversight, and leadership of Air Force intelligence, surveillance, and reconnaissance.

**SLD: UAVs and the ISR provided by UAVs have become prominent in public discussions about the future of airpower. What are your thoughts about their future contributions?**

**LtGen Deptula:** Well, it's an interesting question because it takes us down a deeper train of thought where we are focusing beyond remotely piloted aircraft vs. piloted aircraft. It takes us beyond the notion of aircraft as individual systems and moves us into the realm of a future that is dominated not by things but by concepts of how you tie all of these things together and how they can all provide military capability, whether they operate from the ground, on the sea, or in the air.

**I like to characterize the point of history we're in today as a transition point between Industrial Age warfare and Information Age warfare.**

And that Information Age is being perpetrated by advances in technology that allows us to do many more things on individual aircraft than we've ever been able to do before. This advancement in technology enables different concepts of operation for employing remotely piloted aircraft and joining them together with modern manned aircraft like the F-35 and F-22. These capabilities can help produce concepts of distributed air operations that we simply have not had the advantage of executing in the past.

Modern fifth-generation aircraft like the F-22 and F-35 are not simply fighters. We're trapped by an old historical nomenclature system here. They are in fact flying sensor platforms that have inherent force application capability associated with them. So we need to think about new and innovative ways that they can contribute to a system of individual elements that create a force that can achieve outcomes that are not just sequential in nature.

**SLD: So we should begin to think of the correlation between ISR and OPS rather than looking at them as separate entities?**

**LtGen Deptula:** Absolutely. The evolution of technology and information is allowing us to change our culture, a culture that in the past tended to segregate intelligence from operations. That historic segregation of "ops" and "intel" is really dysfunctional and slows our ability to accomplish desired outcomes. Let me give you an example.

In the 21st-century I would tell you that ISR is operations, it's not simply support to operations. A good example is when we took out al-Zarqawi, the Al Qaeda leader in Iraq in 2006. That outcome took about 600 hours of *Predator* time, thousands of hours of analyst time to evaluate that observation activity from those remotely piloted aircraft, and about six minutes of F-16 time to send al-Zarqawi to the nether regions. So the question is which one was the operation?

The fact of the matter is each one of those activities was required to achieve the desired outcome. As we move into the future—enabled by the variety of different fifth-generation systems that we're going to acquire—we have to think about incorporating all the elements that they can bring to the table, not just the force application pieces. The old approach is sequential thinking as opposed to parallel application of mission capability, which is the fused con-ops approach of 21st-century air operations.

**As we move to the future, we need to think about not manned or unmanned aircraft as separate entities but how we can join them together in an integrated fashion to accomplish desired outcomes of a particular joint force commander.**

**SLD: In a way we shouldn't refer to this as fifth-generation fighters, we should talk about this as integrated sensor strike platforms?**

**LtGen Deptula:** Absolutely. We have to get rid of last-century designators. If you look at either the F-22 or F-35, they conduct a panoply of missions. ISR strike is perhaps a better way to describe them because they perform all of those roles simultaneously.

**SLD: The F-35 brings with it significant computational power, several sensors, 360-degree awareness with the distributed aperture system, a different kind of helmet, all of which leads to a different kind of capability. How will that shape the next generation of UAVs?**

**LtGen Deptula:** Because of the powerful nature of the sensor suite resident on the F-35 we're only scratching the surface; we don't know yet. It has a fascinating degree of capability when you look to the future because of the modularity of the avionics packages that were built into it.

At the same time, we have some inkling because you can conceive of a next-generation remotely piloted aircraft that is built to supplement and enhance the capabilities that an integrated ISR on the F-35 can bring to the fight. For example, by acting as out-riggers in the context of providing information beyond the immediate range of the sensors of a particular F-35, the RPA can act as a weapons mule, if you will, by providing additional weapons at a much lower cost, in terms of both the remotely piloted aircraft themselves and in the context of not exposing a human to the threat.

So it can be used in higher threat situations than you would want the F-35 actually to penetrate, and as a part of robust distributed air operation that the F-35 and F-22 in conjunction with remotely piloted aircraft can bring to the fight.

So there's a variety of different ways, but we need to think about using remotely piloted aircraft—not just as separate aircraft to be used in traditional ways, but as elements of a distributed air operation where they can contribute to the entire panoply of missions that an air operation might encompass.

**SLD: Can you discuss how the notion of "fractionation" plays off the distributed air operations you just mentioned?**

**LtGen Deptula:** The notion of a fractionated system is separate and distinct from what has been discussed over the past couple of years as network systems. A network traditionally involves different nodes, different systems performing different missions. The notion of a fractionated system is that you have multiple entities operating to provide a particular effect; you can afford to lose some yet not lose the effectiveness of the overall system.

So again, that should lead us toward a concept of operations where we can marry-up remotely piloted aircraft with fifth-generation aircraft in a way to amplify the entire force package in ways we never conceived of in the past. This package is much more survivable than the way we've operated in the past or by using a traditional network approach to the problem. ✪

# SUPPORTING

## THREE-DIMENSIONAL WARRIORS

# MANUFACTURING FOR SUSTAINABILITY: THE F-35 CASE

[In August 2009, SLD interviewed Bob Fiorentini, former head of F-35 production, and now VP for Global Strategic Sourcing at Lockheed Martin Corporation, and discussed key aspects of the approach to design, development and manufacturing for sustainability.]

A key argument for buying newer platforms is the savings built into a new platform over the operational and logistics costs of the older platform. In the commercial airplane business, both Boeing and Airbus design and build their newest platforms with significant enhancements in sustainability in mind. According to one senior official at Airbus, "We have a design committee which reviews recommendations with regard to sustainment and logistics support from commercial customers to determine the most desirable enhancements we might then build into the new aircraft (the A350). We then determine priorities and feasibilities with regard to the design approach and manufacturing process to shape the new build aircraft."

This is true as well for military aircraft. The F-35 has been designed in part in ways to mimic a commercial manufacturing process and the development, design and manufacturing approach for the F-35 have been built around enhanced sustainability for the new aircraft. Indeed, the F-35 team has focused on ways to ensure that the build and sustainment process have as much inherent overlap as possible.

According to Fiorentini, the focus of the program from the beginning of the design of the aircraft has been upon affordability, both in terms of initial cost and sustainment. The designs of the aircraft and notably the tooling for both production and sustainment have been built with a keen focus on logistics considerations. Fiorentini underscored that "historically, legacy aircraft have been built and then sustained in the field. These processes have operated virtually independently of one another. And learning which has occurred in the process of building the aircraft has not been passed on directly for the post-build or sustainment process. In this program, the relationship has been changed to allow significant interaction between production and sustainment approaches."

A core element of the approach has been upon designing and building tools for both manufacturing and sustainment.

Fiorentini noted, "We are designing and building dual-use tools versus build and then sustainment tools." In other words, many of the tools used in the build of the aircraft will be deployed to the field. This leads to cost containment for the tool companies that get a much longer run because they are producing for *both* production and sustainment processes. This also leads, according to Fiorentini, to "much earlier maturity for tools used in sustainment than has been the case in legacy programs."

Fiorentini offered several examples of the build for sustainment approach for the F-35 program.

The first example is the integrated power plant (IPP) which is used to support the integrated suite of applications, which provide electrical power, temperature control and engine start systems. "On legacy aircraft, all of these systems are separate and require separate maintenance efforts. On the F-35, the IPP uses the same tools and maintenance process." The result is a significant reduction of time needed to maintain the aircraft. The tools used to build the aircraft and to sustain it are identical and are seen in the accompanying photos.

*Integrated Power Plant* | *Electrohydrostatic Actuation System* | *Tool Kit* | *F-35 Engine Trailer*

A second example is what the F-35 program team calls the EHAS or the electrohysdrostatic actuation system. The EHAS is a "revolutionary step in the control of aircraft surfaces. Hydraulic systems for the F35 are not centralized. EHAS allows each unit on the surface to control itself." Fiorentini adds that this "significantly reduces the risk of catastrophic failure. The EHAS system reduces the amount of maintenance for the aircraft by eliminating a number of components in the airframe such as hydraulic tubing, hose lines goring through the airframe."

The EHAS reduces the overall weight of the aircraft and by simplifying the aircraft simplifies the maintenance tasks as well. As with other systems in the F-35, the EHAS tools for the build of the aircraft are the same as the tools which will be used to sustain the aircraft.

Another example of how design change shapes sustainment capabilities is the operation of the F-35 canopy. The canopy tilts from the back, which allows the ejection seat to be removed and serviced. In legacy aircraft, the canopy has to be removed to take out the ejection seat. By designing the canopy this way, the time for servicing the ejection seat is significantly reduced. The tools used for seat alignment are the same for both production and maintenance.

A fourth example is how the engine trailer is used for the F-35. The engine trailer looks like a modified truck with four large wheels on it. The engine is installed on the aircraft or pulled off by the engine trailer. This allows maintenance to be facilitated by use of the fitted trailer "truck." The engine trailer used in production is the same as the one being used in test and then-run stations. Fiorentini noted that "not only is training going on as the engine trailers are used in the production process, but both line workers and maintainers (who are on the lines as well) are inputting suggestions. This facilitates an early maintenance learning curve prior to deployment."

There are additional examples throughout but the point is clear: in the design and production of the F-35 future sustainment has been built in wherever possible. And design features like the reduction of panels, which need to be removed to do repairs, reduce downtime. "Many of the components of the airplane which in legacy aircraft required panel removal are now built into the weapons and landing gear bays where no panel disassembly is required for most commonly serviced parts of the aircraft."

The maintainers for the F-35 use a ruggedized laptop to do initial systems checks. In legacy aircraft, very specialized equipment proprietary to the manufacturer has to be used. And again, the same procedures used in the factory are those used in the field for flight tests.

Fiorentini emphasized that the build-to-maintain approach has enhanced significantly the reliability on the flight line. "We use one database throughout the design and maintenance process. This guarantees consistency and will provide important metrics for sustainment. The use of the same design tools to design for production and sustainment tooling ensures compatibility throughout."

# F-35 LOW OBSERVABILITY: LIFELONG SUSTAINABILITY

[In January 2010, SLD interviewed Bill Grant, Lockheed Martin F-35 Supportable Low Observables Integrated Product Team Lead, at a joint Lockheed Martin – Northrop Grumman facility to discuss the facility as well as the F-35 approach to LO maintenance.]

Everyone knows that the F-35 is a stealth aircraft. This is one element of what makes it a fifth-generation aircraft. But what is not widely known is that the stealth or low observable (LO) character of the aircraft is significantly different from other stealth aircraft, like the F-22. The F-35 LO capability is significantly more robust than legacy stealth. The F-35 stealth is designed to leave the factory and to be maintained in the field rather than having to come back to the depot or the factory. In addition, the training of the maintainers for the LO repairs are being done at the partner level. That is, if a coalition partner buys an F-35 they will be able to maintain it with the proper training (such as the one to be received at the Eglin AFB facility) and do so in the field.

**SLD: Would you discuss the LO facility set-up?**

**Grant:** We had the privilege of being able to work with complete access to data and experience of historic stealth programs, including the F-22. Our perspective was simply that LO was an afterthought from the standpoint of manufacturing, whereby stealth was added on to the aircraft. In our program, stealth is manufactured into the aircraft. The program recognized the LO repair needed to be focused on as an effort by itself. The repair development center was an early invention of the program and was given the resources to go out there and experiment with different material systems and to help refine them and then to incorporate them into a system level approach. We have developed repairs for each of the materials themselves and then as an entire system.

**SLD: How would you describe the stealth LO capability of the F-35 when compared to legacy systems?**

**Grant:** Performance-wise, it is a very aggressive capability. From a design standpoint, it is a radical change from legacy systems. In legacy stealth, the stealth in effect is a parasitic application of a multiple stack-up of material systems done in final finish after the actual airframe is built and completed. In the case of the F-35, we've incorporated much of the LO system directly into the airframe itself. The materials have been manufactured right into the structure, so they have the durability and lifetime qualities. It makes them much more impervious to damage. It is a much simpler system with fewer materials to contend with.

**SLD: Will this have a significant impact on maritime operations?**

**Grant:** The Navy and Marine Corps have set the benchmark for the LO repair facility program and approach. They work in the worst maintenance environments. It was the challenge we had to meet. So our material development effort and material qualification program was predicated and populated by requirements that were specifically suited for the Navy and Marine Corps. We have the most extensive and aggressive material qualification in our history, probably in industry history. We have as many as ten times more coupons per materials being tested. We have engaged in a very aggressive approach to testing which has been developed with the military labs and the program office. We have worked with them to shape the most aggressive and most challenging test regimen from all of their different programs and their experience, and thereby compiled those experiences into our test matrix. The testing process has led to changes in the repair approach as well as the manufacturing approach for the program. Obviously, when we found deficiencies, we suggested changes to the manufacturing processes, which in turn were adopted. The interaction between maintainers and designers has been followed throughout the F-35 program in shaping the manufacturing approach.

**SLD: You've mentioned "ten times the coupons being tested." What exactly does that mean?**

**Grant:** We use little mechanical coupons. They are then used to do mechanical testing in corrosion and twisting and pulling, and those are representatives of all of the structural integrations of panels and substructure, and the material systems that spanned gaps in the panels and substructure. We test those coupons in those mechanical situations in both hot and cold extremes and we've yet to see any of those gaps open up. Naturally, if you can keep the gaps from opening up and introducing contaminants, the potential for corrosion is much lower. We also have a large selection of similar types of coupons representative of various elements of the structure that are in exposure environments. These environments are either in the laboratory, in our salt bog, exposed to acid rains, or stack gas type of environment—a very, very aggressive environment where they're out on exposure racks or at Battelle's corrosion test facilities in Daytona Beach, which is considered by the Air Force to be the most corrosion-prone area in the continental 48. The coupons being tested, by the way, are in both pristine and in deliberately damaged conditions so that we've introduced damage that either the maintenance environment or manufacturing anomalies could represent so that we have a good test of what all the materials do in that environment.

**SLD: Can you discuss how the Systems Development and Demonstration (SDD) phase for the F-35 has been shaped to front-load many manufacturing and maintenance capabilities prior to the full production run of the aircraft?**

**Grant:** There has been tremendous investment both on our part and the government in the way that they configured the plan and the entire program to address these issues. Supportability, in general, and supportability of the LO system, specifically, is a highlight of the program. It's one of the pillar elements of the program to ensure aircraft availability and affordability. Obviously, the issues of the past and the expense of maintaining LO on an airplane were of paramount concern to a fleet like the F-35, where there'll be thousands of the airplanes flying that need to be operational and maintainable around the globe.

**SLD: The program inherited a significant LO legacy capability given that Northrop Grumman and Lockheed are key partners in the program. Can you elaborate on this heritage and how it has been leveraged?**

**Grant:** The legacy stealth programs—which to a lesser or greater degree had to invent the technology in a stovepipe mode. In the F-35 program, we are partnered with Northrop Grumman and, as such, our team represents 100 percent of the operational stealth experience in the industry in the world. My team and the LO sustainment area is comprised of half Lockheed and half Northrop Grumman employees. Most of the Northrop Grumman employees are actually retired Air Force LO maintainers who collectively have experience on all of the previous jets currently flying out there. Those who are retired have brought a tremendous wealth of innovation and experience. They can dramatically improve on the conditions for the F-35 maintainers. We are not starting from zero. Leveraging this experience is allowing us to build a sustainable LO capability. We're all about creating systems that are durable and easily maintained.

**SLD: Can you discuss the interactive process between the maintenance and the manufacturing sides of the house?**

**Grant:** From day one, the supportable LO has had a profound influence on the design of the airplane. In fact, the element that is manufactured into the skin was an initiative brought about by our LO maintenance discipline. We've also had a profound

influence on the selection of the materials and then, once they were decided upon, we helped refine the properties to make them more workable for field use. In addition, our team has innovated and simplified tools and processes and reduced the training burden so that all can be easily done in a unit-level environment.

**SLD: What is the role of global partners in the F-35 LO repair facility?**

**Grant:** The partners weren't involved from the very beginning because our technology transfer agreements didn't permit it for a while. But as of November 2008, they have participated in what has become a real institution here. We have quarterly two-day, hands-on familiarization courses where members from maintainers from all of the services and several partners come in and get some experience with the tools and the processes affecting the restorations and the repairs. That's been a tremendous plus in terms of their input and shaping our understanding of what works and what doesn't work, and we've modified our designs and our concepts accordingly. But mostly, they've provided a high-level validation that these tools and processes do, in fact, work for them, for both experienced and inexperienced LO maintainers, and that it's doable in their environment.

**SLD: So a lot of the LO maintenance will be done by the services and partners in the field?**

**Grant:** Yes.

**We have no need to return to the depot or return to the manufacturer for any LO maintenance.**

Our system requirement was for end-of-life, which means that throughout the 8,000-hour service life of the jet it is to remain fully mission-capable. We projected the amount of maintenance that would be done over the life of the airplane and allowed for that in the design. The F-35 will be delivered with a significant margin of degradation that's allowed for over the life of the airplane, again, without having to return to the depot for refurbishment. There may be some cosmetic-based reason why the jet might go back to a facility, but from a performance-standpoint we recognize no need to do that. The unit-level maintenance will be adequate for maintaining the full-mission capability of the jet.

**SLD: In entering the facility, I noticed you have a "door mat" of stealth that's been there for some time. Can you comment on this "door mat?"**

**Grant:** Oh, the slab of stealth? That's our welcome mat. It is actually one of the test panels that we use for assessing the stealth of the various materials. It represents a stack-up that's consistent with the upper surface or the outer surface of the jet. It has the exact same structure and the primer and topcoat system that you'll find on the operational jets. That gets walked on every time somebody comes in or out of the repair development center. Occasionally, we take it up to test to see if there's any electrical or mechanical degradation to the system, and…

**with around 25,000 steps across that system we have not seen any degradation whatsoever.**

So we have a great deal of confidence, however anecdotal that may be, that we have a very robust system.



AN UPDATE ON THE LO MAINTENANCE APPROACH:

# THE LO REPAIR CAPABILITY DEPLOYED TO PATUXENT RIVER

[In April 2010, SLD followed-up with Bill Grant to get an update on the LO maintenance approach to the F-35.]

**SLD: When we last met you outlined the role of the LO repair facility and the maintenance approach in the field. You have deployed this capability to the Patuxent River test facility. Could you provide an update with regard to this activity?**

**Grant:** We now have three F-35Bs being maintained in support of flight tests. We have two Supportable LO tech reps there facilitating activity: one Lockheed Martin and one Northrop Grumman employee. A lot of what they're doing is making the maintenance personnel familiarizing with LO procedures for restoration and repair.

We don't have a high volume of repairs yet. What little has occurred has not been from an inherent failure of the material systems; they've been maintenance-induced. But it gives us an opportunity to test our approaches. We're very encouraged about the experience; maintainers who typically are wary of LO because it was so tedious and time-consuming have been very, very positive about what they have seen and what they've been taught. The maintainers see LO support as very doable and it's not onerous as in the past.

We just completed our first formal training class at Pax, supporting the training IPT. We had about a dozen maintainers in a four-day class learning the tools and processes and becoming familiar with the technical orders in the form that's available right now. We don't have formal joint tech data (JTD) yet but we have a very, very favorable response so far.

We have around a dozen fairly minor LO type of repair activities and a few panel restorations. We often see a problem when people invent processes.

**SLD: So, one of the challenges is to adapt the maintenance culture to the new aircraft.**

**Grant:** The maintainers need to apply the discipline of using proper procedures; they're easy to do but you have to know what they are. It's important to pay attention—easily done but it does take a modicum of awareness and training.

PAX RIVER INTERVIEW:

# GUNNERY SERGEANT LARONE THOMAS IN CHARGE OF F-35B MAINTENANCE

[In April 2010, SLD interviewed Gunnery Sergeant Larone Thomas on F-35 maintenance.]

GySgt Thomas is in charge of maintenance for the F-35Bs that are undergoing tests at Patuxent River. He recently received the Maintenance Officer of the Year Award from the Marine Corps Aviation Association. Thomas has significant experience as an F-18 aviation electrician.

**SLD: How is maintaining the F-35 different from traditional aircraft?**

**GySgt Thomas:** The aircraft is the aircraft. Any good maintainer is going to be ready to walk in and be able to do maintenance on this aircraft. There is going to be a learning curve for some, but it's not going to be much of a learning curve. If the aircraft does half the things that it is projected to do, it is going to be sweet. It's going to be ten times better than any aircraft that we have right off the bat.

The capabilities I've seen on a hover pad—how much thrust and force I have seen—will be a major increase in capability. It's very promising, and as we work on shaping protocols and routines we can help make decisions for the fleet to make it easier to maintain in the field.

**SLD: So during the test process you are shaping a protocol process for the maintainers in the fleet?**

**GySgt Thomas:** Correct. For example, we had some difficulties but they were based on past practices. Unlike other aircraft, you can access many things from panels. This takes getting used to. One day one of the maintainers was having some difficulties, but we found that he was not following a procedure appropriate to the aircraft.

This aircraft is tighter and a lot more reliable. Its chips are pretty hard to damage. The maintainability package is smaller and focused because the F-35 is more maintainable and more solid state.

**SLD: Tell us about your approach to shaping the metrics and protocols for maintenance on the F-35B?**

**GySgt Thomas:** One big change is how we do our maintenance day. On traditional aircraft we have a maintenance checklist and we do a set of tasks each day. Now the day is defined by what the aircraft "tells us" it needs to have repaired. And we are trying to match our work approach to how the aircraft operates.

We're working towards the goal of having an aircraft tell us—"Hey, I'm low on oil." We have to get used to working with this kind of capability. In the long run we will waste less as we won't change things that don't need changing.

**SLD: Tell us about your handheld laptops or Personal Maintenance Aids (PMAs).**

**GySgt Thomas:** These tools allow the maintainer to connect to the aircraft and run up certain systems to verify if the aircraft is in working order and running properly. Right now, the software is not at that state, but that's what we're working towards.



**SLD: So the goal is to have the software and the computer to dialogue with the aircraft?**

**GySgt Thomas:** Correct. The goal is to have my maintenance day determined by what I'm seeing on my screen.

**SLD: As opposed to being defined by a checklist?**

**GySgt Thomas:** We'll have two separate entities. The PMA is able to access CMMS, the Computerized Maintenance Management Tool System. CMMS is where we document our maintenance. We use it to document ordered parts and more, but the other function, the other PMA, will run up systems on aircraft—pull up Joint Technical Data (JTD), things of that nature.

**The impact will be shortened maintenance time and the ability to repair the aircraft and generate more sorties in support of the Marine in the field. That is the whole point.**

**SLD: Unlike the F-18, the F-35 has internal weapons bays. How hard is this to work with?**

**GySgt Thomas:** I've loaded this aircraft, I've been part of the team here, and I am certified. It's not hard at all. It's not going to be a steep learning curve that will require extra schooling.

**SLD: This is the test regime for maintenance, so presumably it will take longer to do maintenance here than when you have necked down the procedures and do it in the fleet?**

**GySgt Thomas:** Doing pre-flight inspections and post-flight inspections on aircraft is cumbersome here because everything has to be documented. We are shaping a process to make sure that there's not going to be an issue in the fleet. Our inspections are way more involved than what they're going to be once the F-35 is in operation. ✪

PREPARING FOR THE F-35:

# THE 33RD FIGHTER WING AT EGLIN AIR FORCE BASE STANDS UP A COMPREHENSIVE TRAINING FACILITY

[In January 2010, SLD interviewed Colonel Arthur Tomassetti, USMC, 33rd Fighter Wing, Vice Commander, and discussed the 33rd Fighter Wing's approach to F-35 training and the nature of the training center.]

**SLD: What is the 33rd Fighter Wing and what's your role at the Wing?**

**Col Tomassetti:** The 33rd Fighter Wing is the wing that has been charged with running the joint strike fighter, the F-35 integrated training center operations at Eglin Air Force Base. I am the vice commander, so I answer to the wing commander, Colonel Dave Haltky, USAF. It is a joint organization. Key leadership roles include representatives from the three U.S. services, and they are on a rotation basis. They're on separate timelines so that we don't ever change out the entire leadership in any given summer rotation.

**SLD: The Wing is located at Eglin Air Force Base, and you are a Marine in a deputy commander role. I was surprised to learn that Eglin is not just an Air Force base, but has several co-located military facilities on the base. This is collectively referred to as Team Eglin, so what are the advantages, from your point of view, of having the training center located in such a virtually joint setting?**

**Col Tomassetti:** Eglin is unique. I've heard it said in several briefs since I've been here that if you count the land ranges and the over-water ranges that Eglin has purview over, it makes it the largest military base in the world. The tenants at Eglin include representatives from all the U.S. services and a variety of missions—everything from special forces to the training mission that we bring to the

table in the 33rd Fighter Wing to the test mission that goes on for Air Force weapons testing, up to and including a phased array radar at one end of the complex that tracks space debris and is a national asset. From a training perspective for future air crew and maintainers, this affords a spectrum of opportunities to interact with organizations, services, and capabilities without having to wait for big exercises or even wars.

**SLD: When are you anticipating a full ramp-up of the program, and how many maintainers and pilots are you planning for?**

**Col Tomassetti:** The original vision was for five squadrons here at Eglin. We still have to decide whether we will stay at three squadrons or grow to the planned five; but basically, in the 2014 to 2015 timeframe, we will hit the peak pilot production based on three squadrons' worth of airplanes.



An average daily student load is one of the metrics we're tracking: how many students are on the campus on any given day. We expect somewhere between 80 and 100 pilot students on the campus on any given day; on the maintenance side, it will be a little slower to hit peak capacity. That comes around 2016 but we expect the average daily student load for maintainers to be somewhere between 600 and 800 on any given day. So you're looking at almost 1,000 students on any given day here at the 33rd Fighter Wing.

**SLD: This feels more like a college campus than a classic military training facility, indicating new approaches to operating this center.**

**Col Tomassetti:** We have, indeed, set up the center to have the campus flavor and approach. The academic training center—the place where everyone will go through their classroom training and some of their initial simulator training, the living facilities for the enlisted folks, and the dining facilities—are all co-located. No one has to cross any major roads to get from one building to another.

In fact, you could probably get everything you need to get done on any given day as a student without leaving a four-block space. We are taking full advantage of electronic classrooms—using a variety of electronic media. Most everything that the pilots will do in a classroom environment is computer-based. Whether you're a pilot or a maintainer you will start out in the electronic classrooms, some of which are led by human instructors and some which are purely computer-led. As an example, the pilots who check in here will be issued a laptop and that laptop, of course, will allow them to access information, words, and pictures about the F-35 that they are learning how to fly.

Additionally, it will allow them to practice procedures that they will need in the cockpit. You can replicate some of the displays that appear in the cockpit of the airplane on the laptop. You can activate certain menus. You can drilldown through certain menus. You can work through certain procedures on the laptop including—if you check out the stick and throttle that can be connected to the laptop—actual practice missions and practice profiles. That can be done in the academic training center, and we're working through what it would take for those pilot students to take that capability home and practice at their own leisure for learning.

**SLD: Are there cost savings as a result of this approach?**

**Col Tomassetti:** Absolutely. When I was a student going through initial flight training, I was issued a stack of books that I had to carry with me from day to day. If I was going to take anything home, I had to drag that big bag of books home. Digitizing all that stuff gives you access to everything that's ever been written or documented to that point in time about the F-35. So if a student is particularly interested in a certain thing and the one page or the one paragraph in the flight manual doesn't fulfill their curiosity, they have the ability to dig down further into engineering drawings and background and stuff that I, as a student, could never access.

**SLD: How will this joint approach shape the training and, obversely, how will the joint experience shape training?**

**Col Tomassetti:** We're going to have representatives from all three services in the United States and whatever partner countries are here at Eglin, and those students, without us doing anything deliberate or specific, are going to be going to the same classrooms, sitting next to each other. They're going to go and they're going to eat breakfast and lunch together. They're going to go run in the same jogging rails. They're going to workout in the same fitness facilities.

Without even trying, there's going to be an interchange of cultural ideas and philosophies. There's going to be an interchange of how we do business, how they do business. There's going to be an interchange of information that the students will naturally gravitate to as they train in close proximity to each other.

That's without even trying. Now if you say, "Okay, what if we put a little bit of effort and thought into this?" We can get a lot more by deliberately setting up events that will make Navy, Marine, and Air Force pilots fly training missions together as they get into the advanced studies where multiple airplanes are required and we allow them to share ideas and service techniques. Imagine adding in the partner countries for even more synergy.

**The opportunity to learn and increase the knowledge base of everybody who comes through the Eglin campus is tremendous.**

**SLD: What's the thinking about involving the partner countries?**

**Col Tomassetti:** Right now, there will be partner countries at Eglin, those who are already involved in the program. Exactly how many and which partner countries will appear at Eglin has not been determined. It could be up to and including everybody who's in the program right now, and we are preparing and planning for it to be of that magnitude. We want to accommodate every partner country involved with the program today and are planning for anticipated foreign military sales.

**SLD: What's the importance of the co-location of the training of pilots and maintainers in the training center?**

**Col Tomassetti:** There are definitely going to be some efficiencies and synergies gained from having the pilots and maintainers together. They're going to be integrated when they get to their operational units. Starting that integration out in the training environment is a good idea.

**SLD: You mentioned that the program approach allows for the sharing of resources across the base, across Florida. Can you elaborate?**

**Col Tomassetti:** You're going to have young soldiers out on the land ranges here who are training in preparation to go forward to a combat area. Part of that training is going to involve working with air support. We are going to have students going through flight training for whom part of the training they have to undergo is delivering that close air support to troops on the ground.

In most pilot training facilities you've got to call in another organization to come and support you, or you've got to wait for an exercise. Here, we're all going to be on the range on the same day. We can both go out at the same time. The soldier on the ground can get training requirements accomplished while our pilots can get their training requirements accomplished because that soldier on the ground was doing their part of the close-air support mission. All we have to do is talk to each other to make it work.

**SLD: So the joint training and the joint fighter go together with an opportunity to leverage the co-located facilities and the shared resources across those facilities.**

**Col Tomassetti:** Absolutely. We have an idea and a vision, of course, about what the F-35 is in terms of its capabilities and how it will be employed on the battlefield. We have that vision today but until we get out there and actually use it we're going to have to validate that vision and our ideas of how we employ it are correct. But in this joint environment at Eglin, we may be able to come up with unprecedented ways of employing what the F-35 can do in some future battle scenario just because we have a variety of players contributing input.



Publisher: Second Line of Defense

Editor-in-Chief: Dr. Robbin F. Laird

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*Three-Dimensional Warriors* is a publication of Second Line of Defense, a dynamic web site that focuses on the development and sustainment of U.S. and allied military and security capabilities and the critical role of the support community and the partnerships of democracies that are key to the evolution of military strength.

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