

## AIR POWER

Air Power is vital and it is important that we don't learn the wrong lessons from operating in recent years in a benign air environment. Yet Air Power is very expensive and we need to ensure that we don't starve other capabilities through paying for the best in the air. The Joint Strike Fighter is billed as the best, but is it really the best answer for UK carrier aircraft, given the level of pain that the defence budget as a whole is likely to suffer in the coming months? In this section, the Royal Air Force defends the choice.

By contrast, Colonel Basilio Martino of the Italian Air Force says that, in the future, a major role will be played not by aerodynamics or propulsion, but rather by cyber technology, nanotechnology and directed energy weapons, with a special focus on their space applications. If he is right then many airmen have been mesmerised by platforms and not the application of Air Power.

# Stealth, Sensor Fusion, Situational Understanding and Precision Attack: Is This the Right Answer to the Balance of Force?

by *Wing Commander Willy Hackett and Dr Rebecca Grant*

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Nearly 15 years ago, the UK joined with the United States in the Joint Strike Fighter programme. The F-35 is now moving into production with the first UK aircraft delivering to the combined test fleet in 2011.

But does the UK still need the F-35? And will it be the aircraft its designers intended?

The programme has been much in the US headlines due to budget and management decisions. However, United States Under Secretary of Defense for Acquisition, Technology and Logistics Dr Ashton Carter told the US Congress in formal testimony in March 2010 that "none of these reviews discovered fundamental technological or manufacturing problems with the JSF program, or any change in the aircraft's projected military capabilities".<sup>1</sup>

Of greater concern to many is the overall strategic utility of airpower and of the F-35 in particular. Since the F-35 programme's inception, the role of airpower in military operations has gone through enormous transitions. Given the number of unmanned aircraft and older fighters at work in Afghanistan today, it is fair to ask if the F-35's design to bring stealth and sensor fusion to heavily defended airspace is still a requirement. Answering this question calls for a wider look at global air defence arsenals and at the future requirements for air and land integration.

## Why Stealth Now?

The requirement for stealth emerged most vividly from the success of the US F-117 stealth fighter in the 1991 First Gulf War. Stealth (an aircraft emitting very low observable signatures) can by its very nature give unrivalled level of access to enemy airspace and terrain. The first all-aspect stealth aircraft was the F-117 fighter, which achieved stealth through its unique design. Flat, faceted surfaces on the aircraft controlled the direction of radar waves. Heavy radar-absorbing material coated on the outer surface further helped control the reflection of radar waves so that an enemy targeting radar could not achieve enough of a return to lock on for a firing solution. Speed, manoeuvrability, radar, communications and

weapons were all sacrificed. The F-117s flew only at night on very carefully planned routes to accent their principal survivability features and minimise their exposure.

Thirty years later, the F-35 has everything the F-117 (which was retired in 2008) did not. It is a true fighter, with manoeuvrability and dash speed above Mach 1.5. The stealth is achieved through the smoothed, canted design of the fuselage, inlets and vertical stabilisers. Surface coatings are hard and durable. The centre point of the design is controlling radar cross section in attack profiles and reducing other signatures in the electromagnetic spectrum such as infra-red and optical. Stealth cannot be retroactively applied to an aircraft except in very limited ways. The F-35 is a born-stealthy design with speed and manoeuvrability, which equip it for the anti-access environment.

One of the most noticeable features of any stealth aircraft is its clean profile which comes from a large internal weapons bay and internal fuel. Weapons hanging off wing pylons or the underbelly hardpoints look ferocious but, unfortunately, they also create bright radar reflectors which make the aircraft that much easier for radars to spot. Hence the F-35 carries its array of precision weapons in two internal centre bays.

Although the skies over Afghanistan and Iraq are permissive airspace, stealth is still a requirement going forward given the missions expected for F-35. Long-range surface-to-air missiles can now lock out non-stealth aircraft at ranges of 75 miles or more. Air defences are also persistent. Iraqi forces in 2003 managed to launch 2884 surface-to-air missile (SAM) attacks in just under 25 days of operations. Most were unguided. However, this was a high number of salvos considering the 12 years of operations from 1991 to 2003.

Equally important, these were older surface-to-air missile systems designed with analogue technology in the 1960s and 1970s. Modern air defences use much more sophisticated digital technology. For example, the Russian air defence systems like the SA-20 are already deployed. SA-20s on the border with Georgia could have made it very difficult for surveillance aircraft to investigate what was going on in that airspace.

Stealth was designed to counter that threat in small or large numbers by getting the F-35 close enough to use its sensor fusion to track and kill missile launchers. Countering these air defences demands active work from the pilot to detect and characterise threats based on the electronic signals they emit. Here the F-35's advanced sensors and situational understanding give its pilots a real edge in survivability.



*F-35 will greatly improve ground support through its combination of sensors, weapons and communications capabilities in one platform [Lockheed Martin]*

### The Need for Sensor Fusion

The F-35 is quite a bit more than a supersonic stealth aircraft. The F-35 is a watershed in combat aircraft design, carrying so many sensor and weapons capabilities that it is erasing old platform-driven distinctions between fighters, bombers and surveillance airframes. Deliberate design choices and technology investment have combined many capabilities in one platform. US Lieutenant General David A. Deptula, Deputy Chief of Staff for Intelligence, Surveillance and Reconnaissance for Headquarters US Air Force, recently described how technology is “blurring traditional lines to the point where we are now able to integrate a sensor-processor-distributor-kinetic-non-kinetic-shooter-penetrator all on one aircraft”. In fact, the one aircraft that can do that is the F-35.<sup>2</sup>

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Consider the mission systems. One compelling combination is synthetic aperture radar (SAR) overlaid with ground moving target indicator (MTI). SAR defines a crisp picture of terrain and objects like trucks or missile launchers. MTI squeezes the radar return for a time sequence to indicate movement of vehicles or people across a swathe of the battlespace. Put them together and the F-35 pilot in the cockpit can track vehicles across terrain. It’s an astonishing capability that today takes multiple aircraft and ground stations to piece together. In addition, this particular combination of sensors works even through cloud cover. The F-35 also has an electro-optical sensor which delivers video – nearly a prerequisite for ground force manoeuvre.

Granted, that capability is at work in Afghanistan today. The catch is that it takes a massive battlefield control aircraft like JSTARS combined with ground stations for SAR/GMTI capability, while video comes from unmanned air vehicles or fighter pods. The F-35 will deliver all this from a single cockpit. “An asset such as the Joint Strike Fighter, for example, should be regarded primarily as a hugely capable comprehensive ISTAR hub sitting at the centre of a C4ISTAR network, but providing the option to deliver near real-time kinetic effects through its organic Control of the Air and Attack capabilities,” said Air Chief Marshal Dalton.<sup>3</sup> Going further, combat air patrols of F-35s can disperse tracking capabilities across the battlespace and relay them to land forces on the battlefield.

### F-35 and Air/Land Integration

So, once the F-35 is over the battlefield, what does it do? The past decade has driven major changes in the relationship between air and land component forces in Coalition

operations. It may not be obvious from the headlines, but the land component is more dependent than in the past on immediate air support. Afghanistan has spurred a level of cooperation not seen since the days of Montgomery, Tedder, Coningham and the Western Desert Air Forces. This support ranges from ISTAR to precision airdrop of supplies to providing air-delivered fires.

No one is suggesting that the terrain features or political detail of Afghanistan will be replicated again. Forces cannot count on the permissive airspace and blanket air superiority that allows all Coalition air platforms to operate with near impunity. Air Chief Marshal Dalton cautioned: “We need to think very carefully about whether our ‘Afghanistan’ era force structure is a model for the future”.<sup>4</sup>

How right. In the first place, the fighting in Afghanistan and the level of NATO’s commitment will have changed by the time the first squadrons of F-35 fill up. What’s much more realistic is to anticipate *how* UK forces will plan to fight.

Ground forces in Afghanistan are highly dispersed. Coalition strategy pushes ground forces to operate light and move in widely separated battle areas, where planned raids – and insurgent ambushes – can take place at any time. There is nothing resembling a front line; rather, the forces are grouped in regions but spread to bases and operations a long distance apart. This is because their mission has been to seek out pockets of insurgents, and to work with the Afghan army to secure specific areas in towns and villages. “There are many areas where you simply cannot go without an MI-17 helicopter or a donkey,” US Air Force Brigadier General Michael R. Boera, Commander, Combined Airpower Transition Force, recently said of Afghanistan’s terrain.<sup>5</sup>

As a result, the small units are almost never close enough to provide mutual support as they might have done on a dense NATO vs. Warsaw Pact battlefield. The air component helps make this highly effective scheme of manoeuvre work in three main ways. First, intensive battlefield surveillance from aircraft provides assessment of the terrain ahead. Second, aircraft are often used for radio communications or even satellite communication relays between units. Third, while artillery has been used in Afghanistan, the primary means of delivering firepower is on-call airpower. When NATO forces are ‘in contact’, i.e. taking fire from insurgents, they call for airpower to disrupt the engagement, causing insurgents to break off the fight. When collateral damage conditions are met they call for airstrikes directly on enemy forces. The F-35’s combination of sensor performance, onboard combat identification capability and use of emerging improvements to weaponry that give greater accuracy and selectable effects, will allow commanders to employ this lethal aircraft and avoid or minimise collateral damage like never before.

As a result, an upswing in air operations began in mid-2006 as more NATO forces deployed and operations intensified.



*Given the number of unmanned aircraft and older fighters at work in Afghanistan today, it is fair to ask if the F-35's design to bring stealth and sensor fusion to heavily defended airspace is still a requirement [Lockheed Martin]*

The table shows a category called Close Air Support which includes all missions flown by strike aircraft (whether they employ weapons or not).

The sheer numbers of missions flown for air support rose fast. By 2008, the amount of close air support fighter and bomber sorties for Afghanistan exceeded the maximum number of sorties required even for the 2007 surge in Iraq. Airstrikes with munitions employed also increased from 176 in the year 2005 to 3369 for 2008. "In Afghanistan, on occasions in 2006 and 2007, the frequency of requests from British ground forces for close air support came close to that in Normandy in 1944," concluded an RAF study.<sup>6</sup>

Returning to Air Chief Marshal Dalton's challenge, assessing airpower and programmes like F-35 through the operational lens of Afghanistan requires recognition of how the conflict has affected the fundamentals of manoeuvre, fire, surveillance, reconnaissance and logistics. Land forces themselves will do this reassessment as they prepare training regimes and doctrine and determine their own equipment needs. Projecting forward for air and land cooperation depends on going through the same analysis, and the requirement for F-35 should stand or fall based on these scenarios.

**Land and Air Interdependence**

In Afghanistan, the land component scheme of manoeuvre depends on the air component by mutual agreement.

One US commander frankly acknowledged the interdependence: "The way we operate could only be done with air power," said US Major General Curtis Scaparrotti, Commander, 82<sup>nd</sup> Airborne Division, who in 2010 was commanding forces in Afghanistan's RC East. Not that this dependence went without question. When a visiting American who had fought in Vietnam warned Scaparrotti that he was taking a lot of risk with his dispersed forces, Scaparrotti replied that he was comfortable with his manoeuvre plan "because I know that I have air power no more than 11 minutes from a dead stop over top of those troopers that are out there in harm's way".<sup>7</sup>

Over the past few years, NATO ISAF forces have learned to use low passes (2000 feet or so) for a reassuring presence or to drive off Taliban forces. As one UK officer observed, the Taliban fear airpower and will often hear aircraft overhead and retreat.<sup>8</sup> This tactical advantage works because the fast-attack aircraft can respond quickly and do so with minimal risk. Most of the aircraft also have the ability to strafe and it is significant that strafing quickly became a popular option on the menu of ground force fire support requests in Afghanistan. Bigger, slower, unmanned air vehicles like Predator and Reaper are not designed for the low-altitude work. They are optimised to employ weapons and sensors from altitudes above 15,000 feet and are highly vulnerable to low-end anti-aircraft weaponry. The demands for precision and situation awareness for ground forces are now being met by a combination of strike fighters, bombers and unmanned air vehicles.

The ISTAR piece is woven throughout the layers of air support. In Afghanistan, air platforms gather, manage and disseminate combat information. Often the dominant activity on a fighter mission is using onboard sensors to watch roads and ground force target areas. This information is not an optional capability. It is the discriminator that allows a relatively small number of NATO land forces to find terrorist leaders who do not want to be found and to move and attack with great precision. Basically, no small unit out on patrol in Afghanistan is out of contact with the larger net established via airpower. This information net provides air support, communications relays beyond line of sight in mountainous terrain, and back-up for airstrikes, precision airdrop resupply and aeromedical evacuation. In turn, the information feeds into ground and air operations centres affecting the day-to-day and minute-by-minute planning of the battle and allocation of air assets by the Coalition.

F-35 will greatly improve this ground support through its combination of sensors, weapons and communications

	2004	2005	2006	2007	2008
Iraq CAS	14,292	16,924	15,676	19,554	18,423
Afghanistan CAS	6495	7421	10,519	13,965	19,603

Table 1: Coalition Sorties Flown for Close Air Support. Source: CENTAF



F-35 being built at the Lockheed Martin facility at Fort Worth, Texas [Lockheed Martin]

capabilities in one platform. Take the case of a small unit on a mission to search and clear a terrorist hide-out. First, the unit receives ISTAR from multiple sources to determine through optical and signals intelligence who or what is moving in and out of the area. On approach, the area remains under constant surveillance of an orbiting fighter which pipes a streaming EO/IR image of the objective area before the unit moves in.

“A bespoke counterinsurgency force with niche capabilities won’t provide policy-makers or political decision-takers with a flexible military lever of power for the mid- to long-term,” noted Air Chief Marshal Dalton.<sup>9</sup> As useful as unmanned vehicles are, they have not taken the place of fast-attack aircraft on the counter-insurgency battlefield.

Add in a threat level just one or two notches higher and F-35 could be the only option for UK firepower and ISTAR for ground forces.

#### Ungoverned Spaces

Predicting with certainty the next scenes of conflict and intervention is impossible. However, long trends such as energy demand, water resource stress, bulging youth populations, failed state governments and nuclear security could all create instability.

A future conflict may keep aircraft on carriers as ground forces project ashore. F-35s from carriers could face significant anti-access challenges. The F-35 brings “advanced sensors, advanced communications and the connectivity and the true stealth to go very deep early into the fight [and] we need that”, said Rear Admiral David L. Philman, the US Navy’s Director of Air Warfare Requirements.<sup>10</sup> The additional range of F-35 and its carrier-based and STOVL options make it a very flexible asset. The low pressure tyres of the F-35B allow it to use twice as many runways and airfields worldwide compared to the other two variants.

A carrier-based F-35 STOVL force has the ISTAR, firepower and endurance to offer a significant Coalition or stand-alone option.

Imagine a situation with one major airfield and limited ramp space being used mainly for transport and mobility aircraft.

On two recent occasions, the United States Marine Corps stuffed up to 20 AV-8B Harriers on smaller amphibious ships to provide focused air coverage.

- In the fall of 2001, a force of Marine AV-8B Harriers completed a two-week stint flying sorties for Operation Enduring Freedom. Three amphibious ships served as one task force: the *Bataan* (LHD-5) with the 26th Marine Expeditionary Unit; the *Peleliu* (LHA-4) with the 15th MEU; and *Essex* (LHD-2) with the 31st MEU. Together they pooled 18 Harriers.<sup>11</sup>
- For the beginning of Operation Iraqi Freedom in 2003, two amphibious ships off-loaded all but two of their helicopters and took aboard 20 Harriers apiece. Together *Bataan* and *Bonhomme Richard* earned the nickname ‘Harrier carriers’. The Marines kept up sustained operations for several weeks, sometimes staging ahead to forward bases on land.<sup>12</sup>

The US LHD class displacing 40,000 tonnes is much smaller at just two-thirds the tonnage of Britain’s planned *Queen Elizabeth*-class carriers.

Where might the F-35s on HMS *Queen Elizabeth* prove useful in the future? For starters, the aircraft carrier will carry 36 F-35s. For illustrative purposes, consider Africa. It’s easy to picture a nasty blend of aggravated border states, government forces and rebel forces with UN peacekeepers and thousands of refugees in the mix. Given the geography of Africa (and other hotspots) there is a strong potential for missions such as hunting high-value targets, supporting special forces, or securing specific areas hundreds of miles inland.

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Even a so-called ‘low intensity’ scenario will demand all that the F-35 has to offer. Take the case of UN-led intervention during a notional rebellion in Africa. Assume that special operations forces will be inserted ashore to control a key objective such as a port or airfield. Opposition forces are likely to have low-calibre anti-aircraft weapons and shoulder-fired surface-to-air missiles. More formidable Russian and Chinese export anti-aircraft weapons are in the hands of many nations in Africa, South America and Asia.

Information is the first thing that commanders want as a crisis unfolds. Most intervention scenarios involve inserting international forces – be it small teams of special forces, or larger elements – in and among a confused situation where one or more armed groups are battling, usually with civilians or refugees caught in the middle. The first days are critical, yet this is exactly when the threat environment is highest.

The range, strike and ISTAR inherent in F-35 could allow a carrier-based force to set up combat air patrols over ground forces working inland. A force of 36 F-35s could sustain two 24-hour combat air patrols over critical areas by assigning two aircraft to three-hour mission intervals. Or, the 36 aircraft could split locations for on-call patrols of shorter duration. The F-35 patrols will provide images and other battlefield signals information to commanders. They can help monitor insertions of UN forces and arrive rapidly for troops-in-contact emergencies.

#### Conclusion: Coalition Operations and the Upper Tier

Careful attention of the lessons of Afghanistan and of prospective future scenarios can clarify how the F-35 will contribute to a balanced force in the years ahead. Coalition commanders will not want to do without the sensor fusion it can bring to permissive or contested airspace. With F-35, commanders will have better options for precise operations in low- or high-intensity conflict environments. The larger question about F-35 is one of national strategy. Does the UK still want the technological edge that the F-35 gives to air, land and sea operations?

The US has already answered the question, for all the debate over the test and production schedule. Secretary of Defense Robert Gates confirmed that the F-35 “will become the backbone of US air combat for the next generation”.<sup>13</sup> This commitment and the scale of the programme will bring a degree of affordability that will be required to field such an array of capabilities.

The F-35 also represents a commitment to Coalition operations – to maintaining not just a US-only but an international ability to shape airspace, facilitate ground operations and bring the advantages of networked ISTAR to bear. But it only counts if those missions still reflect the national role of the UK.

General Sir David Richards outlined his view of the UK’s place in the world in his January 2010 address to the International Institute for Strategic Studies. In it were compelling statements of the UK’s role, including this one:

“We are a permanent member of the Security Council, a lead actor in NATO, the EU, G8 and G20, the Commonwealth and many other international bodies that link our present to our past through the communities and diversity that enrich our society and bind us in a unique way with nearly every culture and people across the world. This gives us reach beyond our size, and influence beyond our position. So, do we punch

above our weight or is this actually what defines this country? Along with our economic position, it is this wealth of history and culture flowing through our people that puts us into the upper tier of nations. And we sit comfortably in it.”<sup>14</sup>

That commitment reflected far-reaching plans to keep UK airpower not only in the upper tier, but at the front rank of military powers. UK military forces retain an ability to act independently or as lead partners in a Coalition. This commitment has not been easy to sustain, and major decisions on the balance of armed forces and on big equipment purchases will test it again. Airpower is central to this role, and the F-35 programme still stands as one of the key investments for the UK to retain this capability in the future. ■

#### NOTES

- <sup>1</sup> Under Secretary of Defense Dr Ashton Carter, Testimony to Senate Armed Services Committee, 11 March 2010
- <sup>2</sup> Remarks by Lieutenant General David A. Deptula to the Mitchell Institute, Air Force Association, 14 April 2010
- <sup>3</sup> Address by Air Chief Marshal Stephen Dalton to the International Institute for Strategic Studies, 15 February 2010
- <sup>4</sup> Dalton Address, IISS, op. cit.
- <sup>5</sup> DoD Live, Interview with Brig Gen Boera, 25 March 2010, at www.defense.gov
- <sup>6</sup> Royal Air Force, Airpower in an Uncertain World, Part 15, raf.mod.uk
- <sup>7</sup> Remarks by Major General Curtis Scaparrotti to the Air Force Association Air Warfare Exhibition, Orlando, Florida, 18 February 2010
- <sup>8</sup> Staff Sergeant Trevor Teirnan, ‘Royal Air Force “ACE” leaves AOR with memories, hope for Afghan future’, Central Command Air Forces, 12 October 2007
- <sup>9</sup> Dalton Address, IISS, op. cit.
- <sup>10</sup> Testimony by Rear Admiral David L. Philman, United States Navy, to US Senate Armed Services Committee, 13 April 2010
- <sup>11</sup> Randy Woods, ‘Marines thank STOVL for Harrier response time, high sortie rate’, Inside the Navy, 21 November 2001
- <sup>12</sup> David Brown, ‘Close Harrier Support’, Marine Corps Times, 28 April 2003
- <sup>13</sup> US Secretary of Defense Robert Gates, quoted in Read more: <http://www.time.com/time/nation/article/0,8599,1975139,00.html#ixzz0l4k4n381>
- <sup>14</sup> Address by General Sir David Richards, Chief of the General Staff, to the International Institute for Strategic Studies, 18 January 2010