F-35A Lightning II 12-5091/HL from the 388th Fighter Wing drops an inert 2,000lb GBU-31 Joint Direct Attack Munition over the Utah Test and Training Range during Combat Hammer, Air Combat Command's air-to-ground Weapon System Evaluation Program.
Scott Wolff/US Air Force

F-35 Lig

Starting Worldw

David C Isby spoke with Admiral Mat Winter, the new F-35 Program Executive Officer, about sustaining the fifth-generation fighter

Before his retirement last July after a gruelling five-year tour of duty as the F-35 Program Executive Officer (PEO) in charge of the Joint Program Office responsible for the development of the Lockheed Martin F-35 Lightning II, US Air Force Lieutenant General Christopher Bogdan issued a warning that the programme could still go "off the rails". Bogdan identified the biggest single risk: "I am worried about our ability to sustain these airplanes globally, with the numbers and locations we'll have in 10-15 years … there's going to be an awful lot of airplanes in an awful lot of places in an awful lot of configurations." Sustainment will account for most of the F-35's costs – 66 to 75% of the total – over the life of the programme.

Speaking in Washington DC on September 6, Bogdan's successor as F-35 PEO, Vice Admiral Mat Winter explained that to manage costs, the United States, international F-35 partners and Foreign Military Sales customers are linked in to a global sustainment enterprise that will grow to provide repair, sustainment and support capability for a global F-35 fleet that will eventually number over 3,000 aircraft. He said: "We are sustaining aircraft right now. F-35s will be operating from 13 new operating locations worldwide in the next four years, with aircraft numbers increasing to almost 1,000." It will be, Winter said, "an exciting time to be the PEO".

Earlier this year, Lockheed Martin's Vice President of F-35 business development and strategic integration, Jack Crisler said: "By the end of the year F-35 flight operations would be under way in Italy, Israel and Norway, with the transition from CONUS-based [continental United States-based] sustainment to an international capability … An ADM [acquisition decision memoranda] signed last year describes how global sustainment is going to work."

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Global sustainment

Once the ADM was issued in November 2016, the US Department of Defense assigned maintenance, repair, overhaul and upgrade (MROU) responsibility to industry in F-35 partner countries for the first 65 of 774 different component repair capabilities. A further 200 components followed. All 774 will be assigned by 2020.

Companies that have not been involved in F-35 manufacturing to date are being encouraged to compete for supplying or providing MROU activities. This is being achieved through an emerging worldwide network of sustainment activities, primarily carried out by companies, but directly interfacing with the air arms of all F-35 partner countries, and not just the air arm in the company's own country.

Winter stressed that in the allocation of sustainment functions there is no entitlement, each partner has a responsibility. He said: "The US Government has an obligation to best value in allocating workshare. Nor does participation in one function in the F-35 programme assure that this will expand to other roles."

Previously on February 16, 2017, General Bogdan explained how this would work to the House Armed Services Committee: "The Department of Defense will assign to the F-35 partners and FMS customers repair capabilities such as wheels and brakes, electrical and hydraulic systems, maintenance of support equipment, and warehousing for the global supply chain. These same capabilities either currently exist or are being developed at depots in the US in accordance with current US law."

In addition to the US facilities, F-35s will also be supported by the two MROU facilities established to support operators in the Pacific and European regions (at Nagoya, Japan and Cameri, Italy) to provide worldwide coverage. Both the European and Pacific MROUs are co-located with F-35 final assembly and checkout facilities. F-35s deployed from the United States will use the regional sustainment networks in Europe and the Pacific regions as Admiral Winter outlined. He said: "We will not have to take aircraft home for organisational or depot maintenance."

In Europe, MROU activity will start in 2018, with work on airframes being done at Cameri, Italy and on F135 engines at the first European regional F135 engine depot overhaul facility by the 1. Hava Ikmal ve Bakim Merkezi (1st Air Supply and Maintenance Centre or 1. HIBM) at Eskisehir, Turkey. As the number of F-35s operating in Europe – including US aircraft – increases, by 2021 additional capabilities may come on line, in the UK for airframes and in the Netherlands and Norway for engines.

In November 2016, the F-35 JPO announced that Australia and the UK had been selected as MROU hubs for avionics, starting, in 2020-2021, with a global support mission. By 2025, both hubs will transition to providing avionics support for the entire European and Pacific regions to meet the requirements of the much bigger fleet of F-35 aircraft in operation by then.

In August, the JPO announced that the Netherlands would be the site of a European F-35 parts warehouse, which will be operational in 2019; an equivalent warehouse for the Pacific region will be built in Australia and become operational in 2020. Both warehouses will provide spares and service equipment to all F-35 operators.

In another example, BAE Systems Australia, which has been selected as the Southern Pacific region airframe MROU provider (the Northern Pacific region is handled by the Mitsubishi Heavy Industries-managed FACO at Nagoya) will support not just Australia's 72 F-35As at its depot facility at Williamstown but also F-35s from other countries in the region. Currently under construction, the Williamstown facility features eight work bays.

Each MROU facility is a major node within a support network that Admiral Winter described as: "A global supply chain as nimble and agile as possible: 110 foreign suppliers in 11 countries, with 1,250-1,300 in the US industrial base." The global sustainment enterprise will work with all F-35 operators to develop partnerships with industry at all levels. Winter said: "If we see a small business emerge with required capabilities, we may need to consider this as a second or third source."

Who owns what?

Liberating the F-35 from the traditional approach of each nation or service investing in and operating its own dedicated support stovepipe – having to buy a stock of spare parts and support equipment – is a goal of the F-35's networked sustainment strategy. A part removed from an F-35 in country A for overhaul, may be sent to an industry partner in country B, where the workers will not necessarily even know what country the

F-35A Lightning II 14-5106/HL from the 388th Fighter Wing fires an inert AIM-120C-7 missile at the Utah Test and Training Range during Combat Archer, Air Combat Command's air-to-air Weapon System Evaluation Program. *Scott Wolff/US Air Force*

US Marine Corps F-35B Lightning II BuNo 169028/ VM28 assigned to Marine Fighter Attack Training Squadron 501 (VMFAT-501) 'Warlords' lands on the flight deck aboard the amphibious assault ship USS Wasp (LHD 1) during the ship's certification exercise in the Atlantic Ocean during August. *Mass Communication Specialist 3rd Class Levingston Lewis/US Navy*

part came from. But once the overhaul is completed, the part could be sent to an F-35 in country C, if that has the most urgent need for it. Winter said: "The global strategy is a spares pool, you don't own the specific fuel pump, but if you are there and need one, one will arrive".

Central management provides oversight of each asset's use and upkeep throughout the global enterprise network of spares and support equipment by linking F-35 operators with central management. Squadrons, bases and services have much the same responsibilities that they have today, providing government-furnished material, overseeing its use, ensuring operational availability and maintaining accountability.

In many countries, the sustainment system may be politically unpopular when not all of the work required by a country's F-35s is performed locally, but rather is the responsibility of an international network. Not only will international partners not own spare fuel pumps – or other components – supplied for their F-35s, but also they will have to explain to the voters why these airplanes' expensive engines are being flown out for expensive major overhauls in other countries, rather than being trucked to the local factory that would dearly love to do the work.

Reducing costs

The objective of the F-35's global sustainment enterprise is to reduce operating costs. For decades, operating costs have relentlessly driven down the numbers of manned combat aircraft available for coalition air operations. From its start, the F-35 programme has been designed to bend the cost curve downward. Winter said: "We need to get ahead to make this affordable for the US and international partners."

Sustainability is the area where the F-35 programme can, if successful, achieve its largest savings. Currently, the JPO estimates it has achieved $81 million in development savings, but foresees an enormous $63 billion in total-programme sustainment costs. These actions, managed through the Lifecycle Affordability Board (LAB) process, have included the Reliability & Maintainability

An F-35C Lightning II assigned to Strike Fighter Squadron 101 (VFA-101) 'Grim Reapers' performs a touch-and-go on the flight deck of the aircraft carrier USS George Washington (CVN 73) during initial qualifications. *Mass Communication Specialist 3rd Class Wyatt Anthony/US Navy*

Commander US Air Forces in Europe, General Tod Wolters, gives opening remarks at an F-35 leadership forum at Ramstein Air Base, Germany. The forum gathered experts and stakeholders from Denmark, Israel, Italy, the Netherlands, Norway, Turkey and the United Kingdom to plan a common vision among F-35 users. *Captain Kay Magdalena Nissen/US Air Force*

Improvement Program (including identifying and improving diagnostics), the US Marine Corps Pathfinder Program (leveraging the Marines' F-35B experience in sustainment for other users) and establishing and using the JPO's cost war room.

Another programme dubbed the Industry Blueprint for Affordability leverages contractor investment to build the global sustainment chain while controlling costs. This programme started in 2014 and was extended in 2016 for a further two years. Explaining what should happen under the programme, Winter said: "We solicit good ideas for cost reduction as part of a larger affordability strategy. Accessing industry through best value competition, domestic and international is critical for creating capabilities and controlling costs."

Competition will be carried out throughout the enterprise, not limited to MROU or other specialist capabilities. Speaking at the Air Force Association convention at National Harbor, Maryland on September 19, Lieutenant General Arnold Bunch, the Air Force's top uniformed acquisition officer said: "For F-35 sustainment, we have put rules in place that everyone agreed to, so they can't say there are problems. Our biggest focus is to drive down the F-35's operating cost. We continue to work with Lockheed Martin and their partners to keep cost under control."

Stressing affordability, Winter said: "The initiatives we use in our war room, aligned with action items and plans to seek out best performers in industry and government, need the best, brightest, most capable performers and this needs to be continuously re-assessed."

ALIS: the sustainment network linking each F-35

The F-35 sustainment enterprise is the capstone that brings together industry, sustainment providers and operators. The F-35's Autonomic Logistics Integration System (ALIS) runs vertically. The system links individual F-35s through successive levels into ALIS's central fleet-management capabilities and represent a single standard user interface for F-35 sustainment that will be used by every operator.

The ALIS portable maintenance aid and portable classified aid — ruggedised laptops used at the squadron level — plugs directly in to each aircraft. Each squadron, worldwide, uses the same ALIS standard operating unit (SOU) terminal. These link to a central node in each operating nation and to a global node at Lockheed Martin's Fort Worth, Texas facility, with separate systems for classified data and another, more restricted, for data relating to the F-35's stealth technology. Members of the international supply chain, depots and industrial partners that provide repairs and sustainment are linked to ALIS.

F-35 international logistics and sustainment is designed around a performance-based logistics approach at two levels: organisation-depot (primarily handled by industry) and main operating base (MOB) or unit (primarily handled by military and government personnel). Contractor support will sustain operations at forward operation locations or ships, where the last mile of transportation and the hands-on support of the F-35s are carried out by the (military or government) users. The ALIS SOU, with its interface with the laptops that monitor the aircraft on the flight line, will according to Admiral Winter, pulse out to the supply chain to get a part or a maintenance activity. The F-35 is designed to operate for up to 30 days without ALIS connectivity.

A MOB can make direct access to contractor support through ALIS, which makes F-35 regional warehouses in the US,

F-35C Lightning II BuNo 169163/ NJ124 of Strike Fighter Squadron 101 (VFA-101) approaches the flight deck of the aircraft carrier USS George Washington (CVN 73) for an arrested landing. During August 2016, VFA-101 aircraft and pilots conducted initial qualifications aboard George Washington in the Atlantic Ocean. *Mass Communication Specialist 3rd Class Clemente Lynch/US Navy*

The Autonomic Logistics Information System is intended to be the same for all users of the F-35. Here a US Air Force and Royal Air Force technician study an ALIS display at Eglin Air Force Base, Florida. *Lockheed Martin*

Europe and Pacific – each an ALIS node like the MOBs and FOLs - important. On August 29, Lockheed Martin announced it was establishing an ALIS team in Australia, supporting the linkage to the sustainment network of the MROU and warehousing facilities there. The regional warehouses will provide spares either to a MOB (by just-in-time commercial transportation) or directly to a FOL or ship (by military transportation). This, and other sustainment management activities will be carried out primarily by industry, connected through ALIS.

However, Winter is concerned that transportation and distribution channels used to get parts and capabilities to where they are required "takes way too long".

Until 2017, F-35 operational logistics and sustainment experience had primarily been with the US armed services. US Marine Corps F-35Bs, participating in Exercise Red Flag this summer, were able to fly 67 of 70 scheduled sorties. US Navy F-35Cs completed 41 sorties in 19 days on board the aircraft carrier USS George Washington. In the final round of developmental testing sea trials in 2016, F-35Bs completed 60 sorties in 21 days on board the amphibious warfare ship USS America. Commenting on the at sea periods, Jack Crisler said: "Lockheed Martin worked with the Marine Corps on how the service can manage its own deployable spares during shipboard deployments."

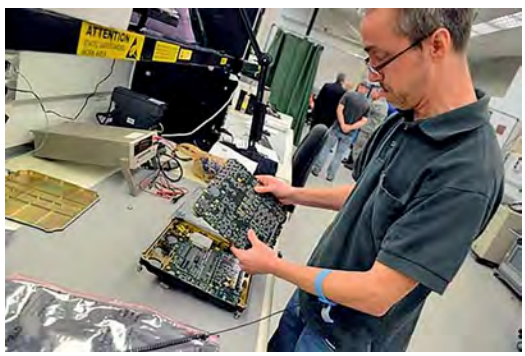
The techniques and procedures developed are likely to be directly applicable to sustaining British and Italian F-35B shipboard operations as well.

While ALIS has still not achieved its full operational capability, the US Marine Corps and the US Air Force have already demonstrated they can support deployments. By 2017, Air Force support for ALIS was strong enough for the service to start examining whether it could be expanded to other aircraft types and into a service-wide system. The upgraded ALIS version 2.0.2 will be in service supporting F-35s worldwide by the end of 2017.

Future sustainment

Making F-35 sustainment work will be a challenge even for its biggest user, the US Air Force. Speaking at the Air Force Association convention at National Harbor on September 18, Air Force Materiel Command, Commander General Ellen Pawlikowski said: "We anticipate the Air Force will buy so many [F-35s] that we are more probably going to be doing a lot of the heavy lifting in support of the JPO to manage the global enterprise. It is going to require global management, because there are going to be platforms and depots all over the world for different things. Managing the enterprise and relations with contractors is something the Air Force is going to have to spend time on. It is going to require heavy lifting from the Air Force, the JPO and international partners to make this as streamlined as we can."

The last word belongs to Admiral Winter, who, when asked if he shared General Bogdan's concern that sustainment might be the thing that finally pushes the long-running F-35 programme off the rails, said: "What General Bogdan was discussing was the capacity demanded by the increasing number of F-35s. Meeting the needs for MROU capability is going to be taxing and demanding. We need to ensure that we have enough engine, airframe and component repair facilities around the world so we do not have aircraft around the world that cannot be repaired. MROU stand-up is on track to be able to accept and accommodate current F-35 production. The US government continues to have performers that are supporting both industry and government. We have performers – US military depot performers – who we plan to run F-35 depots and overhauls. We are transitioning to a hybrid project support strategy."



A 568th Electronics Maintenance Squadron technician at Robins Air Force Base, Georgia, removes a faulty circuit card assembly from a remote input/output unit, which is part of the F-35's communication system. *Tommie Horton/US Air Force*