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How The Joint Strike Fighter Seeks To Preserve Air Supremacy For Decades To Come

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Since its inception in 2001, the Joint Strike Fighter (JSF) program has cleared several technical and political hurdles as it is nearing the end of its development stage, formally known as System Development and Demonstration (SDD), which is expected to be completed in the spring of 2018.

The JSF is designed to be a game changer – with the combined air-to- air and air-to-surface capabilities – which means that it can both support ground troops and naval forces – when it comes to targeting enemy strategic targets during warfare. The JSF, also known as the F-35 Lightning II Program, can also operate in areas where the F-16 cannot. Furthermore, the JSF program has established comprehensive planning processes that seek to identify and analyze technological advances by adversaries such as North Korea, Russia, China and Iran as they seek to respectively close their military gaps with Washington.

The initial debate over the affordability of the aircraft – which was exacerbated by U.S. President Donald J. Trump shortly after his inauguration – has since evolved to whether its multi-platform role, which ranges from cutting edge intelligence gathering to intelligence sharing capabilities – through a centralized systems engineering network – is capable of delivering on its promise to help preserve U.S. and its allies air supremacy for decades to come.

Towards that end, the JSF partner countries – the U.S., Australia, Canada, Denmark, Italy, the Netherlands, Norway, Turkey and the United Kingdom – drew up a joint requirements document in 2008 detailing specific guidelines for the capabilities of the aircraft at full capacity, which have undergone a comprehensive set of tests by the Pentagon's SDD to ensure that the initial set of requirements are met by its Joint Program Office and its principal contractor. Once the development phase has been completed, further testing will then be carried out by another Pentagon program entitled Initial Operational Test and Evaluation (IOT&E).

In tandem with these processes, the Government Accountability Office (GAO) has also published periodic reviews of the JSF program, including of its testing phases to ensure its overall quality control and that program benchmarks are being met. This includes accounting for that the various threat scenarios planned for – ranging from war games to simulated exercises – are being met, and to ensure that the program meets its budget obligations.

Within this context, understanding the various processes governing the program is not only paramount for policy makers and the tax payer alike but could also impact the aircraft's attractiveness for future customers who will have to acquire it through the U.S. State Department's Foreign Military Sales (FMS) program.

This analysis seeks therefore to identify how the program is governed, how its various challenges – ranging from software development to the acquisition of the latest weapon systems are integrated – are overcome and how its modernization procedures are carried out.

Development and Security

During the installment of Block 2B phase (2015), central weapon systems have been installed, including air-to-air and air-to-ground capabilities. This was followed up by the installment of Block 3I phase (2016) which included the capabilities of Block 2B but was released to the program's international partners.

The impending completion of Block 3F means that the SDD phase has been completed, which entails that all program requirements have been met. Once the JSF's software has been fully completed, installed and tested, the F-35 will operate in a similar fashion to any modern smart phone

where the system engineering will be subjected to constant updates and modernization. Ensuring that the JSF can resist hacking and a broad range of cyber attacks are also being tested during the SDD stage. Moreover, like prior generations of fighter jets, the JSF has built in capabilities to self-destruct and destroy all data if an aircraft is obtained by an adversary.

As of June 2017, over 200 F-35s have been delivered to the U.S., Australian, British, Dutch, Norwegian and Italian air force. An additional 100 aircrafts are at various stages of production. The F-35 comes in three versions: F-35A; F-35B; F-35C.

The F-35C is designed for U.S. Navy only, with the added capability and strength to handle catapult starts and barrier landings needed to safely operate on the various U.S. aircraft carriers.

The F-35B has been ordered by the U.S. Marine Corps, Britain and Italy and has the added capability of short takeoffs and vertical landings.

The F-35A has been ordered by the U.S., Australia, Canada, Denmark, Italy, Netherlands, Norway and Turkey. Canada, however, is the only F-35 partner country that has yet to decided whether to acquire the aircraft.

Japan, South Korea and Israel will also require it through the FMS. However, Seoul has yet to formally commit to the F-35 acquisition. Belgium, Finland, Switzerland and Singapore have also expressed interest in acquiring the F-35 jets through the FMS program.

Testing

The program has established two types of test regimes to verify that the requirements set by the partners are being met: The first is carried out by a development community, which is responsible for the entire development process of the JSF, and consist of an estimated 1,000 individuals working out of Joint Base Edwards where 19 aircraft (primarily the B and C version of the F-35) are used for testing. The 19 F-35s, however, are not production aircraft as they are instrumented for their special purpose.

Towards that end, the IOT&E oversees the testing and development of the aircraft – also known as the Development Test & Evaluation (DT&E) – and operational testing, known as Operational Test & Evaluation (OT&E). DT&E is conducted throughout the acquisition process to assist in engineering design and development and to verify that technical performance specifications have been met. DT&E is planned and monitored by the developing agency and is normally conducted by the contractor. For its part, OT&E is a fielded test, under realistic combat conditions, for a Major Defense Program (MDP) – in this case the F-35 program - in which any item or component of a weapons system, equipment, or munitions for the purposes of determining its operational effectiveness and operational suitability for combat.

The DT&E ensures that the joint requirements document of 2008 which outlines specific guidelines for the capabilities of the F-35 at full capacity are being met.

The OT&E phases ensures that the aircraft actually works during war against existing threat scenarios and partially against future threat scenarios.

In the event that the OT&E phase determines that the aircraft's capabilities does not meet the present threat scenario – because the adversary capabilities may have evolved since the initial requirement document was first draw up in 2008 – the OT&E will then specify requirements targeting the renewed enemy capabilities. Because of the ever changing adversary capabilities, the OT&E process ensures that the development process is in place for the program's lifespan.

The second part of the testing is carried out by the Initial Operational Test & Evaluation (IOT&E), which is not only responsible for overseeing that the technical requirements are being met, but to ensure that they work during conflict.

Overseeing all of the testing is a program entitled Operational Test & Evaluation (DOT&E),whose director reports directly to the U.S. secretary of defense. The testing covers the three versions of the F-35, and include developing various war scenarios - real and simulated threat scenarios – where the F-35 effectiveness and survivability are tested. A wide range of strategic scenarios are accounted for during this part of the testing and air tactics are developed in this process.

Follow On Modernization

Once the last part of the testing has been completed, which centers on completing the last segment of the F-35 software coding, also known as 3F, the program's requirements have bee met and the aircraft will not only be operational but fully capable of targeting the present range of global threat scenarios. Within this context, the operational testing seeks to identify the various existing threat scenarios – as per the program requirements of 2008. Once the basic platform has been completed, which the end of the SDD entails, the follow on modernization phase can begin. This follow-on-modernization will go on throughout the lifetime of the weapon system, just like the legacy platforms, like the F-16, has undergone for the last 40 years.

The program initially established a process that outlines a comprehensive upgrade regime for the aircraft every second year. While Block 4 is expected to be launched in Spring 2018, Block 4.1 is planned to be released in 2020 timeframe and focus on software updates. For Block 4.2. slated for 2022

timeframe, the aircraft will undergo both software and hardware upgrades; Block 4.3, slated for 2024 will target software upgrades and Block 4.4. is expected to have the aircraft undergo another round of software and hardware upgrades pending the development in the threat environment. This process will continue through the future developments of block 5, 6 and 7 and so forth. The program, however, aims to revise its upgrade procedures and will in the process adopt a system-of-system approach that will not only focus on the aircraft itself and its software but also on the various weapons systems attached.

The next phase of the F-35 program, formally known as Follow On Modernization, or Block 4, seeks to develop capabilities meant to preserve U.S. and its allies' global military supremacy against adversaries and their steadily improving defense systems and capabilities. Towards that end, the various F-35 partner countries may implement their respective and collective intelligence to customize their fleet with added on technologies of their choosing, which may be incorporated into the aircraft.

The modernization program will enable program executives to plan for various enemy capabilities as the aircraft is being upgraded on a regular basis to meet emerging threats. While Block 4 is primarily about weapons, it is equally important for the aircraft to develop all of its censors throughout the lifetime of the weapon system.

Common Capabilities, Common Standard and Unique Capabilities

The Block 4 framework ensures that an estimated 95 percent of the JSF's capabilities remain the same under what is known as Common Capabilities. Common Capabilities seeks not only to guarantee quality control as the program embarks into its Follow On Modernization phase, but also seeks to keep that process cost efficient as each partner contributes to its development and are collectively responsible for its financing.

In the event a partner chooses to include additional technologies on to its aircraft beyond what is provided through the Common Capabilities framework, it can choose between the following two sub categories: Partially Common Capabilities and Unique Capabilities.

Partially Common Capabilities include technologies or weapon systems that two partners/FMS customers or more may seek to acquire.

Unique Capabilities include technologies or weapon systems that only one partners/FMS customer or more may seek to acquire.

Each partner/FMS customer is responsible for the financing of technologies acquired either through the Partially Common Capabilities and/or Unique Capabilities.

In the event it is U.S. technology, when it comes to acquiring the additional capabilities, each partner country/FMS customer must adhere to the requirements set by the U.S. National Disclosure Policy.

Common Package: In the case of Norway, as it has specific needs and requirements that not all of the other F-35 partners presently have, Oslo has requested that a long-range missile capable of targeting well protected land and naval targets entitled the Joint Strike Missile (JSM) being integrated in Block 4.

At the time of the launching of the JSF program, Norway was the only member in need of that capability – which is why it requested the JSM as a unique requirement for its program participation – but over the past decade as threat scenarios evolve other JSF partners have expressed an interest in that capability, including Australia. In 2013, Norway and Australia signed an agreement for further developing the JSM, but Canberra has yet to commit to its acquisition

Fellow JSF program partner Turkey is also developing its own long-range missile, the SOM Cruise Missile, which competes with the JSM should Australia indeed seek to acquire the long-range missile capability as they both can be integrated onto the F-35.

While no agreement between Turkey and Australia has been signed, Canberra is expected to make a decision in 2018 or 2019 regarding whether to acquire a long-range missile.

Given that Norway, Turkey and Australia are program partners, the potential acquisition would have evolved from Unique Capacity to Partially Common, which is governed by a separate set of program regulations. However, once Australia has committed itself to acquiring either of the missiles, it can influence the process going forward, including by jointly financing the continued development of the missile and it's integration in the F-35.

Other Weapon Choices

While the Drag Chute capability has been developed by Norway to ensure that the
F-35 can land safely on the country's icy runways during severe winter conditions, Canada and the Netherlands are also considering acquiring that capability. But unlike the JSM, the Drag Chute capability is released and available to any potential customer of the F-35 as it is not subjected to the same set of regulatory framework governing its release of technology. Norway's NAMMO, a state-owned joint venture with the government of Finland, is a subcontractor of Raytheon's Advanced Medium Range Air-to-Air Missile (AMRAMM),

which is another capability that will be installed on the JSF and which is meant to compliment the JSM through its air-to-air capability.

The ARAMM missile, however, faces competition from Britain's Meteor missile, originally manufactured for the Eurofighter Typhoon, which will also be integrated on the JSF. UK and Italy is currently partners that are looking for this integration.

Neither Denmark or Canada entered the F-35 program with any specific requirements beyond what the program's Common Capabilities offer and is currently not developing their own technologies for the JSF.

The U.S. has existing weapons systems on other planes that will be integrated within the F-35, including the Small Diameter Bomb (SDB) that it seeks to develop further. In the case of nuclear weapons, this is a capability that the U.S. is unlikely to share with any of its partners as it would violate its long-standing policy of counter proliferation. It is unclear whether the F-35A or the F-35C, or both, will have a nuclear capability. Regardless, for any partner country to acquire the SDB or other technologies, it would have to secure them through the U.S. National Disclosure Policy, which is evaluated on a bilateral basis. If the technology is not released by the U.S., it remains a Unique Capability and program partners should not have to share any development nor integration costs of such capabilities.

The debate over the F-35 has evolved from its affordability to whether it can indeed meet expectations centering on its alleged ability to preserve the military supremacy of the USA and its allies amid a time increasing global uncertainty. Given the rapid evolution of military technology worldwide, this question cannot be answered once and for all. The strength of the JSF will depend on the both the agility and the quality of the program. Understanding the processes governing the program is therefore instrumental for policymakers and the taxpayers alike.

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