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F-35B the right choice and the only choice for the Royal Navy

The F-35 Lightning II has proved highly controversial since the program's conception in the 1990s. There are still those in the UK who would be happy to see the back of it, but the arguments in favour of the aircraft that is an essential part of the RN's future are overwhelming.

The F35 has problems, all aircraft have problems

The scope of the project is incredibly ambitious; producing a 5th generation, multi-role aircraft to replace many different aircraft types and meet the needs of multiple international partners was always going to be costly and technically demanding. The F-35 has attracted an army of critics, including President-elect Donald Trump, calling for its cancellation during his election campaign, even as the aircraft is coming into service. The F35 hate mob, armed with half-truths and simplistic alternatives can be found across the internet, and their influence extends to high places. As a complex, multi-faceted project, it does not sit well with those who want to live in a world of easy-to-understand, quick solutions and sound bites. Every aircraft design project has to overcome

unexpected hurdles. Innovating at the cutting edge will always involve risk. During the development of the much-admired F-15 (In production for 45 years and over 1,200 built), it was continually criticised as too big, too complicated and too expensive. Many very successful aircraft designs experienced major issues along the way but the discussion was mostly confined to aviation experts and specialist analysts. In contrast, today's online world allows the detail of F-35's problems to be quickly put in the public domain and subject to the instant judgement of anyone with an internet connection.

It is undeniable that the F-35 is late, around seven years behind the original schedule and the price is approximately double that quoted in 1997. There have been mistakes in the program and a 'conspiracy of optimism' in the early days that has been a regular feature of many UK and US defence projects. Because of the scale and ambition of the project, failures are inevitably magnified. Those who still advocate axing the F-35 entirely fail to explain how it could be replaced more cheaply. Billions of dollars have already been spent on three decades of research, development and manufacture. It would be madness to throw that away. The entire lifetime cost of the F-35 will supposedly be around \$1.5 Trillion dollars which seems staggering, but replacing each of the 4th generation aircraft designs in the US inventory, is estimated at \$3 Trillion. Unfortunately, some of the expected cost savings through large-scale production has been more than offset by growth in development cost. The F-35 will never be cheap, but the unit costs are falling and will continue to fall, to date more than 220 aircraft have been built, already making it the most numerous 5th generation aircraft in existence. The predicted cost-death spiral has not materialised with international partners sticking with the project, even cash-strapped Britain intends to buy 138 eventually.

The latest [report from the Pentagon](#) on the F-35 project highlights significant on-going problems. Most notably the Block 3F software which is critical to many of the aircraft's capabilities will not be ready until 2018. There are also a variety of other issues with the Automated Logistics System, the new pilot's helmet and the safety of the ejector seat. These are serious concerns, but with at least 11 nations buying more than 3,000 aircraft, it is too big to be allowed to fail, there is such momentum and finance behind it that the problems will eventually be solved. This situation is not ideal but the RN does not expect to deploy HMS Queen Elizabeth operationally until at least 2021 by which time more of the F-35's issues will have been fixed. Aircraft are operating under some restrictions and is far from full its full potential, but the US Marines already have enough confidence in its ability to forward-deploy F-35Bs to Japan in 2017.

A networked aircraft for a networked age

The majority of the critics of the F-35 have limited aviation experience or are retired pilots who flew 3rd or 4th generation aircraft. The F-35 is not just an upgrade on earlier aircraft, but is conceptually quite different, drawing its greatest strength from its situational awareness. The older generation may question its close-range dogfighting capability, but it will be very hard to kill an F-35 when it can

see you in any direction at great distances, while itself almost invisible to radar. It can manoeuvre hard, but shouldn't need to. Early beyond-visual-range missiles were unreliable, so all good fighter pilots believed in having an aircraft and the skill for the dogfights that were inevitable. Radar and missile technology has moved on to the point where the F-35 pilot can reliably expect to engage the enemy from a distance almost every time.

If recent history is a guide, the F-35 will probably spend more time on strike missions than in air-air combat. Its situational awareness, stealth and networking capabilities will make it exceptionally capable and its mere presence will act as a significant deterrent. The perception that F-35B is just an upgraded Harrier is entirely wrong. Vastly superior to the Harrier, it has longer range, is supersonic and can penetrate advanced air defence systems which the Harrier could never have contemplated. Even when only a handful of F-35s are embarked aboard HMS Queen Elizabeth, the RN will have a step-change in capability that can even mitigate for some of the weaknesses in its undersized fleet. Effectively a flying networked 'data node', the aircraft can not only fight but share intelligence and vast amounts of sensor data with ships and other aircraft. By buying into a massive international program, the RN will benefit from interoperability with the US and other NATO allies. Its potential will still be being expanded into the 2030s and 40s as new software and weapons are developed.

Royal Navy CATOBAR is dead, long live VSTOL

There is no question that a conventional aircraft carrier (CATOBAR) with catapults and arrestor gear would be more flexible and powerful than the Vertical Short Take Off and Landing (VSTOL) configuration of the QEC. CATOBAR offers the ability to operate a much greater variety of aircraft than the just helicopters and the F-35B. Unfortunately, the cost of building and maintaining a conventional carrier is beyond the inadequate resources government is willing to provide the RN. With more money and more time, pinning the success of the QEC project on the F35-B could have been avoided. Although we could have purchased F-18 Super Hornets much more cheaply than the F-35, the F-18 will look out of date in 10-15 years while the F-35 is a generation ahead. As a Tier-1 partner, the UK has a significant financial stake in the F-35 project, worth around £1Bn a year to the British economy and sustaining around 24,000 jobs, a fact that government just cannot ignore. Alternative imported carrier aircraft such as the Super Hornet or Rafale would have no such benefit.

Many believe that the costs quoted by BAE Systems in 2012 for fitting EMALS (Electromagnetic launch system developed by the US Navy) were inflated as it was not in their commercial interest to allow anything but F-35B to fly from the QEC. The US Navy was even willing to subsidize the cost of EMALS to some extent. What is certain is that 2010 CATOBAR plan was adding costs and significant further delays to the QEC program. In 2017 the RN budget is still stretched to breaking point, the pound is weak against the dollar and the US Navy having teething problems with the EMALS while at the same time, F-35B has achieved Initial Operating Capability with the US Marines. CATOBAR operations require more manpower, involved greater complexity and more training. Against this

background, it looks sensible for the UK to have compromised on the VSTOL concept, at least in the short-medium term. Only the unlikely prospect of Donald Trump cancelling the F35 puts this at risk.

Trump won't cancel the F-35

Axing the F-35 would have a worldwide impact on the defence planning of many US-aligned nations. Trump may be rather less bothered about international partnerships than his predecessors but fortunately, from a NATO and UK perspective, the appointment of hardened US Marine Corp veteran James Mattis as his defence secretary, seems to indicate the F-35B at least will be safe. The USMC has bet the farm on the aircraft and Mattis is a big supporter. Trump campaigned on a platform of protecting American workers. Around 150,000 US jobs depend on the F-35, Trump would have a hard time explaining why he was making thousands redundant. As Trump seems to be more of a businessman than the politician, he may ultimately see the bottom line is that it will cost more to cancel F-35, than continue. His actions may at least help drive down the price by forcing Lockheed Martin to reduce their profit margin and find further efficiencies.

The F-35C is probably the most vulnerable of the variants. The US Navy has never been as enthusiastic about the aircraft as the Airforce or Marines, and the C variant is having the most development problems. Lobbying by Boeing and delays to the F-35 has kept the F-18 Super Hornet production lines open. In 2013 Boeing revealed the Advanced Super Hornet concept with new engines, radar, conformal fuel tanks and a more stealthy design. Although an evolved 4th generation aircraft, lacking real stealth/low observability characteristics, it would offer maybe 70% of the F35's capabilities at 50% of the cost. Perhaps a compromise will be reached where Trump shows he delivered something by axing the F-35C and the US Navy is content to get the cheaper Advanced Super Hornet instead.

On 11th January 2017 Trump rather optimistically stated *“we're going to do some big things on the F-35 program and perhaps the F-18 program. And we're going to get those costs way down, and we're gonna get the plane even better, and we're going to have to competition. And it's going to be a beautiful thing.”*

VSTOL is the now only realistic option for the RN and accepting that means accepting the F35-B is the only credible fixed wing aircraft choice. Any change to this plan would be unaffordable with the current defence budget and would involve delays measured in years. It is pretty safe to predict that F-35Bs will continue to be delivered to the UK, albeit more slowly than everyone would like. It is also safe to say that the introduction into service will see more problems emerge but they will be overcome. In the next decade, we should expect the aircraft's negative reputation to recover as it fulfils its potential. Ultimately the F-35B Lightning II and the Queen Elizabeth aircraft carriers will give the UK a very powerful tool of foreign policy.



US Marine Corps F-35Bs transit the Pacific from Yuma, Arizona to be forward-deployed at Iwakuni, Japan