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## **The Farnborough Airshow and a Look at Airpower**



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# The Next Hundred Years of the RAF and the 2018 Farnborough Air Show

By Robbin Laird

Recently, the RAF celebrated its first one hundred years.

With this year's Royal Air Tatoo and the Farnborough Air Show, it is launching its next 100 years. The RAF is in the course of a fundamental transformation and is doing so within the context of significant strategic change and uncertainty.

Not present at the Farnborough Air Show will be a new combat platform fundamentally shaping the way ahead for the RAF, namely, the new Queen Elizabeth Class carriers.

With the new carriers, the RAF is working with the Royal Navy to train jointly their new air combat force, an F-35B force flying off of the new ship.

The UK has built the carrier as part of a national shipbuilding effort, and one enabled by the coming of the F-35 as well. The coalition working relationship surrounding this effort will be evident at both Royal Air Tatoo as the Air Chiefs meet and discuss the way ahead and at the Farnborough Air Show as the F-35s fly as well.

The coming of the F-35 to the RAF and Royal Navy will intersect with the global partners also flying the aircraft, and notably the partners within Europe.

With the UK flying the same aircraft as the Northern Europeans, including the Dutch, this shapes new opportunities and capabilities as well. And the close working relationship with the US Navy and Marine Corps will be evident as the HMS Queen Elizabeth comes this summer for F-35 integration training off of the Virginia Coast and when the Marines operate off of the ship, including next year during further ship trials off of the British coast as well.

As Group Captain Ian Townsend, the RAF Marham base commander, where the first F-35s arrived recently, noted in my interview with him:

“In the past two decades our airpower has been dominant. But we do not want to introduce the F-35 as a replacement aircraft operating within the constraints of the legacy system. We need a multi-domain capability to ensure that our adversaries do not simply work around a classic airpower template.

“The challenge is to exploit the F-35 as a lever for broader multi-domain combat innovations. What we need to make sure is that people don't use multi-domain to go around our combat air advantage but rather to evolve our combat air advantage and make it a core part of our own cutting edge multi-domain capability.”

Group Captain Townsend noted that there was very little real familiarity with the F-35 in the UK defense structure, and that from the outset the first squadron at RAF Marham would engage in that familiarization process. And flying at the RAF centennial and at Farnborough is part of the introductory familiarization process.

At the same time, the other aspects of RAF transformation highlight another key aspect of the coalition approach, namely, the incorporation of new or modernized European built aircraft.

For the UK, Project Centurion is the core modernization effort with regard to Typhoon, the main focus of which is upon transferring some of the weapons carried by the Tornado, soon to be retired, onto the Typhoon, to enable that aircraft to take over some of Tornado's capabilities.

But less visible is the progress the RAF has made with regard to aircraft availability for Typhoon as the UK government and industry has worked with the RAF to shape new approaches to provide for enhanced fleet performance.

The contract is the product of the evolution over more than a decade of working on support arrangements associated with various modalities of performance-based logistics to a fleet availability approach. Indeed, the new TyTan contract has much to teach the rest of US and European defense industry with regard to sustainment and investments in force structure development.

The latest iteration of Typhoon support is the TyTan contract which was launched in 2016. The TyTAN contract is focused on availability of aircraft for the Typhoon fleet taken as a whole. The contract focuses on fleet management and fleet availability, and the progress made on the sustainment side is part of the overall evolution of where the RAF is going as well. It is less flashy than a flyover at Farnborough, but availability rates are crucial to flying the kind of combat capability which the RAF will need going forward into a strategic environment defined by competition with peer competitors.

The new TyTan approach is based on organizational and legal changes which allow savings from sustainment to be plowed back into the modernization of the aircraft. As Steve Worsnip, Vice President F-35 Sustainment, BAE Systems, with more than 20 years of experience in the sustainment business and a key player in shaping the Typhoon approach, commented during an interview at RAF Coningsby earlier this year with me:

“Industry was not being paid to replace things or benefitting from the need to repair, alternatively we had buy-in from the RAF, MoD and industry to enhance performance, generate costs savings and to provide for new monies for modernization of the aircraft.”

In other words, the TyTan approach is incentivizing support for fleet enhancement, rather than simply sustaining aircraft. It means as well that savings can be provided to support the Centurion Program and other modernization efforts for Typhoon.

It is not simply about PBLs, and parts support. It is about setting in motion a process whereby MoD, the RAF, and industry can work together to shape a collaborative outcome, and with that cultural shift comes organizational change.

Two other key elements of RAF transformation are its new A330MRTT Voyager Tanker, and the A400M lift aircraft.

Both are part of the transformation of the air support structure based at RAF Brize Norton, where the RAF is working force integration for the support fleet.

These aircraft are built in cooperation with Airbus, and the Typhoon built in cooperation with the other Eurofighter partners.

But Brexit is raising challenges to sort through the future of UK aerospace industry with Europe. While the F-35 is also coalition built with British industry having 15% of the F-35 program and thereby well positioned for significant engagement over the next three decades in the program, but the European industrial working relationship with UK industry is a pressing issue.

Brexit is occurring at a time of profound change in Europe, triggered perhaps in part by Brexit, but due to a wide range of dynamics which are clearly leading to the politics within nations focused on their future and the kind of European working relationships those nations wish to see.

It is very clear that Brexit provides a major challenge to UK defense and aerospace industry given that the major focus and major capabilities in those sectors rests on their role in global supply chains and programs, many of which are European.

Airbus is a central player in the UK aerospace industry, and in defense as well. Leonardo is many ways a UK-Italian company. MBDA is a Franco-UK company with German and Italian aspects. Thales has a very large UK component which both complements and challenges its French dominant part of the company.

What is their fate and how will these relationships work in practical terms as movement of personnel, taxes and import and export issues get sorted?

Will joint investments continue between Britain and the continent within these companies?

What is the future of Eurofighter if the UK and continental European relationship is disrupted?  
Will France and UK co-investments in missiles via MBDA continue uninterrupted?

There are a number of key questions to consider determining the fate of European and UK defense in dealing with the looming Brexit impacts.

The CEO of Airbus recently highlighted how he saw the Brexit challenge:

Soft or hard . . . light or clean, [it] will be damaging for industry, for our industry and damaging for the UK,” he said.

The Airbus chief said the UK government had “no clue, no consensus on how to execute Brexit without severe harm,” in a briefing in London on the European aircraft maker’s operations. He said Brexit was distracting politicians — both in the UK and Europe — from important issues that would determine the future of the UK and Europe.

“This Brexit discussion is consuming so much bandwidth of our political elites — over here and in Europe — that it seems the governments have very little time to focus on those questions that really count for the future and competitiveness . . . proper educational infrastructure . . . proper infrastructure. These are the things that will decide our competitiveness in Europe in future”

<https://www.ft.com/content/92515978-80fd-11e8-bc55-50daf11b720d>

In short, the future of the RAF is on display at the Farnborough Air Show. With the F-35, the RAF is part of the multi-domain airpower transformation and will work closely with Northern European allies in reshaping Northern Tier Defense.

With the Typhoon, the RAF is seeing a modernized aircraft being reworked to compliment the F-35 but with a yet undetermined relationship with its European partners.

And the A330MRTT and A400M aircraft as well as its MBDA missiles part of a broader Brexit resolution context.

It is challenging enough to deal with the Russian moves in Europe; but many of the most significant changes are coming within Europe and between Europe and the US.

The recent visit of President Trump shows the US President highlighting challenges without actually contributing to their resolution.

But the British and the Europeans clearly need to resolve some core challenges in moving ahead with their aerospace industry.

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## **Europe's Combat Aircraft Conundrum: Will UK Partner With France, Germany?**

07/16/2018

By Douglas Barrie

Barring the collapse of the British government, London plans to unveil its Combat Air Strategy during the Farnborough Air Show. Unlike its Brexit strategy to leave the European Union, there is general consensus here around the broad thrust of the document: position the UK to remain a key player in the design, development and manufacture of a future multi-role fighter.

Like Brexit, however, London has a problem with Europe, and Europe – or more accurately France and perhaps Germany – has a problem with London. Berlin and Paris have already teamed on the initial phase of a next-generation combat aircraft development (Future Combat Air System, or FCAS), and for this stage no additional partners will be added. Germany also held discussions with Spain and Sweden in early 2017, with the latter more recently also in exploratory talks with the UK.

The crux of Europe's problem is that at some point in the 2020s all three of the present generation of multi-role fighters – the Swedish Gripen, the French Rafale and the four-nation (Germany, Italy, Spain and the U.K.) Typhoon — will end production.

Without a successor project the European defense-aerospace industrial base will suffer arguably near irreparable damage. Sovereign capability, sometimes referred to within Europe as the vaguely defined 'strategic autonomy', will erode.

Europe has been lax about considering what was needed beyond the fighter aircraft then in development or production since the end of the Cold War. Since the Gripen, Rafale and Typhoon will

remain in service beyond 2040, the apparent lack of a state-threat after 1989 meant there was a reduced urgency to address future needs. Increasing interest in Unmanned Combat Air Vehicles (UCAV) also took the focus away from a direct successor multi-role combat aircraft.

France, at least, maintained some long-term interest in a future crewed air platform largely because an air-launched cruise missile would remain as the second element of its deterrent force. That meant a delivery platform beyond the Rafale would at some point be required.

In the U.K. the 2005 Defense Industrial Strategy suggested London had no plans for the development of a crewed combat aircraft beyond the Typhoon and F-35, although there was interest in a possible UCAV program.

UCAVs became a focus of technology cooperation under the auspices of the 2010 Franco-British Defense Cooperation Treaty. Initial interest in parallel Intelligence, Surveillance and Reconnaissance (ISR) or combat drone projects was paired back to the latter to address funding constraints.

The demonstrator phase of the UCAV, under the Future Combat Air System banner, was due to begin in 2017, and would have built on the £120 million investment in the initial phase of the project made in 2014. The second phase, however, required a far larger investment –some £1.5 billion — and the erstwhile partners commitment wavered.

Requirements were diverging and the UK was in the process of re-examining assumptions as to whether a crewed platform to succeed initially the Typhoon would be needed from around 2040.

While UCAVs will be part of the inventory of both France and the U.K., there is increased interest in such platforms operating in concert with crewed combat aircraft, rather than independently. Lower cost UCAVs, affordable in greater numbers, and therefore able to absorb greater attrition rates, are finding favor over exquisite high-cost systems that could only be bought in relatively small numbers.

In seeking a successor to the Typhoon, the air-to-air role, rather than the air-to-surface role will be the primary driver. This is generally held to be the most challenging role for a UCAV to fulfil. Concerns over the level of technological maturity, and wider societal issues of the acceptance of at the least a highly automated UCAV – if not fully autonomous – being used for air-to-air engagements may also be influencing UK thinking.

The UK's Combat Air Strategy is unlikely to be particularly prescriptive in terms of identifying exactly how to meet future RAF needs, either in terms of technology or partners. What would appear highly unlikely, however, would be the emergence of a fully-funded national-only program to develop a combat air system.

UK defense spending is already under pressure with the present equipment plan under-funded. Efforts by Secretary of State for Defense Gavin Williamson to gain additional funding from the British government's finance department, known as The Treasury, have not met with success. Instead, given this government's increasing interest in arms exports, it is likely that the Combat Air Strategy will at the very least give a considerable nod to potential exportability as a factor to also be considered.

Some of the countries that have previously been export customers for combat aircraft in which the UK has been involved could be considered as development partners, either at the platform level or for key

subsystems. Countries that have in the past been satisfied with off-the-shelf acquisition are now looking to develop their own defense industrial capacities.

Technology demonstrators are one area that may be supported by the Combat Air Strategy. These would build on some of the classified work that has previously been undertaken within industry, and help to sustain the skills base required to design, develop and manufacture advanced combat air systems.

The UK strategy, for good reason, is unlikely to shut any doors on possible collaboration, irrespective of the near-term difficulties with European Union that are resulting from Brexit. The UK and Germany have worked together on Europe's last two combat aircraft developments, the 1970s Panavia Tornado and the 1980s Eurofighter Typhoon. France and Germany cooperated on the 1970s Alpha Jet. While Paris was originally one of the five nations looking to collaborate on a European Fighter (along with the then West Germany, Italy, Spain and the U.K.) it withdrew from the project in 1985 to pursue a national program, the Rafale.

German industrialists have already suggested they would continue to view the U.K. as a potential future partner in a wider European combat aircraft program.

It remains to become clear whether such a view will be embraced by their French partners. Of course, all this may change in light of Britain's future relationship with the European Union, let alone the survival of Theresa May's Conservative government.

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## **The Challenge of Building an Indigenous European Fifth Generation Fighter**

07/17/2018

By Giulia Tilenni

*European produced fighters (Rafale, Gripen and Typhoon) belong to the so-called 4<sup>th</sup> generation.*

*However, countries such as France and Germany have recently reaffirmed their interest in producing a next generation fighter by 2040.*

*What challenges do they face to be successful, both in industrial and operational terms?*

During the Franco-German ministerial council on defense held in July 2017, France and Germany agreed on the need to boosting their industrial partnership in the defense domain.

In particular, the two countries expressed their willingness to strengthen political-military cooperation within the EU and to develop bilateral capability-driven programs.



These would include, among others, a new main battle tank, a new maritime patrol aircraft and the next generation fighter jet.

The decision to push forward the fighter program has been formally taken during the ILA Berlin air show (April 2018).

On April 25, the two companies in charge of developing the program, Dassault Aviation and Airbus, signed the industrial agreement on the Future Combat Air System (FCAS). The acronym indicates the comprehensive program encompassing the next generation joint fighter.

Dassault Aviation has been assigned the lead of the FCAS program, while Airbus will lead the MALE RPAS program (with the latter carried out in cooperation with Italy and Spain).

On April 26, the French Defence Minister Parly and her German counterpart Van der Leyen signed the cooperation agreement that officially kicked-off the development of the ambitious FCAS program.

On the same day, the French Air Force's Chief of Staff, General Lanata, and the German Air Force's Director-General for Planning, General Bühler, signed the High Level Common Requirement Document (HLCORD), thus drafting the operational requirements the new joint fighter would respond to.

Should the agreed schedule be respected, first prototypes/demonstrators of the next generation joint fighter would start trials in 2025, with first deliveries of series aircraft expected between 2035 and 2040.

As declared in official statements, the joint fighter is intended to “complement and eventually replace current generation of Eurofighter and Rafale fighter aircraft by 2035-2040.”

However, this possibility should not be taken for granted, as well as the real accomplishment of the objectives established in the HLCORD.

According to the document, the next generation fighter will be tailored on future operational challenges.

It will likely be multi role (like the Rafale) and flexible, thus being able to respond to the whole spectrum of air-to-air and air-to-surface missions.

Key capacities for future high-intensity battlefields, such as survivability and deployability in contested airspaces, will be ensured by novel technical features, including a certain degree of stealth or low observable characteristics.

The next fighter will have to be deployable alone or in collaboration with allied systems (interoperability) and the other FCAS systems (in fact, would take the form of a system of systems).

Thus, the fighter will likely have real-time data merging capabilities, and high connectivity features.

The French might have expressly asked for a navalized version of the fighter, probably to minimize duplications during the program development, as is the case for F-35A (CTOL), B (STOVL), and C (CATOBAR).

Conversely, the HLCORD does not mention any nuclear capability.

Previously mounted exclusively on Dassault Mirage 2000N, the ASMP-A nuclear cruise missile (a component of the French nuclear deterrent) has been integrated on Rafale F3.

Should the next joint fighter not include any nuclear weapon capability, it is unclear which aerial asset would be in charge of the French airborne nuclear deterrent after Rafale will complete the phase-out (expected in the 2040 timeframe).

## The F-35 Benchmark

The joint Franco-German fighter-to-be is conceived as a 5<sup>th</sup> generation one, and presents several points of comparison with Lockheed Martin F-35, the state-of-the-art among fighters.

However, France and Germany (at least for the time being) do not have any operational experience in flying the US-produced aircraft and, consequently, they are not used to its philosophy – which, to some extent, is as significant as the technical features themselves.

The Lockheed Martin F-35 is an advanced multi-role fighter that features a number of remarkable technical capabilities – namely stealthiness or low observability and agility, avionics, and fully-fused sensor information.

It is a multi-domain aircraft rather than being a multi-role fighter.

Sensor fusion and management of information for the pilot are the true revolution this fighter brings to its pilots, and to the battlefield in general.

In fact, the pilot can focus on a number of limited, yet essential tasks (for example, deciding which kind of offensive or defensive action to take) rather than being in charge for the whole intelligence cycle.

Thanks to sensor fusion, F-35 pilots get a comprehensive situational awareness in a short amount of time, with a positive impact on efficiency.

The F-35 sensor package provides pilots with a 360-degree access to real time information, allowing them to receive comprehensive intelligence from the battlefield, rather than “gross” information to be aggregated and analysed individually by pilots. This global situational awareness is enhanced thanks to Northrop Grumman AN/APG-81 AESA (Active Electronically Scanned Array) radar and AN/AAQ-37 Distributed Aperture System (DAS), BAE Systems AN/ASQ-239 electronic warfare/countermeasure system, and Rockwell Collins Helmet Mounted Display.

Additionally, the F-35 avionics provide an outstanding support to the pilot not only in terms of input (information gathering and intelligence cycle), but also in terms of output (once a task is selected, the fighter systems’ work together to accomplish it autonomously).

For example, the Electro-Optical Targeting Systems suggests priority targets and engagement solutions.

Once the pilot has made its decision and selected the operation to be executed, the fighter puts in place all the actions needed to accomplish the task and reach the desired result.

Furthermore, the F-35 has a revolutionary approach to interoperability. The Multifunction Advanced Data Link (MADL) allows for sharing the data gathered by each platform with the others involved in the same missions – for example, modern and legacy strike aircrafts, as well as other aerial or ground-based platforms.

This information sharing allows for reaching an unmatched degree of situational awareness.

And the communicators system known as the CNI or Communications, Navigation and Identification system provides capability to connect with aircraft on various channels, including Link 116.

The 5<sup>th</sup> generation fighter reshuffles the chain of command as well. F-35 technical capabilities are a game changer for pilots’, who finally become responsible for taking decisions.

So far, pilots have been encompassed in a top-down pyramidal decision-making command chain, with them being at the base.

Since the 5<sup>th</sup> generation fighter provides comprehensive threats’ identification and suggests potential actions to take for its neutralisation, pilots become small decision-makers in charge for choosing the best solution among the available ones.

The more pilots are able to take autonomous decisions, the more the Air force is enabled to fully exploit F-35 features.

Therefore, taking decision is less pyramidal, and it is distributed among a larger number of small decision makers, thus speeding up the whole decision-making process as well as increasing the resilience of the whole task force – which is difficult to decapitate.

Put in simple terms, the F-35 is about reshaping air combat operations, not simply building a new combat platform.

## The Challenge for European Development

As European Air forces gain experience in flying the F-35 system, notably the former F-16 fighter forces — Italy, the Netherlands, the Norwegians and the Danes — as well as the UK RAF and Royal Navy, the challenge will be to draw upon this experience and to leverage it for a new European fighter.

If this is not done, then the Franco-German project will be an iteration of their already flying 4th generation aircraft.

Yet the advanced tankers and A400Ms will be interacting with the F-35 as well as Rafale and Eurofighter as well.

How will this experience be shaped and leverage.

Otherwise, European requirements about the next generation fighter could prove short-sighted.

The requirements France and Germany have expressed for their future fighter, expected to be operational in about 15-20 years, mirror 5<sup>th</sup> generation aircraft' technical features.

Nevertheless, the U.S. and its F-35 partners will build out from an operational fifth generation aircraft, and will evolve combat fighter capabilities over time, notably as the F-35 is a software upgradeable aircraft and will evolve over time.

This means that, as happened with other European joint programs, the Franco-German fighter could end up not be a state-of-the-art technology – or, worse still, it could be somehow obsolete – when it would enter into service.

And should the program schedule not be respected, the French and German air forces will face the challenge of expensive upgrades to their fourth generation aircraft.

The phase out is expected in the 2040 time frame for Rafale. Germany is struggling to replace its Panavia Tornado's fleet (90 aircraft), which will reach the end of their operational life in 2025-2030.

It is likely that Berlin will expand its Eurofighter fleet (currently 130 aircraft) to compensate for Tornados' phase out.

German Eurofighters could be operational until 2060s, but only if Airbus maintained the production line open until 2030s.

On the one hand, this seems the most logical choice, as it allows for economy of scale and savings in terms of delivery time and operational costs.

On the other hand, despite the Eurofighter's development has been based on 1980's operational requirements.

To build up an efficient Eurofighter fleet and to maintain the same capabilities expressed by Tornados, the fighter will need further upgrades – for example for what concerns radar.

However, as the German Eurofighter fleet showed a low efficiency ratio due to budget constraints, it is unclear how the country could fund Eurofighter's upgrades and the development of the new generation fighter.

Indeed, the RAF has funded upgrades and shaped proprietary technology to do so.

And sorting through the Brexit challenge to UK industry working with the French and Germans will affect any Eurofighter modernization strategy.

## A New European Fighter: Impact on Bilateral Relations

As recalled by both French and German defence ministers, developing a joint fighter could be an outstanding opportunity to gain in strategic independence from foreign countries – namely the U.S. for what concerns the 5<sup>th</sup> generation fighter.

The issue of enhancing European strategic independence from foreign products is one of the key drivers for current EU efforts towards stronger defence cooperation.

French and German stakeholders have repeatedly recalled that the concept of strategic autonomy will be at the core of the whole set of programs the two countries are willing to jointly develop – the next generation fighter jet and FCAS, the MALE RPAS, and the future maritime patrol aircraft.

Yet France and Germany do not share the same idea of what strategic autonomy means.

Paris considers strategic autonomy as the ability to launch and maintain autonomous military missions to protect French interests. Developing stronger and effective bilateral (Germany) and multilateral (European) military capabilities is deemed as an important step to reach this level of autonomy – as recalled in the French Strategic Revue released in 2017.

Thus, the French approach to the use of the military instrument is a pragmatic one, and effective military capabilities are considered indispensable to reaffirm and maintain the country's credibility on the international stage.

In contrast, Berlin praises a stronger EU strategic autonomy, but without providing any definition or indication about what this should mean – in fact, official documents do not refer to this topic – and what missions is expected to take on.

This is part of a cautious German approach to defense, which should be used mainly in multilateral frameworks (e.g. United Nations) and preferably under the form of peacekeeping missions.

The result of these competing visions is that numerous Franco-German joint programs promoted in the latest years rely on industrial or military considerations only, rather than responding to a common strategic approach.

Looking at the next generation fighter, strategic differences between Paris and Berlin could have a twofold negative impact.

First, they could negatively affect operational requirements – for instance, the inability to define a shared potential operational scenario could originate discrepancies on fighter's expected capabilities.

Second, they will likely have an impact on export.

If on the one hand this will be crucial for the program's sustainability, on the other the two countries do not share the same view when it comes to selecting export partners.

## A New European Fighter: Impact on Defense Industry

Programs such as the joint fighter have a significant potential for relaunching the European aerospace industry, and thus maintaining its *savoir-faire* and competitiveness.

Both Dassault Aviation and Airbus have declared they deem their respective expertise sufficiently developed for the ambitious aeronautic projects that France and Germany are willing to advance together.

In fact, Dassault is the only European company able of autonomously delivering on a fighter program, from the design phase to series production. The Rafale program has provided evidence on this sense, and has been feeding the ambition of keeping up such capacity.

Working on a new fighter, a next generation one, would allow Dassault to exploit its know how while generating a new wealth of innovation.

For Dassault, the new fighter brings the company and the whole French aerospace industry a step closer to the state-of-the-art – or at least to the benchmark represented by U.S. 5<sup>th</sup> generation fighters.

The German wing of Airbus represents the core of German aerospace industry.

The sector will likely experience a capacity shortfall at the end of the Eurofighter program(which is one of the reasons why production will be prolonged with new orders, to replace the Tornado fleet).

Without a new program that – likewise for Dassault – allows for retaining key expertise while developing new ones, the German military aviation complex would experience a loss of competitiveness that Berlin is unlikely to accept (aerospace industry is a cornerstone of German economy).

In principle, should these program be successful, Dassault and Airbus will likely have acquired enough know how to relaunch their competitiveness in the top tier segment of the international fighter marketplace.

To some extent, the new fighter is the key program for establishing a kind of European champion in the fighter domain.

However, developing a 5<sup>th</sup> generation fighter requires significant cross-domain defense industrial efforts, especially in R&D.

The more the fighter will be technologically advanced, the (relatively) cheaper the MRO cycle will be.

In other words, today's programs usually need high initial investment, while maintenance of delivered aircraft is cheaper than legacy aircraft throughout the product's service life.

As comprehensive projects such as the next fighter heavily rely on public funds, the political impact is significant.

The current economic situation (France) and the fact that public opinion and some political parties are not always in favor of defense initiatives (Germany) make difficult to sell well the idea of spending plenty of funds to pledge to the next generation fighter instead of building schools, giving pensions, or raising wages.

Put bluntly, can France and Germany launch a significant and sustained financial investment in a fifth generation fighter?

## A New European Fighter: Impact on Technological Development

The 5<sup>th</sup> generation fighter should not be intended as a technical accomplishment, rather as a new philosophical approach to contemporary warfare.

The 5<sup>th</sup> generation fighters do not ameliorate 4<sup>th</sup> generation fighters' capabilities linearly. Looking back at fighters' history, it is possible to observe that 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> generation fighters were, respectively, an evolution of the preceding generation.

The idea was to improve technology in order to make them able to fly higher, further, and faster.

Instead, the 5<sup>th</sup> generation brings a revolution in the way of thinking to military aviation.

This process involves outstanding technical features, but also important military and industrial developments that would maximize 5<sup>th</sup> generation fighters' operational impact.

The F-35 is at the core of this revolution, and it will have to be the point of reference in shaping up the Franco-German next generation fighter for at least two reasons.

First, the F-35 is the state-of-the-art, and is expected to remain a cutting-edge technology (and philosophy) for the next decades as well.

Second, should the Franco-German fighter be deployed within coalitions, it will operate along the F-35.

American fighter pilots recognize that F-35 is easy to fly, but that carrying missions requires some form of adaptation due to the new role the pilot is given.

Sensor-fusion, 360-degrees situational awareness and information sharing with the other platforms participating in the same mission are among the most disruptive features F-35 brings.

However, the full exploitation of F-35 network centric capabilities will likely be limited in European countries that have procured the fighter (Great Britain, Italy, Denmark, the Netherlands, and Norway).

In fact, at least for the time being, air forces seem more inclined to use the F-35 as a legacy aircraft, rather than reshaping their doctrine of employment (and especially their chain of command) to exploit the F-35 potential.

In theory, the FCAS would mirror (at least in an embryonic form) the 5<sup>th</sup> generation network centric philosophy.

According to the limited information available about the program, the FCAS would be smart, modular, and interconnected.

The multi-mission fighter with C2 capabilities on unmanned effectors is expected to increase platforms' smartness, and allow for interconnection with the other assets participating in the mission.

In addition, interconnection would enhance multi-domain capabilities, thus providing the possibility to carry missions involving air and space, electronic warfare and cyber.

The FCAS will likely have an open networked architecture in order to perform ISR, data fusion and distribution thanks to upgrades.

However, France and Germany could suffer of the same weaknesses of their neighbours if they do not adapt the whole spectrum of military assets to the 5<sup>th</sup> generation fighter's doctrine.

This process should involve the chain of command (which means limiting the number of pyramidal decisions in favor of disseminating part of the decision-making process, thus providing pilots with more autonomy in taking decisions) as well as network centric capabilities (F-35 capabilities can be exploited only if the other assets can handle the same volume of information, with the same coding).

It is not simply about the network; it is about distributed decision-making and multi-domain warfare.

It is a warfare driven revolution, not simply about a low observable platform.

This is the challenge which F-35s operating in Europe will provide for non-F-35 air forces.

And this is a challenge which the European Air Group is already working.

## Conclusions

Dassault CEO Trappier provided his perspective on the prospective new program earlier this year before the French parliament.

*Eric Trappier, CEO of Dassault Aviation, answered the questions of the French Parliament on February, 28, 2018.*

*When asked about the hypothetical Franco-German fighter plane project, he appeared open but with a few conditions.*

*According to Trappier, the new project has to be made on long-term arrangements.*

*Trappier also questioned concrete and long-term advantages of several past cooperation projects such as the Lancaster House agreement signed by France and the United Kingdom, which led to the Future Offensive Air System (FOAS), a conjoint Franco-British stealth drone based on the Dassault nEUROn and BAE Systems Tanaris. The prototype should currently be under construction.*

*Trappier also mentioned former dissensions between European countries at the time of the Eurofighter Typhoon development that led to France building its own plane – the Rafale.*

*The needs of each European country were poorly defined: while other partners were aiming for a basic NATO plane, France was in need of a fighter that could equip both its Marine and Air Force, and that could also act as a nuclear platform.*

*According to Trappier, undefined objectives or difference in expectations could become a problem with the new project as well.*

*There is a legitimate need for a new fighter plane in Europe, Trappier believes: “We don’t have a Cold war anymore, but we certainly have a Hot peace”.*

*On an hypothetical Franco-German collaboration, Trappier agrees to the idea but with a few conditions: “Collaboration cannot be made on a 50-50 basis [...] It would be like putting two steering wheels in the same car. It requires leadership,” adds the CEO of Dassault Aviation.*

*And for him, that leadership should be assumed by France: “It is not because the Germans can put more money into it that they have more skills in fighter planes.”*

*He regrets the choice of other European countries such as Netherlands and the United Kingdom to have preferred the F-35 to the Rafale, and urges the European politicians to push for more independence vis-à-vis the United States when it comes to defense industry and policies.*

*“If European collaboration is needed to counter the American wave (in European defense acquisition), it is in our interest to do so.”*

Despite Dassault and Airbus experiences’ with Rafale and Eurofighter, respectively, the two firms might not be able to close the technology gap with the U.S. – where public and private investments on military R&D have been kept up even in times of economic constraints.

The next generation fighter will unlikely be equivalent to the F-35, thus limiting the extent of the gain in terms of strategic independence.

The Franco-German next generation fighter might not put in place the “doctrinal revolution” that 5<sup>th</sup> generation aircraft brought to the battlefield.

For example, should the new joint fighter not reach the same sensor-fusion and 360-degree access to information, France and Germany would still rely on the U.S. for what concerns information gathering.

If Europe wants greater strategic independence from the U.S., at least in the fighter sector, only consistent, extraordinary-sized pledges of funds would have some chance to succeed.

But the lack of political-military cohesion among European stakeholders and the unpopularity of defense politics play make such an option an uphill battle.

The author is an Italian defense analyst based in France.

# The Iron Dome, the ADIR and the Israelis Work a 21st Century Combat Web

07/17/2018

By Ed Timperlake

As Herman Kahn once noted: “Anything that reduces war-related destruction should not be considered altogether immoral.”

There is now the demonstrated promise of advanced weapons systems integrated together in an offensive and defensive enterprise to actually save the lives of innocents on both sides of combat action.

The Israeli Defense Force is pioneering such lifesaving con-ops of reducing the term “collateral damage.”

Collateral damage is a euphuism that can capture two parts of the loss of life.

Often in so called “friendly fire” incidents, which is actually not “friendly,” one’s own forces come under attack by their own forces.

The second, and most widely used expression for collateral damage, is hitting non-combatants with munitions.

Tragically in global war, at times, “collateral damage” really isn’t a mistake in ordinance delivery but rather a deliberate direct targeting of a civilian population to achieve a strategic outcome.

The Cold war debates about how to fight and win a nuclear war had two building blocks of strategic thinking that defined a generation of intellectual turmoil and weapons development.

The two words on how to target ones opponent was “counter-force” (CF) and “counter-value. (CV).

At times many vicious debates were engaged in by very smart people on the issue of CF or CV targeting and Herman Kahn tried to always bring enlightened thinking to that intellectual debate.

Fortunately those very public strategic debates had a desired effect of actually freezing the use of nuclear weapons by the USA and of our nuclear armed allies against the USSR and to a lesser extent the PRC.

Inside that construct President Reagan and his defense and foreign policy team prevailed and the Wall came down.

Sadly the proliferation of nuclear weapons to places like North Korea and Pakistan, and the growth of PLA arsenal now complicates deterrence thinking and in not a good way.

The rumored removal of devices from South Africa, the actual removal from Ukraine and the IDF’s strategic ambiguity is often seen as positive steps but in different ways.

Hopefully the process of dealing with North Korea will led to de-nuclearization, and Iran can be dealt with effectively to abort completely its quest for a workable weapon system a warhead married to a delivery vehicle, aircraft or missile.

Inside the issue of debating nuclear deterrence, since 1945, conventional wars and flash point combat engagements have clearly continued.

Tactical wars with strategic implications flourished from the dawn of the nuclear age to this day.



Combat engagements, including terrorism in the name of religious ideology sadly have followed the lyrics of a song “and the beat goes on,” from the 20<sup>th</sup> Century into this one.

But unlike the counter-force and counter-value debates at a strategic nuclear level there has been so far an unspoken, for the most part, merging of 21<sup>st</sup> Century offensive and defensive conventional tactical weapon systems that have allowed for reduced collateral damage with the context of defending key interests against adversaries.

And this approach saves lives.

Conceptually, this can be understood in terms of changing how to execute the payload-utility function of warfare. A distributed kill web can deliver a combat effect with reduced collateral damage and has the tremendous promise in saving the lives of innocents in a limited conflict.

Employing OODA loop thinking can capture the two elements of fleet wide payload utility (Pu) and it is very simple to explain and difficult to execute:

Observe/Orient (OO) is essentially target acquisition, and Decide/Act (DA) is target engagement.

Thus there is a very simple formula, better and better TA and TE = more effective employment of all payloads available to the battle commander.

The Israeli Defense Forces are on the cutting edge of understanding, developing and employing advanced payload utility kill web capabilities.

The new capabilities begin with their Iron Dome.

*The Iron Dome missile defense system, designed and developed by Israel and jointly funded through the United States, is a response to the threats Israel faces from short and medium-range rockets and mortar shells fired by Palestinian terrorists in Gaza.*

*The system has the capability to identify and destroy such projectiles before they land in Israeli territory and is considered one of the most effective anti-missile systems in the world.*

*Iron Dome is comprised of three key components:*

- (1) the design and tracking radar, built by the Elta defense company;*
- (2) the battle management and weapon control system, designed by the mPrest Systems software company; and,*
- (3) the missile firing unit, manufactured by Rafael Advanced Defense Systems Ltd.*

*One of the most advanced features of Iron Dome is its capability to determine where an incoming rocket will land and to only intercept such projectiles that pose meaningful threats to populated civilian areas.*

Note the emphasis on directly focusing on threat to populated civilian areas.

A few years ago I was given the opportunity to be part of a press call by a senior supporter of the IDF/Iron Dome and he made a brilliant point. Because their Iron Dome resulted in fewer deaths of innocent Israel citizens, included targeted schools, the IAF could more accurately target their counter strikes to the identified point of origin.

The counter force strike had the potential for collateral damage because their very nasty opponents often launched from high value civilian areas where it was almost guaranteed innocents would die.

But with the introduction of the most accurate bombing aircraft to ever fly, the F-35, a new chapter in fighting in civilian – military conventional hybrid-wars is opening.

The Iron Dome not only saved Israeli lives but gave the IDF much more accurate aim points in their appropriate retaliation.

Enter the F-35 or as the IDF calls it the Adir or “Strong One”

Israel has struck targets in the Middle East with the F-35 Adir jet twice, making the Jewish state the first country to use the stealth fighter in a combat role in the region, Israel Air Force Commander Maj.-Gen. Amikam Norkin announced on Tuesday.

“We are flying the F-35 all over the Middle East. It has become part of our operational capabilities.

“We are the first to attack using the F-35 in the Middle East and have already attacked twice on different fronts,” he said during the IAF Senior Air Force Conference in Herzliya.

<https://www.jpost.com/Israel-News/IAF-commander-Israel-first-to-use-F-35-jet-in-combat-558030>

For the first time in history, individual IAF F-35 pilots will have the best database of real time knowledge in the history of combat aviation.

And all of this is internal to their cockpit and enabled by advances in computer processing and sensor information fusing.

Each F-35 pilot combined with human sensing (seeing visual cues outside the cockpit) will be enabled by machine driven sensor fusion to allow combat “situational awareness” (SA) better than any other opponent.

Concurrent with their ability to look-see, which is limited by physical realities, the F-35 pilot will be able to “see” using cockpit electronic displays and signals to their helmet allowing them not to just fight with their individual aircraft but be able to network and direct engagements at significant range in 360 Degrees of 3 dimensional space out to all connected platforms.

A fleet of F-35s has the inherent capability **to share** their fused information displayed at the speed of light to other aircraft and other platforms, such as ships, subs, satellites, and land based forces, including UAVs and eventually robots.

Marrying the Adir with Iron Dome is the dawn of this next chapter of 21<sup>st</sup> Century Kill Web integrated war fighting that will actually save lives on innocents on both sides.

Today over the skies of the Middle East a “tactical” aircraft is evolving into a key technology for strategic operations and impacts.

**The Payload-Utility dynamic executed within a distributed kill web is leaving the legacy kill chain in the rear view mirror**

Payload utility as practiced by IDF/IAF can be a driver for understanding the future development of combat systems.

It is the process of understanding the huge complexities in such a simple Payload/Utility formula that is the challenge.

Understanding the technology and human dynamic through an analytic filter of a Payload Utility function consisting of weapons (kinetic and TRON) and the dual components of Target Acquisition (TA) and Target Effectiveness (TE) effectiveness in a fighting fleet engaged in high or low intensity combat in the unforgiving cauldron of battle and mitigation of unfortunate collateral damage maybe a war winner.

Either in one platform, or melded into a unified fighting force to bring all different types of appropriate “weapons on” for the kill shot is a powerful concept.

America must always appreciate that no platform should fight alone if the Wynne Doctrine, named for 21<sup>st</sup> Century Secretary of Air Force, is employed: “If it is a fair fight someone failed in planning.”

A very simple filter to look at platform and weapons development within the integration of current weapon systems and platforms is asking the largest questions possible and pursuing force design and operational answers to these questions:

What does weapon or system add to fleet Payload/Utility?

How does this system help in TA?

How does this system help in TE?

What is the best weapon for the highest Pk against the target?

Is the TA, TE and Weapons (kinetic and Tron) carried together F-35 or separate?

So far every nation flying in the F-35 global enterprise can learn from the IDF combat leaders merging the Iron Dome and F-35 into a demonstrated and formidable building block in Kill Web con-ops, while saving lives or otherwise known by the military acronym, “collateral damage.”

# Project Centurion and the TyTan Sustainment Contract

07/16/2018

By Robbin Laird

In past visits to the UK and to Spain, I have spent time with Eurofighter squadrons and have focused on the upgrade path for the aircraft.

I have talked with various fighting forces about Typhoon operating in various allied operations as well to get a sense of the evolution of the air system and its contribution to allied operations as well.

I summarized my findings with regard to Eurofighter and its modernization approach in a report published in 2015.

For the UK, Project Centurion is the core modernization effort with regard to Typhoon, the main focus of which is upon transferring some of the weapons carried by the Tornado, soon to be retired, onto the Typhoon, to enable that aircraft to take over some of Tornado’s capabilities.

Project Centurion is the part of Typhoon modernization, which can be visibly seen as weapons are integrated onto the aircraft.

But less visible is the progress the RAF has made with regard to aircraft availability for Typhoon as the UK government and industry has worked with the RAF to shape new approaches to provide for enhanced fleet performance.

The latest iteration of Typhoon support is the TyTan contract which was launched in 2016.

According to a BAE Systems press release on July 12, 2016, the new support contract was described as follows:

*Working in partnership with the Royal Air Force (RAF) and Leonardo-Finmeccanica, the arrangement will introduce new ways of working to further reduce the costs of operating the fleet at RAF Coningsby and RAF Lossiemouth by more than a third. The deal could see more than £500m of savings reinvested to develop new capabilities for the aircraft.*

*For the first time in the support of the UK Typhoon fleet, the formal Typhoon Total Availability eNterprise (TyTAN) agreement, which is expected to be signed shortly, will combine contracts with suppliers from across Europe into a single programme.*

*It will include a joint avionics solution with Leonardo-Finmeccanica.*

*This builds on the former Typhoon Availability Support contract that we delivered to the RAF over the last seven years.*

*Minister for Defence Procurement, Philip Dunne MP, said: “This will be an exciting, innovative support arrangement for our Typhoon aircraft, and will help ensure Typhoon continues to meet the RAF’s future operational requirements, including replacing our Tornado jets from 2019.*

*“It represents a substantial change in the way support is provided, optimising and driving efficiency through improved ways of working.”*

*Chris Boardman, Managing Director of Military Air & Information, said: “Combining support arrangements into one programme will help to increase reliability and availability of the fleet, whilst making it cheaper to support.*

*The efficiency savings generated will enable new capabilities to be developed for the RAF Typhoon aircraft.*

*“We’ve worked with partners across our supply chain to drive improvements ensuring that we deliver the lowest possible costs to the MOD. We are extremely pleased that the agreement will extend our close working relationship with the MOD and will enable us to continue to support the Typhoon fleet until 2026 as it continues to perform its vital role in safeguarding our nation at home and overseas.”*

The contract is the product of the evolution over more than a decade of working on support arrangements associated with various modalities of performance-based logistics to a fleet availability approach.

The effort is grounded on the experience gained with the Tornado ATTAC contract and the initial support contracts with Typhoon. The Typhoon has been in service for more than a decade but is still in the process of evolution.

It was designed initially as an air defense aircraft, which was spearheaded in many ways by the requirements of the Central Front and the role of Germany and with the post-Cold era, a migration was started to make it a more flexible aircraft. Project Centurion is part of that migration.

And as the Typhoon fleet was stood up and operational experience accumulated with various deployments by the RAF, the opportunity to shape a new sustainment approach, one, which would embrace the Typhoon as a fleet, was possible.

*Obviously, the impact of Project Centurion on the fleet is to diversify the fleet at the outset and to require any sustainment strategy to work around and to support modernization of the aircraft.*

Another challenge associated with diversified modernization is to manage the different variants of Typhoon.

During a visit to RAF Lossiemouth, a senior RAF officer provided his sense of the nature of this challenge.

*As Wing Commander Peters put it in an interview conducted in his office at RAF Lossiemouth in 2016:*

*Question: What is the big fleet management challenge for you?*

*“We have fleets within fleets.*

*“We have Typhoons with different Tranches, and different software configurations or PSCs (Production Software Configurations).*

*“A different PSC can do different things.*

*“It has a different level of capability.*

*“We need to deliver a SHADER standard Typhoon to the Middle East operation and that drives a lot of intra-fleet movement.*

*“It is things like moving Laser Designator pods around within the fleet, to make sure that we have the right configuration at the right place at the right time.*

*“The key disconnect which we have to manage is between the need to deliver the SHADER standard aircraft, and the presence of variable configuration Typhoons in the overall fleet.*

*“A lot of our support challenges are driven by not having enough aircraft at the same standard.*

*“If all of our fleet was to the same standard, the challenge would be much easier.*

*“There is steady progress towards increasing numbers of key variants (specifically the PIE aircraft and standards beyond) but this takes time.*

*“Of course, this is somewhat of a historic challenge that has always affected armed forces across the world, which have strived to deliver the best military capability within the resource available.”*

**The challenge which Wing Commander Peters highlighted is clearly a key focus of the TyTan approach.**

During my visit to the UK in May 2018, I had a chance to visit RAF Coningsby once again, and during my visit was able to talk with senior BAE Systems managers involved in dealing with Typhoon sustainment over the years and the coming into reality of the new sustainment approach.

The day before I met with the senior manager for the ATTAC contract at RAF Marham and learned from her the evolution and focus of that contract which was clearly a foundation stone for working the approach to Typhoon.

The point is really a simple one:

**The TyTan contract is one which leverages two decades of sustainment experience and working an enterprise approach with the MoD and the RAF and shaping new working relationships to achieve the core goal: to provide the right number and types of aircraft at the right time and at the right place.**

I met with Steve Worsnip, Vice President F-35 Sustainment, BAE Systems, with more than 20 years of experience in the sustainment business and a key player in shaping the Typhoon approach; Richard Hamilton, UK Typhoon Support (TyTAN) Delivery Director, BAE Systems, and Gary Williams, Head of Joint Change Programmes.

The TyTAN contract is focused on availability of aircraft for the Typhoon fleet taken as a whole.

It is clearly a challenge to position oneself to be able to get a bird’s eye objective with regard to an entire fleet and the effort is a work in progress.

**But clearly such an approach would not be possible unless an enterprise approach had been created within which MoD, the RAF, and industry are partners in shaping a joint fleet support approach.**

As Richard Hamilton put it: “The key is to have a jointly owned fleet plan.

“This is a plan to which the RAF, MoD and industry are all committed to and work together and do so on a daily basis but with a longer term perspective informing the regular work process.”

What is at stake is being able to take a longer view with regard to the year ahead of the state of the fleet and the projected availability demands and to make daily decisions informed by the strategic direction of fleet use.

And given the mix of Typhoons, it is also about understanding what kinds of sorties are demanded within the framework of the joint fleet plan, and to work the broader approach in terms of being able to provide the right aircraft, to the right place at the right time.

To get to the TyTAN opportunity, the UK MoD, RAF and industry have worked together for a number of years on performance based contracts.

The evolution of those contracts started with managing elements of the supply system to provide for parts and to provide technical query management.

But as Steve Worsnip put's it: “We soon realized that if we take an engineering approach to sustainment, we could get much better results.”

The reason for that is straightforward: industry would take a longer view to the cause of performance and failure and take a systems approach to enhancing performance.

In many ways, that was the initial Typhoon support contract.

But it became clear in working that contract, that for a leap forward in sustainment, namely to get the point where joint fleet management was possible would require more than a PBL approach.

It was beyond the kin of industry alone to find ways to better support the RAF.

What was required was nothing less than a fundamental change in the regulations, laws and practices that governed how industry and the government could work together.

And by changing the context, an enterprise approach could be empowered. What happened was nothing less than revolutionary.

The rules were changed so that savings generated by sustainment efforts could be recycled back into the increasing the capability of the aircraft.

According to Steve Worsnip this meant that “industry was not being paid to replace things or benefitting from the need to repair, alternatively we had buy-in from the RAF, MoD and industry to enhance performance, generate costs savings and to provide for new monies for modernization of the aircraft.”

**In other words, the TyTan approach is incentivizing support for fleet enhancement, rather than simply sustaining aircraft.**

It means as well that savings can be provided to support the Centurion Program and other modernization efforts for Typhoon.

This is especially important as I believe the other partners of Eurofighter have not been exactly pushing the envelope on aircraft modernization which has increased the burden for modernization on the RAF.

What all three of senior managers emphasized was that the culture change which has preceded TyTAN was crucial to enable the possibility of TyTAN to emerge at all.

It is not simply about PBLs, and parts support. It is about setting in motion a process whereby MoD, the RAF, and industry can work together to shape a collaborative outcome, and with that cultural shift comes organizational change.

But organizational change is not an end state; it is an ongoing process which means that as the approach is implemented and evolves new plateaus will be reached and it is hoped that the enterprise rules can then be modified to enable whatever the next phase might be.

As Richard Hamilton noted: “It is a journey not simply a contract.”

I was able to tour some of the sustainment facilities with my three interlocutors. And they provided a great opportunity to see the state of play with regard to the ongoing effort to work fleet management.

Data flows into the fleet management decision center, where various displays work tabs on the state of the fleet, worldwide at that moment. The data is then organized in ways to facilitate decision making on implementing or modifying the fleet management plan.

This flows down into how maintenance is done as well.

Another facility, which was in the process of being reworked, physically organized parts by a red, amber, or green characterization. The various suppliers had been organized into support cells rather than being located into isolated industry cells; and the support cells were directed towards prioritization on repairs.

Red being the priority parts needed right now by the fleet; amber within a few days; and green as not urgent.

Part of the fleet management approach is focused on prioritization of support to choke point parts.

As Steve Worsnip put it: “There are thousands of parts, but only a few drive costs, significant delays and maintenance burden.

“The key is to be able to focus on those parts and to provide support for the fleet to ensure that disruptions due to problems with key parts get solved as a priority.”

In short, the TyTAN approach is a key effort in support of the RAF as they move forward with Typhoon deployments.

And as these deployments change in the post counter-insurgency phase, new demands will be placed on the fleet, and the enterprise will adjust to try to provide optimal fleet support.

## The ATTAC Contract and Its Legacy for RAF Sustainment

07/16/2018

By Robbin Laird

The UK MoD, the RAF and its industrial partners have been at the cutting edge in finding a path to enhanced combat aircraft availability through the evolution of its approach to performance based logistics.

It has been and is a journey, one which started with parts support, to systems support to where they are working now with the new Typhoon support contract, TyTAN.

The new approach now embraces a fleet support approach in terms of combat air availability, and given the key role, which the Brits are playing in F-35, their work in this field can certainly inform a way ahead for the global support approach for the F-35 as well.

But the harbinger of the new approach was born with the Tornado support contract.

When I discussed this approach with now Air Vice Marshall Harvey Smyth when he was the Lightning Force Commander, he underscored how important the Tornado support approach was to him as the Tornado force commander and how he clearly wanted lessons learned in that program applied to Typhoon and F-35 as well.

*Air Commodore Smyth spoke at some length and passion about his experience as the Tornado Force Commander, where a 40+-year-old aircraft was able to be maintained throughout the very high tempo ops facing an aging force.*

*He argued that simply put: “We could not have had the operational performance of the aircraft without our exceptional contractual and joined-up working relationships with BAE Systems and Rolls Royce.”*

*The contracts deliver a product – an aircraft able to go to combat, and he would like to see the focus shift from payments to industry based on simple aircraft availability, to ones based on dispatch rate and mission achievement for combat aircraft.*

*Air Commodore Smyth also discussed the ROCET contract with Rolls Royce as an example of how to do sustainment leveraging using the right kind of industrial-service partnership.*

*“In the ROCET contract, a few years ago we contracted Rolls Royce to do our FOD management for us.*

*We were probably trashing upwards of 2 or 3 engines a year through a FOD.*

*We were doing everything we could from an air force point of view to be good managers of foreign object damage.*

*We incentivized Rolls Royce to take that on, and as the subject matter experts, they were, and are, fantastic at it.*

*In fact last year, we had zero engines rejected due to FOD, and that’s down to them applying proper analysis and procedures and recommendations with regards to how to drive down a FOD-engine repair rate.*

*All of a sudden it’s a win-win for everybody.*

*As a Force Commander, I get better operational capability out of my airplanes.*

*I also have engineers that aren’t changing engines, and are able to concentrate on other work.*

*Rolls Royce makes more money due to the contract incentivization, and I get much better operational performance.*

*Why wouldn’t this be a good thing?*

*More importantly, we do this effort together, as a Whole Force, so regardless of being Industry or Serviceman, we are all pulling together to deliver operational excellence.”*

*He clearly wishes to see the F-35 program build on this historical experience and not follow the USAF historic approach to sustainment with their F-15s at Lakenheath.*

During my most recent trip to the United Kingdom in May 2018, I had a chance to visit RAF Marham and Coningsby and to discuss the Tornado support approach at Marham and the Typhoon approach at Coningsby.

[maxgallery id=”86805”]

At RAF Marham, I was able to sit down and talk with Sam Myatt, Head of Fleet Operations and General Manager from BAE Systems at RAF Marham.



She is the General Manager for BAE Systems in charge of the ATTAC contract, or the Availability Transformation Tornado Aircraft Contract.

BAE Systems describes the contract as follows:

*The contract, known as ATTAC (Availability Transformation: Tornado Aircraft Contract), includes on-aircraft maintenance of the GR4 fleet, spares support, technical support and training.*

*The approach builds on availability improvements and cost reductions achieved through earlier pilot programmes.*

She has many years of experience – including 18 in the RAF — working on a variety of combat aircraft, including Tornado. She worked on the inception of the ATTAC contract from the RAF side then later joined BAE Systems to join the other side of the partnership.

During our time together, she provided a wide-ranging look at the evolution of the support approach for this aircraft, which has been in operation since 1979-1980.

She explained that the contract has been executed as a partnership among the RAF, BAE Systems, and MoD's Defence Equipment and Support (DE & S) organization.

At the outset, a key challenge was to find a mechanism where the RAF could be clear about their expectations and DE&S and BAE Systems roles became clear.

It was especially important from the industry side to have metrics of performance against they would be held accountable and for which they would be paid as well.

The mechanism, which emerged, was the CASP or the Command Acquisition Support Plan.

According to Myatt: "Through this plan the RAF would project their anticipated requirements for the coming years in terms of how many aircraft the RAF thought they would need and how many flying hours they required to be available. "

"Prior to this, the RAF would do traditional maintenance planning.

"They would move from aircraft to aircraft until their maintenance hours were wrung out of them.

"It was a sequential maintenance process; not a fleet approach.

"It was single airframe driven."

"With the contract, the RAF could step back and look at the mix of aircraft, reconnaissance or strike, they projected they would need in a 12-18 month time frame.

"And then could focus on ways to ensure availability of the right mix of aircraft for operations."

"This also allowed DE&S to have a commitment from Air Command with regard to their anticipated needs.

"They then could contract with us in terms of how many aircraft were needed to fly a projected set of flying hours in a 12-month period."

"So instead of having to burn through money to support operations, the team was able to focus on aircraft availability for the RAF to do what the UK government wanted it do.

"And we could collectively focus on the having the right capability of available aircraft."

“It was a challenge to put such a planning process in place, rather than having money flow to the problem without regard, to thinking overall about how best to make aircraft available.”

**Question: But how has the relationship between RAF maintainers and BAE maintainers worked out in practice?**

**Who does what and how does this make the RAF more effective?**

She explained that the focus was upon working the system for maintenance at the home bases in the UK and the system for supporting expeditionary operations.

With the contract, the RAF could focus on support to the edge of the spear, namely supporting expeditionary operations.

BAE systems could focus the majority of its effort at maintenance at the home bases, but with a mix of RAF maintainers so that their skill levels for deep depot maintenance was at a good level as well.

“Because of the way the contract worked, if there was a deeper level engineering problem with a deployed aircraft, it could be sent back and we would swap that out with one we had ready back at the home base.”

“That meant that the engineers at forward only had the number of aircraft they required.

“There is no point in having a squadron with 15 aircraft if they only have manpower to engineer 10.”

“In the contract, we would be able to provide a replacement aircraft within 72 hours for any that had a deeper level of fault investigation or repair required for both UK based and deployed aircraft.”

“We would take that aircraft out of the forward fleet, bring it back to the maintenance hangar to get the repair done, and give the RAF another aircraft, so they could maintain the level of availability they required.”

“The goal has been to ensure that the RAF had the right aircraft at the right time and in the right place.”

**Question: With industry building a significant reliability data base, the BAE engineers and maintainers can provide some significant learning baselines as well, one would assume.**

**Is that correct?**

Myatt: It is and let me give you an example.

“There are many control panels in the cockpit.

“The RAF technician will do what he thinks is the right thing to do but perhaps the same problem comes up a couple of flights later.

“The technician will repair it the same way.

“But our engineers may well have identified an alternative procedure to fix the problem at the forward or deployed base or even something we need to fix when we do deep maintenance.”

“And the reachback function into our industry is a key to availability from deployments to our home bases.”

“With targeted engineering information, we can increase the serviceability of a very old aircraft, and one that is mechanical, not digital, as the newer ones are.”

Because it is a mechanical aircraft, data needs to be put into the computer systems manually.

And they generate learning tools from that data to enhance the serviceability of the aircraft.

“We have developed with the RAF a system capture tool, whereby when the pilot returns to base and they have an issue, they will identify the conditions they noted at the time they had the problem.

“And we can use that data to analyze the problem.”

“Based on what we learn, we can then develop procedures for dealing with that problem when it happens in the future.

“But again, we are working on the issue of whether regular problems can be better solved by deeper level maintenance approaches to solve the problem.”

**Question: Are you surprised at how successful the effort has been to generate significant availability rates for an older aircraft?**

Myatt: Not really.

“The key was that from the beginning there was a real commitment from the MoD and the RAF to find a way to get enhanced availability for lower cost.

“It did not take too long for people to actually understand the benefits. ATTAC has been a hugely successful contract for us, BAE Systems and for the MoD.”

**Question: The core shift is to find ways to do fleet management and obviously the ATTAC contract has been a key stage in the process.**

**How important is getting to a fleet management approach?**

Myatt: Fleet management has taken time over the past 15 years to come to the fore.

“If you do it aircraft by aircraft with no sharing of information among partners as well, you will not have a fleet approach.

“For instance, air-forces around the world have flown Tornados in very different conditions to what we typically find in the UK.

“But by not having data shared across the global fleet, we end up with little to no engineering information generated through other user experiences.

“If there was data being shared across the global fleet, we could do a better job in reducing the number of engineering issues that might occur with UK Tornados meeting these different weather conditions.”

“If you’re flying the same aircraft you’re going to get the same issues.

“If you’ve got the same components in the aircraft, then you’re going to get the same faults such as sand ingress, and how that affects the air systems.

“If that data was there from day one, who knows how much money the UK could have saved on parts and engineering hours.”

“That will clearly be the case for F-35.

“There is an opportunity with a global support system, to do this from day one, and could improve performance and save money at the same time.”

**Note: The RAF provided the following overview on the Tornado GR4 on the RAF website.**

*The Panavia Tornado GR.Mk 4 is the UK's primary ground attack platform and also fulfils an important reconnaissance role. The aircraft conducts attack missions against planned targets, armed reconnaissance against targets of opportunity and close air support (CAS) for ground forces, typically under the control of a Joint Terminal Attack Controller (JTAC).*

*For attacks against pre-planned targets the Tornado GR4 usually employs GPS/laser-guided bombs from the Paveway family, or the Storm Shadow cruise missile, the latter fired from considerable stand-off ranges. In the armed reconnaissance and CAS roles, Tornado normally carries a mix of Paveway IV and Dual-Mode Seeker Brimstone, combined with a Litening III targeting pod, and in addition to the internal 27mm gun. This gives the crew an unparalleled array of options to engage targets with the most appropriate weapon, achieving the desired result with minimum, if any, collateral damage.*

#### **CAPABILITY**

*With its mix of weapons, the Tornado GR4 is capable of engaging all targets on the modern battlefield. Paveway III and Storm Shadow afford the ability to strike bunkers and other hardened facilities, while Brimstone is effective against armoured vehicles, both static and on the move. Dual-Mode Seeker Brimstone enables precision strike against targets with collateral-damage challenges; these can be moving at high speed and still successfully engaged.*

*Paveway IV offers huge tactical flexibility, with cockpit-programmable impact angle, impact direction and fuse delay offering precisely tailored strike on planned and unplanned targets. The 27mm gun offers the ability to strike targets including light vehicles and personnel; it proved invaluable in Afghanistan for halting insurgent ambushes when crews strafed into tree lines.*

*During Operation Ellamy in 2011, Tornados flew from the UK to strike targets in Libya using Storm Shadow missiles, a round trip of more than 3,000nm, accomplished with essential support from Vickers VC10 and Lockheed TriStar tankers. Some missions saw the Tornados launch their missiles and then turn for Gioia de Colle, Italy, where they joined other Tornados, and Typhoons, in a sustained campaign against Libyan government forces.*

*Through its unique weapons effects and the RAF's air-to-air refuelling capability, Tornado provides the UK Government with a rapid and flexible crisis response tool.*

#### **TYPE HISTORY**

*Britain's relationship with variable geometry (VG) wing design dates back to the 1950s when Sir Barnes Wallis, better known for developing the Upkeep 'bouncing bomb' used by 617 Sqn 'The Dambusters' in 1943, worked through several VG concepts. Barnes and others recognised that with a VG aircraft's wings swept forwards, or spread, it could use shorter runways and display greater manoeuvrability, before sweeping them back for maximum high-speed performance.*

*From the 1940s into the early 1970s, VG wings were an excellent solution to difficult aerodynamic and operational challenges, although at a penalty of additional airframe weight compared to fixed wings. The advent of more advanced aerodynamics, and especially of powerful, lightweight computing systems, enabled designers to extract similar performance without the weight and complications of VG.*

*Although no aircraft were built as a result of Wallis's work, it inspired the British Aircraft Corporation (BAC) P.45 VG fighter-bomber study and subsequent Anglo-French Variable Geometry (AFVG) attack/interceptor concepts, from which France soon withdrew, but the UK continued as UKVG.*

*Looking for an industrial partner, BAC approached West Germany's MBB, which was on the verge of termination of the Advanced Vertical Strike (AVS) vertical take-off and landing aircraft on which it had worked with US companies. It was already also contemplating a single-seat, single-engined lightweight fighter-bomber as the Neue Kampfflugzeug (NKF). There was some commonality in intended role between UKVG and NKF, and the difficult process of international collaboration began.*

*The Luftwaffe's primary requirement for NKF was to replace its Fiat G.91 and Lockheed F-104 Starfighter fleets and since Belgium, Italy and the Netherlands had similar F-104 issues, they joined with West Germany in January 1968 to propose an NKF-informed Multi-Role Aircraft for 1975 (MRA 75). The UKVG had, meanwhile, been replaced by two concepts, one for a light combat aircraft and the other for a heavier, twin-engined design.*

*In concept the latter was close to MRA 75 and on July 25, 1968, Belgium, Canada, Italy, the Netherlands, West Germany and the UK launched feasibility studies around the requirement. Belgium and Canada soon fell by the wayside since they were primarily looking for an interceptor, but in December, BAC, Italy's Fiat and MBB formed a joint industrial company to formally develop a new aircraft.*

*BAC and MBB had quite different VG designs in progress, the former focussing on a twin-engined aircraft powered by two new technology RB.199 turbofans, while the MBB concept relied on a single General Electric TF30 engine. Compromise was eventually agreed and the layout for a new Multi-Role Combat Aircraft (MRCA) described in a March 14, 1969 meeting. The joint industrial company formed the previous December became Panavia on March 26 and BAC, MBB, Fiat and VFW-Fokker in the Netherlands began work.*

*Although a degree of compromise had been reached, Panavia was established to produce a single-seat Panavia 100, primarily for interception duties, and a two-seat Panavia 200, which satisfied the UK requirement for a long-range attack aircraft. Neither specification really suited the Dutch, who needed a multi-role interceptor/attack aircraft, rather than a pure interceptor or heavy, long-range striker and the Netherlands soon withdrew from the programme. In November 1969, Fiat merged with Aerfer to form Aeritalia and it was therefore this new concern, along with BAC and MBB that continued MRCA development, the single-seat requirement fading away during 1970.*

*A new company was formed to develop the RB.199 turbofan, Fiat, MTU and Rolls-Royce creating Turbo-Union. The resulting engine was extremely compact, enabling a relatively small airframe design, and incorporated afterburning for an unprecedented thrust increase of near 50%.*

*With the Panavia 100 concept extinct, the MRCA authorised for prototyping in 1970 was a two-seat, multi-role aircraft with provision for a range of air-to-air missiles, but when the first prototype completed its maiden flight from Manching on August 14, 1974, it was optimised for air-to-ground work. Nine prototypes and six pre-production aircraft were built, the last of the latter flying almost three years after production had been authorised on March 10, 1976.*

*Back in 1971, the RAF had, ironically, laid out its plans for a stretched interceptor variant of the MRCA, although the UK's intention to pursue such a development dated back as far as 1969. By the time the first of the pre-production aircraft flew on February 5, 1977, the MRCA had become Tornado, specifically Tornado Interdiction Strike (IDS), since the RAF interceptor had become the Tornado Air Defence Variant (ADV). Featuring minor equipment variations compared to the West German and Italian IDS aircraft, the initial RAF Tornado variant was the GR.Mk 1, which first arrived with the Trinational Tornado Training Establishment (TTTE) at RAF Cottesmore on July 1, 1980.*

*The TTTE trained aircrew from all three Panavia nations, using relatively small numbers of dual-control aircraft that retained all the capability of their regular counterparts. The RAF's first frontline Tornado squadron exchanged Avro Vulcans for Tornados in 1982. Re-forming at RAF Honington on June 1, No. IX (Bomber) Squadron has remained with the aircraft ever since.*

*Meanwhile, the Tornado ADV had flown for the first time on October 27, 1979, beginning a long and somewhat troubled test programme for what had become known as the Tornado F.Mk 2. The aircraft's radar caused most concern and the F2s delivered to 229 OCU from November 1984 carried ballast rather than the detection equipment. They were never brought up to full ADV standard, represented by the Tornado F.Mk 3, which formally entered frontline service with 29 Sqn on April 1, 1987.*

*Over almost 25 years in service, the F.Mk 3 was dramatically upgraded, initially for the 1991 Gulf War, which also saw new systems and capabilities added to the GR.Mk 1. The brief conflict saw the attack Tornado employed in the low-level airfield denial role for which it had been designed, before switching to medium-altitude laser-guided bombing, for which it had not.*

*A handful of aircraft introduced the prototype Thermal Imaging Airborne Laser Designator (TIALD) pod into service before the fighting ended, marking the start of a precision attack capability that has become the Tornado's hallmark. Since 1991 there has been little relief from combat operations, with Tornado GR.Mk 1 and F.Mk 3 active in policing and combat missions over the Balkans and Iraq, then back to Iraq in force for Operation Desert Fox in 1998 and Telic, the UK contribution to Operation Iraqi Freedom, in 2003. The GR1 fought alongside the dramatically upgraded Tornado GR.Mk 4 in 2003, the latter bringing true precision capability to the jet and compatibility with the Storm Shadow cruise missile, which 617 Sqn debuted in service during the conflict.*

*As soon as the GR4 was released from combat over Iraq, it deployed for Operation Herrick, replacing the McDonnell Douglas/BaE Harrier in Afghanistan from 2009. Less than two years later, Tornado Force was simultaneously deploying jets to Kandahar and Italy, for Operation Ellamy over Libya in 2011. Employing Paveway IV and Brimstone in both operations, Tornado exercised precision, low-collateral damage weapons options that remain unique to the RAF.*

*It also employed the Reconnaissance Airborne Pod Tornado (RAPTOR) system and Litening III targeting pod on intelligence-gathering missions. The Tornado had pioneered digital imaging technologies in its GR.Mk 1A version from December 1986. The variant performed exceptional Scud-hunting work during Granby and remained an important tactical reconnaissance asset. Some GR1As were modified to GR.Mk 4A standard, but with the advent of RAPTOR, the reconnaissance capability has since been absorbed into the general Tornado GR4 fleet.*

*The Tornado also held a dedicated anti-shipping capability, embodied in the GR.Mk 1B in service with 12 (Bomber) Squadron from 1993 and 617 Sqn from 1994. The aircraft was modified to fire the Sea Eagle missile, but the capability fell into abeyance when the GR.Mk 4 programme began.*

*Since Operation Ellamy, the Tornado Force has drawn down towards the type's planned out of service date (OSD), now set for 2019. The 2010 Strategic Defence and Security Review called for a reduction in frontline GR4 squadrons to two, but the need to maintain a constant deployment for Operation Shader saw a squadron re-formed and 12(B) Sqn was thus only very briefly disbanded, returning as a third unit.*

*The GR.Mk 4 has been subject to a constant series of minor upgrades, gradually enhancing its capability so that today's Tornado is very far removed from the jet conceived to meet a multinational requirement during the 1960s.*

*With Tornado's OSD set, Project Centurion is transferring its capabilities, particularly Brimstone and Storm Shadow, to Typhoon. Two new Typhoon squadrons and the incoming Lightning will take over and build upon the tactics and effects that will have been delivered by Tornado in almost four decades of service.*

<https://www.raf.mod.uk/aircraft/tornado-gr41/>

#### PANAVIA TORNADO GR.MK 4:

- Powerplant: two Turbo-Union RB.199 Mk 103 turbofans each rated at 16,000lb st (71.50kN) with afterburning
- Length: 56ft 6¼in (17.23m)
- Height: 19ft 6¼in (5.95m)
- Wingspan, spread: 45ft 7½in (13.91m)
- Wingspan, swept: 28ft 1in (8.56m)
- Wing area: 286.33sqft (26.60m<sup>2</sup>)
- Maximum take-off weight around: 61,600lb (27,950kg)
- Maximum speed: Mach 1.3
- Armament: Paveway II, III and IV series GPS/laser-guided bombs, Brimstone air-to-ground missiles, Storm Shadow cruise missiles, ASRAAM for self defence, one internal 27mm Mauser cannon, plus 1,500-litre and/or 2,250-litre drop tanks, Litening III targeting pod, RAPTOR, Sky Shadow and BOZ countermeasures pods, up to a maximum disposable load of around 19,840lb (9,000kg)

We have published several articles on Tornado, including the following:

<https://sldinfo.com/2017/07/weapons-in-the-tornado-typhoon-transition-shaping-a-way-ahead/>

<https://sldinfo.com/2017/03/the-tornado-transition-squadron-at-raf-lossiemouth-closes-shop/>

<https://sldinfo.com/2017/03/the-last-tornado-student/>

<https://sldinfo.com/2016/11/training-the-final-tornado-weapons-instructors-shaping-a-way-ahead/>

<https://sldinfo.com/2016/11/leveraging-the-legacy-of-the-tornado-the-perspective-of-wing-commander-paul-froome/>

<https://sldinfo.com/2016/07/visiting-the-tornado-transition-squadron-at-raf-lossiemouth-leveraging-the-past-and-preparing-the-future-for-the-raf/>

<https://sldinfo.com/2016/05/visiting-raf-lossiemouth-macroberts-reply-and-tornado-thunder/>

## Visiting the 132nd Air Wing

07/16/2018

By Robbin Laird

I have had the opportunity to visit F-35 bases since the startup of the first one at Eglin Air Force base.

And this year, I have visited Williamtown, RAF Marham, Ørland, and MCAS Yuma.

In each case, changes have been made to accommodate the coming of the F-35 but also, infrastructure has been or is being changed to shape a 21<sup>st</sup> century base appropriate to the transformation of 21<sup>st</sup> century air combat operations.

With the coming of the data rich aircraft, there are new requirements, needs and opportunities to manage data. With the coming of a data generated maintenance system, new hangars are being built which can better facilitate the ability to work with data and to shape new maintenance approaches.

And security is a key requirement as well, but a work in progress.

At Williamtown and at Ørland, both the RAAF and the RNoAF are building F-35 centered airbases with legacy aircraft being moved out from the base.

At RAF Marham, the new facilities are being built as an enclave while the Tornados remain a key flying combat asset for the RAF and changes will be then be made at the base leveraging older facilities, such as hardened shelters, as the Tornados leave and the F-35s ramped up.

During my visit to Ørland, I had a chance to talk with Lt. Col. Eirik Guldvog, XO/COS 132 Airwing, at the end of April 2018, about the way ahead for the base.

The entire infrastructure for air operations in Norway is being restructured as the F-35 and the P-8 enter the force.

Ørland will be the main operating base for the F-35, with Bodø being closed and Evenes becoming the QRA base from which a squadron of F-35s could operate in a crisis as well.

The base is being built by the Armed Forces Estate Agency, and security is a key consideration. Workers have been brought from throughout Norway to work on the base.

According to Lt. Col. Eirik Guldvog: “The Armed Forces Estate Agency has built camps on the base to house workers to work on the base. Because of classifications, only Norwegian workers are being used.

When you fly into Ørland, one enters a small civilian terminal. But that is the only aspect, which is civilian; the base is military and everything is run by the military on the base.

The F-16s will leave Ørland next year, and those at Bodø will be retired in 2022.

Lt. Col. Eirik Guldvog underscored that “The main objective is by 2022, to have the F-35s replace the F-16s and to provide the base line combat capability needed by the RNoAF.

“During the next three years, when Final Operational Capability is achieved, we will be utilizing the expanded capabilities of the aircraft.”

Because the introduction of the F-35 is not just about the aircraft, but the entire air system, the build out of basing and training is a key part of the standing up of the aircraft.

And indeed, it is recognized that doing so will be a work in progress for several years as well.

Force protection is a key part of building out the base, and, indeed, the center of excellence both for ground based air defence, force protection and mobile logistic support operates currently from the base.

And these skill sets will become even more important in the years ahead as well.

The transfer from Luke to Norway began with the arrival of the first three F-35s from Luke last November.

And in April, the first maintainers started their training at Ørland. The maintainers trained at Luke form the cadre of the initial Norwegian training capability.

And the ramp up of maintainers will be correlated with the arrival of the aircraft as well.

As Lt. Col. Eirik Guldvog added: “Each six months, we will receive three new aircraft and we will have trained the requisite personnel prior to those aircraft arriving in Norway.”

And because of the concentration of fighter aircraft at the base, flight activity will be closely monitored to control for noise and other impacts on the local community.

Lt. Col. Eirik Guldvog noted that “There will be about three times the amount of total flying over current conditions once the F-35 base is fully functional. The Estate Agency is closely monitoring noise and flight patterns, to provide a base line from which future decisions can be made to deal with any challenges.”

Clearly, the standup of the F-35 is at the heart of the base modernization, but it is about shaping a 21<sup>st</sup> century combat base.

## The Next Step in the Automated Tanker Boom

07/16/2018

By Robbin Laird



The RAAF was the launch customer for the A330MRTT.

And the Aussies have been from the beginning key drivers of innovation working with Airbus Defence and Space in evolving the capabilities of the global tanker.

Part of Tanker 2.0 is providing new capabilities for the combat fleet to support operations in terms of data, connectivity and enhanced tanking capabilities.

One of those is the automated boom.

*During an interview at the Amberley Air Base in the Spring of 2017 with Air Commodore Lennon and the 86th Wing Commander, Group Captain Adam Williams, we discussed the evolution of the KC-30A into Tanker 2.0.*

*One aspect of that evolution was the coming of the robotic boom.*

*According to Air Commodore Lennon: “The best way to think about the new boom capability is that it is an automatic boom similar to how autopilot works in the cockpit. The automatic pilot simplifies the pilot load, but the pilot is still there and can override the autopilot in case of need.*

*“There will always be an operator monitoring what’s going on with the boom, deciding what the boom should do, and when it should do it, but now he can let the boom do all the work of positioning and marrying up with the receiver.”*

*The KC-30A is a refuellable aircraft so with a fatigue reducing automatic boom, the crew can stay airborne for longer to generate additional operational impact and enhanced sortie generation effects.*

*“If it can anticipate and react to movements of the receiver aircraft faster than the boom operator can, then you end up with faster contacts.*

*You also potentially end up with more consistent contacts when the turbulence level increases, in cloud or when night falls.”*

During a return visit to RAAF Amberley earlier this year, the new Air Mobility Commander, Air Commodore “K-9” Kourelakos, highlighted the coming of the new capability as follows:

*“With a robotic boom, you are increasing your combat capability through enhanced efficiency.*

*“You can also achieve a reduction in maintenance as you work through ways to efficiently operate the the boom.*

*“What we are talking about is taking force projection to a new level.*

*“If you can have our fighters on station-longer and delivering combat effects, because you can tank them more rapidly, that will be a significant gain.”*

*“We are a small Air Force.*

*“If you look at the history of small air forces, they win or lose on the first day. You want to be ready for the first day.*

And progress has been made since that interview earlier this year.

According to a recent Airbus Defence and Space media release dated July 12, 2108:

*Airbus Defence and Space has followed its earlier achievement in demonstrating Automatic Air-to-Air (A3R) refuelling of a fighter with another world-first – the same operation performed with a large receiver aircraft.*

*In a joint operation with the Royal Australian Air Force (RAAF), which is collaborating with Airbus in development of this pioneering technology, Airbus' A310 company development tanker performed seven automatic contacts with a RAAF KC-30A Multi Role Tanker Transport, also made by Airbus.*

*The system requires no additional equipment on the receiver and is intended to reduce refuelling boom operator workload, improve safety, and optimise the rate of air-to-air refuelling (AAR) in operational conditions to maximise aerial superiority. Airbus has begun work towards introducing the system on the current production A330 Multi Role Tanker Transport (A330 MRTT).*

*During initial approach of the receiver, boom control is performed by the tanker's Air Refuelling Operator (ARO) as usual. Innovative passive techniques such as image processing are then used to determine the receiver's refuelling receptacle position and when the automated system is activated, a fully automated flight control system flies and maintains the boom aligned with the receiver's receptacle. The telescopic beam inside the boom can be controlled in a range of ways including: manually by the ARO; a relative distance -keeping mode; or full auto-mode to perform the contact.*

*In the 20 June flight off the southern Spanish coast, the A310 tanker performed the scheduled seven contacts over a two-hour test period.*

*David Piatti, who again acted as Airbus Test ARO, or "boomer", on the A310, said: "It was extremely impressive to see how accurately the A3R system tracks the receiver. It can be very useful to be able to refuel another tanker or transport, for example to extend its deployment range or to avoid taking fuel back to base, but it is also a challenging operation and this system has the potential to reduce workload and the risk involved."*

*The trial was conducted in conjunction with Test Pilots and Flight Test Engineers from the RAAF's Aircraft Research and Development Unit (ARDU).*

*Squadron Leader Lawry Benier, Executive Officer for ARDU, said the RAAF were assisting Airbus Defence & Space on the development of A3R and other technologies to increase the utility of the KC-30A within a battlespace.*

*"It's very encouraging to come to Spain and see the progress that's been made with A3R, and be able to witness it firsthand refuelling our KC-30A," Squadron Leader Benier said.*

*"Refuelling large receivers is a role RAAF has conducted extensively on operations and exercises, allowing us to extend the reach and responsiveness of our air mobility fleet, as well as keep surveillance aircraft in the air for longer."*

## **The Indian Air Force Looks at Its Options: The Role Royal Air Tattoo and Farnborough**

07/24/2018

By Gulshan Luthra

New Delhi. The Medium Multi Role Combat Aircraft (MMRCA) competition for the Indian Air Force (IAF) has started afresh, this time at the Royal International Air Tattoo (RIAT) show in London where five of the six contenders in the fray will flutter their beautiful machines before the most important man of the moment, the Chief of Air Staff of the Indian Air Force (IAF) who has to pick one of them for a rather large order.

Air Chief Marshal Birender Singh Dhanoa is there July 9-15 at the invitation of the Royal Air Force (RAF) to mark its 100th Anniversary and Annual Air Power Conference, and not really to make any selection of an aircraft.

But his timely presence at the event does give an opportunity to the participants to showcase their technologies, and hope their powerful jets would catch the eyes and ears of his delegation.

With a declared requirement of 110 combat jets, India is the biggest buyer in the market now, and there is an unstated but understood requirement of another 100 to 200 aircraft once the production of the selected machine begins in India with Transfer of Technology and Manufacturing knowhow.

## IAF Selection Process

Under the IAF procedures, while the nod of the Air Chief is crucial, the parameters are laid down by the Vice Chief of Air Staff (VCAS) and the selection process is executed by the Deputy Chief of Air Staff (DCAS).

Only after due diligence and flight trials carried by younger Wing Commander, Group Captain and Air Commodore level officers, does the file move upwards for technical qualifications and approval.

And then, the financial consideration is left to the managers in the Ministry of Defence (MoD). A Tender has to be submitted in two parts, Technical and Financial.

## Royal International Air Tattoo

Held at RAF Fairford, Gloucestershire, the annual Royal International Air Tattoo (RIAT) is the biggest military aircraft show in the world. Combat jets, Transport aircraft, Helicopters, Unmanned systems are all there.

Proceeds from the show are given to the RAF Charitable Trust.

This year, the Air Tattoo is being held from July 13 to 15, while the Farnborough International Airshow (FIA) will begin a day later from July 16.

## Foreign OEMs and Collaborations

In an interview with India Strategic, Air Chief Marshal Dhanoa officially confirmed that six vendors have responded to the Request for Information (RFI) issued by IAF on April 6.

He did not specify which ones, but they are understandably the same who took part in the 2007 competition for 126 Medium Multi Role Combat Aircraft (MMRCA).

The deadline for submissions after a three-month period was July 6. IAF now has to examine what is on offer, in terms of ToT and manufacturing capability, and then send the Request for Proposals (RfP), or tenders, to all or some of them, selected on the basis of their submissions.

Fifteen percent of the aircraft, meaning 16 or 17 machines, will be bought in flyaway condition and the rest will be gradually made in India by foreign Original Equipment Manufacturers (OEM) in collaboration with Indian companies.

The F 16 and Gripen are single engine aircraft, and the remaining four, twin engine.

Significantly, IAF would place orders only with the Indian entities, which would be expected to mature into self-sufficient aircraft or aerospace manufacturing industries.

That is the most important element of the Defence Procurement Procedure (DPP) 2016 stipulating Prime Minister Narendra Modi's Make in India programme.

Four OEMs have already announced partnerships; Boeing with Mahindras and HAL, Saab with Adani, Dassault with Reliance Defence and Lockheed Martin with Tata.

## Newer Technologies

It's been 10 years since the 2007 tender was floated, and as technologies have leapfrogged, the OEMs have added some newer elements in their combat machines.

Lockheed Martin for instance says its newer F 16 Block 70 shares some Electronic Warfare (EW) capabilities with its F 35 aircraft while Boeing is presenting the F 18 Advanced Super Hornet with extended range, better EW engagement and fuel efficiency.

The same for Swedish Saab Gripen E.

Rafale, which has already made its mark, is hoping for this order as also that of the Indian Navy's for 57 shipboard fighters.

Besides these four aircraft, the others in the fray are European Consortium's Eurofighter Typhoon and Russian Mig 35, a newer variant of IAF's Mig 29.

IAF has done away with the classification 'Medium' as in the 2007 Medium Multi Role Combat Aircraft competition and its officials have stated that it is the onboard capabilities and ToT that would help determine the winner.

Another factor would be who helps in development of India's own stealth Advanced Medium Combat Aircraft (AMCA).

Notably, the 2007 tender was cancelled as Dassault, the selected manufacturer, declined to accept responsibility for the quality of production at India's state-run HAL, which was mandatory.

The Government then bought 36 Rafales, or two Squadrons of 18 each, in flyaway condition to meet IAF's urgent requirements along with infrastructure support at two airbases.

Their delivery is due to begin from September 2019.

Except for the Mig 35, all the other aircraft are taking part in the Air Tattoo.

Some of them will also fly across to the Farnborough International Air Show (FIA), opening on July 16. Both Civil and Military aircraft are showcased there.

## Sixth Generation Aircraft

Informed sources tell this writer that at both the Air Tattoo and Farnborough shows, the Talk of the Town will be the futuristic 6th generation systems.

Nobody is clear yet what this aircraft would finally look like or what its capabilities would be.

But Lockheed Martin and Boeing have already been working on them, and there are reports now of the BAE Systems joining hands with Swedish Gripen to develop it for the European requirements after 2040, a long time away.

France hasn't been behind, and its scientists are further developing on the capabilities of Dassault's unmanned aircraft Neuron. But again, who knows what will be will be!

The Conference at Air Tattoo should touch the subject, and what comes out should be interesting.

Fundamentally, the 6th gen should be less about the platform's own flight and more about the hypersonic delivery of its onboard missiles or laser weapons.

India is far away from considering acquisition of 6th generation assets. But the decision on the current requirement of 110 aircraft will have implications for IAF's 5th Generation technologies.

Lockheed Martin's F 35 has a mention in discussions with no firm commitments, while talks with Russia seem to be on and off due to Moscow's reluctance to share engine technologies.

Nonetheless, in the current 4-plus generation competition, help in developing AMCA could give a winning edge to the one selected.

This article first appeared in [India Strategic](#) and is published with their permission.

<http://www.indiastrategic.in/2018/07/11/the-combat-jet-dogfight-for-indian-skies-begins-afresh-in-london/>