

MILITARY FLIGHT TRAINING

MIDDLE EAST AND NORTH AFRICA



**IN-DEPTH ANALYSIS OF MENA'S
TRAINING AND SIMULATION NEEDS**

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The Egyptian Air Force operates a mix of German, Brazilian and Chinese trainers for a fighter fleet comprising F-16s, Mirage 2000s, Rafales, Su-35s and MiG-29s. There is unlikely to be any simulation.

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With an ongoing civil war, the once mighty Libyan Air Force is no more, and neither the LNA or GNA, which are fighting each other, has any needs for training aircraft – only offensive ones and UAVs.

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Undoubtedly the star air force of the region, the RMAF bought T-6C Texan IIs in 2012 to fulfil the bulk of its flying training needs. Integration of its combat fleet is not an issue; it has 24 Block 70 F-16C/Ds on order.

IBC Tunisia

An air force that has stagnated in recent years, its training inventory is set to be boosted by eight T-6C Texan IIs, and there is a possibility of four AT-6C Wolverines for the front line.

WELCOME

Recruiting and retaining manpower is a global challenge and at the heart of the solution is training.

The development of people whether it is to fly fast jets, to remotely pilot drones or handle engineering, refuelling and operational challenges is crucial to the safety and security of military personnel and the nations they protect.

MENA is no different.

The region has seen a remarkable change in its air defence over the past decade or so. It has seen more conflicts than that of any other part of the world.

With new sophisticated equipment and weaponry then it is perhaps no surprise that investment in training and particularly in simulation devices and technologies has grown at the same time.

In this special report, Alan Warnes takes a tour around the whole of the Middle East and North Africa (MENA) to assess the current situation and to outline the development.

At Times Aerospace, we are committing to the support of MENA's defence industry. The launch of a monthly TV programme and, of course, our award-winning Arabian Aerospace magazine as well as our daily online news headlines will continue to update the defence community with the latest developments not just in MENA but in the neighbouring regions as well.

Alan Peaford
Editor-in-chief

PICTURE: AEROCOMM



THE AUTHOR: ALAN WARNES

A purchasing binge, mainly on fighters – nearly 200 of them – broke out all over the Middle East in 2016/17.

North Africa, not feeling the threat from Iran, and, of course, not blessed with oil revenues has taken things a bit calmer.

Most of these new 4/4.5 generation fighters will start arriving next year and with this revolution will come the added necessity of ratcheting up areas of military flying training.

Many of the air forces have different needs requiring differing solutions but one thing is certain, these new jets, with their huge operational costs, should only be used in the operational role.

Saving the hours on their airframes, allowing them to remain operational longer is, of course, another necessity. In an age when most platforms have easily upgradeable architectures and systems, they will remain potent for 30 years or more.

Training whenever possible will now be done on the ground using the

latest generation synthetics and simulation. We see their use on the increase, playing a major role in training pilots and aircrews, not just to fly but in the tactical training scenario and, increasingly, mission integration.



The days of using simulators to teach aircrews the basics of flying and safety are long gone. These days you are often using the real operational flight software in the sim, so replicating the manoeuvres and tactics will be similar to the real jet.

But, as many aircrews have told me while researching this report, there is no better feeling than having the air under your backside!

We hope you enjoy our first Military Flying Training in Middle East and North Africa report. If you feel you have any information that could update this report then please e-mail Alan Warnes:
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The Kuwait Air Force has acquired the F/A-18E/FTOFT: Picture: Boeing Boeing F/A-18E/F Super Hornet: Creator: SN Kevin T. Murray | Credit: U.S. Navy ©Public Domain

Published by



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HOW TRAINING IS BREAKING NEW GROUND

Why simulation and synthetics is a game-changer.

Simulation will undoubtedly foster new ways of working.

Qatar for example, is set to receive 96 fighters over the coming years. However, with the country only being 160kms (100 miles) long, and having a constrained airspace, there will not be much of an area in which to train.

Relations with Saudi Arabia have, until recently, been strained, so straying into its neighbour's territory might not be an option. To the north and east is the Gulf, where airlines regularly route. Bahrain to the north-west is even smaller, occupying just 780sqkm of air space, so much of its flying takes place over the sea in the Straits of Hormuz.

Training over Saudi Arabia is an option for Bahrain, but it needs to gain permission prior to accessing the air space.



So, live flying is going to be difficult and, whenever possible, training will take place on the ground.

Saudi Arabia, has plenty of space and a mature relationship with the likes of BAE Systems, so its training set-up might not need the same shake-up as others.

Military pilots have many hurdles to overcome before they become fully operational.

They start off with screening, then basic training, when newly winged aviators are usually streamed according to their skill-sets or the air force's needs. Helicopters, multi-engine aircraft, or fighters, are the usual categories, but unmanned aerial vehicles has become increasingly common in recent years.

The would-be fighter pilots will then head to an advanced flying training course and, if all goes well, on to a lead-in fighter training (LIFT) course. After completing this successfully, the fighter pilot should know how to use his or her platform as a weapon.

In the UK, it takes around 120 hours

of flying a BAE Hawk T2 during the LIFT course, alongside around 60 hours of simulation work.

There are some that might say the simulation work could be higher and the live flying lower, and, of course, it varies according to the course's needs and objectives. Weighing up the most cost-effective platform in tandem with synthetics is now a top priority.

Many LIFT syllabuses are now taking on more of the expensive fast-jet training, too, from the operational conversion units, where pilots learn to master the tactical and flying needs of increasingly complex fighters.

Flying a Eurofighter or F-35 Lightning can cost an eye-watering \$80,000 to \$100,000 per hour, so you can understand why many air forces would like to keep things as cost-effective as possible.

Some companies, like Canada's CAE, can offer capabilities spanning much of the spectrum, from 'cradle to grave' you might say.

Giant aerospace companies Boeing, Lockheed Martin, and BAE Systems, which produce combat aircraft, also offer simulation solutions for their jets.



It's the same story with many other training aircraft original equipment manufacturers (OEMs) – the likes of Aero Vodochody, Embraer, Grob, Korean Aerospace Industries, Pilatus, and Turkish Aerospace – although their levels might not match the sophistication of the bigger international businesses. The days of training just in the air, are long gone.

The screening, basic flying, advanced flying, and LIFT training used to mean flying different platforms. Today, some like the Aero L-39NG, Grob G120TP, Leonardo M-345 and Pilatus PC-21, can span at least two of these tasks, all coupled with a comprehensive learning



Cockpit procedure trainers provide an opportunity to train without leaving the ground. Here a senior Egyptian Air Force pilot checks out his flying qualities.

PICTURE: ALAN WARNES.

management system, also known as ground-based training (GBT).

Computer-based training (CBT) is now common, with interactivity the key teaching tool. Programmes and models are often 3D, including cockpit and flight manuals on the aircraft the student is set to fly.

Then come the tools to evaluate the students' skills; first the desktop trainer (DTT), then the cockpit procedure trainer (CPT); and finally the full mission simulator (FMS). A sophisticated tactics simulation system is also an option.

The simplest simulator is the desktop trainer. This is often a very simple PC with screens where you can do the basics – similar to a game.

This can then progress to the more sophisticated CPT, with touch-screen and controls. It has switches and multifunction displays (MFDs) in what looks like a real cockpit. You can do a lot – fly, train on the ground, and also indulge in some very simple tactical training.

Ultimately, the ground-based flying



solution is the FMS, often referred to as a dome. This is the daddy of simulators, and can be designed with 180° or 300° display coverage.

It's a lot more sophisticated and is essentially a real cockpit with push buttons, switches, hands on throttle and stick (HOTAS) controls, and even a copy of a real ejection seat. It looks simple, but is quite a complex device and is a classic way of teaching tactics.

You won't be surprised to learn the FMS can cost the same as a real aircraft.

There is also the option to integrate the aircraft's weapons management system into the FMS, as well as the tactical simulator, allowing aircrew to learn the operational capabilities of missiles and weapons.

Obviously, when you want to train with a number of aircraft in the air, or on complex missions, a simulator is the best bet to drive down costs. Basically, you train for missions you don't want to train for in the aircraft.

In the commercial world, the FMS or



The Hawk T2 dome, or full mission simulator, at RAF Valley was built by CAE, and allows budding fighter pilots to carry out much of their flying training on the ground. It was delivered in 2010.

PICTURE: CAE.

full-flight simulator (FFS) is known as the moving dome; or a flight training device (FTD) level 2, where tactical and advanced sorties can be carried out to simulate a real mission.

The FMS can also include live virtual control (LVC), which most companies are now integrating into their aircraft and simulators. Students sitting in the FMS can effectively fly with aircraft that really are flying.

Most air forces are now linking the FMS so they can 'fly' from the ground in formations of mixed live aircraft, often with foreign air forces. They won't just include combat aircraft either, but airborne early warning and control (AEW&C) and other intelligence surveillance and reconnaissance (ISR) platforms, which provide the fighter pilots with much of their situational awareness.

It's great learning and a far cry from simulation of 25-30 years ago, when air jeopardy or flight safety was its prime goal. ■



Primary and basic trainer manufacturers are now offering simulation solutions alongside their platforms

GROB CATCHES THE HIGH-SPEED TRAIN

There are many types of training aircraft used for different requirements.

The Pakistan Aeronautical Complex MFI-17 Super Mushshak, or Grob 120TP, are among today's most popular screening aircraft solutions and vary in sophistication.

The flying instructor will judge whether a student is proficient enough to fly.

There are those, like the Pakistan Air Force (PAF), who say the MFI-17 Super Mushshak is so cheap and easy to operate that you don't really need anything other than the aircraft to check-out budding aviators. Even so, the PAF has an MFI-17 simulator used by students for basic training at its Asghar Khan Academy.



Several Middle East countries have sent cadets to Pakistan to train and others – Oman (8), Qatar (8) and Saudi Arabia (20) – have all acquired the small two-seater 260hp piston engine platform for screening and some basic training.

Grob has been a little more advanced with its Grob 120TP solution, used for the screening and basic flying training. In a bid to reduce the time and cost of training military pilots, the company has developed a revolutionary system around the G120TP platform. Its pilot selection and evaluation system (PSES) will radically cut the assessment time, according to Tom Reinert, Grob test pilot and head of sales.

"We have developed the PSES, in cooperation with a renowned aviation psychologist who previously worked with the Luftwaffe," he explained. "With the computer-based training system and simulator, we had no control or standardisation of the selection. We are planning to change that."

The fully computerised tool utilises a combination of methods to test candidates on basic pilot skills, operational competencies, and psychological factors. Designed as a complete package, the PSES eliminates the need for traditional pen and paper aptitude tests by converting these into practical tasks, as well as integrating the use of simulation functions. It allows for no bias, which could occur in traditional screening methods.

Reinert, a former Luftwaffe Tornado pilot, said: "Our domed system, coupled with a PSES instructor station, took H3 Grob Aircraft two years to develop and build. It will see student pilots go through around eight hours of testing, on a variety of skills such as concentration, decision-making and adaptability. It's a new method of assessment, helping to reduce the attrition rate and save time and money."

An embedded simulator in the dome system will advise the student of an intended plot and will analyse the reaction and mark them accordingly. Reinert said: "A complete assessment that currently takes a year in Germany will now take two-and-a-half days!"

The first PSES system was sold to an African nation in early 2020.

In 2018, Grob even trained two Mexican Air Force students who had never flown before. The only stipulation was they could speak some English and had the appropriate medical examinations. After just 15 simulation hours and five flight hours on the Grob 120TP they were able to go solo.



According to Grob chief operating officer, Karl 'Charlie' Furrrohr: "It proved the high value of flight training devices/simulators. We can take them all the way to the LIFT if required. We mix it with simulation hours and drastically decrease the flying hours – even for take-off and landings."

Furrrohr, a F-4F and MiG-29 pilot continued: "On computer-based training, the student uses a tablet computer and everything goes through the digital world. They spend all day playing with their phones and tablets anyway, so now they can learn to fly on them!"

It means the Mexican Air Force does not have to use the Cessna 182 Skylanes any more.

In the ten years the Grob 120TP has been certified, the 'pocket-rocket' turboprop 456hp trainer has been phenomenally successful. Argentina (which acquired 10) and Indonesia (30) were the first customers, with the aircraft fitted with analogue Garmin GTN 750 – a fully

"A complete assessment that currently takes a year in Germany will now take two-and-a-half days!"

The Grob 120TP is a new-generation turboprop trainer that can fulfil the primary, basic, and some advanced flying training needs. There is also a ground-based training package available.

PICTURE: ALAN WARNES.



integrated GPS/NAV/COM/MFD system.

Since then, the company has sold fresh production aircraft with the Genesys IDU-680 glass cockpit, to (in delivery order): Myanmar (20), Mexico (25), Jordan (16), US Army Aviation/CAE (6), Affinity/UK Military Flying Training System (23), QinetiQ, UK (2), Ethiopia (12), Ecuador (8 – three delivered to date).

The Royal Jordanian Air Force (RJAF) originally ordered 12 in April 2017, and then added another two, before the German Government donated an additional pair in January 2018. The latter was part of an agreement to allow the German Air Force to operate out of Al Azraq Airbase during Operation Inherent Resolve. The RJAF purchase also included an embedded simulator.

The aircraft are all based at the King Hussein Air College (KHAC), at Mafraq, and are flown by No 4 Squadron to screen and train student-pilots in basic flying.

The RJAF also acquired 12 higher-spec and more capable Pilatus PC-21s between August 2017 and April 2019, to fulfil the advanced and lead-in fighter trainer role. With them came a CBT system and a Frasca FTD simulator.

In recent years, the Korean KT-1 Woongbi has been a popular basic trainer. It is not only serving the domestic market in relatively big numbers, but has scored relatively well in the export market, with Turkey (40), Indonesia (17 plus three attrition replacements) and Peru (20 including 10 KA-1s) all customers.

Powered by a 950hp Pratt & Whitney

PT-6 engine, it made its first flight in November 1991, continuing its test programme until 1998. A year later, the Republic of Korea Air Force (ROKAF) ordered 85 KT-1s, leading to deliveries in 2000. Today, they serve with the ROKAF's 3rd Flying Training Wing at Sacheon Airbase.

The Indonesian Air Force purchased its aircraft between 2003 and 2012, with the last five assembled in Bandung by PT Dirgantara Indonesia (PTDI) – unofficially known as Indonesian Aerospace.

They are all flown by the Flying Training Wing at the Adisutjipto Airbase in Yogyakarta, which also accommodates four KT-1B cockpit procedure trainers (CPTs) alongside a flight-training monitoring system, and a Mode S ES-based flight situation display.

Four have been lost to date, two in a mid-air collision during a practice display at the Langkawi International Maritime and Aerospace (LIMA) show in March 2015. The most recent was in early December 2020, when one crashed with engine failure. The front-seat student ejected safely at 600ft, while the instructor in the back

remained with the aircraft to the ground and survived with just minor cuts.

A contract for three attrition replacements was signed in November 2018, with deliveries expected in 2021.

The Turkish Air Force was the second export customer, ordering 40 in August 2007. Options for a further 15 have lapsed.

An initial four were built by KAI in Korea; the remainder were assembled at the Turkish Aerospace facility at Akinci in Ankara. All were delivered between early 2011 and March 2013 to the 122 Filo at Izmir-Cigli, the home of the air force's new Multinational Military Flight Crew Training Center (MMFCT-C).



An initial 17 KT-1s were purchased for the Indonesian Air Force, along with four cockpit procedure trainers. They replaced the German-manufactured AS 202 Bravo.

PICTURE: ALAN WARNES.

The third export customer, with an initial order of 20 KT-1P Woong Bees, was the Peruvian Air Force. Four were delivered direct from the KAI facility, and the remaining 16 assembled by the Peruvian Air Force SEMAN maintenance facility in Lima. They were delivered between April 2015 and December 2016. Ten of them are the armed KA-1 version.

All 20 KT-1s are based at Pisco-San Andres, the KT-1Ps serving Escuadrón Aéreo 512 and the 10 (although one has been involved in an accident) KA-1s are with EA 513.

The Senegal Air Force is the most recent customer, after signing a contract on July 15, 2016, to acquire four KT-1s. A 2019 KAI marketing document showed the aircraft are designated as the attack KA-1S version. ■



LIFT ELEVATES PC-21 TO HAWK'S REGIONAL RIVAL

The arguments for and against flying turboprops in the Lead In Fighter (LIFT) role.

Pilatus has been very successful with the PC-21 in the Middle East, with the air forces of Qatar (24), Saudi Arabia (55) and UAE (25) all operating the turboprop trainer alongside a suite of ground-based training systems.

The aircraft has removed the BAE Hawk as the Middle East's preferred lead-in fighter trainer.

The Hawk has built a healthy reputation as an advanced and lead-in fighter trainer in the region, with nearly 200 serving the GCC air forces for the last four decades.

Bahrain (6); Kuwait (12, now withdrawn from use); Oman (25); Qatar (nine on order); Saudi Arabia (72 plus 22 on order); and the UAE (61, now being phased out) have all operated the successful jet trainers over the past 30 years.

Renowned as expensive to operate, the Hawk's halcyon days of the 80s/90s/00s are gone for BAE Systems, with the emphasis being put on ground-based training systems.

CAE provided simulators for the RSAF Hawk Mk127s in August 2013.

Some of the earlier Hawk versions have been retired. Oman, for example, replaced some of its Mk103/103A/203s with new-generation Mk166 versions, while the UAE has disposed of its Mk 63s and abandoned the jet in favour of the Pilatus PC-21.



BAE does, however, see the Hawk continuing to play a major role in the region for a few more years yet, preparing pilots for life in the cockpit of frontline combat jets.

A BAE Systems spokesman told me in early 2020: "Countries that have, or are soon to refresh their frontline aircraft, are at the main focus of our current [marketing] activities." The Hawk's technology enables it to closely emulate all of the most popular frontline aircraft in current or future service in the region, including Eurofighter Typhoon, F-16, and F/A-18 Hornet and Super Hornet.

"We are also seeing a real desire in the region to embrace interoperability," said the



The Hawk has been a popular LIFT choice amongst Middle East air forces, with the Royal Bahraini Air Force flying six Mk129s.

PICTURE: ALAN WARNES.

spokesman. "Air forces utilising the same aircraft and similar training programmes and pipelines as each other in the Gulf will extract even more benefits from collaboration and efficiencies than they would working alone. We hope air forces currently operating previous models of Hawk would look to the new generation of the aircraft as part of the natural development of their training programmes.

"Keeping costs down is another area in which we wish to support our customers. We are also leading the way, in partnership with the UK RAF, in introducing more simulation to the fast-jet training programmes. This allows customers to save money by conducting more training in realistic simulated environments, and less time flying in aircraft."

While the Pilatus PC-21 is a popular choice, not everyone sees the turboprop trainer as an ideal solution for the high-end flying training. One fighter pilot and an instructor recently told me: "I don't agree with turboprops being used in the LIFT role. How can proper lead-in fighter training be done on an aircraft that flies a maximum of 360 knots, when these people need to fly a super-cruise-capable jet. Psychology plays a big part when a new pilot steps into a big faster aircraft and going from PC-21 to Rafale [as in France and Qatar] is a huge step."

He added: "Simulating a sensor is great but if you don't explore performances as well, you miss something. The PC-21 also struggles

in the hot desert weather conditions and you need a jet to sustain those high temperatures."

That could be one reason why the Qatar Emiri Air Force (QEAF) is set to take delivery of nine Hawk Mk167s in 2021/22 and is also considering the option of joining Leonardo's International Flight Training School.

Responding to the criticism, André Zimmermann, VP general aviation at Pilatus said. "The PC-21 was designed from the outset to satisfy the requirements for basic and advanced military pilot training and to cover the LIFT phase. The class-leading 1,600shp powerplant and five-blade graphite propeller push the speed and climb rate of the PC-21 into an area that was, until a couple of years ago, exclusively jet territory.



"In 2019, the Swiss Air Force demonstrated the 'proof-of-concept' when the PC-21 fitted perfectly into the advanced and lead-in fighter training. The first class of student pilots successfully transitioned from the PC-21 directly to the F/A-18C/D Hornet fighter and, during the last 11 years, all students coming from the PC-21 trainer stream successfully completed their F/A-18 operational conversion unit (OCU) training."

Zimmermann explained that students normally enter into the LIFT phase after around 140-170 flying hours, when their flying experience is

"The PC-21 was designed to satisfy the requirements for basic and advanced military pilot training and to cover the LIFT phase."

The Pilatus PC-21 is a popular LIFT trainer all over the world. In the Middle East it serves the air forces of Qatar, Saudi Arabia and the UAE.

PICTURE: PILATUS.

RIGHT:
In the PC-21 full-mission simulator.

PICTURE: PILATUS.



still very limited. In the LIFT phase, it will be the first time where the pilot will practice a combination of basic flying skills, tactical communication and manoeuvring, weapons employment in combination with physiological stress (G-loads). This combination of individual skills is very challenging, even for an above-average student at this point.

On the simulation of sensors, Zimmerman said: "Yes, we do simulate sensors; one example being the air-to-air radar. We can assure you that the simulated radar is so realistic that most pilots will forget, after about 20 minutes of flying, that it is only a virtual radar. From a training point of view, there is absolutely no benefit having the real sensor and you get the same quality of training."

□□□□□

As for speed, Pilatus says it is obvious the PC-21 cannot reach fighter speeds (typically 400-500 knots) and is limited to around 250-300. However, this has very little effect on the training outcome, since it is more important that the cadence of events (how quickly the student has to perform his tasks and react to the evolving situation) is comparable.

Pilatus offers a fully integrated training system working alongside the PC-21. This includes a comprehensive ground-based training system with state-of-the-art simulators, cockpit procedure trainers, part-task trainers, computer-based training, mission planning and debriefing systems etc.

On the cost, Zimmerman said: "The operating costs per flying hour for high-end jet trainers (like Leonardo M-346, Lockheed Martin/KAI T-50, BAE Hawk T2) will be in the region of 10 times more than the PC-21. A typical fourth-generation fighter will have an operational cost factor of around 40 times that of a PC-21." ■



The Turkish Aerospace Hürkus -B, Beechcraft T-6 Texan II, Korean Aerospace Industries KT-1, and the Embraer T-27M Super Tucano are all new or successful advanced training options.



The Beechcraft T-6C has enjoyed advanced flying training successes all over the globe, with 18 Texan T1s serving the RAF.
PICTURE: RAF VALLEY.

Turkey's Hürkus -B turboprop trainer deliveries started in mid-2018.

The variant is exactly the same as the original two Hürkus -A prototypes, which flew in 2013 and 2014, except that they are configured with a glass cockpit for military use, housing a HOTAS, head-up display (HUD) and three multi-function displays (MFDs) developed by Aselsan.

The Turkish Government signed a contract with Turkish Aerospace in 2014 for 15 Hürkus -Bs, with options on a further 40, to equip the Turkish Air Force (TurAF) flying training wing at Izmir-Cigli, the home of the newly opened MMFCT-C. It is believed that two have been delivered to date, but it's unclear if the MMFCT-C is functioning as was planned due to a lack of instructors following the attempted-coup in 2016.

The Beechcraft T-6 Texan II has enjoyed relative success in the advanced flying training market, and comes with a large array of ground-based training systems. The turboprop trainers serve 13 air forces, but none in the Middle East where the Pilatus PC-21 and BAE Hawk dominate.



The 13 operators are Argentina (12 T-6C+, delivered August 2017-December 2019); Greece (45 T-6A, 2000-2003); Iraq (15 T-6A, December 2009 until 2013 when grounded, but they are believed to be operational again now); Israel (20 in 2009, one was lost and replaced in 2012); Mexican Air Force (60, delivered August 2012 to July 2018, but there have been five losses and some attrition replacements); Mexican Navy (13, delivered between 2014-2016); Royal Moroccan Air Force (24, February 2011-January 2012); Affinity (for UK RAF, 14 May 2017-December 2018, another four

ADVANCED TO THE FORE



The KAI/Lockheed Martin T-50 supersonic jet trainer is operational with South Korea, Iraq, the Philippines and Thailand. Note the UAE insignia on the tail of this jet.

PICTURE: ALAN WARNES.

delivered on Oct 30, 2020); NATO Flying Training in Canada (CAF, 26 CT-156/T-6As in service from May 2000, although two have been lost, two withdrawn from use for spares in 2005); Royal New Zealand Air Force (11 T-6C, August 2014-April 2015, one damaged in landing accident October 2018); the USAF (454 T-6A, May 2000 to May 2010, eight lost); the US Army (4 T-6Ds in service from June 2015); and the US Navy (295 T-6A/B, August 2009-2016).

The Tunisian Republic Air Force is set to buy eight T-6C+s after the government approved the purchase in November last year. A similar deal for four AT-6C Wolverines was cleared by the USA in February 2020, at a cost of \$325.8 million, but nothing has progressed.

It was announced, in October 2020, that the Colombian Air Force had selected the T-6C as a T-37B/C replacement.

The Korean Aerospace Industries (KAI) T-50 is operating with five customers, in addition to the ROKAF's 62 AJTs, in the T-50 and slightly modified T-50B configuration. The ROKAF went on to buy 22 TA-50s in the counter-

insurgency/light-attack role.

Being supersonic, it is an expensive jet trainer to operate, so introducing an offensive capability while working with Lockheed Martin made sense. Since then the jet has been awarded several contracts, although they were US foreign military sales (FMS) deals rather than winning a competition.

All of the aircraft have the capability of carrying weapons.

Indonesia took delivery of 16 T-50Is in 2013/14; Iraq continues to receive 24 T-50IQs, with the first ones arriving in February 2017; the Philippines now operates 12 FA-50PHs; and Thailand has 22 T-50THs on order to replace its L-39ZA/ARTs.

The Embraer EMB 314/A-29 Super Tucano is a more advanced version of the EMB 312 Tucano, but normally fulfils a light-attack role.

The Tucano was relatively successful in its 80s heyday to train pilots in the advanced flying role – the UK RAF operated the type until three years ago.

Not too surprisingly, the Brazilian Air Force (FAB) is the biggest operator, with around 50 of the 148 that were delivered, still being used. Some were converted to the attack AT-27 standard, but all are now used by the FAB Academy at Pirassununga.

The FAB has modernised two aircraft with a glass cockpit. They made their flying debut on October 23 last year during Brazil's 'day of the aviator'.

The FAB is planning to upgrade 42 T-27s to the T-27M derivative to equip the academy, where students initially train on the Neiva T-25 Universal before progressing to the T-27. The glass cockpit will allow the pilots to progress seamlessly to new-generation aircraft that already have improved avionics. ■



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THE THIRTY-NINE'S STEPS

The new L-39NG is a prime example of a very successful design modernised with a new look, new avionics, new engine and, of course, simulation at an affordable price.

Less than two years after the prototype aircraft flew in December 2018, Prague-based Aero Vodochody certified the new generation L-39, aptly known as the L-39NG, in September 2020.

With the European military airworthiness requirements (EAMAR-21) and European military airworthiness certification criteria (EMACC) paperwork completed, the sales drive is now on.

Aero built 2,888 L-39 Albatrosses spanning the 1970/80s and 90s. The aircraft has been out there a long time and is a proven training platform.

From that experience the company, which celebrated its 100th anniversary in 2019, is sure the L-39NG will be a winner and will gain its first contract soon.

If the Czech Government supported its aerospace industry in the way that other European Union countries and the UK

does, the new-generation basic/advanced jet trainer would probably have already found sales success.

There are currently two prototypes flying, while the first series aircraft is now in production. Hungary and Slovakia could well be the first customers as they look for new flying training solutions.

Maybe the Czech Republic might even sign off on the contract for

four L-39NGs that the government-owned flying training centre (CLV) desperately needs to acquire by 2022. Replacing the retiring L-39Cs that continue to be used to train Czech Air Force pilots is a top priority.

Senegal has ordered four light-attack versions of the L-39NG, and work is currently under way to convert one of the two prototypes into this configuration.

Aero is now finalising the integrated training systems, with the ground-based training system a key part of that. As Vit Pavelec, senior director aftermarket sales recently told me: “When we talk with customers about the NG, it’s not just the aircraft – that’s just part of a complete training solution.”



One of Aero’s key partners developing the ground-based training system is VR Group (VRG), a leading Czech provider of comprehensive training solutions for the armed forces, security forces, and crisis management authorities. Pavelec, added: “With them, we are expanding the dynamics of training to follow the market trends and the customers’ needs or expectations.”

One of the key parts is the learning management system (LMS), which is really an umbrella for key elements of the ground-based training system. Pavelec

explained: “Currently, when we have a student pilot, we have an instructor as the evaluator. There is a test and there are some flights in the aircraft/simulator, all based on the instructor’s observations.”

With the LMS, the new pilot’s development has the potential to be evaluated in a very automated and objective process. According to Pavelec, it’s really more about artificial intelligence processing and integrating the different modes of inputs. “Not just from the simulator but the camera’s output, measuring the movements and other parts of the system and the automated flight analysis.”

Pavelec sees this as a great differentiator because a good student will be allowed to move faster in training or, if the system shows someone is not good enough to proceed, then the process can be repeated. “Essentially, its multi-speed training,” Pavelec said. “This makes it much more efficient and, in addition, it’s good quality training. You spend more time with students that really need it, or you don’t need to spend time with students who are good enough already.”

Typically, Aero would prefer students to have some flight experience, so they should have flown a screening aircraft before stepping into the L-39NG. It really depends upon the customer and, according to Pavelec, there are recommendations on how many hours a

“When we talk about the NG, it’s not just the aircraft – that’s just part of a complete training solution.”

AERO'S NEW GENERATION L-39NG



The L-39NG was test-flying from unpaved air strips in August 2020 and was certified a month later. PICTURE: ALAN WARNES
Left: Like all credible training aircraft, the L-39NG comes with a ground-based training system, including this cockpit procedure trainer developed by VRG. PICTURE: AERO

student should have flown. He believes moving to a ground-based training system, or the NG training system, a pilot should ideally have around 150 hours of military flying time.

Aero is aiming at a full scope of solutions for the customer pilots' needs.

Starting with the ground-based training system, or ground school, the student would go through all the different systems of the aircraft, as well as flying aspects. Typically, it takes six to eight weeks, to go through ground school.

The usual approach now is to use interactive 3D models, ensuring students can increase their knowledge with the systems. It could be on a computer screen, so a specific part of the aircraft can be studied, while needing to understand all the systems in the aircraft.

The L-39NG has an embedded virtual training system (VTS) acquired from Israel Aerospace Industries (IAI), with a propriety data-link integrated into the simulation solution, predominantly for radar and tactical training.

Pavelec, who joined Aero from Bell (formerly Bell Helicopters) in March 2020, said: "The advantage of working with VRG is that they are a small, efficient company and the simulators are very affordable compared to the bigger players, while having one of the best technical parameters on the market.

"The cost benefits are good, which ensures the L-39NG remains very

affordable, with the best hourly operating cost/lifecycle ratio in the market."

The VTS transmits data in the air and from the ground – it's a propriety data-link and if integrated into the ground-based training system there is a great tool.

The L-39NG is not limited to just the IAI data-link either; it could take any kind of data-link and integrate if required.

Aero has also been working with Spiel, its long-term supplier, which developed the L-39NG's head-up display, on a flight data recorder to work alongside the new mission planning and debriefing system (MPDS). This allows instructors to plan the mission and, after the flight, pull the memory card from the aircraft's computer and take to the debrief.

A great feature is the data recorded on the flight can be linked into the simulator, so the student can see how they fared. It means you can stop the sortie and review the decision – a simple overview from which the student can learn. For a faster debrief you can plug the card into the ground-based training system because it's all linked together.

Pavelec explained that VRG acquires NG parts from Aero to build the cockpit procedures trainer (CPT) and FMS. The VRG dome field-of-view under development could be either 180° by 90° or 300° by 150°.

One of the key values of being an OEM is that Aero owns the expensive data/flight control system that will be used in the simulator. "As a sim manufacturer you

have a couple of options; you can buy data from the OEM, you can decide to rent the aircraft and fly it across the envelope to collect the data, or you can base your sims on other similarities on other models, but then it's not precise. Either way it's not cheap," said Pavelec.

Another advantage of the FMS is that pilots can be trained on how to use weapons like the joint direct attack munition (JDAM) or the GBU-12 Paveway II aerial laser-guided bomb, through its weapon management system replicated from the aircraft itself. "So the computer on the real aircraft can be replicated in the simulator, with all the parameters of each weapon."

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The embedded training system will work with tactical simulation training, where aircraft or sims are linked together.

Pavelec added: "We use LOM Praha's tactical simulation centre (TSC) at Pardubice, which the L-159 simulator was developed for. We could still use TSC but, obviously, with VRG, we can build a tailored centre for our customers.

"There are proposals for an EU/NATO jet training centre that would include the Czech Republic, Slovakia, Hungary and some of the Balkans countries as well. It's a great idea – but it involves a lot of political decisions. Everyone wants it in their own country and no one wants to give it up!" ■

"The L-39NG remains very affordable, with the best hourly operating cost/lifecycle ratio."



With two new jet trainers, the M-345 and M-346, Leonardo could change the way pilots are put through their paces.

LEONARDO REVOLUTIONISES THE ART OF PILOT TRAINING

Leonardo launched its International Flight Training School (IFTS) in July 2018.

This strategic collaboration between the Italian Air Force and Leonardo is aimed at establishing an advanced flight-training centre. Both sides hope the initiative will become an international benchmark for military pilots' training.

Most recently the IFTS has worked out of Lecce-Galatina, the Italian Air Force's training school, which the company has modernised and intends to internationalise.

Following on from the relative success of its M-346 (known in Italian Air Force service as T-346) advanced jet trainer, Leonardo is now offering air forces the lower-cost M-345 (T-345), which the Italian company claims could spell the end of the screener aircraft for the entry-level pilot.



Emanuele Merlo, senior vice president trainer aircraft at Leonardo, told me some time back: "Our M-345 and M-346 relationship, coupled with an integrated training concept, will revolutionise the way air forces train their pilots. Our vision looks at the flying training phases and we believe new technologies will provide different selection criteria."

Merlo went on to say that pilot selection can avoid the need for a screening aircraft. With new simulation, plus psychological and methodical testing, pilots could start their flying on a basic trainer.

Not too surprisingly, he suggested the M-345. "We have changed the concept of training pilots by expanding the capabilities of our new platform. The performance of the jet covers the higher end of the propeller aircraft, up to the end of basic training, so it would cover most of Phase 1 training up to the M-346 at Phase 4 (advanced jet training)."



Merlo added: "Surrounded by an integrated training system, there is no need to fly an actual aircraft before the pilot jumps into the basic two-seater M-345 jet. It is the best and most cost-effective system."

The M-345 high-efficiency trainer pre-series aircraft (CPX 532) made its first flight on December 29, 2016. With a requirement for 45 M-345s, to replace 137 MB 339A/CDs, the Italian Air Force ordered five aircraft in January 2017, which was followed by an additional 13 in June 2019.

On December 21, 2018, the first serial production aircraft, CCX 55232, made its inaugural flight, and was used to certify the M-345 in May 2020. The first two jets (MM55234/0003 and MM55235/0004) were delivered to the Italian Air Force Flight Training School at Lecce-Galatina on December 23, 2020.

Leonardo's M345/346 integrated training system concept sees ground-based training systems like the real-time monitoring system (RTMS) linked up to

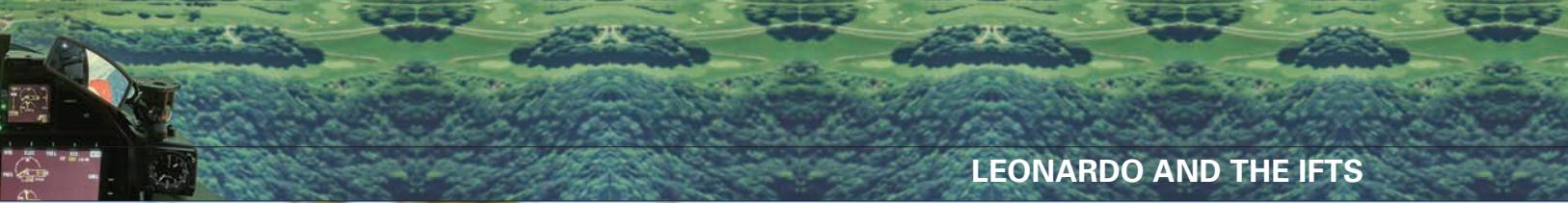
The IFTS is building an advanced jet training hub at Decimomannu in Sardinia, where a fleet of 22 M-346s will be based.

PICTURE: LEONARDO.

a full mission simulator (FMS), flight-training device (FTD) and a mission planning/debriefing system (MPDS). The instructor operating station (IOS) is linked to them all and is able to inject different scenarios into the training flights. This allows everyone working in the system to be connected with the M-345 and/or M-346 live in the air via the live virtual constructive (LVC) and embedded tactical training system (ETTS) network.



Merlo added: "It serves both the aircraft and simulators, with the M-345/M-346 FMS following the mission in real time, 'learning while turning'. It allows the instructors working on the IOS to change the scenarios, to increase the tactical challenges in the mission, maybe by injecting a MiG-29 so you can watch the student cope. Our LVC can, in fact, link 10 aircraft together – seven real ones working with two simulators and one real-time monitoring station."



LEONARDO AND THE IFTS



One of the T-346 instructors at Lecce-Galatina, Lieutenant Colonel Simone ‘Sossi’ Orlandini, explained in more detail the way the Italian Air Force carries out training there.

“There are two full-mission simulators linked to the aircraft, allowing the instructors to increase the complexities of the tactical scenarios to improve the output skills of the students, at a lower cost than flying a T-346.

“The ETTS allows the T-346 students to work with the radar, targeting pod, recce pod, etc, in many scenarios, such as basic air-to-air training, radar intercepts, advanced radar intercepts, basic electronic warfare for the air-to-ground threat, and more complex scenarios like air-to-ground sensor in surface attack training, tactical air-to-ground, surface attack and tactical air support for maritime operations (TASMO). This greatly improves their skills by the time they have left for the Eurofighter operational conversion unit (OCU).”

Leonardo believes the Italian Air Force could cut the 90 or so hours that a

new Eurofighter pilot will spend on the at Grosseto OCU to around 45 hours because of this new training system.

He continued: “We have changed from a world that is very fast but not very manoeuvrable, to a world that is highly dynamic. The progression to a more performance-based aircraft, like the M-346, gives students the ability to handle the task much work quickly. It means we get the same result with less hours or get more output with the same number of hours, which is important for the fighter community.”



The M-346, powered by two Honeywell F124-GA-200 engines, has been sold to the air forces of Italy (18), Singapore (12), Israel (30), and Poland (16), while Leonardo has provided four to the IFTS being set up at Lecce-Galatina.

All are lead-in fighter trainers to fourth-generation fighters (F-15, F-16 and Eurofighter) and, increasingly, to the fifth-generation F-35.

Leonardo is offering two jet trainer options – the M-345 for primary and basic flying training and the M-346 (seen here) advanced jet trainer.

PICTURE: LEONARDO.

The Leonardo/Italian Air Force IFTS will eventually have up to 45 T-345s – Tutor IIs as they have been named – and 22 T-346s training pilots from all over the world.

The T-345s will replace the MB 339A/CDs covering Phase II and Phase III, while the T-346 system will eventually transfer to Decimomannu (Sardinia) to become the future advanced training excellence centre.

A ground-breaking ceremony for the new IFTS at Deci took place in late December 2020, attended by senior government, military and Leonardo officials. T-346 operations are expected to commence there in 2022.

Kuwait Air Force student pilots have been training at Lecce in recent years on both the MB 339 and T-346.

Bahrain and Qatar have also evaluated the aircraft in a Middle East market that Leonardo reckons will require 150-200 advanced jet trainers between 2019-2028.

Qatar and Italy signed a technical agreement in November 2020, which could lead to the QEAF signing up IFTS. ■



The Kuwait Air Force has acquired the TOFT, which replicates the Block III F/A-18E/F avionics and systems, so it's like flying the real aircraft.

PICTURE: BOEING.

BOEING'S FIGHTER SIMS TAILOR-MADE FOR STUDENTS

Using the operational flight programme as a simulation solution for F/A-18E/F Super Hornet and Boeing F-15QA.

Most aircraft OEMs, or high-tech simulation companies, use the same methods to teach aircrews to fly tactically.

Those who become MENA's top-notch fighter pilots will fly sophisticated cutting-edge multi-role platforms like the Dassault Rafale, Eurofighter Typhoon, Boeing F-15QA/SE Strike Eagles, Lockheed Martin F-16 Block 70/72s and, maybe soon, the F-35 Joint Strike Fighter.

These are computer-driven tactical aircraft and, with the exception of the F-15, are single-seaters. It means pilots will have to attach more time and concentration to handling information coming from sensors.

Boeing has sold the F/A-18E/F Super Hornet (Kuwait) and F-15QA Eagle (Qatar), and offers the usual computer-based training systems all the way to full-up simulators.

Kuwait is procuring what is termed as the F/A-18 tactical operational flight trainer (TOFT), while Qatar is undoubtedly buying the F-15QA weapons systems trainer (WST).

Tanya Noble, Boeing's director of international defence training, said: "Boeing is uniquely positioned because, being the OEM of both the F/A-18E/F Super Hornet and the F-15QA, we can integrate the aircraft's operational flight programme as a foundation for our software in the simulation trainer, so the student will be flying the real system. We provide customised solutions, so we don't start from scratch."

The TOFT and WSTs are such systems, with a

hi-fidelity display and typical touch-screen avionics. They both contain a dome with a 360° or 180° field of view, depending upon the customer's requirements.

These training devices support a variety of requirements – squadron readiness, crew coordination, formation flying and weapons integration. They basically provide the aircrew with a safer environment in which to fly, reducing the 'air jeopardy' as it often called.

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"The main purpose of our simulation is to replicate the performance of the aircraft, train like you fight, fight like you train."

Tanya added: "Readiness begins with training and we cater our programmes to customer needs. As OEM, we have unique courseware and electronic systems to use the simulation environment in true life-like scenarios in an affordable environment. We can network training devices so we can provide critical mission training and coordination with aircrews."

Integrated live virtual construction (I-LVC) will play a big part in the Boeing simulation, when live aircraft work with simulated assets on the ground.

Noble concluded: "Some of the technology is under development, but we are shaping those requirements with customers, as well as cost-effective features and capabilities." ■

PAKISTAN BACKS ITS DARK HORSE FOR TRAINING

The Sino-Pak JF-17 Thunder Block 3 could be a good option for some MENA air forces.

The Pakistan Air Force is currently introducing the dual-seat JF-17B Thunder into service, for tactical operations as well as LIFT. The prototype made its first flight at Chengdu Aircraft Corporation on April 27, 2017 and, since then, 26 have been rolled out.

Illustrating its close relationship on the programme with China, the first batch of 12 saw four built at Chengdu and eight at the Pakistan Aeronautical Complex (PAC) Kamra.

Another 14 were completed by December 30, 2020 and were planned to be delivered early this year.

A new operational conversion unit is expected to stand up to take the bulk of the latter, with the remainder operating with the five front-line squadrons.

PAF chief of air staff, Air Chief Marshal Mujahid Anwar Khan, told me in early-2020 that the introduction of the JF-17B would streamline the JF-17 training.

"JF-17 pilots were being posted to



Lockheed Martin F-16, Chengdu F-7PG, or ROSE Dassault Mirage IIIEAs before converting to JF-17. But soon they will start going straight to a JF-17 OCU, after completing their advanced jet training. It will ensure pilots transitioning to the Sino-Pak jet are a lot younger than they are now," he said.

Several of the JF-17Bs are also equipped with air-to-air refuelling probes.

PAC's aircraft manufacturing factory managing director, Air Vice Marshal Shams Ul Haq, said: "We don't need to put air-to-air refuelling probes on all the aircraft because they are easy to move around the fleet."

The Pakistan Air Force has acquired 26 JF-17Bs, which will eventually be equipped with an AESA radar. They could easily fulfil a surrogate trainer role for air forces in MENA.

PICTURE: ALAN WARNES.

To increase the dual-seater's capability, an air-cooled airborne KLJ-7A electronically scanned array (AESA) radar, from the Nanjing Research Institute of Electronics Technology (NRIET), will also be introduced into the new Block III JF-17s.

This is bound to attract the interests of some Middle East countries, particularly the

QEAf, whose commander, Staff Major General (Pilot) Salem Hamad Eqail Al-Nabet, is a regular visitor to Pakistan and is said to be regularly updated on the programme.

Now there is also three full mission systems (FMS), built by Spain's Indra, that link up the main JF-17 operating bases at PAF Base Minhas, Peshawar and Masroor, allowing training to gain more momentum.

More FMS will undoubtedly follow as more squadrons are built up at other bases. It's only a long-shot, but the JF-17B might be a good LIFT/OCU contender, or even a surrogate trainer, with some MENA countries. ■

The CAE MedallionMR eSeries is one of several options for fast-jet pilots. It normally includes a back-projection 360-degree dome display system, laser projectors, and the proven CAE Medallion image generators in a fully integrated visual solution.

PICTURE: CAE.

CAE KNOWS HOW TO MAKE A LASTING SIMPRESSION

It may not be an aircraft OEM, but Canada's CAE has a growing presence in the military training world.

In the defence and security sector, the Quebec-based company trains pilots on fast jets, helicopters, multi-engine aircraft and, increasingly, UAVs, all the way through to operational mission training.

Having cut its teeth on providing simulators to air forces and commercial airlines almost 70 years ago, CAE is keen to assist nations through a range of training products, services and capabilities.

Ken Patrick, an ex-Royal Canadian Air Force aviator, founded Canadian Aviation Electronics Ltd in 1947. In 1960, the business was awarded two F-104 simulator contracts by the Royal Canadian Air Force, but the first flight simulator did not arrive in the Middle East until 1982, for the Royal Saudi Air Force.

Over the 40 intervening years, the business has come a long way in the region, as David Waddington, CAE's director, strategy and business development for military flying training in Europe/Middle East and Africa explained: "Each country today has its own set of benefits they are trying to seek from these training programs – the operational effect is just one. They also have constraints, whether that is airspace, finances, or a reduced number of pilots.

Whatever your military flying training challenges, CAE probably has the answer.

All their requirements are unique, so all our solutions aim to give them what they need to fulfil their priorities."

CAE has a presence in most GCC countries, but its most recent simulation solutions include RQ-1E Predator remotely piloted aircraft (RPA) training for the UAE Air Force. Other clients include: UAE Joint Aviation Command/Northstar Aviation Bell 407MRH and UH-60M Armed Black Hawk (ABH) force; GCC's Joint Multinational Simulation Centre (JMSC); Oman Aviation Academy; KC-130J training centre for Kuwait Air Force at Al Mubarak Airbase; and delivering a comprehensive NH90 helicopter training package to the QEAF.

Like most of the defence industry, CAE is not keen to discuss the specifics of all its projects in the Middle East.

CAE has been the prime contractor for the NATO flying training programme in Canada since October 2015. So, it obviously has the expertise to introduce a high level of

synthetic training combined with live flying. This includes a network of solutions covering multiple aircraft in the training environment.

Qatar is likely to be a top target but, as Iain Walsh, director, strategy & business development, CAE Middle East added: "You need a sufficient combat mass with a realistic threat doing realistic things with some kind of governing AI, or a strategy that puts entities into that environment through simulation or synthetics, so they are doing meaningful things. It's those kind of technologies we need to use – not just for Qatar."

Philippe Perey, CAE's head of technology, defence and security, views integrated live virtual constructive (LVC) training as one solution. "The ability to connect live assets with virtual assets on the ground, in the same way you would fight in a multi-ship engagement, gives you a cost-effective yet realistic integrated training environment," he said.

Working this way in the air is a huge challenge, defending your air space against a potential massive onslaught of threats, which is what fifth-generation platforms are designed to do. However, if the crews in that environment do not live it, then they are not necessarily trained to

Each country has its own set of benefits they are trying to seek from these training programs.

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on Page 20

CONTINUED FROM PAGE 19

the mission radius required. It is prohibitively expensive to get so many assets into the air and, so, a broader adoption of LVC is required.

Perey added: "It's this sort of progression of building up needs that means many of the countries in the Middle East, and around the world, are looking at LVC as a training multiplier going forward, not just a force multiplier."

Simulation is clearly a tool for training delivery. CAE's objective is not to just build simulation, but to train pilots, build proficiency and make them the most capable in the shortest period of time.

Perey continued: "In our training toolbox, simulation is just one of the tools. We use the capabilities that technologies offer, plus insights from the science of learning and the data analytics and good simulation adapted for the task.

"For the LIFT trainer, forget the fact that it might not have a radar. We could download all the training before they go out and do it. We want to deliver the training capability with its underlying requirements, rather than simulator versus simulator. There is much more potential than being a standalone simulator."



Data analytics is where CAE sees incredible potential, focusing around the insights derived from the data coming out of pilot training. "We already have this deployed in civil aviation training centres, where you are gathering terabytes of data from simulators," explained Perey. "What it is trying to do, just like Amazon and Apple, is analyse how people are performing and glean valuable information from the clusters of individual students' performances."

This would obviously help with future training requirements and provide insight into adapting the training curriculum. A fighter pilot might be excellent in a one-versus-one dogfighting scenario, but not as proficient as required on another type of mission, so they could spend more time on that and less in other areas, where they are already proficient.

Perey pointed out: "We can broaden this application out to MENA, and harness the power of data analytics, applying it to the science of learning. So the pilot could practice two hours of cross-wind landings because the data tells you that's what he needs. We also

"With the CAE Trax Academy we are already looking at self-paced training delivery."

have the instructor to supervise the learning and, as the results come out, validate the decision."

According to Perey, the US Air Force has demonstrated that training programmes can be shrunk by up to 30% (and possibly more) just by looking at new training technologies.

"With the CAE Trax Academy we are already looking at self-paced training delivery; where today's millennials/youngsters who expect to learn off their tablets, have access to gaming technology or immersive learning environments," said Perey. "It means they don't have to wait for two weeks to get a slot in the training simulator. The bonus is they all have personalities, want to be top guns, so they are training 10-12 hours a day and loving it.

"The US has demonstrated close to 30% reduction in both cost and time to training these groups – as part of their pilot training next experiment.

That's what these technologies can promise."

CAE is now working with the USAF and its defense innovation unit as part of its pilot training transformation initiative, where elements of the CAE Trax Academy are

CAE is already working with the UAEAF&AD training personnel on the RQ-1E Predator RPA.

PICTURE: CAE.



being incorporated into undergraduate pilot training.

The company wants its systems to be able to help judge whether a student pilot might be a better fit for helicopters, fighters, or multi-engine aircraft, much earlier in the process.

Other than trying to determine the aptitude with exams, you could put them in the immersive training device – flying loops etc – and from that glean whether they will be a good pilot. These kind of technology benefits definitely reduce the training timeline and potentially support other screening methods.



Working with the military customer is CAE's objective. The company's Dave Waddington said: "They [military customers] always have their own standards and we are the contractor support. Our ambition is to offer the full training capability they require, so they are contracting us for training output and outcomes, not for just a simulator.

"We do what we do best, which is training delivery, and the military keeps what they require and manage the operational risk that goes with that."

With training centres, CAE will work



The CAE Sprint virtual reality trainer with a student pilot. He is seen wearing a VR headset, with a stick and control panel under his left hand.

PICTURE: CAE.

to realise the benefits in the most cost-effective way, and at the lowest risk. The air force maintains control, signs off the syllabus and, of course, retains absolute ownership.

CAE is proficient at looking at ways of downloading training from the frontline, from, say, an operational conversion unit (OCU). Waddington retired as an air commodore in the UK RAF, commanded IX (Bomber) Squadron, as well as the Tornado GR Force, so knows a thing or two about that subject. "Training is an overhead and if you are a combat commander you want maximum combat capability from your frontline forces and a minimum training overhead. We are not talking about operational training here, though we believe we can do that too. There are other good reasons, like managing your fleet, as fatigue life is paid back in terms of a benefit."

Waddington suggests there needs to be a good balance between flying in a simulator and time in the air, because air jeopardy cannot be replicated on the ground. "If you are flying at Mach 1.6 at 30,000ft in, for example, a Typhoon, and you make a mistake, it's a bit different and more realistic than just hitting the reset button on a simulator. Simulator use is way more than I experienced during my

career, but sometimes you just need to feel the air under your backside."

All these digital trends are globally relevant, driven by some of the major air forces around the world. Given the geographical restrictions, and population, they are well suited to the constraints faced in the Middle East.

Qatar and Saudi are different in terms of geography, but their tactical goals are the same.



Walsh said: "Middle East air forces are on a journey and are in a position, based on their relative youth, to take advantage of what the USA, the UK and Canada are doing, where we see a greater use of synthetics in their training environment.

"In the west, the ability for students to do their training in their bedrooms, instead of watching Netflix, is a real development. They want to try things on their own first, without the instructor. They then learn in a self-paced fashion, so it's not such a waste of time when they go to the classroom.

"In the Middle East, they are more traditional but they are catching up, and one of our jobs is to educate them in the benefits of that. In lower fidelity

solutions, like augmented and virtual reality (AR/VR), you can use these capabilities in specific components of training where it is most suited.

"Forgetting the culture and geography of the Middle East, the young people want to be future pilots and they absolutely will take advantage of all technologies to accomplish that goal."

The geo politics of the region is also changing. Israel now has better relations with Bahrain and the UAE. This could mean the F-35 Joint Strike Fighter will arrive in the region and, in doing so, create a leap in capability from the Typhoon, F-15EQ, Rafale to a fifth-generation aircraft.

There will need to be fourth and fifth generation fighter integration just as the UK, with its Typhoon and F-35Bs, has been trialling, and the US has been doing with its F-15, F-16, F/A-18 and F-35s in recent years.

It's an evolving political climate, which also drives the threat environment, and air forces will consider how their front-line forces are operating and what effect that will have on the training as well.

So it's not all technological questions – numbers, people and the geo-politics matters too. ■

"Young people want to be future pilots and they will take advantage of all technologies to accomplish that goal."



As well as flying training, the UK RAF is using its simulation solutions to train aircrews for network-centric and anti access area denial (A2AD) operations.

VIRTUAL THREATS BRING A CONSTANT TASTE OF REALITY

Imagine the complexity of bringing together a variety of air assets, like fighters, airborne warning and control systems (AWACS), signals intelligence/electronics intelligence (SIGINT/ELINT), maritime patrol aircraft (MPA), and helicopters into a live environment.

Most senior air force officers would tell you it's difficult. Now, in the synthetic environment, they can.

Air Vice Marshall (ret) Gary Waterfall, who retired from UK RAF service in December 2019, after 34 years explained: "If you look at some of the US flag exercises, there is a mix of live flying and synthetics, so you bring it all together in the live virtual construct (LVC) world. You can dial up the threat, or the weather, in that simulation environment to make it as harsh or as easy as possible.

"You can also dial out service issues with the aircraft, in terms of radar, and the threat, including surface-to-air missiles (SAMs) and air-to-air threats. It brings a sense of realism into the training that you cannot get on a day-to-day basis."



So, imagine the RAF Typhoons and Tornados striking chemical weapon facilities in Syria nearly two years ago. The mission would have been rehearsed over and over again in the synthetic environment, from taxiing out to returning to base.

Waterfall, whose last position was chief of staff (ops) permanent joint headquarters (PJHQ) said: "You could do all the communications, check in the right people and the air traffic. You already know all the threats and when they were coming up, and how to step around that. So your training limit doesn't necessarily limit you to the North Sea, or to the borders, as it did when I was flying my Harrier not so long ago."

It means people can train in any environment, anywhere in the world. Match that with the air and

People can train in any environment, anywhere in the world.



The RAF has two Hawk T2 units, with the 4 FTS, training pilots in the art of lead-in fighter training.

PICTURE: RAF VALLEY.

threat intel and you can do almost anything.

It costs a vast amount of money to fly live modern aircraft like the F-35, Typhoon, Rafale and new generation F-15s, so you don't want to waste the training time in the live environment when you can do it with synthetics. "But it's not cheap if you want to get it right, to get everyone on board at the right time in a mix of AI with live virtual players that includes simulators versus emulators," said Waterfall.

However, you do only pay once for the purchase of the systems. The operational cost of, say, £100,000 per hour to fly a Typhoon will be saved.

Waterfall continued: "As the officer commanding the RAF's Typhoon operational conversion unit once said to me, 'I have a four-ship on the flight line that I can use, but I have a 16-ship in the simulator. It's actually only a four-ship, but I can do it time and time again, so I can send four guys out into the sim, fly for an hour, come back send four more out, fly for an hour, come back and so on.

I can do four trips of four in the time I can do one four-ship on the flight line.' So cost is a kind of force multiplier when you get it right."

After complexity and cost comes capability, the former Harrier pilot,

now a senior defence advisor for Clarion Defence and Security, told me.

"With the exquisite capabilities you find on a Typhoon or F-35, you might not want to fully show your radar footprint, radar capabilities, your missile capabilities, or your tactics or defences in that live environment," said Waterfall. "We know the proliferation of space, where we can be watched, and vessels at sea, and on land, sniffing around all the time – just as we would be to keep an eye on our adversary. But, with such a capability, why would you want to give them your crown jewels away in that live environment?"

Simulation doesn't, of course, make you feel like you are flying a real aircraft. So you still need to fly live. There are many issues that you could never train for in a simulator, as Waterfall explained: "Your wingman having a problem taking off, then you need to talk to him in the air while flying the aircraft. Then there are the questions of getting the sense of acceleration and turning, experiencing G-forces during air combat. Unless you get four centrifuges lined up together to do two-versus-two air combat, where as they pull the stick back to fly the G, you are never going to replicate that."

So familiarity – flying in the air – has to be a top requirement, too.

In November, Rear Admiral Gregory 'Hyfi' Harris, the US Navy's director of the

F-35B pilots train on the F-35B/Queen Elizabeth Carrier simulator at BAE Systems Warton before flying from the aircraft carrier.

PICTURE: BAE SYSTEMS.



air warfare division, acknowledged the service was considering the use of surrogate training aircraft, aimed at reducing flight hours on front-line fighters.

An aircraft that could give flying experience, with the Boeing eT-7A Red Hawk being a real possibility, could allow the pilot to emulate flying the Lockheed Martin F-35 Joint Strike Fighter.

A second reason why simulation isn't always the complete solution is that everyone has to come to the party in the same outfit. For example, the UK F-35 and Typhoon pilots are required to work with, let's say, a Type 45 frigate, for air maritime integration as part of their annual competency and currency. They could, of course, do that in the sim, but unless the Type 45 principal warfare officers (PWOs) are getting the same experience, there is no

point. And the same applies to the joint terminal air controller or forward air controller (FAC).

Under 'Astra', the campaign to build the next-generation RAF, there are aspirations to carry out 90% of flying in simulation.

Some would argue that the E-7T Wedgetail, P-8 Poseidon, and RC-135 AirSeeker will only need to fly operationally; all the training could be done in a simulator. So the days of the 2,500 hours patch, once donned with pride by Waterfall, will be a thing of the past.

He said: "The mark of a warrior now is the 'pairs lead', your 'fours lead', your 'eights lead'. You can now probably become an 'eights lead' with 1,000 hours flying [and 1,000 hours on sim], instead of 2,000 hours when I was flying.

Pilots flying front-line fighters, like the Typhoon, will now spend more time in the simulator. Those passing through No 29(R) Squadron, the RAF's Typhoon operational conversion unit based at RAF Coningsby, will spend less time in the dual-seat T-2 as they are withdrawn from use.

PICTURE: ALAN WARNES.

"I'd like to think a lot of people in the RAF now recognise the synthetic environment because it wasn't the case until recently."

In May 2019, the UK Ministry of Defence (MoD) announced a new RAF virtual system had been selected that would allow crews and supporting ground forces to train together in multiple locations.

The defence operational training capability (air) core system & services contract will create a capability, known as Gladiator, to support multiple complex training scenarios, simultaneously and independently of each other.

Rather than personnel based at different sites having to travel to train together in simulators at a common location, the system will allow them to stay where they are and train together in their own high-fidelity simulators, linked by a secure network to a new hub at RAF Waddington. The seven-year £36 million contract is expected to be operational in autumn 2021.

There is likely to be resistance to using more simulation in some Middle East air forces because, just like all pilots, they want to fly. It was like that in the RAF, but now, with such big benefits, the RAF has gradually realised it's the future. Undoubtedly the Middle East air forces will too, eventually. ■



MIDDLE EAST OVERVIEW:

Interoperability with allies like the USA, the UK and France remains one of the main objectives of Middle East (covering the GCC countries in this report) air forces. Most have been going through major fighter modernisation plans; Qatar has really bought big recently with Kuwait and Bahrain just behind. Saudi Arabia still has a need for 40 Eurofighter Typhoons.

Only the UAE has not been on a major spending spree, although that will change if it goes ahead with plans to buy the F-35A. Bahrain and Kuwait don't have their own flying academies, so what does the future hold for them?

One thing is certain, all will need to revolutionise their training capabilities – both with simulation and new training aircraft. Here's a country-by-country analysis.

BLOCK BOOKING MAY SPARK DRIVE FOR FIGHTER PILOTS

The RBAF outsources its primary and basic flying, but this could change as the need for fighter pilots increases. With 16 advanced Block 70 F-16C/Ds set to join the 20 F-16C/Ds already in service, it looks likely.



With the Royal Bahraini Air Force's (RBAF's) small fleet of Slingsby T-67M Fireflies grounded, there is no elementary or basic flying training platforms in the desert kingdom.

Instead, student pilots are being trained at three different overseas facilities before they return to fly the BAE Hawks used by 4 Squadron for lead-in fighter training (LIFT).

The UAE Air Force and Air Defence (UAEAF&AD) Sheikh Khalifa bin Zayed Air College Flying Training School at Al Ain uses Grob 115TA Acros to screen pilots who, if successful, will proceed to the Pilatus PC-21s to fly around 20 hours.

Alternatively, it could be the Royal Saudi Air Force's King Faisal Air Academy at Riyadh-King Khaled Airbase, where students will be screened on the Cirrus SR22 or MFI-17 Super Mushshak before stepping up to PC-21.

The third option is the Egyptian Air Force's Air Force Academy at Bilbeis Airbase, where they will fly the Grob 115Es and Hongdu K-8 Korakoram before heading back to the RBAF's Isa Airbase to fly Hawks and then on to F-16s.

It's obviously a lot more complex flying in Egypt, but the slots are probably not always available at the other two locations.

At Isa, the students are

taught the LIFT fundamentals on six Hawk Mk129s serving 5 Squadron. They also train on a recently upgraded Thales dome simulator. Unfortunately Thales UK was not willing to provide any further insight on this.

Today, the training wing at Isa Airbase is busy preparing pilots for the 16 F-16C/D Block 70s that will arrive next year.

In June 2018, the Bahraini and US Governments signed a \$2.18 billion foreign military sales (FMS) deal for 14 new F-16Cs and two dual-seat F-16Ds, alongside logistical and training support. The RBAF commander, Major General Hamad bin Abdullah al Khalifa, was looking forward to the jet's arrival in 2022 when he told me in November 2018: "The pilot selection process is now under way; we started preparing for the arrival of the new F-16s two years ago."

Production of the first two aircraft, an F-16C and F-16D, began at Lockheed Martin's new production line at Greenville, South Carolina, during

November 2019. They will leave the facility in 2022 and move to Edwards AFB, California, for flight-testing. It's thought the RBAF pilots will train on the new version in the USA before deliveries begin in 2023.

A Lockheed Martin spokesman said: "We are

One of the original RBAF F-16Cs departs from Isa Airbase on a training sortie loaded with GBU-12s.

PICTURE: ALAN WARNES.

merging more than three decades of in-person F-16 training for many of our regional customers. We have new training tools to meet increasing demands for a greater training bandwidth and shorter training timelines."

As the OEM, Lockheed Martin says it can rapidly meet dynamic changes in regional F-16 training and provide tailored operational flight programme (OFF)-based training devices ahead of aircraft delivery to ensure pilot readiness.

The spokesman continued: "Our unlimited access to aircraft weapons and sensor data gives our simulation devices unmatched accuracy. The design and production of our F-16 training systems incorporate all customer requirements, while matching F-16 aircraft design and production to ensure we provide the best value and system concurrency to our customers."

Lockheed Martin's family of systems includes F-16 Block 70 full mission trainers, touchscreen partial cockpit trainers, and a flexible architecture desktop trainer that merges leading-edge extended reality and virtual reality (XR/VR) with touch-screen and Prepar3D simulation software.

The jewel in the new F-16's crown is the Northrop Grumman AN/APG-83 scalable agile beam radar (SABR) active electronically scanned array (AESA) radar. But, as Lockheed Martin's JR McDonald, vice president, integrated

Student pilots are being trained at three different overseas facilities.



We don't know what will happen after the Block 70s arrive.

at Isa Airbase, where the new Block 70s will be housed, serving the 1st and 2nd tactical fighter squadrons (TFS).

The initial PCI order, made up of eight F-16Cs and four F-16Ds, was followed 10 years later by the delivery of 10 F-16Cs under PC II. The first of these were handed over on June 22, 2000, with the rest delivered by the end of that year.

The second batch of aircraft differed from the initial F-16s in having AN/APG-68(V)-8 radar, a colour cockpit TV system, and the capability to launch the AIM-120 advanced medium-range air-to-air missile (AMRAAM). They also carry AIM-9M Sidewinder AAMs for the air defence role and are maintained on a round-the-clock quick reaction alert status.

Weapons used by the RBAF F-16s in the air-to-ground role include 2,000lb GBU-10 and 500lb GBU-12 laser-guided bombs, plus TV-guided AGM-65D and infra-red-guided AGM-65G Mavericks.

Only two RBAF F-16s have been lost to date, both single-seaters. One was on September 27, 2003, and the other on December 30, 2015.

The RBAF F-16s saw combat action during anti-Islamic State operations in Syria, as well as the Saudi-led coalition against the Houthis in Yemen. It was during a mission to Yemen that the second of the attrition losses took place, following a technical failure. Fortunately the pilot ejected safely before the aircraft crashed in Saudi Arabia's southern Jizan province.

Co-located at Isa with the F-16s is the RBAF's fleet of F-5E/F Tiger IIs, which are operated by 6 TFS.

The type entered service in December 1985 and deliveries comprised eight F-5Es and four F-5Fs.

Even after nearly 35 years of service, there have been no losses of the type, which continues to remain operational. The F-5E/Fs are used as lead-in fighter trainers, for dissimilar air combat training, and in the anti-shipping role by the RBAF. ■

fighter group business development, told me in July, 2020, it's not necessarily all about the aircraft.

"When you buy the F-16 through the US Government's FMS, it forms the part of a strategic relationship with the US. It is one of the key selling points.

McDonald, a former USAF F-15C pilot, continued: "The USAF knows the F-16 is a proven way to build those strategic partnerships. If we give a customer a capability like the Block 70/72 they can easily work alongside the US when required."

The SABR replaces the older F-16's existing AN/APG-68 radar and is a development of the F-35 Joint Strike Fighter's AN/APG-81. Lockheed Martin claims it brings fifth-generation air-to-air and air-to-ground radar capability to the F-16, giving pilots unprecedented situational awareness, targeting and intelligence, surveillance and reconnaissance capabilities.

Randy Howard, former director F-16 business development, now working on the F-35, recently told me: "Our experience on the F-35 and F-22 has allowed us to take the latest technologies into the F-16. With a high-speed data networking system and processing technology, information coming out of the radar can be fed into the cockpit as high definition (HD) imagery and video. It means the F-16 pilot has a significant increase in situational awareness,

allowing him or her to make tactical decisions in real time."

With the F-16V upgrade programme sharing commonality, at least at radar level, with the F-35, not only will the RBAF operate one of the most proven platforms on the planet, it will also fly with the latest technology. Howard added: "If the air force wants to step up to the F-35 at a later date, it wouldn't be such a big jump in technology from say, an earlier F-16 or its contemporaries."

The Block 70s will complement the RBAF's existing fleet of 16 F-16C and four F-16Ds. Lockheed Martin was hoping it would have sealed a deal to upgrade these to the same configuration, but nothing has yet materialised.

When the draft US Government Defense Security Cooperation Agency (DSCA) F-16 Block 70 notification came out on September 28, 2016, there was a separate \$1 billion upgrade for the existing 20 F-16s. One insider indicated that the \$1 billion asking price was just too much.

The RBAF commander told me: "Our priorities lie with the 16 new Block 70s. Our current fleet has been modernised to a very high standard and is extremely capable. We don't know what will happen after the Block 70s arrive."

The RBAF's current fighter fleet comprises 20 F-16C/Ds, acquired under the Peace Crown (PC) I/II programmes and in service since 1990. They are based

A RBAF pilot tries out the F-16 Block 70 cockpit procedure trainer at the Bahrain Airshow in November 2018.

PICTURE: ALAN WARNES.



With 56 new fighters on order, but no primary, basic, advanced or lead-in fighter trainers, the KAF probably faces one of the stiffest of training challenges.

Delivery of 28 F/A-18E/F Super Hornets and 28 Eurofighter Typhoons is expected to begin in 2021, and the Kuwaiti Air Force (KAF) is now reviewing aircrew training options.

In recent years that has not been possible because it's fleet of 16 Tucano Mk 52s and eight Hawk Mk 64s, based at Ali Al Salem, has been grounded. BAE Systems offered to return the Tucanos and Hawks to service in 2015 as a first step to buying new Hawks, but the KAF declined.

It has led to many pilots being sent overseas for training in France, Italy, Pakistan, the UAE and the UK.

Little detail has emerged on KAF's progress to bring the flying training back in-house but there is a need, as one source told me, "to stop foreign currencies flowing out of the country".

In France, Defense Conseil International (DCI) has been training KAF pilots for several years under a commercial contract, in association with the French Air Force. Pilots are known to have been flying Alphajets at Tours Airbase.

KAF pilots have also been flying on Italian Air Force FT-339A/Cs (MB339s) at Lecce-Galatina, the home of 61 Wing, since 2014. They complete around 150 hours on Phases II-III (basic and advanced flying training).

Seven KAF pilots had graduated in November 2018, and then went on to fly the T-346 (M346) in Phase IV, the lead-in fighter training course. By late-2019, 17 KAF cadets had completed their LIFT on the T-346.

Phase IV will be part of the International Flight Training School (IFTS) offer. It is now available at Lecce Galatina and, starting from 2022, should be available in Decimomannu, where facilities are under construction.

The KAF is keen to solve its training quandary soon and recently looked at both the IFTS at Lecce-Galatina and the UK's own military flying training system. However, it is thought the latter does not have any available slots.

An €8 billion (\$9 billion) deal for 28 Eurofighter Typhoons was signed on April 5, 2016, made up of 22 single-seat and six twin-seat aircraft. In addition, the contract includes three years of support, from delivery of the first aircraft; training for operations with the Italian Air Force; and the building up of infrastructure at Ali Al Salem Airbase, where the aircraft will



The KAF Typhoons, like the Qatar examples, will be the first to house the Captor-E AESA radar. Deliveries, though, are well behind their original schedule.

PICTURE: LEONARDO

TEACHER SHORTAGE

be housed. A complete training package will be created for the Academy training centre.

An initial eight KAF instructor pilots, together with ground personnel, in cooperation with the Italian Air Force's Typhoon operational conversion unit, were trained by 4° Stormo/20° Gruppo at Grosseto.

In early December 2020, 13 KAF Eurofighters were on the Leonardo production line at the Turin-Caselle plant, with deliveries of 26 aircraft expected between 2021 and 2023.

The KAF Typhoons are the latest Tranche 3 (P3EB) multirole standard, equipped with the new Captor E-Scan active electronically scanned array (AESA) radar.

The ECRS Mk.0, as it is officially known, is being developed by the Leonardo-led Euroradar consortium, made up of Leonardo/Hensoldt/Indra), with BAE Systems integrating the system on to the Typhoon platform.

Weapons will include the MBDA Brimstone 2 air-to-ground weapon, the Meteor BVRAAM, and the Storm Shadow cruise missile. The latter is a top requirement for the Gulf regions because of the Iranian threat.

Under its missile technology control regime (MTCR) restrictions,

the US Government will not export stand-off weapons and, as a result, Kuwait will not have this capability until it receives the Typhoons.

Development of the Captor-E radar and its integration is the responsibility of Leonardo. A company spokesperson said: "The Captor-E has an enormous amount of potential for future capability enhancements; with one of the largest radar antennas of any combat jet it can generate the most power."

Leonardo's instrumented serial production aircraft-6 (ISPA-6), an aircraft configured to test the new radar, avionics and weapons integration, first flew on December 23, 2019. As part of the E-Scan XCR#1 flight-test it had flown seven sorties by March 27 2020, when the campaign ended.

Eurofighter said in June last year that ISPA-6 was being used to refine electronic counter-countermeasures (ECCM) for the radar, and for software release certification flights.

Lockheed Martin announced on September 28, 2016, the award of a direct commercial sales contract to integrate its Sniper advanced targeting pod (ATP) on the KAF Typhoons. The deal, signed with Leonardo, includes 18 pods, integration and logistics support. Pod deliveries to support integration

The KAF is keen to solve its training quandary soon.

The KAF is set to receive 26 dual-seat Boeing F/A-18E/F Block III Super Hornets. They are the first customers of the Block III version. Deliveries are expected in mid-2021. This example is a US Navy F/A-18F Super Hornet.

PICTURE: CROWN COPYRIGHT



SETS TOUGH EXAMINATION

efforts began in 2017.

Ken Fuhr, fixed-wing program director at Lockheed Martin Missiles and Fire Control said: “This contract marks the start of a successful relationship with the Eurofighter consortium to provide critical targeting capability worldwide. As a new Sniper ATP user, the KAF will see significant targeting benefits, including high-resolution imagery, advanced targeting modes, and intelligence, surveillance and reconnaissance capabilities.”

Sniper ATP detects, identifies, automatically tracks and laser-designates small tactical targets at long ranges. It also supports employment of all laser- and GPS-guided weapons against multiple fixed and moving targets.

The KAF agreed an FMS, worth \$1.50 billion with the US Government, in June 2018, for 28 Boeing F/A-18E/F Block III Super Hornets to replace its F/A-18C/D Hornets. To train pilots, Kuwait has ordered two tactical operational flight-trainers (TOFTs).

According to a notice released on the US Federal Business Opportunities website on June 18, 2018, Boeing will supply one legacy TOFT that has been modified for the Super Hornet and one new Super Hornet TOFT. It will provide training for an initial batch of 26 pilots.

The first TOFT has been delivered to

NAS, New Orleans, to support initial aircrew training, which is scheduled to begin in the first quarter of 2021. The first aircraft are expected to be delivered in 2022.

The six dual seat F/A-18Fs and 22 F/A-18Es will house the AN/APG-79 AESA radar, providing a huge leap in technology over the current legacy Hornets.

They will be the first Block IIIs to be delivered and will house the AN/ASQ-228 advanced targeting forward-looking infrared (ATFLIR) system; AN/AAQ-33 Sniper advanced targeting pods; the joint helmet-mounted cueing system (JHMCS); the multifunctional information distribution system (MIDS); an advanced high capacity computer system; a state-of-the-art cockpit; and conformal fuel tanks.

A marketing image issued by Leonardo of a Typhoon with a photo-shopped KAF insignia.

PICTURE: LEONARDO.



The Super Hornets will initially supplement, and eventually replace, the KAF’s ageing legacy F/A-18C/D Hornets.

Boeing’s Alain Garcia, director international fighter and sales marketing, told me in February, 2019, that the first four dual-seat F/A-18Fs were to be delivered to the US Navy for testing, which would be split between Patuxent River and China Lake, while the second four aircraft were to train pilots.

However, these plans have subsequently been altered due to the Covid-19 pandemic.

Deliveries to Kuwait were to start in the first quarter of 2021, but this has probably slipped.

Initially, the KAF was intending to sell the bulk of the single-seater F/A-18Cs and hold on to the dual-seater F/A-18Ds for aggressor training, but those plans have now been dropped. Instead, all of the aircraft will now be disposed of but, according to Garcia, that will not happen until the Super Hornets have been delivered.

Boeing instructors are embedded with the KAF’s 61 Squadron, which currently carries out the initial training on the classic Hornets at Ahmed Al Jaber Airbase.

It is likely that a similar arrangement will continue when the new Super Hornets arrive, and the same, too, with a Eurofighter OCU being created. ■

Of all the Middle East countries, the RAFO seems to be the most content with its capabilities.

The RAFO took delivery of 12 Hawk Mk166s in 2017 and 12 Typhoons in 2017/18. The first Typhoon, seen here, was delivered in June 2017.

PICTURE: BAE SYSTEMS.

Unlike Bahrain and Kuwait, the Royal Air Force Oman (RAFO) runs its own in-country pilot training at Sultan Qaboos Flying Academy, located at RAFO Masirah.

Pilot students are screened on the seven MFI-17 Super Mushshaks that have been operational with 1 Squadron since August 2002, when five new aircraft were delivered. They were later joined by three Mushshaks that were delivered in 1994 and upgraded. One was lost on March 28, 2005.

The unit also operates 12 PC-9Ms, delivered in October 1999. Unlike other Middle East customers, Oman had no plans to replace them with the PC-21, so all 12 were progressively returned to Pilatus in Switzerland to undergo a major refurbishment that saw them rebuilt with new fuselages between 2014-16.

While they were grounded, the Croatian Air Force trained 16 RAFO student pilots and two flight instructors at Zadar-Zemunik on PC-9s, with training split into basic and aerobatic, visual flight rules (VFR), instrument flight rules (IFR), night-time and formation flying.

The RAFO flies a sizeable fleet of Hawks, with three early version Hawk Mk 103/103As and six Mk203s survivors, which had been delivered in the mid-90s. They operate with 6 Squadron in the advanced jet training role as part of the Sultan Qaboos Flying Academy.

In 2008, a single second-hand CT-155 variant was acquired from NATO Flight Training in Canada (NFTC) and re-designated a Mk 103A in RAFO service.

The pilot training role is now served by 12 Hawk Mk 166 advanced jet trainers, in the same configuration as the UK RAF Hawk T2s. These were also acquired for 6 Squadron and were delivered from July-December 2017. One was subsequently

OMAN-MADE MODERNITY

lost in a flying accident on April 1, 2018.

Oman modernised its fighter fleet 10 years before most of its Middle East counterparts, consigning its old Jaguars to the history books.

The initial step took place between 2005-2008, when a batch of eight Lockheed Martin F-16C and four F-16Ds were delivered to 18 Squadron at Thumrait.

They were followed by an order, in December 2011, for an additional 10 F-16Cs and two F-16Ds that led to the jets being flown to Thumrait between July and December 2014, with a second F-16 unit – 20 Squadron – standing up.

Delivery of these additional F-16s enabled the RAFO's Jaguars to be retired, after making their final flights on August 6, 2014.

One of the F-16Cs was lost on September 22, 2013.

Equipping the F-16 fleet is an unspecified number of Sniper advanced targeting pods purchased for \$23 million, alongside four Goodrich (now Collins) DB110 surveillance and reconnaissance pods that cost \$34.3 million.

The US Congress was notified in June 2012 of a planned \$86 million purchase of 55 AIM-9X Block II Sidewinder and 36 AIM-9X Block II captive air training missiles (CATMs). Six months later, the RAFO ordered \$112 million worth of weapons that included 27 AIM-120C-7 AMRAAMs, 162 500lb GBU-12 Paveway II laser-guided bombs, 210

500lb BLU bombs and 32 CBU-105 wind-corrected munitions dispensers.

After two years of speculation, the Sultan of Oman signed a deal on December 21, 2012, for 12 Tranche 3 P1Eb Typhoons, made up of nine single-seat and three T-2 dual-seaters. Alenia Aermacchi (now Leonardo) was awarded a contract by Eurofighter GmbH, worth some €170 million (\$207m), for the supply of components, logistical support, systems and services relating to the 12 new jets. Deliveries took place between August 2017 and June 2018. The aircraft are operated by 8 Squadron at RAFO Adam.

The UK RAF's Typhoon OCU No 29 (Reserve) Squadron trained the RAFO pilots during 2016/17, with most of them returning to Oman in June 2017.

The first 8 Squadron officer commanding, Wing Commander Bader Al Jabri, who was one of four pilots to become Typhoon-qualified flying instructors and flew the first Typhoon to Adam Airbase, said in 2019, that RAFO officials had initially visited three partner nation's instructional set-ups in Italy, Spain and the UK, but opted for the UK way of doing things.

An in-country flying course was set up at Adam, with a BAE Systems-supported maintenance programme in-situ for the first Typhoon arrivals. Student flying training was carried out by four RAFO Typhoon instructor pilots, an RAF-qualified weapons instructor (QWI), as well as two BAE Systems pilots.

The first conversion Typhoon course, known as Typhoon course one (TC1) began in December 2017, comprising of four weeks of ground school/computer-based training, two weeks of simulator flying on a Rockwell Collins FMS, provided by BAE Systems, and six months of type conversion. ■

Oman modernised its fighter fleet 10 years before most of its Middle East counterparts.

With the smallest fighter fleet, the QEAF ranks are set to be inflated with at least 96 new fighters. While it does run its own flying academy, it is going to need more advanced jet training aircraft and a revolution of its current tactical training methods.



The first F-15QA flew on April 14, 2020. Two are currently being used by Boeing for flight testing purposes. The first new aircraft are expected to be delivered in March.

PICTURE: BOEING.

SMALL FORCE'S COLOSSAL CHALLENGE

Of all the Middle East nations, it's the tiny kingdom of Qatar that faces the biggest training challenge of all.

Since its creation in 1974, three years after gaining independence from the United Kingdom, the Qatar Emiri Air Force (QEAF) has kept its fighting force at modest levels. In recent years, that has comprised a fleet of 12 Dassault Mirage 2000-5DDA/EDAs and six Alpha-Jet Es.

Now the QEAF is going through a major revolutionary modernisation programme, with the procurement of 96 new fighters – 36 Dassault Rafales, 36 (or even 48) Boeing F-15QAs, and 24 Eurofighter Typhoons. They will catapult the QEAF's capabilities into a new generation and will need it to come with improved training systems.

In light of these deals, Qatar will enjoy significant support from the French, UK and US governments.

Now the QEAF needs to ensure its military doctrine is in order and that its assets are interoperable. The only way of doing this is going on a huge training curve.

Continued
on Page 30

MODERNISATION

CONTINUED FROM PAGE 29

Unfortunately, all companies sign non-disclosure agreements when dealing with the Doha government, so trying to understand who is doing what has been difficult.

Just like the UAE and Saudi Arabia, Qatar looks set to contract huge swathes of foreign pilots from the likes of the US, French, and Pakistani air forces, and the UK RAF.

Fortunately, the Saudi and Qatar governments look to have settled their differences in early January, after signing a US-brokered deal. The problems stemmed back to June 5, 2017, when Saudi Arabia, backed by Bahrain, Egypt, and the UAE, severed ties with Qatar because of its alleged ties with “various terrorist and sectarian groups”. This led to the countries blocking off Doha’s air space, territorial waters, and land borders.

Qatar enjoys a cordial relationship with Iran, but it did support Saudi Arabia in the Yemen War. In Libya, where the main issues lay, it is backing the UN-recognised Government of National Accord (GNA) alongside Turkey, in opposition to the UAE, Saudi and Egyptian-backed Libya National Army (LNA). Cairo also accuses both Qatar and Turkey of meddling with its internal affairs in its support for the Moslem Brotherhood taking control of Egypt in 2012-13.



Back to the fighter procurement; an initial order for 24 Rafales worth €6.3 billion (\$7.8 billion) was signed on May 4, 2015, and the numbers were boosted when options were exercised for 12 Rafale fighters on March 27, 2017.

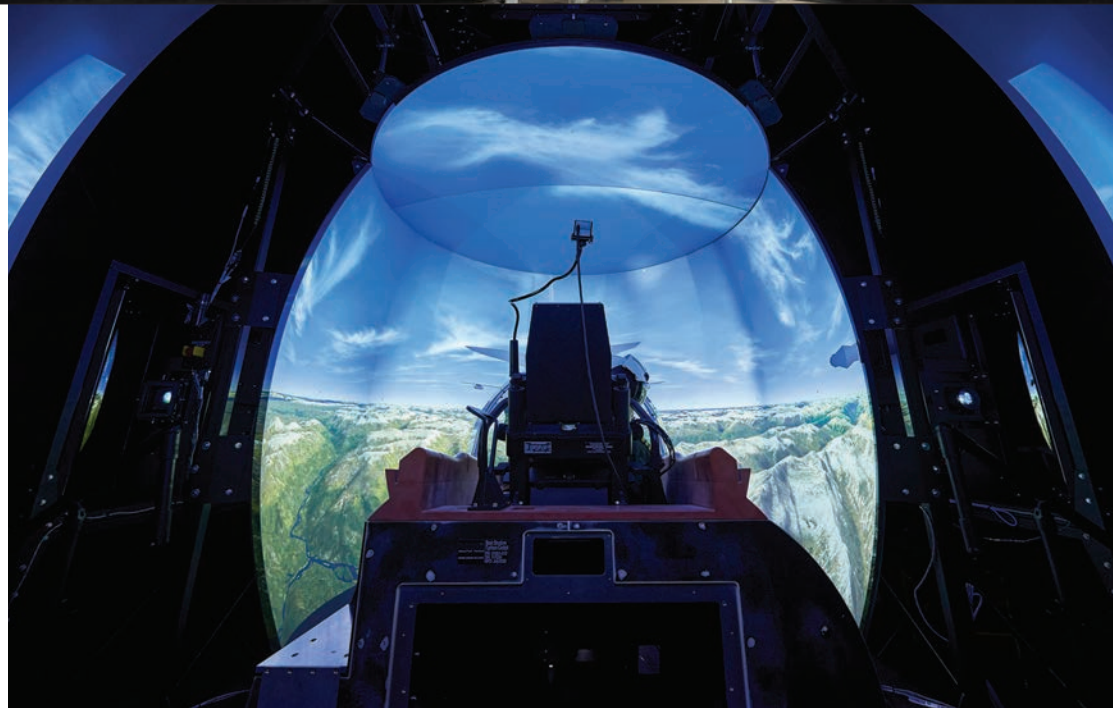
The first five of the 24 Rafales were officially handed over at Dunhoh Airbase on June 4, 2019.

Most of the Rafale instructor pilots were trained at Mont de Marsan (Base Aérienne 118) with EC 04.030, the Qatar Rafale training unit that was set up in October 2018.

St Dizier, where the French Air Force Rafale operational conversion unit is based, has also trained QEAF pilots, although this is believed to have stopped now.

All 18 single-seat Rafale EQs and six Rafale DQs, covering the first procurement, have now been handed over and are operated by the Al Adiyat Squadron, based at Tamim Airbase near Dukham.

Just a week after Saudi announced sanctions in June 2017,



CAE is supplying the Medallion MR e-series visual systems for the QEAF Eurofighter Typhoon full-mission simulators.

PICTURE: CAE.

Qatar ordered 36 Boeing F-15QA (Qatar advanced) Strike Eagles (although the US Department of Defence claims it is 48), an enhanced version of Saudi Arabia’s F-15SA. The aircraft brings next-generation technologies alongside the world’s speediest mission computer, a digital cockpit, modern sensors, modern radar, and improved electronic warfare systems.

In QEAF service the aircraft will be known as Ababil, a mythical swallow, according to the Koran.

The \$12 billion deal was updated with a \$6.2 billion undefined contract, to include US-based LIFT for the F-15QAs.

Boeing hopes to start delivering the 36 F-15QAs in March 2021, through to early 2023, but if options for another 36 are exercised it would stretch production by a further three years to 2026.

On November 10, 2020, the US giant acknowledged three foreign military sales contracts with the US Air Force for training services and support in Qatar, valued at more than \$800 million. They included a previously unannounced contract, awarded in 2019 to support the QEAF with F-15QA programme management, maintenance and aircrew training, valued at \$240 million over a five-year period.

Boeing also received a separate not-to-exceed \$68 million deal to provide maintenance and logistics support for the QEAF during pre-delivery training for the F-15QA aircraft in early 2021. It means QEAF pilots and

weapons system operators will learn in the US how to independently operate the F-15QA ahead of receiving their new mounts. Training will include in-person instruction, simulation, and flying operations, and will take place near Boeing’s F-15 production facility at St Louis, Missouri, through to mid-2021.

Following this, the company will establish and operate an aircrew and maintenance training centre for the QEAF at Al Udeid Airbase, Qatar, through 2024.

The third contract, awarded in November, 2020 and valued at more than \$500 million, will provide the QEAF with in-country spares and logistics support once the aircraft are delivered to Qatar.

Tim Buerk, director of Middle East defense services for Boeing, said: “The tailored training and sustainment delivered by our team, coupled with Boeing’s platform expertise, allows us to deliver a holistic solution to our Qatari customer so they can optimise the full capability of their fleet with high availability rates.”

In June 2020, a foreign military sale contract, valued at \$524 million, was awarded by the US Air Force’s Security Assistance and Cooperation Directorate to the Bahadir Construction Engineering and Impresa Costruzioni Giuseppe Maltauro joint venture for the construction of an operational fighter wing for the F-15QA bed-down at Al Udeid Airbase, Qatar in 2022.

JP ‘Jeep’ Wedding, the division’s Qatar section chief said: “This is the first time Qatar has purchased F-15s, so there are a lot of unique requirements for the facilities to be able to support the aircraft.”

Saudi and Qatar governments look to have settled their differences.



The massive, sprawling airbase at Al Udeid, south-west of the country's capital, Doha, is now one of the biggest building sites in the region to accommodate all the fighters.

The first six F-15QAs are expected to arrive in March 2021, according to a leading QEAF official, Brigadier General Issa al-Mahannadi, who also said that a further six will be delivered three months later, with four aircraft batches expected to follow at three-month intervals. All 36 aircraft should be in-country by late 2022, and the fleet fully operational the following year.

Boeing announced the first flight of a F-15QA on April 14, 2020, from St-Louis-Lambert IAP, Missouri. "We are very proud of this accomplishment and are looking forward with great excitement to the continued successes of this programme," said Colonel Ahmed Al Mansoori, commander, QEAF F-15 Wing. "This successful first flight is an important milestone that brings our squadrons one step closer to flying this incredible aircraft over the skies of Qatar."

Boeing's flight-test team, led by chief test pilot Matt Giese, implemented a precise mission checklist to test the multirole aircraft's capabilities. Checks of systems such as avionics and radar were also successful.

Prat Kumar, Boeing vice president and F-15 programme manager said: "The F-15QA is built using advanced processes, which make the jet more efficient to manufacture. In the field, the F-15 costs half per flight hour when compared to similar fighter aircraft and delivers far more payload at far greater ranges."

By early December, three F-15QAs were involved in the flight-test programme, two of them at Palmdale, home to Air Force Plant 42.

The F-15QA programme will help to fund development of the new domestic F-15EX; the US Air Force has a requirement for 144. One of the prototype aircraft was drawn from the F-15QA production line.

Qatar's digital fly-by-wire F-15QAs will provide the pilots with a huge leap in situational awareness, compared to anything they may have experienced before. A completely remodelled cockpit will allow information to be displayed on the 10x19in large area displays (LADs) in front of the pilot from on-board and off-board sensors, the latter via data-links.

The jewel of the F-15QA's crown is the AN/APG-82(V)1 advanced electronically scanned array (AESA) radar, while both the pilot and weapon systems officer (WSO) can utilise a joint helmet-mounted cueing systems (JHMCS), as well as view a low-profile BAE Systems-designed head-up display (HUD) when required. The latter was seen on display at the company's stand during the Dubai Airshow in November 2019.

Undoubtedly, Boeing's integrated live, virtual and constructive (I-LVC) technology will play a significant part in training crews in complex threat environments. I-LVC minimises the need for multiple aircraft to participate in training scenarios, extending range capacity and reducing the costs of expensive live flight training.

Qatar has ordered 36 Dassault Rafales, with the first five handed over at their new base, Tamim, on June 4, 2019. Seen here in December, 2020, is a single-seat Rafale EQs and dual-seat Rafale DQ (closest) preparing to refuel from a USAF KC-135R tanker.

PICTURE: USAF/ST SGT TREVOR MCBRIDE.



The system is aircraft-agnostic and can support training against air- and ground-based electronic warfare threats for domestic and international customers.

According to Boeing, this is possible through a wing-mounted LVC pod, to deliver processing power and integrate simulated threats into the cockpit environment.

The I-LVC has been designed for further expansion, covering new weapons and threats.

The third batch of fighters soon to be flying in country are 24 Eurofighter Typhoons. BAE Systems signed a £5 billion deal with Qatar on September 17, 2017, to make it the fourth operator of this multirole jet in the Middle East after Saudi Arabia, Oman and Kuwait.

The QEAF Typhoons will be very similar to those being purchased by Kuwait. Both are being equipped with the Captor-E AESA radar and Sniper advanced targeting pod (ATP); neither systems are operated by the four Eurofighter partner nations.

Eurofighter GmbH and its partner companies are working to ensure the Captor-E radar is compatible with the Typhoon's P3EB package.

Captor-E is a hybrid radar, having a conventional E-scan array mounted on a rotating mechanical repositioner also known as a swashplate. This method of operating will increase its angle of scan from +/-60° either side of the centreline, to greater than 90°, allowing the fighter to manoeuvre quickly after launching a missile, making it less vulnerable to a return missile shot.

The added bonus is the radar can still provide mid-course updates for the missile as it is en route to the target.

The Captor-E design was frozen while the software was being developed and matured through flight-testing by Leonardo and BAE Systems.

The value of the Eurofighter deal was increased with the simultaneous signing of a £1 billion order for MBDA Meteor and Brimstone missiles.

Qatar's MoD also said that the agreement includes "an electronic warfare system through continuous joint cooperation between the two countries". This will probably lead to a dedicated mission data centre being set up in Qatar.

BAE Systems has opted for the CAE Medallion MR e-series visual systems for the Eurofighter Typhoon full-mission simulators used by the QEAF. Thibaut

CONTINUED FROM PAGE 31

Trancart, CAE managing director, defence & security – Middle East, said at the company’s Oneworld virtual conference and tradeshow in July, 2020: “We are excited by their selection.”

Training QEAF personnel on the Typhoon saw the UK RAF re-establish No 12 Squadron on July 24, 2018, as a joint QEAF-RAF Typhoon training unit at RAF Coningsby. RAF personnel are training QEAF aircrews and ground personnel before the Typhoons are delivered in 2022. The first Qatari pilots to fly Typhoons with 12 Squadron started at the Lincolnshire base in June 2020.

As part of the ongoing training, a series of exercises, known as Epic Skies, have been held since 2017. Last year’s event, Epic Skies IV, saw six RAF/12 Squadron Typhoons deployed to Doha Airbase in early December. It led to RAF and QEAF pilots flying Typhoons together for the first time as a joint squadron in Qatar.

More than 130 personnel from the RAF deployed to Doha to support the two-week joint exercise, with Qatari pilots and engineers flying and maintaining the Typhoons alongside their RAF colleagues. Wing Commander Chris Wright, officer commanding 12 Squadron said: “Considerable progress has been made since last year’s Epic Skies, with many pilots and engineers from the QEAF thoroughly embedded into 12 Squadron. The first of the Qatari pilots to begin flying the Typhoon are eager to put their new skills and training to the test, flying alongside their colleagues in a series of challenging scenarios on home turf.”



Lieutenant Colonel Faisal Al-Ghanim, deputy officer commanding, 12 Squadron, added: “This year’s Epic Skies is unique. I’ve been involved in several of these exercises in the past, but this is the first time I have returned home to fly the Typhoon alongside my RAF and Qatari colleagues, wearing the 12 Squadron crest. We joined the squadron earlier this year. Returning to fly from Qatar at a familiar airbase is an absolute privilege.”

Over the course of the two-week exercise, 12 Squadron conducted a variety of air-to-air and air-to-ground missions against and alongside Qatari Rafales and Mirage 2000-5s. The manoeuvres saw QEAF commander, Staff Major General (Pilot) Salem Hamad Eqail Al-Nabet, flying in the rear of a dual-seat Mirage 2000-5DDA during a mixed-formation sortie.

Procuring the three highly capable fourth-generation fighters will, of course, bring higher costs, not just in the air but on the



ground, with more infrastructure and logistical needs. We have seen this through contracts issued to Boeing by the US Government in support of the F-15QA procurement. But, on the plus side, there is the effectiveness of operating three different fleets that are complementary, with different sets of weapons and capabilities.

Training aircrews and ensuring they are all operational when these new jets come along will take some doing. Qatar is working with both the industries and air forces of France, the UK and the USA to make sure new pilots are ready when they arrive.

Much of the initial training is being done at the newly built Qatar Air Force Academy, founded in 2011 at Al Udeid Airbase. The facility, officially known as the Al Zaeem Mohammed bin Abdullah Al Attiyah Air Academy, was created by France’s Defense Conseil International (DCI), which oversees the training there. The primary objectives of DCI is the transfer of French Air Force know-how to foreign air forces. DCI did not respond to a request to be interviewed.

In January 2017, the academy was employing 110 staff spanning 11 different nationalities and had trained 49 student pilots, although the bulk of them were for helicopters. Come graduation day on January 29, 2020, the QEAF was bidding farewell to a seventh batch of graduates including 33 fixed-wing pilots, 28 helicopter pilots, seven WSOs, and 29 fighter controllers, including nine from Kuwait.

The facility uses eight PAC MFI-17 Super Mushshaks to screen pilots and also to take some of the basic training work off the 24 Pilatus PC-21s. Along with a suite of ground-based systems, the latter are used for both basic and advanced training before pilots step into a fast jet.

For the latter, the QEAF is set to acquire nine Hawk Mk 166 advanced jet trainers,

Personnel from the RAF’s No 12 Squadron, a joint Qatari-UK Typhoon squadron deployed to Qatar in December 2020 under Epic Skies IV.

PICTURE: CROWN COPYRIGHT.

which should be delivered in 2021. It is undoubtedly a low number when you consider the inventory will swell from 12 jet fighters to at least 96. Undoubtedly, there will be more AJT purchases.

On October 14, 2020, the UK and Qatar governments signed a joint statement of intent to form a joint UK-Qatari Hawk squadron in the UK, probably at RAF Valley in Wales. QEAF pilots will take up lead-in fighter training, working with QEAF and RAF instructor pilots before progressing to the Eurofighter Typhoon.

The RAF’s No IV Squadron has been training QEAF pilots, at least six so far, on the BAE Hawk T2s at RAF Valley.

The Leonardo M-346 has been evaluated by the QEAF. In November 2018, an Italian Air Force T-346A jet trainer set a record by flying non-stop from Pratica di Mare Airbase, near Rome, to Al Udeid Airbase in Qatar, a distance of more than 4,000kms.

The advanced trainer, flown by the RSV (Italy’s test unit), was accompanied by two F-2000A Eurofighters and a Boeing KC-767A tanker; on a 10-day promotional tour of the Gulf, sponsored by the Italian Air Force and Leonardo. The tour comprised demonstrations in Qatar, Kuwait City, and Bahrain. The M-346 re-fuelled from the tanker five times, both to the Gulf and back.

On November 13, 2020, Italy and Qatar signed a five-year technical agreement that will cover bilateral military and technical industrial cooperation. According to Italian Minister Of Defence, Lorenzo Guerini, who travelled to Doha to sign the deal, this cooperation could include pilot training at the International Flight Training School (IFTS) at Lecce-Galatina and Decimomannu, but no contract has been signed yet, despite media reports. ■

Training aircrews and ensuring they are all operational will take some doing.

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The RSAF acquired 25 all-composite Cirrus SR22s for primary training in 2013.

PICTURE: ALAN WARNES.

HOW WILL SAUDI ARABIA'S 2030 VISION SHIFT ITS FOCUS?

After working so closely with BAE Systems since 2012, the RSAF training set-up is very mature. However, with Saudi's 'vision 2030' are we going to see a change in the dynamics?

Saudi aircrew training requirements have been overseen by BAE Systems since a £1.6 billion (\$2.19bn) contract was announced on May 23, 2012.

The deal was agreed as part of the Saudi-British defence cooperation programme, leading to the acquisition of 55 Pilatus PC-21 turboprop trainers for basic and advanced training, 22 Hawk Mk 165s for lead-in fighter training, as well as aircraft simulators and training aids.

The new Hawk AJTs, delivered in 2016/2017, have replaced the Royal Saudi Air Force's (RSAF's) Hawk Mk 65s, in service since 1997.



The Hawk Mk 165s provide state-of-the-art simulation for weapons, radar and defensive aids training, thus easing transition to the RSAF's latest front-line aircraft. They are similar in configuration to the UK Royal Air Force's Hawk T2, but house an upgraded variant of the Rolls-Royce Adour Mk 951 engine, new data-link and an alternative radio system. Unlike the RAF T2s, they can also drop live weapons and fire weapons, whereas the T2s only simulate this capability.

A follow-on contract for a further 22 Hawk Mk 165s for the

RSAF was announced by BAE Systems on February 18, 2016, but these are being assembled from kit-form as part of the Saudi 'vision 2030', at King Abdulaziz Airbase. This will bring the total purchased to 44. By December 2019, six had been put into service. BAE Systems would not provide any further update.

CAE supported BAE with the design and development of Hawk ground-based training systems delivered in 2015/16. This includes full mission simulators, integrated procedure trainers, egress training, ejection seat training, and brief/debrief stations.

The RSAF PC-21s were delivered between June 2014 and March 2016, and are operated by 9 and 22 Squadrons of the King Faisal Air Academy at Riyadh-King Khaled Airbase.

BAE Systems also brokered a Cirrus Aircraft deal, announced on July 29, 2013, for 25 all-composite, four-seat Cirrus SR22T aircraft to support RSAF primary flying training requirements. All were delivered between August and October, 2013. They are an unusual type to be selected for military flying; the only other air force to use them in this role is the French.

Also operated by 8 Squadron in the training role, alongside the

SR22Ts, are 20 PAC-AMF MFI-17 Super Mushshaks, acquired from Pakistan under a contract awarded in 2003.

The RSAF has, for a number of years, been looking to upgrade its Super Mushshaks with a digital cockpit, probably a Genesys IDU-680, but so far nothing has materialised.

The RSAF boasts the best-equipped armed forces in the Gulf Region, with a mix of Boeing F-15SA and F-15S Strike Eagles, Eurofighter Typhoons, and Panavia Tornados providing a cutting edge.

The 84 new F-15SAs were the most advanced variant of the Eagle built, until the Qatari F-15QA. They incorporate a number of features taken from South Korea's F-15K Slam Eagle and Singapore's F-15SG, as well as some newer systems. Two additional outboard under-wing hardpoints (stations 1 and 9) have been incorporated, which prompted the development and installation of a new digital fly-by-wire flight control system.

In addition to the fly-by-wire controls, the F-15SA features a new Raytheon AN/APG-63(V)3 active electronically scanned array (AESA) radar, and F-110-GE-129 improved performance engines. The equipment fit includes the Tiger Eyes targeting and navigation pod (an updated version of LANTIRN), a DB-

The RSAF boasts the best-equipped armed forces in the Gulf Region.



Like many Middle East air forces, the Royal Saudi Air force has opted for the Pilatus PC-21 in the basic/advanced flying training role.

PICTURE: ALAN WARNES.



110 reconnaissance pod, an AN/AAQ-33 Sniper targeting pod and a new digital joint helmet-mounted cueing system with night capability.

A new digital electronic warfare system and common missile warning system are also incorporated into the aircraft.

The weapons fit includes the AIM-9X Sidewinder and AIM-120C7 AMRAAM for self-defence, plus a wide range of laser/GPS-guided munitions for air-to-ground attack missions. The RSAF purchased 158 Sniper ATPs for its F-15SA fleet, providing one for each of the eventual 152 aircraft, together with six additional spare pods.

In a related move, Lockheed Martin has established a Sniper ATP expanded repair capability centre in Saudi Arabia, in association with the local Advanced Electronics Company (AEC), marking the first such facility outside the US. On January 28, 2016, the US manufacturer announced that it had recently celebrated the opening of this facility. Having a local centre expedites repair times for the

RSAF's Sniper ATP, improving fleet readiness.

All 68 F-15S are being upgraded to a similar standard.

The F-15SA deliveries started through RAF Lakenheath, UK, in December 2016. All but two, which are now part of the aircraft's development programme, are now in Saudi.

The first delivery comprised two prototype conversions from the existing F-15S airframes, under what is termed the F-15SR (S retrofit as the upgrade is known internally), alongside two new-build F-15SAs.

One of the F-15SRs was converted by a team at Boeing; the second by engineers from Alsalam Aerospace Industries based at Boeing. The remaining upgrades from existing F-15S airframes are being undertaken in-country by Alsalam Aerospace Industries in Riyadh.

Work started on the first Boeing F-15S to F-15SA conversions in Riyadh during March 2017. This came after the US Government awarded a \$59.7

All except two of the F-15SEs have now been delivered to the Royal Saudi Air Force. They offer a new generation of weapons, which the RSAF has been ordering in big numbers over the past few years.

PICTURE: ALAN WARNES.



million fixed-price contract to Alsalam Aerospace to convert six Boeing F-15S at its factory. Work was expected to be completed by August 2020, although it's unclear if this happened. Work on the remainder of the 68 F-15S was scheduled to continue through to 2026.

The bulk of the F-15SR work sees the forward fuselage and both wings built by the company fitted on to the original fuselage, along with new pylons, and adaptors for under-wing station 1 and 9.

An Alsalam spokesman told me in March 2019: "Each retrofit will take around eight months, with several aircraft on the conversion line at any one time."

The RSAF completed the delivery of its 72 Eurofighter Typhoons in June, 2017, and BAE Systems announced on March 9, 2018, that a memorandum of intent (MoI) had been signed with Saudi Arabia for an additional sale of 48 more Typhoons to the RSAF. No firm contract has been signed, and one wonders how it will all fit in with the Saudi Arabia's 'vision 2030' strategy, calling for production of the aircraft in Saudi Arabia.

One major difference between the RSAF Typhoons and the other operators is the French-designed Thales Damocles LDP, which was selected over the Israeli-designed Litening III pod. It made sense, with the Damocles pod being built under licence by Saudi Arabia's Advanced Electronics Company (AEC) for use by RSAF Tornados. A contract for the integration of Damocles on Saudi Typhoons was believed to have been placed in May 2012. The pod was in service by 2014.



With no major investment in its fighter fleets, the training hasn't needed to be reviewed. But if the UAE's aspirations to buy the F-35A are fulfilled, that could all change.

SHOPPING LIST HIGHLIGHTS NEED TO UPGRADE TRAINING

The bulk of the UAE Air Force and Air Defence (UAEAF&AD) training capability is delivered by the Sheik Khalifa bin Zayed Air College Flying Training School at Al Ain, Abu Dhabi.

A fleet of 12 Grob G115TA Acro aircraft, delivered in February 2001, fulfil the primary training, with cadets then moving on to basic flying training on the 30 PC-7s in service since 1982.

For advanced flying, students sharpen their tactical skills on 25 Pilatus PC-21 turboprops, delivered in 2011-12, along with a ground-based training system and logistics support. This has enabled most of the elderly Hawk Mk 63s to be withdrawn from the role. Some have been used for target towing, but 13 were transferred to the Royal Jordanian Air Force in 2015, although they were soon replaced by the PC-21 as well.



The UAEAF&AD is looking for a new lead-in fighter trainer and, last spring, both the Leonardo M-346 and China's Hongdu L-15 had been invited to Al Ain for a flight evaluation. However, Covid-19 thwarted those plans.

The M-346 was selected by the UAE back in 2009, but the deal fell through when, allegedly, Alenia Aermacchi could not fulfil the offset agreement, paving the way for the PC-21 purchase.

Rotary-wing training is contracted out to the Horizon International Flight Academy at Al Ain, which operates 12 Bell 206 Jet Rangers, 13 Bell 407s, two Bell 429s, and 12 Bell 505 Jet Ranger Xs, as well as four simulators.

Horizon's CEO, Hareb Al Dhaheri, believes that operating three fleets of Bell helicopters helps to keep costs down, providing more value for the customers. "The 12-strong Bell 206 fleet flew their last training course recently, so now the



Bell 505s will replace them, working alongside the Bell 407s in the basic flying training course. The dual-engine Bell 429s are being used for advanced training," he said.

All 27 helicopters have joined Horizon within the past four years, and are helping the biggest civil helicopter training academy in the Middle East to flourish.

Al Dhaheri, who has been CEO at Horizon since 2011 continued: "We are unique because we mainly train the military, although we do offer civilian students the private pilot license (PPL) or corporate pilot license (CPL) training course. Air forces recognise our high quality of training."

Horizon, established in 2003, has graduated more than 1,500 pilots and flown more than 150,000 flight hours from its Al Ain facility. While most of its students are from the UAE and other GCC countries, there are many coming from Asia and Africa, although Al Dhaheri was reluctant to reveal which nations.

Simulation, of course, plays a big part, so it's no surprise to learn the company has four (206, 407, 429 and 505) simulators.

Horizon International Flight Academy, based at Al Ain, is operating an all-Bell helicopter fleet that includes two twin-engine Bell 429s for advanced training.

PICTURE: ALAN WARNES.

"The Bell 505 is a full training device (FTD), rather than a full-motion one, because we didn't have the need, and we are upgrading the Bell 429 simulator to an FTD," said Al Dhaheri. "They are almost a replication of the real aircraft; the system is the same and its good for our customers because it reduces the flying and the costs of the courses. They are great training devices. We also have two flight navigation and procedure trainers for the Bell 206 and Bell 407."

The CEO revealed that his next step is to link up the simulators, so they are interoperable. "With the sims 'talking' to each other, the military students can 'fly' together in formation, land together etc, which will be great preparation for their tactical training," he explained.

During basic training, students used to fly 10 hours in the sims over the 135-hour course. However, with the FTD, that has been increased to 25 hours. "We count the sim hours as part of a student's flying hours because, whether it's in the sim or in the real helicopter, it's all flying," said Al Dhaheri.

The two Bell 429s, delivered in

"We count the sim hours as part of a student's flying hours."



Could the F-35A be flying with the UAEAF&AD? If so, radical changes to the training set-up there will be needed. Here, a USAF/56th Fighter Wing F-35A taxis back to the ramp with weapons bay still open.

PICTURE: ALAN WARNES.



The Mirage 2000-9s and F-16E/F Block 60s represent the UAEAF&AD's combat force. Both aircraft are going through upgrades.

PICTURE: ALAN WARNES.

late-2018, were acquired to teach new pilots how to operate a twin-engined helicopter, which most will fly when they return to their air force.

“The twin engine gives us the flexibility of teaching advanced flying techniques at low level, wearing night vision goggles, using auto-rotation, or conducting search-and-rescue and longer missions,” said Al Dhaheri.

“There are six basic flying courses a year and, once the students have their wings, they can progress to the advanced flying. There is the capacity to train between 80 and 100 students at Horizon, where there are about 35 qualified helicopter instructors (QHIs), the majority of them ex-pats.

“The instructors have a lot of experience, which is what we need, and, at the moment, we don’t train instructors; they will have gained that qualification with their military.”

Al Dhaheri, a former UAE military helicopter pilot himself and a QHI, admitted that he believed the British flying training is the best. That’s the reason he has 15 UK QFIs on Horizon’s books.

Similarly, some UAEAF&AD fixed-

wing pilot training, is carried out by Etihad Airways, which acquired Horizon’s fixed-wing training operation in 2014 and formed the Etihad Flight College, also at Al Ain. It uses Cessna 172SP Skyhawk and twin-engine Diamond DA42NG aircraft.

On the fighter front, the Yemen War has taken its toll on the UAE’s 77-strong F-16 Block 60 Desert Falcons and the 56 surviving Mirage 2000-9DAD/EADs. Sustaining the fleets has been a main priority, with supportability packages to cope with the additional workload, allowing them to continue flying until 2030.

The 77 Lockheed Martin F-16E/F Desert Falcons (two are also retained in the US for trials work), comprise 54 F-16Es and 23 F-16Fs. They entered service in 2004 and are operated by I, II and III Shaheen Squadrons as part of the fighter wing under the control of Western Air Command at Al Dhafra Airbase, Abu Dhabi.

Working alongside the F-16s is a fleet of 56 Mirage 2000-9s – 13 Mirage 2000-9DADs, 35 Mirage 2000-9EADs, and eight Mirage 2000-9RADs. They are flown by 71 and 76 Squadron at Al

Dhafra, plus 86 Squadron at Al Safran Airbase, Abu Dhabi.

In November 2019, the UAEAF&AD announced an upgrade of the entire F-16E/F and Mirage 2000-9 fleets.

A \$350 million deal upgrade to the Mirage 2000-9s will address the jet’s mission computer system, fire control radar, electronic warfare suites, cockpit displays, and helmet-mounted systems. The package is also likely to include the Thales RDY-3 radar and TALIOS targeting pod.

Little detail has been given on the F-16 contract, worth \$1.65 billion, with the UAE only saying it will address “obsolescence issues” in the jet. A new faster data processor is among the solutions, as well as spares and support.



The UAEAF&AD has spent a decade examining options for the purchase of around 60 new fighters to replace the ageing Mirages, at a potential estimated cost of around \$6 billion. Both the Dassault Rafale and Eurofighter Typhoon were contenders, but the UAE has always longed for the F-35A Joint Strike Fighter. Now, with the historic accord signed with Israel in September, the export of the fifth-generation fighter to the Middle East nations has been made easier.

The UAEAF&AD looks set to purchase up to 50 F-35As and, undoubtedly, the UAE will want to be a part of any production or maintenance programme. Purchasing the F-35A will bring a need to revolutionise its training requirements with new mission data centres, simulators and synthetics. It’s likely to bring wholesale changes to the flying training syllabus at Al Ain if the UAE can afford it, because the PC-7 and Grob 115s are now pretty long-in-the-tooth. ■

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MODERNISATION

ALGERIA

NORTH AFRICA OVERVIEW:

Unlike the Middle East, North Africa without the substantial oil revenues, has not been modernising its air forces in the same manner.

Synthetics and simulation is unlikely to figure very highly in the training, although this is likely to change in Morocco and Tunisia.

Algeria and Egypt, still very old-fashioned in the way they operate their air forces, with no real operational integration or network solutions, look to Russia to fulfil their modernisation plans.

The Royal Moroccan Air Force, renowned for its vision, prefers to stick to the US now after years of being equipped by its old colonial masters, France and Dassault.

Algeria still relies on the Aero L-39ZA for basic and advanced jet training. The manufacturers still continue to support the veteran jet.

PICTURE: AERO.

ALGERIA STILL STUCK IN THE PAST

Training is still being done the old fashioned way, without any integration of its capabilities and platforms. Simulation and synthetics are probably not on the air force's radar either, but cutting-edge technologies like the fifth-generation Sukhoi Su-57 are. Things will have to change.

Algeria's training systems have not advanced much since the 80s, which means there has been little requirement for simulators, or any other types of synthetics.

For primary training, the 658th Basic Training Squadron (BTS) and the 678th Basic Training Squadron, operating from Tafaraoui, fly a mix of around 50 Farnas 142s, Safir 43s, Zlinn 142Cs and Zlinn 43s.

The Farnas 142 and Safir 43 are license-built Zlinn 142 and Zlinn 43 aircraft, assembled by Algeria's own Enterprise de Construction Aeronautique-(ECA).

Algeria also looked to Czechoslovakia, later the Czech Republic, to fulfil its jet training needs, by acquiring 56 L-39C/ZAs.

Today, Algeria relies upon around 30 Aero L-39C/ZAs, split between Tafaraoui, home of the 618th Advanced Training Squadron (ATS), and Mecheria, where the 620th APC is based. Seven original L-39Cs, delivered in 1991, were augmented by 32 L-39ZA-1s, with Russian avionics, between 1987 and 1990.

Another 17 L-39ZA-4s, with western avionics, originally destined

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MODERNISATION



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for Nigeria, arrived between November 2002 and March 2003.

Aero signed a contract, in 2013, to overhaul the 15 surviving L-39ZA-4s, as well as two L-39Cs for upgrades with western avionics. The Prague-based company's support of the Algerian Air Force L-39 fleet is a good example of how it has improved customer support in recent years.

Pavel Sedlacek, Algeria project manager, told me in 2017: "We have a follow-on service and support (FALSE) contract for delivery of spare parts and services in Algeria. We have also sent technical staff to Tafaraoui to extend the service life of the 14 L-39ZA-1s. Two of the latter were also to be upgraded with western avionics."



Between 2013 and 2015, the Czech manufacturer overhauled a batch of eight aircraft at Aero, comprising six ZA-4s and two C versions, while a second batch of nine followed.

Algeria is one of six countries to operate the Yak-130 Mitten for advanced training. While the Algerian Air Force (AAF) operates 16, the other countries are Russia (109), Bangladesh (16), Belarus (12), Laos (4), Myanmar (14), and Vietnam, which ordered 12 in 2019.

The first group of Algerian pilots underwent conversion training on the Yak-130 at Irkutsk, with delivery of the first three aircraft in November 2011. The aircraft has suffered from serviceability issues, and perhaps this is why the AAF still also flies the L-39ZA in the advanced training role.

Force integration at the tactical level is not common, like in most other MENA air forces, so all the combat aircraft generally work independently.

Way back in 2006, Algerian officers convinced air force headquarters (AFHQ) senior staff that they needed to develop exchange and training exercises with NATO forces. This materialised with four Belgian Air Force F-16 mid-life upgrade (MLU) jets detaching to Bou-Sfer Airbase. While welcomed by the pilots, the HQ was much less enthusiastic and, eventually, the visit was terminated abruptly by the joint chief of staff.

After a few two-versus-two combat training missions were flown, he stopped

Algerian MiG-29C pilots from the 3rd Air Defense Wing from flying four-versus-four sorties. The reason was so as to not reveal the weaknesses of the Algerian training system, despite the strong desire by the Algerian pilots to learn.

After a trial of a German ACMI pod took place on a MiG-29C in November 2006, the AFHQ stopped all attempts to purchase the system, failing to realise the importance of such a valuable asset.

The AAF has to make the older MiG-29C and Su-24MK2 Fencer co-exist with 57 modern SU-30MKAs (one crashed in a fatal accident on January 27, 2019), but there is no interoperability, and definitely no network-centric solutions. Without it, the air force lacks all forms of combat flexibility and has no tactical cohesiveness or effectiveness, thus denying the benefit of a powerful force multiplier in combat operations.

As an example, Algerian SU-30MKAs, equipped with a very basic data-link capability, should be able to exchange limited messages. However, they are unable to exchange or receive a complete tactical situation update. So they get no recognised air picture from a ground-based air defence system, or a battlefield picture from an airborne ISR platform. Despite the AAF having deep pockets, it is unable to influence or impose technical requirements when buying new aircraft, most probably because of ignorance

and a lack of vision. This is in stark contrast to the UAE, Saudi, and Qatar so, when Algeria procures equipment, it focuses on the political aspect and the appearance of an aircraft, rather than the heart of the system and how it really enhances the combat operations. One great example

recently was the speculation, in September 2020, that the AAF was looking to procure 14 Sukhoi Su-57s, after the Algerian Army chief of staff, Said Chengriha, hosted Russia's Dmitry Shugaev, from the Federal Service for Military Technical Cooperation. Surely, with the Su-57 at such an early stage in its development, it would be wise to wait.

Obviously, Algeria did not learn any lessons from the purchase of the Yak 130 Mitten advanced jet trainer in 2006. The jet was ordered in 2006 but didn't arrive until 2011, and it suffered from various issues after delivery because the on-board systems had allegedly not even been validated. ■

The air force lacks all forms of combat flexibility and has no tactical cohesiveness.



VARIETY
THE SPICE
OF EGYPT'S
SECRET
LIFE

The Egyptian Air Force has one of the most varied fighter fleets in the world, with the Dassault Mirage 2000 still in operational use. Three are seen here training with a French Air Force KC-135FR.

PICTURE: VIA ALAN WARNES.



Egypt operates a mix of German, Brazilian and Chinese trainers for a fighter fleet comprising F-16s, Mirage 2000s, Rafales, Su-35s and MiG-29s. There is unlikely to be any simulation.

The Egyptian Air Force (EAF) is one of the most secretive in the world, largely because of Egypt's internal conflict in the Sinai Desert. As a result, it's difficult to establish a recent picture.

The Air Force Academy, at Bilbeis, took delivery of 72 Grob 115Es for primary flying training in 2000, split across 3 and 5 Squadrons. It's unclear how many are still operational, but Grob has been keen to sell the 120TP for several years now.

Grob's chief sales officer, Karl 'Charly' Fuernrohr, is optimistic the EAF will consider a purchase of new Grob 120TPs soon. He told me last year: "We can take students all the way to the LIFT sector. We mix it with simulator hours and drastically decrease flying time, even for take-offs and landings. For computer-based training, the student receives a tablet or computer and completes his or her training through the digital route."

While 54 Embraer 312 Tucanos were delivered in 1984, it is difficult to know the current set-up.

Four squadrons at the academy still operate the survivors of 120 Hongdu K-8Es, built locally by the Helwan-based Aircraft

Factory between 2000 and 2010. The facility has now also completed the overhaul of most of them.

Obviously, the training set-up needs modernisation, but the EAF has been concentrating on the sharp end of its requirements.

Egypt signed a €5.2 billion (\$6.32bn) deal with the French Government, in February 2015, for 24 Dassault Rafales (16 two-seat DMs and eight single-seat EMs) that led to Egyptian Air Force pilots being sent to Istres Airbase, near Marseille, to be trained by Dassault.

The first three DMs were subsequently delivered, in July 2015, with EAF instructor pilots on board. They are training the new batches of pilots, coming from Mirage 2000s and F-16s.

It is unclear if there are any ab-initio pilots coming straight from the academy yet.

The Rafales flew their first combat mission in May 2018 and, in March 2019, with jets from the French Air Force were involved in their first joint exercise, indicating the aircraft and their crews were now fully operational.

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This model of an F-16 on display at the Lockheed Martin stand in December 2018 illustrated some of the upgrades the Egyptian F-16 fleet could get.

PICTURE: ALAN WARNES.

“There are so many conditions attached and always the threat of sanctions.”

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Another 12 Rafales were subsequently ordered in January 2019.

The EAF has taken delivery of 240 F-16s, spanning four decades, but they have lacked any real smart weapons capability.

At the Egyptian Defence Exhibition (EDEX) in December 2018, I saw an F-16 model, in EAF markings, positioned at the Lockheed Martin stand and fitted with a joint direct attack munition (JDAM), AIM-9X Sidewinder and AIM-120 AMRAAM – weapons the EAF does not have.

These display models are usually a clue as to what a company is marketing to the host nation.



The reason why Egypt never acquired these weapons, even when they acquired the Block 52s in 2013, was, according to a Lockheed Martin source: “because it never signed an agreement that allowed it to acquire these weapons.”

In January 2018, Egypt signed the communications, interoperability and security memorandum of agreement (CISMOA) with the US Central Command, which could pave the way for such munitions. Until then, the Arab state had declined to comply, largely because it did not want to allow US personnel access to its facilities and communications.

Instead, the local F-16s flew with the outdated AIM-7 Sparrow and AIM-9 Sidewinder air-to-air missiles and the

likes of the Mk 81/82 laser-guided bombs.

A source told me in 2018 that Lockheed Martin had offered to upgrade the EAF’s 30-plus surviving Block 15s with the more capable and longer range Northrop Grumman APG-68(v9) multimode fire control radar.

If agreed upon, this would see the oldest F-16s in the fleet fitted with the likes of the AIM-120, AIM-9X, joint helmet-mounted cueing systems (JHMCS), and JDAMs seen on the EAF F-16 model.

Undoubtedly the US Government has offered Egypt the F-16 Block 70/72, providing a significant increase in capability

Although the EAF operates one of the biggest F-16 fleets in the world, the Egyptian Government is reluctant to acquire more US fighters because, as one source told me: “There are so many conditions attached and always the threat of sanctions.”

There are plenty of other options out there now and Egypt, like so many other countries, realises it must go outside of the International Traffic in Arms Regulations (ITAR) if possible.

Good relations with Russia means the latest MiGs and Sukhois are always an option, even if inter-operability with the French and US fighters will remain a problem.

Egypt signed a \$2 billion contract with Russia for the delivery 30 Su-35 Flankers in late 2018. The aircraft are being built by the Sukhoi facility at Komsomolsk-on-Amur Aviation plant (Russia), with

22 due for delivery in 2020 and the balance by this year. It appears none have been delivered yet for whatever reason.

The last of 46 MiG-29M/M2s, purchased in 2015, are thought to have arrived in Egypt during the second half of 2020, three years after the first examples arrived in October 2017.

In January 2020, during Exercise Qader 2020, the Egyptian MoD released a video of two MiG-29Ms, fitted with air-to-air ‘buddy-buddy’ tanks, refuelling two Rafales.

The system is believed to be the PAZ-MK refuelling pod, designed at the outset to increase the range of carrier-borne MiG-29K/KUBs, a naval version of the MiG-29M operated by the Russian Navy and Indian Navy.



The pod taps into the aircraft’s own fuel supply, made up of internal and external tanks, offloading fuel to the receiver aircraft at a rate of up to 750 litres-per-minute.

There is speculation that MiG-29Ms, equipped with these buddy tanks, may have refuelled in an attack on Al Watiya Airbase in Libya on July 5, 2020.

The Turkish-supported Government of National Accord (GNA) took back the facility from the Egyptian-backed Libyan National Army (LNA) nearly two months later.

It’s unlikely the attack would have been carried out by Egyptian Rafales because the EAF lacks any destruction of enemy air defence (DEAD) capability. ■

LIBYA UPDATE

With an ongoing civil war, the once mighty Libyan Air Force is no more. Neither the LNA (Libyan National Army) or GNA (Government of National Accord) which are fighting each other has any needs for training aircraft – only offensive ones and UAVs. ■



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MARRAKESH AND MEKNÈS PLAY KEY MOROCCAN ROLE

Undoubtedly the star air force of the region, the RMAF bought T-6C Texan IIs in 2012 to fulfil the bulk of its flying training needs. Integration of its combat fleet is not an issue and has 24 Block 70 F-16C/Ds on order.

The Centre d'Instruction au Pilotage (CIP, Pilot Training Centre) at Marrakesh is tasked with training new pilots for the Royal Moroccan Air Force's (RMAF's) fighter, transport and helicopter streams.

Students enter the sélection en vol (flight selection) to pilot one of around 10 AS 202 Bravos used specifically for this task. If successful, they will be cleared to fly one of the 24 new Beechcraft T-6Cs.

Deliveries of this aircraft to Meknès-Menares began in late January 2011 and, within a year, all 24 had been delivered. Students fly 120 missions in the T-6C during their year at the CIP, while undergoing basic flying training. If selected for advanced flying training, the Alpha Jets at Meknès will be the next stop.

Newly qualified pilots spend around a year with the Centre d'Instruction des Pilotes de Combat (CIPC) at Meknès (BAFRA 2). They learn the basics of flying fast jets and tactical manoeuvres on the upgraded Alphajets.

A €27million (\$32.9m) deal to upgrade 22 Alpha Jets was awarded to Thales in late 2009. SABCA, based at Charleroi, was responsible for developing the upgrade kits that included a hands-on-throttle-and-stick (HOTAS), a head-up display and flight instruments in the centre of the control panel.

The rear cockpit has a new multi-function display, enabling the instructor to monitor the weapons and navigation systems. These new digital systems provide most of the advantages of a glass cockpit without the expense of fitting one.

Modernising its fighter fleet has been a main priority for the RMAF.



The whole fleet of around 20 F-5s was upgraded during the 2000s. Under the utmost secrecy, Israel Aircraft Industries (IAI) revolutionised the fighter's capabilities by integrating the multi-mode Elta EL/2032M radar. Litening laser designator pod systems and a batch of light Israel Military Industries Delilah cruise missiles were also believed to have been sold.

One source told me: "Their F-5s now have a complete tactical situation awareness system, working with a Link-16-type data-link, allowing aircraft to share and receive tactical information from ground-based air defence radars to build the air picture."

All the F-5s are based at Meknès, where Escadre de Chasse (EdC) 'Chahine' specialises in the air-to-ground role and EdC 'Barak' focuses on air defence, although pilots are trained in both missions.

Then came the upgrade of 27 Mirage F-1EH, F1CH and F1EH-200s, the latter fitted with air-to-air refuelling probes, into one common Mirage F1EM/CM-VI fleet. The enhancement was designed by the Association Sagem Thales pour la Rénovation d'Avions de Combat (ASTRAC) consortium.

A joint venture between Thales and Sagem Défense Sécurité (SAFRAN) was established in November 2005, at the request of the French Ministry of Defence, which had tired of them competing against each other for this work.

SABCA of Belgium integrated the Thales RC400 (RDY-3) multi-mode Doppler radar, based on the Mirage 2000-5 RDY radar, albeit with a smaller antennae giving shorter range.

After acquiring 24 F-16C/Ds in 2011, the RMAF ordered 20 F-16C/D Block 72s in August 2020 to beef up its offensive prowess. It will probably mean the end of the F-5E/Fs.

PICTURE: ALAN WARNES.

The cockpit was transformed with two colour multi-function displays, a HUD and HOTAS. Another main feature of the upgrade was the enhanced electronic warfare capabilities. As well as a new digital radar warning receiver (RWR), there is an external electronic countermeasures (ECM) pod designed to detect, classify and counter the search, fire-control, and missile seeker radars.

The aircraft's suppression of enemy air defences (SEAD)/destruction of enemy air defences (DEAD) capabilities are a real threat to Algeria, its neighbour and long-time foe. The jet is equipped with the Armement Air-Sol Modulaire (AASM) Hammer, principally to challenge the Algerian air defence systems' Pantsyr S2 surface-to-air (SAM) systems and SU-30MKAs.

Four Thales Analyseur de Signaux TACTiques (ASTAC) electronic intelligence (ELINT) pods were supplied by the French Government to equip the upgraded F1s. They have allowed the RMAF to develop an impressive capability to map Algeria's radar and communication networks. The imagery can be data-linked to two Falcon 20ECMs, modified in 2005, to attack Algerian systems with their on-board electronic warfare wizardry.

Air defence capabilities have also been considerably enhanced, with the Mirage F-1M-VI's ability to uplink the complete air picture through its Thales avionics systems from the Thales-Raytheon ground air defence radar network (GMA-400 and AN/APQ-64 Sentinel radar). Combined with the beyond-visual-range

With a bulk-buy of Beechcraft T-6Cs in 2012, the RMAF has a significant training capability.

PICTURE: ALAN WARNES.



Mica EM/IR missile, the Mirages can bring down a high-flying Algerian MiG-25, or a low level Su-24MK, fairly easy.

Many in the French fighter industry regard this upgrade as the most complex ever undertaken on the F1.

Around 15 F1s are split between EdC 'Assad' and 'Atlas' with the remainder being cannibalised. The main issue stems from the non-availability of spare parts for the SNECMA ATAR 9K engines. Several two-seat Mirage F1Bs are believed to have come from ex French Air Force stocks, even if there was a disagreement over who should pay for their overhaul before delivery.

Morocco's \$2.4 billion acquisition contract for 16 F-16C Block 52s and eight F-16D dual-seat Block 52s, in 2008, was a big surprise, as the country had been expected to stick with France and buy the Rafale.

Morocco had always previously preferred its former colonial masters, but the new deal didn't work that way. Lockheed Martin was just as startled with winning the contract as Dassault was at losing it.

The first pair of F-16Cs were officially accepted during a formal handover ceremony on August 4, 2011.

Three F-16 units – EDC 'Falcon', 'Viper' and 'Spark' – operate in the air-to-air and air-to-ground roles serving the 6 BAFRA at Ben Guerir, which was officially opened on July 27, 2009 after many years of renovation.

One of the F-16Cs was lost in a fatal accident on May 10, 2015, during an operation over Yemen, supporting allied efforts against the Iranian-backed Houthis.

Just like the Mirage F1 crews, the F-16s, too, have been training regularly on SEAD missions, working with the AGM-88 HARM missile and Raytheon digital radio frequency memory (DRFM) electronic warfare systems.

Actively training its personnel in SEAD is a priority to ensure they can distinguish a real radar system from electronic decoys that the Algerian air defence radars may emit.

In September 2019, Morocco signed a letter of agreement for the acquisition of 25 F-16C/D Block 72s, equipped with Pratt & Whitney F100-229 engines, in a deal worth \$3.78 billion. Among the weapons approved for sale to Morocco were 40 AIM-120C7 AMRAAMs and 60 GBU-39 small diameter bombs (SDB 1s), in addition to 26 AN/ALQ-213 electronic warfare pods. A mission-planning system was also included.

In August 2020, Lockheed Martin was awarded the contract and, while the US Defense Security Cooperation Agency (DSCA) has approved the upgrade of the existing 23 F-16C/Ds, no deal has yet been signed off.

All Moroccan combat aircraft are net-centric, highly integrated by data-link, with the newly acquired Thales ground radars.

These capabilities did not exist 20 years ago but, today, represent a sustained effort very cleverly achieved by Moroccan personnel. This modernisation programme has been well thought through and will certainly stretch the Algerian air defences, despite Morocco's lack of financial resources. ■

TUNISIA

SCHOOL FLEET MOVES INTO A DIFFERENT CLASS

An air force that has stagnated in recent years, its training inventory is set to be boosted by eight T-6C Texan IIs, and there is a possibility of four AT-6C Wolverines for the front line.

The Tunisian Air Force Aviation School at Borj El Amri Aviation School (BAAS) operates a mixture of light aircraft, which includes the PA-28-161 Archer, PA-34-220T Seneca V, TB-20 Trinidad, TB-20GT Trinidad, and TB-9 Tampico.

According to the school's website, pilots gain their multi-engine training there, but helicopters and fighter training is carried out on one of the Tunisian Air Force squadrons.

On November 19, 2020, the Tunisian minister of national defense announced the purchase of eight T-6C Texan II turboprop training aircraft through the US foreign military sale (FMS) route.

According to the October 2019 Defense Security Cooperation Agency (DCSA) notification: "The proposed sale will replace Tunisia's ageing trainer fleet and allow it to continue training pilots to support its counter-terrorism and border security missions."

On February 26, 2020, the US approved a possible military sale to Tunisia of four AT-6C Wolverine light-attack aircraft, worth an estimated \$325 million, including associated equipment.

Operating both the trainer and light-attack versions will allow pilots an easy transition and brings cost-savings.

Also included was a list of other items including, 468 Mk81 250lb bombs, 48 Mk82 500lb bombs, 3,290 advanced precision kill weapon systems (APKWS) rockets, two spare Pratt & Whitney PT6A-68D 1600shp engines, six L-3 WESCAM MX 15D multi-spectral targeting systems, six 12.7mm machine guns, as well as other equipment and training.

No contract has been signed yet for the four AT-6Cs. These are likely to replace the six L-59T Albatrosses serving 13 Squadron at Sfax since 1991.

A handful of F-5E/Fs remain at Bizerte-Sidi Ahmed with 15 Squadron. They are the survivors from 12 F-5Es and four F-5Fs that entered service in 1984. ■

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