VAYU

Aerospace & Defence Review

IV/2019

Paris Air Show 2019

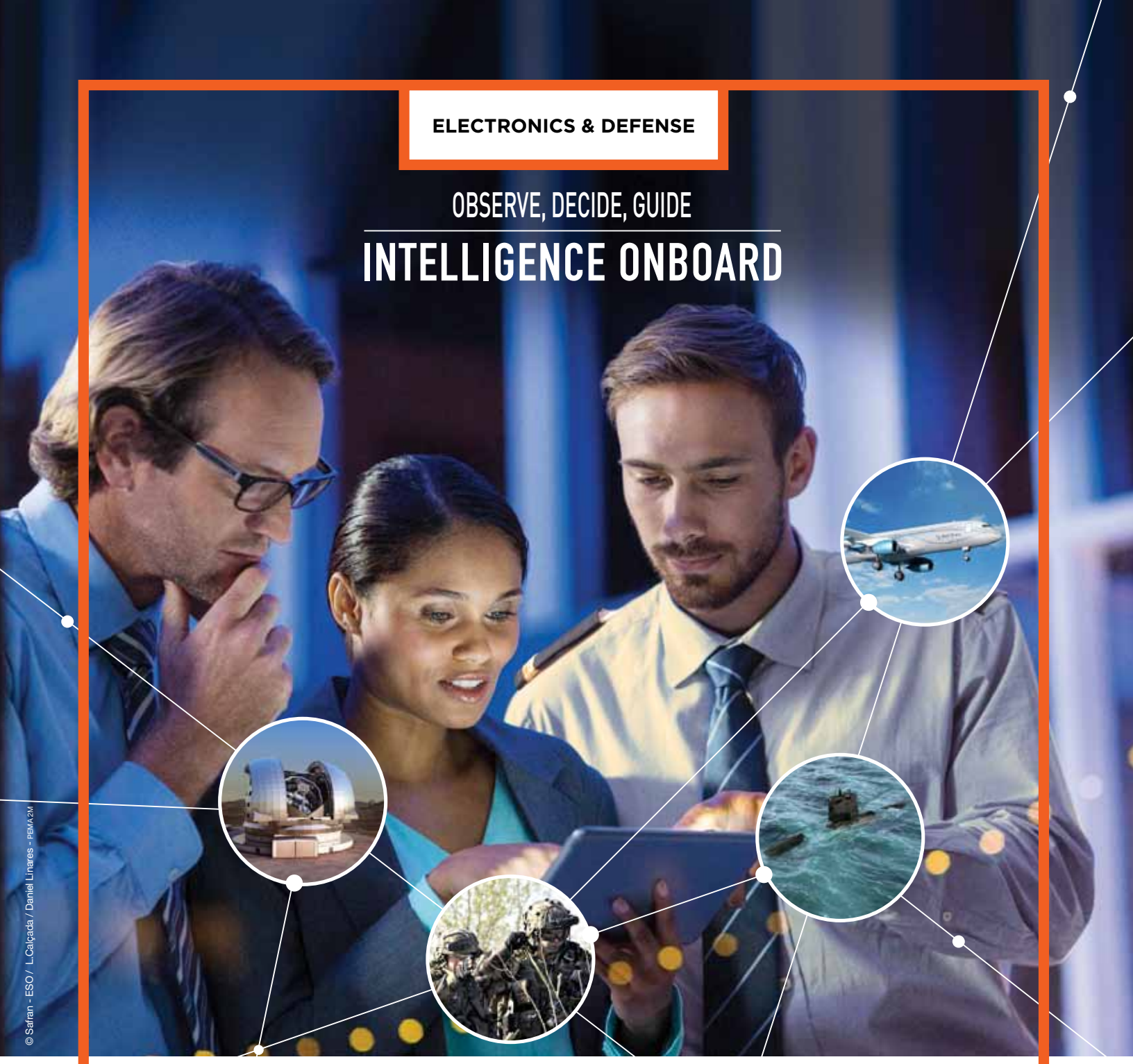
Flankers over France

Chandrayaan-2

JF-17s at Le Bourget

'Exercise Anatolian Eagle'

NATO Tiger Meet



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Cover : PAF JF-17 Thunder at 'Exercise Anatolian Eagle'. Photo : Onur Kurc and Tayfun Yasar

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COMMENTARY

Restructuring India's Armed Forces

With the din of elections over and India having a new government, there could not be a more opportune time for the new dispensation to ensure that important pointers from transborder actions like Balakot do not get obliterated but are acted upon — after all, they give an even handed political heft to all. It could indeed serve as an outline of a blueprint for the future.

First, while it was heartening to see everyone praise the Indian Air Force after Balakot, the bitter war of chest-thumping and credit capturing between political parties that followed, with some even questioning whether the strike had taken place at all, was most unfortunate. Such events do propel security dialogue to the forefront, but military operations remain the preserve of the government for ordering them and the armed forces for carrying them out. They cannot be politicised by any political party claiming ownership to garner votes or worse, glorification of personalities. This has grave ramifications. It distorts the apolitical fibre of our armed forces and is a dangerous portent for national security. Let our political brethren not forget that apolitical armed forces are the strongest support to the edifice of democracy.

Second, while the government's decision to strike and effectively combat Pakistan retaliation was the right one, between 2015 and 2018, Gurdaspur, Pathankot, Nagrota and Sunjuwan terror attacks went without a response and accountability. Is there an institutionalised decision making mechanism in place at all? India is perhaps the only major democracy where the armed forces headquarters are outside the apex governmental structure and, therefore, not institutionally part of the decision making process. It is imperative that we have an Act of Parliament which mandates the creation of a permanent Chief of Defence Staff (CDS), thereby making the armed forces a part of the decision making mechanism for cogent single point military advice to the government. It must be underlined that the Defence Planning Committee recently created under the chairmanship of National Security Adviser (NSA) has been established through an administrative order and thus remains unaccountable to Parliament. But it cannot replace the idea of a permanent CDS created by statute.

Third, the climate of elections pushed national security to the fore as an electoral issue, if rhetoric and party manifestos were anything to go by. Political parties need to take note that having spelt out big ticket plans and promises, public discourse is going to get sharper and better informed. If their manifestos offer to "speed up purchase of outstanding defence equipment and weapons or ensure defence spending is increased to meet the requirement of the armed forces," then questions regarding the time plot for implementation and budgetary support cannot be faulted. On the other hand, if it promises to "establish the office of CDS to act as the principal adviser to the government on defence matters or provide statutory basis to the National Security Council and the office of NSA, with both being accountable to the Parliament," it will have to be showcased with a timebound plan for execution; or else the intent could rightly be questioned. People are a lot smarter than one perhaps believes.

Against the backdrop of India fielding an aging upgraded MiG-21 Bison to combat a modern Pak F-16 in the recent case, they'll be justified in asking for modernisation to be expedited with reasons for delay, enlarging the query to: Are the defence forces properly equipped and organised? Are they being looked after? This is our ultimate tool, is it well honed? It is good that national security has become an electoral issue, but if the concern does not endure after votes are won, it will be the last time one will see the issue at centrestage. That will jeopardise the nation's security.

Fourth, Pakistan's nuclear bluff has been called, but has catapulted India such that it can no longer be seen as a soft State. For this perception to last, India will need to equip, modernise and restructure the armed forces post-haste for 21st century warfare to credibly deter Pakistan and dissuade China from aggression, while gradually building its potential.

Lt Gen (Retd.) Yash Malhotra in *Hindustan Times*

India as new US 'ally' ?

In an acknowledgement of India's growing ties with the United States, the US Senate passed a bill that puts the South Asian power in the same bracket as Washington's NATO allies, Japan, Australia and South Korea. As a non-NATO ally, New Delhi may soon benefit from fast-tracking of the sale of US military hardware to this country, once various foundational and security agreements are in place.

The bill will go into effect after it is endorsed by the House of Representatives, and ahead of that final seal of approval, the US defence secretary is required to lay out the details of the extent of military cooperation between the two militaries, both in training and operations, particularly in the western Indian Ocean as much as the Indo-Pacific. This is where China's growing footprint poses a challenge for New Delhi as much as it does for Washington.

That, and China's open espousal of Pakistan's cause, which challenges India's writ in South Asia as well as in Afghanistan, where India has invested in goodwill as much as infrastructure to keep a line open into Central Asia via Iran's Chabahar port, was clearly the driving force behind India allowing itself to be drawn into Washington's embrace. But will New Delhi have enough room to breathe, to manouevre? And does it want to be built up as a counterweight to China, to be Washington's cat's paw in the region?

Clearly, the strategic shift that began under Atal Behari Vajpayee that saw Delhi shed its antipathy to allying with Washington after years of being seen as a Soviet ally, and under Dr Manmohan Singh's government when India forged a tricky civil nuclear agreement in 2005 with the US, has come full circle under Prime Minister Narendra Modi. There is today a greater convergence of interests in a multiplicity of fields that range from defence, counter-terrorism and maritime security. It's been a long time coming. The Donald Trump administration conferred strategic trade authorisation status to India in July last year. In 2016, the Obama administration recognised New Delhi as a major defence partner, opening doors to the purchase of sensitive technologies.

But as India now openly steps into Washington's camp, it's much-vaunted multilateralism, an euphemism for keeping alive ties with Russia (which has grown ever closer to China) as well as Iran, could be dead in the water. India has already scrapped petroleum supplies from Iran. US President Donald Trump's Twitter attack on India's high tariffs on American goods shows what the other quid pro quo could be — India may have to water down tariffs as well as adjust GST.

While the move takes defence and strategic ties between the two nations to a whole new level, a word of caution. India must not weaken ties with old allies at the expense of the new. The tag of non-NATO ally, remember, was also conferred on America's once-preferred ally: India's arch-rival Pakistan.

From *The Asian Age*

Battling the squeeze

While presenting the regular budget for the current fiscal on 5 July, the finance minister made no mention of, and proposed no additional funds for, defence. Consequently, the total outlay for defence remains at Rs 4.31 lakh crore, as proposed earlier in the interim budget presented to Parliament in February. This works out to 2.04 per cent of the gross domestic product (GDP) and accounts for 15.47 per cent of the total expenditure of the central government envisaged in the budget. On both these counts, the allocation for defence shows a downward trend vis-à-vis the last year's outlay. The question, however, is whether additional funds could have been provided by the finance minister at this stage.

Considering that the die had already been cast by the interim budget and the finance minister had barely five weeks to prepare the regular budget after the present government was sworn in, it was never going to be easy to make any substantial change in the budget already allocated to various ministries and departments.

Last year (2018-19), the allocation for the armed forces was approximately Rs 1.12 lakh crore less than what they had demanded. Assuming that this year the gap would be half of that, it would still be more than Rs 55,000 crore. So, even if the entire additional income of Rs 2,149 crore were to be passed on to defence, it would have been just a drop in the ocean. The finance minister could, of course, resort to higher taxation, disinvestment and borrowing, or reduce the allocation for other schemes in order to generate more income or savings and then set aside a substantial portion of that for defence. But no one can seriously argue that it would have been pragmatic to exercise one or more of these choices to provide additional funds for defence in the regular budget.

The crux of the matter is that the funds have to be raised by the finance ministry through one or more of the means mentioned above, regardless of whether these are made available via a non-lapsable modernisation fund or out of the budget outlay for the year in which these are required by the armed forces. Bemoaning inadequacy of the budget outlay for defence is of no help. Serious efforts have to be made to figure out how the level of defence funding can be raised in a sustainable manner without causing an adverse impact on the funding for health, education, agriculture, infrastructure development, and other social sector schemes. While everyone talks about the need to raise the defence budget no one seems to have a clue as to how this can be done.

It is time to get real and work according to a financially viable plan, which recognises that money is going to be the biggest challenge till the experts find a solution to the problem or India's economy hits the $5-trillion mark and starts yielding higher receipts for the government.

Amit Cowshish in *The Indian Express*

Air India on the block again

The government's reported plan to raise Rs 22,000 crore for Air India via the bond market is fraught with risks. The broad objective of this big-bang fund-raising exercise is to help the state-owned carrier improve its financials ahead of a second attempt to sell the airline. The loss-making airline owes foreign and Indian lenders Rs 58,000 crore, and this amount, which will be raised in two tranches of Rs 7,000 crore and Rs 15,000 crore, will be used to part-pay creditors without resorting to financing via the Government of India's Budget.

To be sure, having learnt from last year's no-show privatisation, the government is said to be moving swiftly to improve the terms when it puts Air India on the block again. It has proposed to ease rules to allow share sale by a buyer without a restriction on the time period (as opposed to a three-year lock-in the earlier exercise); allow a merger or reverse merger with the buyer's existing business; and enable sale and leaseback of aircraft so that the new owner can raise capital. In addition, the government will no longer hold any residual stake — the single biggest deterrent for prospective investors. But these terms, though attractive, do not address the deeper structural issues embedded in the airline's functioning that any prospective buyer would consider. The government may discover that, at best, they only postpone the inevitable.

From *Business Standard*

Lift off

In a big relief, and a proud moment for India, the country's second Moon mission *Chandrayaan-2* successfully launched from Sriharikota at 2.43pm on 22 July 2019. This was a week after the first attempted launch had to be aborted due to a technical glitch just an hour before lift-off. The second time, however, the powerful GSLV-MkIII-M1 rocket lifted off smoothly and placed the 3,850kg spacecraft into the Earth orbit. It will now take a series of complex manoeuvres for the spacecraft to be inserted into the Moon orbit following which the lander – christened *Vikram* – will detach from the orbiter and attempt a soft landing on the lunar surface.

Should that be successful, a rover named *Pragyaan* is supposed to roll out of the lander and conduct experiments on the Moon's surface. At that point, India would be catapulted into an elite club presently comprising just the US, Russia and China. Taken together, there's no denying that *Chandrayaan-2* is a far more complex mission than our first lunar project *Chandrayaan-1*. The stated objectives of *Chandrayaan-2* are to explore the South Pole of the Moon, find more evidence of lunar water, uncover clues about the Moon's evolution and work in the direction of converting the Moon into a test bed for deeper forays into space.

Thus, *Chandrayaan-2* is expected to enhance our space capabilities manifold. In fact, it's an important step before India attempts to launch a manned space mission in 2022. Besides, space today is much more within our reach than ever before. Thanks to improving technologies and falling costs of space missions – the Indian Space Research Organisation itself has been at the forefront of launches that are a fraction of previous expenses – space activities are set to get increasingly democratised.

And in the next phase, a host of other developing nations and private companies are expected to exploit space for commercial, strategic and security reasons. Elon Musk's SpaceX is a good example of the private sector stepping up its space game. From space tourism to exoplanetary mineral exploration, all are on the table. In such a scenario, India needs its space prowess to be on point to bolster its growing geopolitical clout. Plus, it should also be at the forefront of formulating new rules for space. With *Chandrayaan-2* India has made a strong statement about its space plans. As a next step, India too should open up space to its private sector.

From *The Times of India*

OPINION

Lt Gen Kamal Davar feels that

The Budget brings dismay for Defence

It does not require any pre-eminent strategic advice to a government to pontificate that requisite military strength and combat capabilities of a nation take inordinately long to achieve. That India is located in one of the most geo-politically stressed regions in the world with two of its neighbours, both nuclear powers, individually and collusively posing a serious threat to India's security is a well-accepted truism. It is also a harsh reality that nations, even among the affluent, find it more than difficult, if not impossible, to allocate adequate resources for funding other countless basic necessities required for their peoples.

The debate between defence versus development remains a constant battle lending itself to no easy answers. Nevertheless, there was no mention of the allocations for defence or its significance for the nation's security by the former Defence (now first-time Finance Minister Nirmala Sitharaman). It indeed is a disappointing mindset. That the BJP romped home in the last general elections, largely on the pillar of national security, the non-mention of defence (specific allocations relegated to the Annexure of the budget document) was indeed surprising - and unacceptable.

Before commenting on the merits or otherwise of the Defence Budget 2019, it will be prudent to briefly look at the depleting combat capabilities of India's Armed Forces, that have to contend with a two and half front threat is a distinct possibility (challenges emanating from China, Pakistan and internal security).

The IAF's fighter squadron strength has fallen from the required 42 squadrons to a mere 30. The Indian Navy's submarine fleet and its aerial component too are down to operationally unacceptable levels so as to counter Chinese Navy's maritime assertiveness in the Indian Ocean and the Arabian Sea.

The Indian Army too suffers from gross shortages in a variety of weapon systems, platforms, ammunition holdings besides the raising of the much-touted Mountain Strike Corps has been put on hold. The development of infrastructure required in the regions that border China too requires immense fillip. The Indian Armed Forces capabilities in the newer domains of cyber and space also require to be energised. Modernisation of the Armed Forces has suffered over the decades owing to not only shrinking budgets but tardy acquisition processes and the lack of carry-over financial allocations in capital budgets from one financial year to the next.

It is also pertinent to note that owing to the general elections which were to be held this year, the Interim Union Budget for 2019-2020 was announced in the Parliament by stand-in Finance Minister Piyush Goyal on 1 February, 2019. The defence budget outlay of Rs 3,05,000 crores ($43 billion) did witness a marginal increase of 6.96% over the 2018 defence budget. For the first time, the defence budget did cross the 3 lakh crores figure. However, this increase still pegged the defence budget to merely 1.45% of the GDP, the lowest budget to GDP ratio since the traumatic 1962 war. Successive parliamentary committees (including those headed by BJP stalwarts) have recommended allocations for defence to be kept at 3% of the GDP.

According to most defence analysts, Sitharaman's defence budget outlays, as announced being pegged at what then Finance Minister Piyush Goyal's had announced on 1 February 2019 is disappointing as it will not match up to the ambitious modernisation plans of the Indian Armed Forces. A cursory mention by Sitharaman to exempt the import of defence equipment from basic customs duty was hardly adequate. Instead, it was hoped that the Finance Minister would have been far more pragmatic towards the nation's inescapable security needs.

It is the fervent hope of all in the nation that the Modi government will now encourage genuine public-private sector participation in defence production under the 'Make in India' programme whilst also inviting major foreign defence players to establish hi-tech defence production facilities for the forces. India's own DRDO and defence PSUs need both generous resources and firm governmental management for our forces to get an uninterrupted supply of state-of-the-art equipment.

The government now has its work cut out to locate and earmark further resources for vastly sharpening India's arsenal. Governments must never forget the simple fact that a nation's economic resurgence possible only in a safe and secure environment.

VIEWPOINT

Air Marshal Brijesh D Jayal on

Merit being crucial for Selecting the Service Chief

When appointment to the post of Chief in any of the armed forces is made, there is much debate on whether the government has adhered to the tradition of seniority and, if not, then allegations and counter-allegations fly thick and fast. This leaves the moral fabric of the forces weakened and shows the government of the day in a poor light. While meekly sticking to the seniority route may be the government's alibi for appearing to be fair and objective and avoiding controversy, the impact of such a lazy approach on the national security firmament merits a closer look.

There can be no dispute that while selecting individuals for highest-level military appointments, the system should be objective and fair and, to the extent possible within the defence ministry, transparent. It is important, however, that these attributes should not relate to an individual's interest but to that of the service concerned and, more importantly, to the security interests of the nation. It is this conflict between personal interest and the larger national one that lies at the heart of the 'seniority versus merit' debate.

Occasions in the past when the seniormost contenders for the post of Chief have been overlooked have invariably been accompanied by whispers of lobbying, favouritism, political interference or even seniority being contrived.

In large parts, such criticism was not devoid of merit. Not surprisingly, absent of any extraneous interests, the governments would prefer to choose the principle of seniority. If recent events, however, were any indicator, it would now appear that the government has chosen to bite the bullet and opt for merit over seniority. If this assessment is indeed true, then it augurs well for the health of the armed forces and the nation's security interests.

When the current Army Chief was appointed late in 2016, there was considerable criticism in the media on the government having bypassed two of his distinguished colleagues, both of whom were senior in service. Recently, when the successor to the former Navy Chief, who land down office at the end of May 2019, was announced, bypassing a senior colleague, the latter approached the Armed Forces Tribunal, questioning his supersession.

A media report now mentions that the government has set in motion the process of deep selection from among five contenders for succeeding the present Air Chief, who relinquishes office in end-September. Being the election season, tongues were even wagging on linkages to the political controversy surrounding the Rafale procurement.

For a greater understanding of the subject, it is perhaps useful to look at the armed forces' rank structure, which resembles a steep pyramid with a base of some 42,000 Army, 10,000 Navy and 12,000 IAF officers, and a pinnacle of *one* in each service. To traverse this through eight ranks, the promotion system, of necessity, centres largely on the principle of merit over seniority. As one approaches still higher ranks, and the pyramid gets steeper, aspects like employability also become important criteria, indicating that not just past performance, but experience and potential to fill specific demands of higher-level appointments and responsibilities also come into play.

With such a highly competitive promotion system, those who do make it to the three-star-rank posts are already the cream of the force, yet those eligible must then compete for elevation to a commander's post–against stiff merit-based criteria. It is on the shoulders of these commanders that the war-fighting potential of the nation resides and it is only fair that the nation chooses the very meritorious for this task. And finally, it is from among the top few commanders that a Chief is selected and whilst experience as operational commander is a pre-requisite for eligibility, many more military attributes and personal qualities become relevant to do justice to leading a force and being the top military adviser to the government. As long as such requirements are objectively defined, it is fair to say that among the handful of commanders from whom the Chief is selected, it is well nigh impossible for two being equal and hence any conflict on the final choice.

If now a lobby promoting seniority over merit rears its head, clearly this has more to do with individual interests, overriding national security ones. The pool of commanders from which a selection is made is already a highly rated lot and being passed over for this final lap in no way diminishes their worth. Indeed, this is not a case of supersession, but of the best man winning.

Having given the bogey of seniority a burial, there remains a question of fairness and bi-partisan political consensus of the process through which a service Chief is appointed. While it should be the responsibility of the MoD to take care of the former by unambiguously defining the criteria for the top slot, it is the latter that has so far been absent in our parliamentary system and judging by the highly polarised political climate, this step assumes significance.

While it is the prerogative of the government to announce its choice, it would be in the fitness of things if an *Empowered Parliamentary Standing Committee on Defence* gives consent to the government's choice through a confidential meeting and discussion with the Chief-designate. The US example, where the President–with the advice and consent of the Senate–makes such appointments is certainly worth emulating. This will not only demonstrate the maturity of our republic's civil-military relations, but also bury the unfortunate whisper campaigns that surround many a Chief's elevation.

Su-30MKIs and Rafales Exercise in France

Exercise Garuda 2019, the bilateral Indo-French large force engagement (LFE) air exercise was hosted by French Air Force from 1 to 12 July 2019 at Mont-de-Marsan France and had IAF Sukhoi Su-30MKIs and French Air Force Rafales operate together in what has been the largest such exercise this year. The IAF contingent which included four Su-30MKIs of No.24 Squadron from Bareilly and supporting Il-78 air refueller and two C-17 Globemaster IIIs, returned to India on 19 July 2019. Air Marshal RKS Bhadauria, Vice Chief of the Air Staff visited France during the exercise and also flew in a two-seat Rafale (*see article Flankers over France*).

First Apaches for IAF

The first Boeing AH-64E (I) Apache Guardian helicopter was formally handed over to the Indian Air Force at Boeing's production facility in Mesa, Arizona, USA on 10 May 2019. Air Marshal AS Butola of the Indian Air Force accepted this at a ceremony. In September 2015, the Government of India had signed a contract with US Government and Boeing for 22 Apache helicopters, and the first batch of these helicopters is scheduled to be transported to India in July 2019. Meanwhile, select IAF aircrew and maintenance personnel have undergone type training at US Army base Fort Rucker, Alabama.

[**Stop Press**: The first batch of four Apaches were delivered at AFS Hindan on 27 July, 2019]

Two more Boeing CH-47F(I) Chinooks arrive

Two more Boeing CH-47F (I) Chinooks for the Indian Air Force arrived at Mundra port in Gujarat on 8 July 2019. Earlier, in February 2019, Boeing had delivered the first four of the 15 Chinooks on order, which were inducted by the Indian Air Force in March and thereafter positioned at AFS Chandigarh to serve with No.126 Helicopter Unit (see *Vayu Issue II/2019*).

US approves 24 Sikorsky MH-60Rs for Indian Navy

The US State Department have approved potential sale of 24 Sikorsky MH-60R naval combat helicopters to the Indian Navy, at the cost of $2.6 billion. Included in the proposal are 24 MH-60Rs, together with 30 Telephonics APS-153(v) multimode radars, 60 General Electric T700-GE-401C engines; 24 Raytheon AQS-22 Airborne Low Frequency System sonar systems, 30 Raytheon AAS-44C(v) multi-special targeting systems; 1,000 SSQ-36/SSQ-53/ssq-62 sonobuoys; ten Lockheed Martin AGM-114 Hellfire missiles (together with four AGM-114 M36-E9 captive air training missiles and four AGM-114Q training rounds); 38 Advanced Precision Kill Weapons system rockets and 30 Mk54 torpedoes.

Indian Navy commissions 5th Dornier Squadron

The fifth Dornier 228 squadron of the Indian Navy, INAS 313 *Sea Eagles,* was commissioned by the CNS Admiral Karambir Singh at Naval Air Enclave, Meenambakkam (Chennai International Airport) on 22 July 2019. Present were Vice Admiral Atul Kumar Jain, FOC-in-C Eastern Naval Command and Rear Admiral KJ Kumar FOC Tamil Nadu and Puducherry Naval Area (FOTNA) .

INAS 313, commanded by Cdr Vivek Koman, is tasked for surveillance over the Bay of Bengal, Palk Bay and adjoining regions. The Indian Navy has ordered 12 additional Dornier 228s from HAL with improved sensors and equipment including glass cockpit, advanced surveillance radar, Electronic Intelligence (ELINT), optical sensors and networking features. The CNS emphasised the importance of maintaining an edge over adversaries in defence preparedness, "with the developing geo-political situation in the region being monitored constantly."

Diamond Jubilee of INAS 550

The Indian Navy's very first Naval Air Squadron 550 *(Flying Fish)* marked its Diamond Jubilee on 17 June 2019 at INS *Garuda*, Kochi. To commemorate the occasion, various outreach activities and community events were conducted by the squadron, the events attended by Vice Admiral AK Chawla, FOC-in-C, Southern Naval Command (SNC) as the Chief Guest. INAS 550 has operated 14 different types of aircraft, beginning with the Sealand amphibian in 1953 to the present Dornier 228 maritime reconnaissance aircraft. INAS 550 has taken part in several operations, from the 1971 Indo-Pak war to Humanitarian Assistance and Disaster Relief (HADR) during the December 2004 Tsunami, Cyclone Okhi in 2017 and the Kerala floods of 2018.

More HAL Chetaks for Indian Navy

HAL has delivered a new Chetak helicopter to the Indian Navy, first of eight such, the balance by August 2020. HAL has of course produced Chetak helicopters at Bangalore for nearly five decades under license from Aerospatiale which later became Eurocopter and is now Airbus Helicopters, with some 350 of the type manufactured, 80 of them for the Indian Navy. The first Chetak helicopter for the IN was delivered in February 1966 and has been operated for various tasks including communications, search & rescue, liaison and helicopter conversion training. Chetaks have also been embarked on the aft deck of some IN warships.

Additional Kamov Ka-31s for IN

The Defence Acquisition Council (DAC) has approved procurement of ten more Kamov Ka-31 airborne early warning and control (AEW&C) helicopters for the Indian Navy to augment the 14 currently operated by INAS 339. These are presently operated from Indian Naval Station *Hansa* at Dabolim, Goa.

IAF Chief visits Sweden

Air Chief Marshal Birender Singh Dhanoa, CAS was in Sweden on an official visit 3-6 June 2019. As per the MoD's spoke person "the visit would provide an impetus to defence cooperation and pave the way for greater interaction and cooperation between the two air forces". The Indian Air Chief met with his counterpart Major General Mats Helgesson, and visited various Swedish Air Force establishments including the Blekinge Air Force Wing (F-17 at Kallinge) near Ronneby in southern Sweden which houses two Gripen fighter squadrons.

Air Chief in homage to fallen 'Air Warriors'

20 years after the Kargil operations of 1999, Air Chief Marshal Birender Singh Dhanoa, CAS visited Air Force Station Bhisiana, near Bhatinda and also Sarsawa near Saharanpur to pay homage to those of the Indian Air Force killed in action during the Kargil Operations of May 1999.

The present CAS was then commanding No.17 Squadron with MiG-21Ms when his flight commander, Sqn Ldr Ajay Ahuja was shot down by a shoulder-fired missile. Although he ejected successfully, Sqn Ldr Ahuja was killed in fighting on the ground. On 27 May 2019, Air Chief Marshal Dhanoa flew in a MiG-21UM two-seater along with a pair of MiG-21s in a'missing man' formation, which included Air Marshal Raghunath Nambiar, AOC-in-C Western Air Command. The CAS later flew in a Mi-17V5 helicopter of 152 HU, which unit had lost a helicopter in action with several personnel on board.

IAF "ready to fight across spectrum"

At a Seminar marking 20 years after the Kargil 1999 war, Air Chief Marshal BS Dhanoa recalled that, inspite of operational limitations, MiG-21s had carried out air strikes against mountain targets at that time and innovative ways were adopted by the IAF to overcome difficulties. "The IAF is now transformed and precision attack capabilities which were then confined to Mirage 2000s are today also with Su-30MKIs, MiG-29s and Jaguars while BVR missiles now equip various fighter types" *(see separate article)*.

An-32s certified for bio-jet fuel operation

On 24 May 2019, the IAF's Antonov An-32 fleet of transport aircraft were formally certified to use blended aviation fuel. Such *green* fuel would comprise upto 10%, of the total, such an approval following a series of evaluation tests and trials for over a year. The indigenous bio-jet fuel was first produced by the CSIR-IIP lab at Dehradun in 2013, produced from Tree Borne Oils (TBOs) sourced from tribal areas and farmers. "Air Chief Marshal BS Dhanoa, CAS has given full support for the testing and certifying such bio-jet fuel."

DRDO's guided bomb tested

The Defence Research and Defence Organisation (DRDO) has flight tested a 500 kg Inertial Guided Bomb dropped by a Su-30MKI Aircraft at the Pokhran test range on 24 May 2019. "The guided bomb achieved the desired range and hit the target with high precision", as per the DRDO spokesperson.

DRDO tests HSTDV

The Defence Research and Development Organisation carried out the first test flight of the indigenously developed Hypersonic Technology Demonstrator Vehicle (HSTDV) from their Integrated Test Range off the Odisha coast on 12 June 2019. The HSTDV (seen in model form above) is an unmanned scramjet (allowing supersonic combustion) demonstration vehicle that can cruise up to a speed of Mach 6, reaching an altitude of 32 km. The mission was to "prove a number of critical technologies for futuristic missions".

BrahMos air–launched from Su-30MKI

An air-launched version of the BrahMos missile was successfully fired from Su-30MKI on 22 May 2019, having first been fired against a sea target on 22 November 2017. The air-launched version of the BrahMos supersonic missile weighs 2.5 tonnes, has a range of near 300 km and is designed and developed by BrahMos Aerospace Pvt Ltd (BAPL). Software development of the aircraft was undertaken by IAF engineers while HAL carried out mechanical and electrical modifications on the aircraft.

Meanwhile, the land-based version of BrahMos has recently been test fired by a unit of the Andaman & Nicobar Command from a site in the Car Nicobar islands in the southern Bay of Bengal "as part of joint services training on long range and accurate engagement of targets in depth."

IAI follow-on agreement on MRSAM systems

On 17 July, 2019, Israel Aerospace Industries entered an agreement for provision of complementary Naval MRSAM (Medium Range Surface-to-Air Missile) systems, the contracts entered with the Indian Navy and MDL Shipyard. Under the contract, IAI will provide complementary systems for a range of maintenance and other services for various sub-systems of IAI's advanced MRSAM systems. Earlier, the Indian Navy recorded a significant milestone with firing of the MRSAM on 17 May 2019, the firing undertaken by the guided missile destroyers INS *Kochi* and *Chennai,* missiles of both ships controlled by one ship to intercept different aerial targets at extended ranges. The MRSAMs are fitted onboard the *Kolkata*-class destroyers and are also to be integrated with future major warships of the Indian Navy.

Nag anti-tank missiles test fired

Three successful test firings of Nag anti-tank missiles were carried out on 7 July at the Pokhran firing ranges, "the missiles test-fired during both day and night during the trials. All three tests were successful," according to DRDO officials. Earlier, the Defence Acquisition Council had approved procurement of production batches of the Nag at a cost of Rs. 524 crore.

Akash Mk.1S tested

The Akash Mk.1S missile, an upgraded version of this indigenous SAM with an advanced seeker was recently test fired from the ITR at Chandipur. The Akash weapon system has combination of both command and active terminal seeker guidance, their performance consistently monitored during the trials.

PSLV-C46 launches RISAT-2B

On 22 May 2019, a Polar Satellite Launch Vehicle (PSLV-C46) successfully launched RISAT-2B satellite from the Satish Dhawan Space Centre (SDSC) at Sriharikota. This was the 72nd launch vehicle mission from SDSC SHAR, and 36th launch from the First Launch pad. Thereafter and after separation, solar arrays of RISAT-2B were deployed automatically and ISRO Telemetry Tracking and Command Network (ISTRAC) at Bengaluru assumed control of the satellite. RISAT-2B is a radar imaging earth observation satellite weighing 615 kg, the satellite providing services in the field of Agriculture, Forestry and Disaster Management.

"Nation Building Through Shipbuilding"

At a largely attended two-day Seminar organised jointly by FICCI and the National Maritime Foundation at New Delhi on 25-26 July 2019, in his inaugural address Chief of the Naval Staff Admiral Karambir Singh stated that "naval shipbuilding is one of the success stories of India. Of the 51 ships and submarines presently on order, 49 are being built in India and the 'plough-back effect' on the economy is considerable." Also addressing the Seminar were Admiral Sunil Lanba, former CNS and now Chairman National Maritime Foundation as also Vice Admiral AK Saxena, Controller of Warship Production and Acquisition, Indian Navy *(see item)*.

IAC-1 by 2021

According to Vice Admiral AK Saxena, the 40,000 tonne indigenous aircraft carrier 1 (INS *Vikrant*) will be delivered to the Indian Navy in early 2021. Speaking at the above Seminar, he said that "the construction is moving at a brisk pace. The gas turbines could be fired in the third quarter of this year. Basin trails and the testing of aviation complex will follow".

RFPs issued for range of warships

On 1 July 2019, the Government of India issued RFPs worth over Rs 15,000 crore for a range of warships which includes six next generation missile vessels (NGMV), as also eight fast patrol vessels, 12 air cushion vehicles and 8 ammunition barges for the Coast Guard. The NGMVs will be of 1500 tonne displacement

and armed with BrahMos supersonic cruise missiles. The RFPs have been issued to four DPSUs, including Mazagon Dock, Mumbai, Garden Reach Shipbuilders and Engineers, Kolkata, Goa Shipyard, Hindustan Shipyard, Visakhapatnam and Cochin Shipyard, a Kerala state PSU that is building the navy's first indigenous aircraft carrier, INS *Vikrant.* Significantly, two private sector shipyards (Larsen & Toubro and Reliance Naval and Engineering, have been included for the RFP.

'Expression of Interest' for six P-75(i) Submarines

On 20 June 2019, the Government of India issued an Expression of Interest in shortlisting of potential Indian Strategic Partners (SPs) for "Construction of six Conventional Submarines", being the P-75(I) Project of the Indian Navy (*representative image above*). The project cost is projected at some Rs 45,000 crore, this being the second project under the latest Strategic Partnership (SP) Model, the first of which is procurement of 111 Naval Utility Helicopters (NUH). The EoI for shortlisting of Indian Strategic Partners was uploaded on MoD and Indian Navy websites, while that for shortlisting of OEMs followed thereafter.

The SPs in collaboration with OEMs have been mandated to set up dedicated manufacturing lines for these submarines in India and to make India "the global hub for submarine design and production." In addition the Indian Navy would have an option to manufacture six more submarines under the project. The potential SPs are expected to respond to the EoI within two months, the Indian companies being shortlisted based on "their capability for integration of system of systems, expertise in shipbuilding domain and the financial strength". The OEMs would be shortlisted primarily on their submarine design meeting the Indian Navy's Qualitative Requirements and qualifying as per the Transfer of Technology and Indigenous Content (IC) criteria.

GSL launches Coast Guard OPV

The second of five Offshore Patrol Vessels for the Indian Coast Guard was launched on 25 May 2019 at Goa Shipyard Limited. Entirely designed in-house by GSL, these OPVs will augment

inventory of the Coast Guard in protecting India's Exclusive Economic Zone (EEZ). These 2400-tonne vessels are equipped with Quick Response Boats for search & rescue and anti-piracy, tasks and equipped with suitable weaponry for the purpose.

Passing out parade at Indian Naval Academy, Ezhimala

The recent passing out parade at Indian Naval Academy (INA), Ezhimala on 25 May 2019 was reviewed by the COAS General Bipin Rawat, who also awarded medals to meritorious midshipmen and cadets after the ceremonial review. The Spring Term 2019 comprised four different courses attended by trainees which included 15 female cadets as also trainees from the Maldives, Myanmar, Seychelles Tanzania, and Sri Lanka. At the culmination, three MiG-29Ks led by Cdr Viaksh Narwal of INAS 303 carried out a formation fly past over the quarterdeck.

INS 'Tarkash' at Karlskrona, Sweden

After its visit to Alexandria in Egypt and Tangier in Morocco during early July, the Indian Navy's stealth frigate INS *Tarkash* made a port call at Karlskrona, Sweden on 19 July 2019, the first

visit of an Indian warship to Swedish shores after more than 15 years. INS *Tarkash*, commanded by Captain Sathish Vasudev, is equipped with a versatile range of weapons and sensors "capable of addressing threats in all three dimensions". Indian and Swedish armed forces have been involved with number of high level bilateral visits and interactions, resulting in rapid growth in relations across a broad spectrum. Operationally, the two navies have worked together in global operations against piracy.

INS *Viraat* to be sold as scrap

After several attempts to get various organisations to adopt the de-commissioned IN aircraft carrier INS *Viraat* for commercial purposes or turning it into a maritime museum, as the Maharashtra Government had earlier proposed, it is now officially announced that this iconic warship will be sold for scrap. Minister of State for Defence Shripad Naik informed Parliament that with the Indian Navy incurring continued expenditure on upkeep of INS *Viraat*, and in considerations of safety and security, a decision to scrap the aircraft carrier has been taken "in due consultation" with the Indian Navy.

IndiGo order CFM International LEAP-1A engines

In a massive order announced at the recent Paris Air Show, IndiGo selected CFM International LEAP-1A engines to power 280 Airbus A320neo and A321neo aircraft on order by the airline. The contract, which includes spare engines and an overhaul support agreement, is valued at more than $20 billion. IndiGo has been a CFM operator since 2016 and currently operates a fleet of 17 A320ceo aircraft powered by CFM56-5B engines as part of a total fleet of 215 A320/A321 family aircraft. Delivery of the first LEAP-1A-powered A320neo is scheduled in 2020.

Six aircraft leased by Vistara

On 24 May 2019, Vistara announced the lease of an additional six aircraft from BOC Aviation, which will "accelerate its growth in the domestic market". As part of the agreement, Vistara has leased four Boeing 737-800 NG aircraft to be delivered in May 2019 and two Airbus A320neo powered by CFM LEAP 1A engines, scheduled for delivery in the second half of 2019.

100th aircraft of SpiceJet

SpiceJet inducted its 100th aircraft (a Boeing 737) into its fleet on 26 May 2019. SpiceJet's fleet now comprises 68 Boeing 737s, 30 Bombardier Q-400s and two B737 freighters, the airline operating 575 flights a day to 62 destinations, 53 domestic and nine international, majority of them connecting the key metros of Mumbai and Delhi. SpiceJet is also India's largest regional operator with 42 daily flights under the regional connectivity scheme, UDAN. SpiceJet placed a $22 billion order for 205 aircraft with Boeing in 2015 and for 50 Bombardier Q400s, the single biggest order for the Q400 in Bombardier›s history.

50th aircraft with GoAir

GoAir has recently inducted the 50th aircraft into its fleet, doubling its inventory in virtually two years. GoAir now operate 270 daily flights connecting 24 domestic and 4 international destinations.

Japanese aviation industry interest in India

According to information from Tokyo, the Japanese aviation industry are keen to include 'Make in India' as part of their long term expansion plans, spurred by the Indian Government's thrust on expanding aviation infrastructure. According to the reports, Japan is keen on increasing export of defence hardware to "friendly countries" and has recently sold several naval vessels to the Philippines and Indonesia. Indian interest in the ShinMaywa US-2i amphibian aircraft (see cover story in *Vayu Issue VI/2014*) has been long and continues. Japanese companies building major parts for both Boeing and Airbus could also outsource production to select Indian industrial units.

HAL financial results for 2018-19

Hindustan Aeronautics Limited (HAL) have recorded turnover of Rs 19,705 crores, registering a growth of 7.8% for FY 2018-19 over the turnover of Rs 18,284 crores in the previous year. The audited results of the Company were approved by HAL's Board of Directors at its meeting held at Bangalore on 27 May, 2019. HAL's Profit After Tax (PAT) for the FY 2018-19 is at Rs 2,282 crores, an increase of 14.8% over Rs 1,987 crores in the previous year. The Company's order book as on 31 March, 2019 was at Rs 58,000 crores and the PSU expects new orders for Tejas LCAs and Light Combat Helicopters in the current financial year.

Meanwhile, HAL's Light Combat Helicopter (LCH) prototypes have cumulatively logged 1500 flights, the milestone flown by Technology Demonstrator (TD) 3 prototype by Gp Capt SHK Nair, DCTP (RW) and Gp Capt RK Dubey *(photo above)*.

BEL achieves Rs 11,789.22 Cr turnover in FY 2018-19

Bharat Electronics Limited (BEL) achieved a turnover of Rs11,789.22 crore during FY 2018-19 registering a growth of 16.90% over the turnover of Rs 10,084.84 crore achieved the previous year. The profit after tax (PAT) was Rs 1,927.29 crore as against the earlier Rs 1,399.29 crore, an increase of 37.73%.

'Awards For Excellence' : private sector now included

Defence Minister Rajnath Singh has approved inclusion of the Indian private sector industry for consideration in the Ministry's annual 'Awards for Excellence' scheme. The revised format includes awards in the Institutional and Individual/ Team category for *Excellence in Technological Breakthroughs, Indigenisation/Import Substitution and Excellence in Exports*. Separate sub-categories for large, medium, small and start-up segments have been included to provide a level playing field for competition. It is expected that this move will facilitate widening and deepening

of the industrial base in Defence and Aerospace with recognition of outstanding Indian firms. It is also expected to provide a boost to export potential of India's defence industry, especially MSME and start-up firms, "promoting their outstanding achievements at the global level."

Tata to build F-16 wings

Lockheed Martin have announced that their partner in India, Tata Advanced Systems, will be building wings for the F-16 at their site in India. According to Dr Vivek Lall, Vice President of Strategy and Business Development, Lockheed Martin Aeronautics, the contract awarded to Tata 'is not dependent on us winning the fighter jet contract here', alluding to the planned procurement of 114 fighters to meet the IAF's immediate requirements. Dr Lall continued that "our partnership with the Indian industry on both the F-21 fighter's for the IAF and S-76D helicopters for the Indian Navy will put India at the epicenter of the world's largest defence ecosystem and promises export opportunities".

Lockheed Martin had hosted a suppliers conference with their Indian partner Tata Advanced Systems at New Delhi in mid-July 2019 (*see detailed report*).

Kalyani Rafael Advanced Systems (KRAS) receives major order from RAFAEL

KRAS (Kalyani Rafael Advanced Systems Ltd. India), have been contracted to manufacture 1000 Barak-8 missile kits to be supplied to Bharat Dynamics Ltd via IAI for further integration purposes as part of the MR-SAM programme. KRAS is a Joint Venture between RAFAEL Advanced Defense Systems Ltd. and Kalyani Strategic Systems, established for manufacturing weapon systems required by the Indian Defense Forces, as well as for the export market. In the photograph are Mr Baba Kalyani, Chairman of Kalyani Group and Mr Pini Yungman, Head of Rafael's Air Defence Systems Division.

Tech Mahindra as part of AFSAC project

Tech Mahindra have received a major defence order worth Rs 300 crores to enable digital transformation of the Indian Navy, as part of the 'Armed Forces Secure Access Card' (AFSAC) Project. Tech Mahindra will implement RFID (Radio Frequency Identification) based Access Control System across all naval bases and ships. The new AFSAC Card will replace the existing paper based Identity Card for all Navy personnel including dependents and ex-servicemen by using the CMMI (Capability Maturity Model Integration) level 5 processes.

HAL invites private participation in ALH programme

In an attempt to encourage private sector participation in manufacturing the civil version of its advanced light helicopter (ALH), HAL organised a workshop at Bangalore on 29 June 2019, chaired by Dr Ajay Kumar, Secretary Defence Production and HAL's Chairman R Madhavan.

HAL is the Design Authority and Original Equipment Manufacturer (OEM) of the Dhruv ALH. The upgraded Dhruv Civil helicopter, which is equipped with the latest avionics and glass cockpit, is under certification from DGCA.

Earlier in the day, participants gave their feedback and suggestions on HAL's initiative, with the selected Indian partners invited to provide support throughout the life of the product (20 years) "thereby ensuring long term business relationship."

HAL deliver 150th gun bay door for Boeing F/A-18 Super Hornet

On 24 June 2019, Hindustan Aeronautics Limited marked a milestone in delivering the 150th gun bay door for the Boeing F/A-18 Super Hornet (*photo*). HAL has been Boeing's long-term supplier for over 25 years, having been awarded the contract to manufacture gun bay doors for the Super Hornet in 2007. As Salil Gupte, President Boeing India said, "our investments in India are robust and ongoing, spanning technology, hi-tech innovation, production capacity, establishing a supply chain network, and developing skilling centers for aerospace manufacturing in India."

Boeing and AAI to modernise Air Traffic management in India

Boeing and the Airports Authority of India (AAI) have signed a technical assistance agreement for developing a comprehensive 10-year Communication, Navigation and Surveillance/Air Traffic Management (CNS/ATM) modernisation roadmap for India, undertaken with a grant from the US Trade and Development Agency (USTDA). This objective of the agreement is to develop a roadmap for AAI to use as guidance in the modernisation of the Indian National Airspace System (NAS), based on global and local best practices to optimally utilize airspace capacity, enhance communications and invest in navigation, surveillance and air traffic management. In the picture above are seen Salil Gupte, president, Boeing India and AP Gajbe, Executive Director (ATM-ATFM), Airports Authority of India.

Airbus Helicopters and Pawan Hans in MoU

On 19 June 2019, Airbus Helicopters and Pawan Hans Limited (PHL) signed a Memorandum of Understanding (MoU) to collaborate on the future introduction of two new categories of rotorcraft in the PHL fleet as well as for the repair, maintenance and overhaul of its existing AS365N Dauphin helicopters. The MoU, signed by Air Commodore Dayasagar, Executive Director at PHL and Ashish Saraf, Head of Airbus Helicopters for India and South Asia, also includes customised training and an on-site Safety Management System (SMS) for PHL pilots.

The MoU stipulates that Airbus Helicopters "will support PHL in growing its onshore, offshore and inland travel markets by introducing the new generation H145 and H225 rotorcraft into their fleet. Airbus Helicopters will also provide predictive and scheduled maintenance, repair and overhaul services for PHL's existing Airbus AS365N Dauphin helicopters."

GKN Aerospace's JV in India

GKN Aerospace's Indian JV partner Fokker Elmo SASMOS Interconnection Systems Ltd (FE-SIL), in Bangalore has been awarded a contract to manufacture electrical wiring interconnection systems (EWIS) for the Pilatus PC-24. Activities

in Bangalore will immediately involve more than 30 highly skilled operators in India "which number will grow after further production ramp-up".

MBDA and SASMOS collaboration

On 26 June 2019, Bangalore-based SASMOS HET Technologies Limited, delivered the 2,000th wiring harness assembly for the MICA missile and also delivery of the first wiring harness assembly for the ASRAAM, both air-to-air missiles selected by the Indian Air Force. In addition to the MICA, SASMOS has delivered qualified First Article products for the ASRAAM. Loïc Piedevache, MBDA country head, India stated "this delivery is not just an important milestone for SASMOS, but also for MBDA and the Indian aerospace and defence manufacturing industry, …. SASMOS deliveries and relationship are perfectly aligned with MBDA's long term strategy on Make In India."

FSTC gets EASA approval for A320neo

Flight Simulation Technique Centre (FSTC) has received EASA (European Union Aviation Safety Agency) approval for its Airbus A320neo full flight simulator, India's first such. This is FSTC's 6th fully functional simulator in the country with the next expected to

be operational shortly. FSTC is India's first registered standalone approved training organisation (ATO), being largest in the region and supporting all airlines in India, including Indigo, Vistara, Jet Airways, Spice Jet, GoAir and Air India.

Safran Helicopter Engines partners with Indocopters

Indocopters Private Limited (ICPL) have been appointed as Safran Certified Maintenance Centre (CMC) and parts distributor for the Indian subcontinent. ICPL will support Safran helicopter engine operators with module changes and parts support on the Arriel and Arrius family of engines. Indocopters Private Limited (ICPL) is the largest specialist helicopter Maintenance Repair & Overhaul (MRO) organisation in the Indian subcontinent, established in 2005 with its headquarters in Greater Noida. In the photograph are (left to right) Swati Rishi Vectra Director, Jade Hannon Safran Helicopter Engines Business Development Executive, Farrukh Qamar Safran Helicopter Engines Customer Support Manager, Per Smedegaard Indocopters Pvt Ltd CEO, and Rajesh Chopra Indocopters Pvt Ltd COO.

APPOINTMENTS

Air Chief Marshal BS Dhanoa is Chairman COSC

Air Chief Marshal Birender Singh Dhanoa, Chief of the Air Staff took over as Chairman Chief of Staff Committee from the outgoing Chairman COSC and CNS Admiral Sunil Lanba, on 29 May 2019. Admiral Sunil Lanba proceeded on retirement on 31 May, 2019 after a distinguished career spanning over four decades. "An ardent supporter of Tri-Services Jointmanship, he was instrumental in harmonising the efforts of the three Services in a number of Tri Services issues".

Admiral Karambir Singh is Chief of the Naval Staff

Admiral Karambir Singh assumed command of the Indian Navy on 31 May 2019 as the 24th CNS. An alumnus of the National Defence Academy, Khadakwasla, he was commissioned into the Indian Navy in July 1980, earned his wings as a helicopter pilot in 1981 and has extensively flown on Chetak (Alouette) and Kamov helicopters. He is a graduate of the Defence Services Staff College, Wellington, College of Naval Warfare, Mumbai and has served as Directing Staff in both these institutions.

In his career spanning over 39 years, he has commanded the Indian Coast Guard Ship *Chandbibi*, Missile Corvette INS *Vijaydurg*, as well as two Guided Missile Destroyers, INS *Rana* and INS *Delhi*. He has also served as the Fleet Operations Officer of the Western Fleet. Ashore, he has served at Naval Headquarters as the Joint Director Naval Air Staff, and as Captain Air and Officer-in-Charge of the Naval Air Station at Mumbai. He was also member of the Aircrew Instrument Rating and Categorisation Board (AIRCATS).

On promotion to flag rank, the Admiral was appointed as Chief of Staff, Eastern Naval Command. His other important flag appointments include Chief of Staff of the Tri-Services Unified Command at Andaman and Nicobar Islands and Flag Officer Commanding Maharashtra and Gujarat Naval Area (FOMAG).

In the rank of Vice Admiral, he was Director General *Project Seabird*, in-charge of infrastructure development of the Navy's expansive and modern base at Karwar. At the Integrated Headquarters Ministry of Defence (Navy), the Admiral was Deputy Chief of the Naval Staff and, subsequently, Vice Chief of the Naval Staff. He then became FOC-in-C Eastern Naval Command at Visakhapatnam, before taking over as Chief of the Naval Staff on 31 May 2019.

Vice Admiral Atul Kumar Jain is FOC-in-C ENC

Vice Admiral Atul Kumar Jain, has taken over as Flag Officer Commanding-in-Chief, Eastern Naval Command (ENC) from Vice Admiral Karambir Singh. Commissioned into the Indian Navy in July 1982, Vice Adm Atul Kumar Jain is a gunnery and missile specialist and has held various Operational, Staff and Command Appointments in the course of his career spanning over 37 years. Vice Admiral Jain has commanded various ships including INS *Nirghat*, INS *Khukri*, INS *Rajput* and the indigenously built destroyer, INS *Mysore*. On promotion to Flag Rank he was appointed as the first Flag Officer Commanding Karnataka Naval Area, thereafter, commanded the Eastern Fleet and was also the Chief of Staff, HQ SNC.

Vice Admiral Dinesh K Tripathi is Commandant INA

Vice Admiral Dinesh K Tripathi has taken over as Commandant of the Indian Naval Academy. A specialist in Communication and Electronic Warfare, he has commanded INS *Vinash*, *Kirch* and *Trishul*. His important Staff appointments include that of Director Naval Operations, Principal Director Network Centric Operations, Principal Director Naval Plans and Assistant Chief of Naval Staff (Policy and Plans). Vice Admiral Dinesh K Tripathi has also commanded the Eastern Fleet, was Additional Director General, *Project Seabird*, prior being appointed as the seventh Commandant of the Indian Naval Academy.

Director General K Natarajan is Chief of Indian Coast Guard

Director General Krishnaswamy Natarajan took over as the 23rd head of the Indian Coast Guard on 30 June 2019. A 5th Batch Officer of the Indian Coast Guard, he joined service in January 1984, specialised in select core competencies including Maritime Safety and Port Operations. At the Coast Guard Headquarters, his key staff assignments included Principal Director (Policy & Plans), Chairman Coast Guard Service Selection Board, Principal Director (Projects), Joint Director (Operations) and Coast Guard Advisor (CGA) to the Director General Indian Coast Guard. In the rank of Inspector General, he was also Commander of the Operational Formations - Coast Guard Region (Andaman & Nicobar) and Coast Guard Region (West).

New Army Command appointments

Several new Army Command appointments have been announced as also new Vice Chief of the Army Staff. Lt Gen Manoj Mukund Naravane GOC-in-C Eastern Command (*photo above*) has been appointed as next Vice Chief, succeeding Lt Gen D Anbu.

Director General of Military Operations Lt Gen Anil Chauhan will be new GOC-in-C, Eastern Command, while Lt Gen Alok Singh Kler, Director General Military Training will take over as GOC-in-C, South Western Command.

Lt Gen I S Ghuman has been appointed GOC-in-C, Central Command, and Lt Gen RP Singh has been appointed GOC-in-C, Western Command, succeeding Lt Gen Surinder Singh.

Rear Admiral (retd) Surendra Ahuja is MD Boeing Defence India

Boeing has announced the appointment of retired Rear Admiral Surendra Ahuja as Managing Director of Boeing Defence India (BDI), based in New Delhi. "Ahuja will lead BDI in alignment with Boeing's accelerated growth strategy for India, which includes the execution of current and future programmes across all BDI business sectors in a collaborative environment with Boeing Defense Space and Security (BDS) and Boeing Global Services (BGS)". As a former Indian Navy Test Pilot, Surendra Ahuja has flown 22 different types of aircraft, and was also the first Indian Navy pilot to fly from a US Navy aircraft carrier.

Seminar on

Defending India:
Urgent Modernisation Imperatives

Continuing their joint Seminar series, *The Delhi Forum for Strategic Studies* (DFFSS) and *The Society for Aerospace Studies* (SAS) organised a seminar on 'Defending India : Urgent Modernisation Imperatives' on 3 June 2019, at the India International Centre, New Delhi.

"India is situated in one of the most volatile regions of the world, and faces numerous strategic and security challenges. Whilst major wars may well be only a distant possibility, numerous threats persist and cannot be wished away. In fact, the asymmetrical challenges to India's security, which are both internal to it and emanate from outside, have created a peculiar dilemma in which the nation finds itself exposed on two-and-a-half fronts, which loom large and real to imperil its safety. Urgent security reforms, including modernisation of India's defence forces is therefore imperative".

The above introductory remarks were made by Lt Gen Kamal Davar, former Director of the Defence Intelligence Agency and founder of the DFFSS, a distinguished soldier and strategic thinker and who has continuously made pertinent precise assessments of the military as well as policy issues. Lt Gen Davar flagged some issues and shared the urgent need for modernisation of the Indian defence forces so as to ensure military readiness to meet conventional and unconventional challenges that are affecting India's sense of internal security and its safety in the volatile neighbourhood. In so doing, he highlighted the importance of private players to co-develop military infrastructure in the country. India being one of the largest importers of military equipment, Lt Gen Davar also suggested that policy-makers must match their rhetoric with actual steps taken on the ground. Bureaucratic sluggishness and an over-cautious approach need to give way to dynamism and fresh thinking, both crucial in an ever-changing world. Capabilities and operations of India's defence forces have certainly been impacted by political overtures, but the lack of requisite equipment can potentially put the country in harm's way, at a time when adversaries are modernising continuously.

Focus at this Seminar was on the status of new fighter aircraft acquisitions, with timelines as priority about which former DCAS Air Marshal Nirdosh Tyagi made his keynote presentation, thereafter followed by industry representatives who flagged the need for establishing catalysts, leading to meaningful transfer of technologies and thus 'Making in India'.

Plans and perspectives of Indian Naval Aviation were thereafter articulated by Rear Admiral Davinder Sudan, former ACNS (Air) and lately Senior Directing Staff at the National Defence College. The Indian Army's modernisation imperatives were the theme of Lt Gen Vinod Bhatia, former Director General of Military Operations and now Director CENJOWS, the Inter

Air Marshal Nirdosh Tyagi

Services think tank. Concluding remarks were made by Dr Manoj Joshi, the well-known political and defence analyst with ORF.

Air Marshal Nirdosh Tyagi began with an overview of the combat aircraft situation as prevails today with timeline estimates as to inductions of new types in the next decades. He did not dwell on the vexed matter of MiG-21/MiG-27s phasing out, with its successor yet to be identified (MMRCA 2.0 ?), however, he focussed on replacement of the present 12 squadrons of 'legacy' types (Jaguar, MiG-29, Mirage 2000), inducted in the 1980-90s and projected for phase out from frontline service in the early 2030s. The IAF has pinned its hopes on the indigenous LCA Mk.II, now given a new appellation of 'MWF' or medium weight fighter, whose induction into the IAF is projected as being from 2028. The earlier 83 numbers of the LCA Mk.IA are planned to be inducted from 2023, even though HAL have yet to complete integration and certification of key new systems which distinguish this variant from the earlier Mk.1.

The former Deputy Chief referred to the '110 new fighters' which the IAF has issued an RFI for two years back but considering the processes ahead, induction of these could take another 8-10 years after selection, which is sobering reality. Considering this, the Air Marshal felt that instead of waiting for the yet to be formalised "strategic partnership" route, the 110 fighter programme should be progressed under the 'buy and make Indian' approach with the private sector fully involved. He was also open in his views that 'offsets' should be discontinued and DPSUs soon privatise or become competitive.

As for the next (5th) generation fighter, the Indian government has "opted out" from joint development with Russia of the FGFA (now the Su-57) and first deliveries of the indigenous advanced medium combat aircraft (AMCA) would not be before 2035. It would be certainly advantageous to team up with other nations and OEMs for co-development and co-production of this next generation fighter.

The Interactive Session was moderated by Pushpindar Singh, President *The Society for Aerospace Studies* who after a brief backgrounder, requested the various distinguished Air Marshals present to reflect on the presentations made. Former CAS Air Chief Marshal SP Tyagi shared his views on the pressing need for modernisation of the Indian Air Force with procurement of not only new gen fighters but other force multipliers. Air Marshal Ajit Bhavnani, stressed the importance of co-development and co-production to ensure both timely availability of different hardware and the need for prioritising on indigenous R&D. His views were seconded by Air Marshal DC Kumaria. While Air Marshal Vinod Patney agreed that while the present state-of-affairs was real, he cautioned against over pessimism. Summing up this Session, it was apparent that the "Air Force knows what it wants – but does not get what it needs" !

Air Chief Marshal SP Tyagi (centre) with Air Marshal Ajit Bhavnani, Air Commodore Suren Tyagi and Air Vice Marshal Kapil Kak

Naval Aviation

Rear Admiral Davinder Sudan, who has recently hung up his flying boots, has had a chequered career, having commanded the Sea Harrier squadron, as also 4 warships, including guided missile destroyers, before taking over as ACNS (Air) and then as being sSenior Directing Staff at the National Defence College.

Rear Admiral Davinder Sudan

He took the previous discussions forward and observed the manner in which Indian defence forces in general and Indian Naval Aviation, in particular, are on the cusp of major changes. These are both structural and operational in nature, but must include reforms of various kinds and progress towards a defined set of goals. He stressed on the need for ongoing upgradation of systems, which as he noted, is different from buying newer platforms. Rear Admiral Sudan also highlighted some of the critical issues that have imperilled the procurement process for the Indian Naval Aviation as well. While he did not deride offsets for what they are worth, he did share the sentiments of the preceding speakers and spoke on the need for (a long overdue) change and take a holistic view of the strategic partnership model, which can certainly become an effective production and delivery mechanism.

The ensuing interactive session was moderated by Vice Admiral Anup Singh, who has had a distinguished career in the Navy, retiring as FOC-in-C, Eastern Naval Command, has since been actively engaged with different think-tanks, sharing

Vice Admiral Anup Singh, with Air Marshal VR Choudhari DCAS on his left

Lt Gen Vinod Bhatia with Vice Admiral SPS Cheema on his right

his insightful views on naval issues and much more. He focussed on the particular challenges that India faces by virtue of being one of the largest peninsular countries in the world. With as many as eight different choke points, many serving as entry and exit to open seas present in the Indian Ocean, he stressed on the need for sustained maritime surveillance as being the major challenge for India's security in this vast ocean-centric region. Recalling what the former US Secretary of State had once said, the Admiral noted the urgency for India to assume a bigger role – that of a net security provider – in the Indian Ocean and not be content in remaining only a linchpin, which it is today.

Indian Army : Modernisation Imperatives

This Session was addressed by Lt Gen Vinod Bhatia, who retired as Director General of Military Operations after which he was appointed at the Headquarters Integrated Defence Staff as the Director of Centre for Joint Warfare Studies (CENJOWS).

There is imperative need to modernise the Indian Army, one of the largest in the world. The General lamented the present state-of-affairs in which, according to him, all of the 38 items essentially required by the soldier, "is suboptimal". On the necessary push needed to spur indigenous research and development, he was of the view that previous US sanctions against India would not have been so bad after all ! The way forward, according to him, was to do away with the present anarchic procurement procedures, create avenues for greater self-reliance and ensure greater alignment of responsibilities, 'authority' currently with the government and 'accountability' shouldered by the Armed Forces !

Major General Ashok Mehta with Air Marshal DC Kumaria on his right

That distinguished solder and now articulate member of several national and international think tanks, Major General Ashok Mehta, cautioned against excessive interference by the National Security Advisor in the matters of the defence forces. The General conceded that while India faces a "many fronts war", perhaps many do not even quite know what the threat is ! Operational requirements and tactics, are vital as much as are strategic and systemic demands. What is needed today is a combined defence ecosystem in which there is greater joint-ness, cohesion and coherence – amongst other things.

Dr Manoj Joshi making his concluding remarks

In his concluding remarks Dr Manoj Joshi, the very well known defence and political analyst who has also been a member of the National Security Advisory Board and is currently a distinguished fellow at the Observer Research Foundation, brought the seminar to close by underlining the importance of comprehensive defence reforms for which, he said, "we need to talk to the politicians". Practical requirements, Dr Joshi observed, must be interactive with policy changes in a manner that they create a symbiotic ecosystem in which "the defence forces thrive and with it the security of India survives".

Chayanika Saxena

Chandrayaan-2 launched successfully

Lift off

One of India's most ambitious space-based missions, Chandrayaan-2, took off from the Second Launch Pad at the Satish Dhawan Space Centre SHAR (SDSC SHAR), Sriharikota on 22 July 2019. Conceived and executed by the Indian Space Research Organisation (ISRO), the mission will attempt to explore the south polar region of the Moon.

The 3840 kg spacecraft which was launched by India's Geosynchronous Satellite Launch Vehicle (GSLV) MkIII-M1 is now orbiting round the earth with a perigee (nearest point to Earth) of 169.7 km and an apogee (farthest point to Earth) of

GSLV MkIII-M1 Chandryaan 2 vehicle night view at the Second Launch Pad

GSLV MarkIII-M1 vehicle coming out of the Vehicle Assembly Building

Another view of GSLV MkIII-M1 vehicle at the Second Launch Pad

45,475 km. The Rs 978-crore Chandrayaan-2 is India's second mission to the moon. It comprises a fully indigenous Orbiter, Lander (Vikram) and Rover (Pragyan). The Rover Pragyan is housed inside Vikram lander and the spacecraft will take 48 days to accomplish the vital task of landing on the Moon through meticulously planned orbital phases.

The spacecraft has 13 payloads in total with eight of them in the orbiter, three payloads in Vikram lander and two in Pragyan rover. Five payloads are from India, three from Europe, two from the US and one from Bulgaria. A Laser Retroreflector Array (LRA) of NASA is among the payloads and is aimed at understanding dynamics of Earth's Moon system and deriving clues on Lunar interior.

ISRO Chairman Dr K Sivan congratulated the launch vehicle and satellite teams involved in this challenging mission. "This is the beginning of the historical journey of India towards Moon and to land at a place near south pole to carry out scientific experiments to explore the unexplored. On 15 July 2019 ISRO observed a technical snag, team ISRO worked out, fixed and corrected the snag within 24 hours. For the next one and a half days, the required tests were conducted to ensure that corrections made were proper and in right direction and with the successful launch, ISRO bounced back with flying colours."

Pragyan Rover

The essential mission objective of Chandrayaan-2 is to develop and demonstrate the key technologies for end-to-end lunar mission capability, including soft-landing and roving on the lunar surface. On the science front, this mission aims to further expand our knowledge about the Moon through a detailed study of its topography, mineralogy, surface chemical composition, thermo-physical characteristics and atmosphere leading to a better understanding of the origin and evolution of the Moon.

Pragyan Rover mounted on the ramp projecting from sides of the Vikram Lander

Reliving IAF History

20 years after Kargil 1999

VAYU and 'Op Safed Sagar'

On 16 July 2019, the Government of India and its armed forces marked the 20th anniversary of what has become known as 'Kargil 1999', the Indian Army referring to those actions in the high mountains as *Operation Vijay* while the Air Force remembers as this as *Operation Safed Sagar* which perhaps is a haunting reminder as to many differences of perspective. Present Chief of the Air Staff, Air Chief Marshal Birender Singh Dhanoa, who was then commanding No.17 Squadron with MiG-21Ms forward-based at Srinagar addressed a special Seminar (*20 years of Op Safed Sagar*) at Subroto Park, New Delhi and recalled that there were then operational limitations but innovative ways adopted by the IAF overcame difficulties during that conflict.

"Over a period of time, the Air Force has evolved in a manner that we have through a process of long long planning and induction. Slowly, we got our ability to take part in operations across the spectrum of the conflict. It is now a force that is capable of full spectrum conflict, from sub-conventional to nuclear," the Air Force Chief said.

"In 1999 (precision bombing capabilities) were operationalised only on the Mirage 2000 aircraft. Now all aircraft, Mirage 2000, Su-30, Jaguar, MiG-29 and MiG-27 have the capability for precision bombing. Not only that, in case we have correct coordinates we can do all-weather bombing through clouds very accurately," the CAS said. He continued with the statement that the "Balakot strike (on 26 February 2019) demonstrated the IAF's ability of precision bombing, asserting that it is capable of taking part in full spectrum of conflict, ranging from sub-conventional to nuclear".

20 years later, the *Vayu Aerospace Review* recalls that it was the only journal to have covered that war, virtually as it took place, with its Issue IV/1999 publishing the war diary, day-to-day from 26 May 1999 till the ceasefire on 16 July 1999, the date set by India for all Pakistani intruders to withdraw well north of the Pakistani side of the Line of Control.

(Left to Rght) : Then Wg Cdr Birender Singh Dhanoa, CO No.17 Squadron, Wg Cdr KT Sebastian, Air Cdre Mohinder Khanna, Gp Capt DN Ganesh, Gp Capt Jitinder Singh Dhillon and Wg Cdr NK Tandon, CO No.51 Squadron at Srinagar airfield, 16 July 1999

MiG-27ML of No.9 Squadron being loaded with free fall bombs, (note 'yeh dil mange more' chalked on the bomb)

Wg Cdr Harjinder Singh Jallawalia, CO No.108 Squadron flying MiG-21Ms

In the following issue (V/1999) detailed analysis of the air operations was given, including the CAS Air Chief Marshal Anil Tipnis's first hand statements plus detailed briefings by Air Marshal Vinod Patney, AOC-in-C Western Air Command. Framed for posterity was the laconic statement made at the time as the IAF Mirage 2000s and MiG-27MLs and MiG-23BMs, using 250kg iron bombs and improvised LGBs struck at targets "specially identified as tactically extremely important and so addressed with a corresponding larger weight of attack. The IAF is a mature service, not easily given to hyperbole but in the case of this attack …. the word obliterated does come to mind".

The ceasefire was effective on 16 July and uniquely, the Managing Editor of *Vayu Aerospace Review* was flown to Srinagar, met with various Squadron and Station Commanders, including then Wg Cdr Birender Singh Dhanoa, CO No.17 Squadron (now the CAS) and later by helicopter on to Drass from where the final army assaults were mounted. He then helicoptered to Point 4875, which critical feature west of Tiger Hill had been captured on the night of 4-5 July.

Before flying back to Delhi, *Vayu* briefly met and interacted with the then AOC J&K, Station Commanders of Srinagar and Awanthipur as also COs of the MiG-21M and MiG-27ML squadrons. That brief visit enabled the recording, firsthand, of the IAF at its operational time during *Operation Safed Sagar*, with some images, having first appeared 20 years ago, now reproduced for readers.

[All photos by Pushpindar Singh]

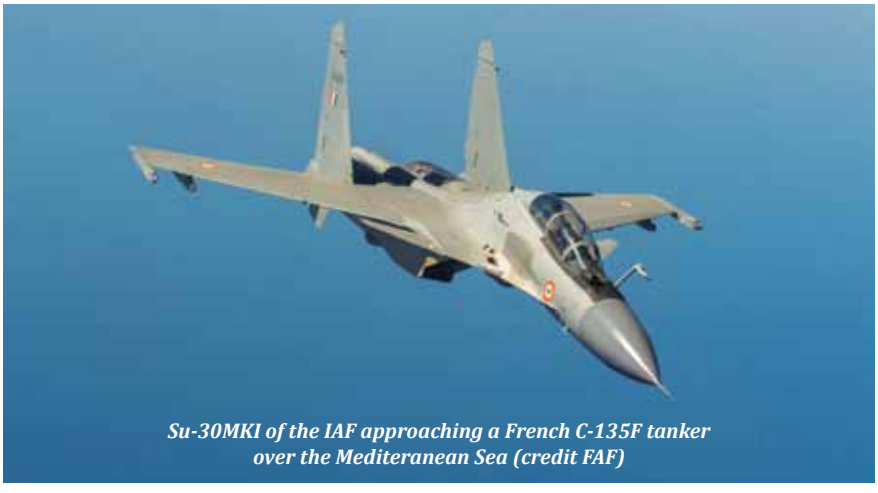
Cover of Vayu Issue IV/1999 : Dramatic photo of Mi-17of No.152 HU lifting off from Drass in the shadow of the Tololing ridge. The characteristic shape of Tiger Hill is framed between the rotorblades.

Flankers over France

Exercise Garuda VI

During the first two weeks of July 2019, sixth edition of the *Garuda* series of exercises between the Indian Air Force and its French counterpart *Armée de l'Air* was held at Mont de Marsan air base in southern France. In sending four Sukhoi Su-30MKIs, an interesting "contest" was witnessed between this formidable Russian-origin fighter and their soon to be brothers-in–arms, the French-developed Dassault Rafale.

Falling under the global framework of bilateral cooperation established in 1998 between the two nations, the *Garuda* exercise is alternately held in France and India, the first edition of which took place



Su-30MKI of the IAF approaching a French C-135F tanker over the Mediteranean Sea (credit FAF)

The relative size of Su-30MKIs and Rafales are clearly seen in this joint formation over the French country side (credit FAF)

An IAF Su-30MKI at Mont de Marsan, with a French Rafale taxing past (credit FAF)

at Gwalior Air Force Station (AFS) in 2003, being the first such exercise between the IAF and a foreign air arm. In 2005, *Garuda II* was held at Istres air base in France which also marked the first such exercise of the IAF in Europe. The third edition, in 2007, was again held in India and the subsequent edition hosted by France in 2010.

During fourth edition of *Garuda*, which was held at Istres again, Indian and French aircraft refueled from each other's tankers for the first time, highlighting increased operating synergy. Also, this fourth edition was exercised in a trilateral format with Singapore deploying their F-16s to Orange air base at the same time. Because of the Libyan war, in which the French were heavily involved under NATO command, the fifth edition of *Garuda* took a few years later than anticipated, in June 2014 at Jodhpur AFS, *Garuda* V witnessing the maiden participation of Rafale fighters in an air exercise in India.

'Hawks' versus 'Normandie'

110 pilots and technicians of the IAF, with four Su-30MKIs of No.24 Squadron 'Hunting Hawks' based at Bareilly AFS and a single IL-78 midair refueler of No.78 Squadron at Agra comprised the detachment. Two IAF C-17 Globemaster IIIs provided transport support for the induction/deduction of Indian personal

An IAF IL-78 was used for cross-nation air refueling during Garuda VI (credit FAF)

for the exercise. Making technical stops in the United Arab Emirates and Egypt, it took the detachment four days to reach France. During last part of their flight, the Su-30MKIs were refueled over the Mediterranean Sea by a French Air Force C-135FR, underlining cooperation between the two nations. The French reinforced importance of *Garuda* by supporting the exercise with a variety of assets. Eye catchers were of course the multi-role Rafales of *Régiment de Chasse 2/30 Normandie Niémen* but there also were Alpha Jets, Mirage 2000s, E-3 AWACS and transport aircraft including the C-130 Hercules and Casa 235 during the two-week long exercise.

Two IAF C-17s provided logistics support for the IAF (credit FAF)

Preflight briefing of French and IAF pilots (credit FAF)

French Rafales and Indian Su-30MKIs fly in formation over the French country side. (credit RC2.30 FAF)

"Crawl, walk and run"

As the IAF is not familiar with European air traffic conditions the exercise was built up through "the crawl, walk and run" principle. First week of flying was to familiarise the IAF pilots with local procedures, weather, (air base) surroundings and the French Air Traffic Control. Basic Dissimilar Air Combat Training (DACT) missions, gradually stepping up from 1v1 to 2v2, were flown within visual range (WVR) with pilots of both nations getting the chance to fly in each other's aircraft to get the best 'feeling' of capabilities of both the Rafale and Su-30MKI. Colonel Gaudillere, base commander of Mont de Marsan, flew with Gp Capt Rodrigues in a Su-30MKI, commenting that : "It was a great experience flying the Flanker." Finally the weapons range nearby Mont de Marsan was visited by mixed formations.

With Indian pilots getting more familiar in France, the exercise stepped up a notch during the second week, largely dominated by Combined Air Operations (COMAO) and Large Force Employments (LFE). These missions centered on gaining and maintaining air superiority against an advanced (air/ground) threat. Missions consisted of 15 Offensive Counter-Air (OCA) aircraft performing all kinds of OCA missions including strike, sweep and slow mover protection versus 7 Defensive Counter-Air (DCA) aircraft defending their assets.

Also practiced during *Garuda* was training of the role of Mission Commanders, which gave the somewhat younger and less experienced pilots the chance to plan, execute and control a COMAO mission

IAF Su-30MKI refueled by French C-135F during their arrival in France late June (credit FAF)

which significantly added to their overall learning curve. As Gp Capt Rodrigues elaborated: "this exercise has been a great experience for the IAF. Going through different phases starting with basic Combat Air Manoeuveres up to the LFEs in the second week provided value experience which we can exploit when we are back in India.".

Forging relationship

Military relationship between France and India has been increasing and has been demonstrated in more than one way. *Garada* VI provided an opportunity to a sizeable number of IAF pilots to have a close-look at the Rafale of which the first of 36 on order will enter service with the IAF from September this year. But not only aircrew benefited from this exercise. For example, firemen of both nations interacted with each other in training together on how to evacuate airmen from each other's aircraft type. As Group Captain Shah, IAF detachment commander for *Garuda* VI, stated: "The exercise is meant to increase interoperability between the two friendly nations as well as learning the best practices from each other so both air forces grow and get better at what they do." Considering the long series of *Garuda* exercises, but also mutual operations between Navy and Army elements of both nations and the imminent arrival of the first French-origin Rafale for India, it seems that the two nations have forged a strong relationship into the future.

Article by Stephan van Geem, Patrick Smitshoek and Remco Stalenhoef

Sqn Ldr Ambure of the IAF before flight in a FAF Rafale aircraft during Garuda VI (credit IAF)

Lockheed Martin and Tata's host 2019 Supplier Conference in India

Dr. Vivek Lall, Vice President of Strategy and Business Development, Lockheed Martin Aeronautics at the event

Phil Shaw, Chief Executive of Lockheed Martin India

Reaffirming their commitment to strengthening India's aerospace sector and India-US ties, Lockheed Martin and Tata Advanced Systems hosted the third annual industry supplier conference at New Delhi on 16 July 2019. Executives from Lockheed Martin, Tata, Tier 1 suppliers and prospective Indian industry partners gathered at the event to discuss partnership opportunities that strengthen India-US defence industrial ties and Make in India partnerships. "In addition to India's highly capable public sector companies, many private Indian companies have entered the aerospace and defence arena, which will continue to drive innovation and broaden the array of capabilities across India's defence-industrial ecosystem."

"Lockheed Martin is fully committed to meeting India's need for advanced, scalable defence capabilities," stated Dr. Vivek Lall, Vice President of Strategy and Business Development, Lockheed Martin Aeronautics. "Our partnership with Indian industry on both the F-21 and S-76D proposals for the Indian Air Force and Indian Navy will put India at the epicentre of world's largest defence ecosystem and deliver unmatched sustainment and export opportunities."

"We are happy to co-host the supplier conference with our strategic partner Lockheed Martin, setting a common platform for the Indian players to meet and share knowledge with global suppliers and OEMs," stated Sukaran Singh, Chief Executive Officer and Managing Director of Tata Advanced Systems. "Our successful partnerships and joint ventures with Lockheed Martin have helped to build new capabilities and strengthen the Indian defence manufacturing sector and India-US ties. We hope to further grow this relationship with the F-21 project and other world-class programmes."

In addition to Tata, Lockheed Martin industry partners and suppliers included BAE Systems, Cobham, Collins Aerospace, Curtiss-Wright, Eaton, Elbit Systems, Elta, GE Aviation, Honeywell, L3Harris, Leonardo, Martin Baker, Meggitt, Moog, Northrop Grumman, Parker Hannifin, Pratt & Whitney, Rada, Rafael, Raytheon, Safran Electrical & Power and other leading global defence and aerospace companies. "Defence industry partnerships have long been a hallmark of strategic ties and trust," stated Phil Shaw, Chief Executive of Lockheed Martin India. "We see tremendous strength and opportunity in India's defence industry and we're very excited by the incredible potential in India."

"For more than 25 years, Lockheed Martin has been committed to building trust, technology development, and strategic collaboration with India".

Lockheed Martin has two state-of-the-art manufacturing joint ventures in India with Tata Advanced Systems. The company recently emphasised its commitment to India by announcing the company would partner with Tata to produce F-16 wings in India for all future customers.

At the well attended conference

Model of the proposed F-21 offered for the IAF

Lockheed Martin also relies on TASL in Hyderabad, India, as the manufacturing base for its global supply of cabin aerostructures for the S-92 helicopter. Lockheed Martin has been a "strong supporter of Government of India initiatives including Make in India, Start-up India, Skills India, and Digital India". As a part of its larger commitment to enhance the growth and development of India's innovation, Lockheed Martin has sponsored and supported the India Innovation Growth Programme (IIGP) since 2007.

"Lockheed Martin is committed to strategic, long-term international defence partnerships with India and hopes to strengthen and grow its relationship with India as part of an unprecedented F-21 fighter aircraft partnership for India, from India", emphasised Dr. Vivek Lall.

[Inputs from Lockheed Martin]

India's First !

The Heliport at Rohini

Early July 2019, I went to the Rohini Heliport which is the first and currently only dedicated heliport in the country, created and owned by Pawan Hans which is a Central Government entity and works under the Ministry of Civil Aviation. The infrastructure has all the qualities to call itself a modern state-of-art creation with all the basic needs that a dedicated heliport or helibase demands. Not only in India but this dedicated heliport is regarded as one of the only integrated helicopter facilities in entire South Asia/ South East Asia.

In 2011 Government and Pawan Hans announced beginning of the work for the heliport and within just six years the heliport finally took proper shape in 2017. The main aim of this heliport was to reduce the burden from the already overburdened Palam Airport in the National Capital. The current conditions of IGI Airport are quite alarming in terms of air traffic congestion as with helicopters, civilian aircraft, defence aircraft activity and with severe VIP movement all vying for the same airspace, the usage of IGI Airport is touching its saturation level which needs to be addressed soon or else it will start hampering operations. Experts and authorities sensed this long back and decided to move helicopter movement out of IGI Airport (to now Rohini) which will ease VIP movement as well make medical emergency procedures easier and faster.

The infrastructure at Rohini includes a dedicated MRO (Maintenance, Repair and Overhaul) hangar/shelter which will allow Pawan Hans to continue taking care of their helicopters and also to carry out the same for other helicopter operators in the country. The total project was estimated to be Rs 100 crore. The MRO hangars are so massive that at any time they can accommodate three medium to small helicopters or two large helicopters like the Mil Mi-172. Pawan Hans has a wide range of helicopters and are using the Rohini Heliport as their base for maintenance. Apart from Pawan Hans, private players are also using Rohini for parking and maintenance.

As for the terminal and apron, the terminal is state-of-art and big enough to cater to 150 passengers at any given time which is quite sufficient for helicopter operations. The facilities includes a dedicated business lounge, a restaurant, private lounge, office and ticketing workspace for proposed airlines, dedicated security room, dedicated arrival lounge with one baggage claim conveyor belt, dedicated check-in counter (a total of four check-in counters), baggage screening area and a gallery with seating arrangements. The terminal building is designed in such a way that the wall art depicts the heritage of Delhi and a glimpse of Delhi's cultural values. The terminal building is a two storey structure where the lower portion is designed to charter the passenger facilities and the upper deck is designed to charter the official needs of the airlines (upcoming).

The apron can accommodate a total of 16 helicopters at a time with two dedicated parking for big helicopters like the Mil Mi-172. The terminal also has an Air Traffic Control Tower and Apron Control Tower. There is a dedicated fire and safety zone to tackle any kind of emergency situation. The runway marking assigned to this heliport is 12/30. The then Minster of Civil Aviation Ashok Gajapati Raju inaugurated the heliport in 2017 and after that Pawan Hans opened the heliport with grand celebrations that included joyrides from its Safdurjang base to Rohini along with the Delhi Darshan scheme which allowed passengers to take aerial trips over Delhi.

It has now been two and a half years since inauguration but the heliport is yet to see its commercial operations since it is currently restricted to helicopter parking and maintenance. The main problem the heliport is facing is its location. The heliport is in Sector 36 of Rohini which is approximately five kilometers away from the nearest metro station and is also at an outskirt location which requires personal transportation. People travelling from Noida, Greater Noida and Gurugram needs atleast two hours to reach. These aspects are negative enough to put a question mark on the operations of this beautiful heliport unless Government takes initiatives to increase the local transportation system towards the Rohini Heliport, this heliport will continue to remain under utilised.

This heliport has all the potential to boost tourism as it can handle charter flights to nearby states such as Himachal Pradesh, Uttarakhand, Rajasthan, Gujarat, Punjab, Uttar Pradesh and Jammu & Kashmir.

Dipalay Dey

VAYU on-the-spot report

The 53rd Paris Air Show in 2019

Fantasy in real life : full size Star Wars X-Wing Starfighter made completely of Lego, at main entrance to the show !

The future of aviation technology was on clear display at the Paris Air Show (17-23 June 2019) which highlighted the concerted efforts made by European nations to remain at the forefront of this cutting-edge technology. Future combat systems will be far more versatile and swing-role capable than ever before as evidenced, including Turkey's TF-X unveiling which stressed the impressive strides made by the Turkish defence industry alongside unveiling of the European New Generation Fighter (NGF) and its Remote Carrier (RC) concept.

On first day of the event, Europe's New Generation Fighter (NGF) and Remote Carriers models were unveiled to an excited audience, these concept models developed as part of the Demonstrator Phase of the Future Combat Air System (FCAS). France, Germany and Spain will now proceed with the European Demonstrator Phase, which will run between 2019 and mid-2021. Dassault Aviation and Airbus expect a

Rivals in many senses : A Pakistan Navy ATR72 and an Indian SpiceJet Bombardier Dash 8Q400 parked next to each other at the static display

contract award for the first Demonstrator Phase by Q4 2019. This will serve as starting point for demonstrators and technology development for a New Generation Fighter (NGF), Remote Carriers (RC) and an Air Combat Cloud (ACC) to fly by 2026.

The FCAS will be much more than a combat aircraft and will be a "system of systems" consolidating a large array of interconnected and interoperable elements: a new generation fighter aircraft, unmanned MALE drones (medium-altitude, long endurance), the current aircraft fleet (which will still be in service after 2040), cruise missiles and drone swarms.

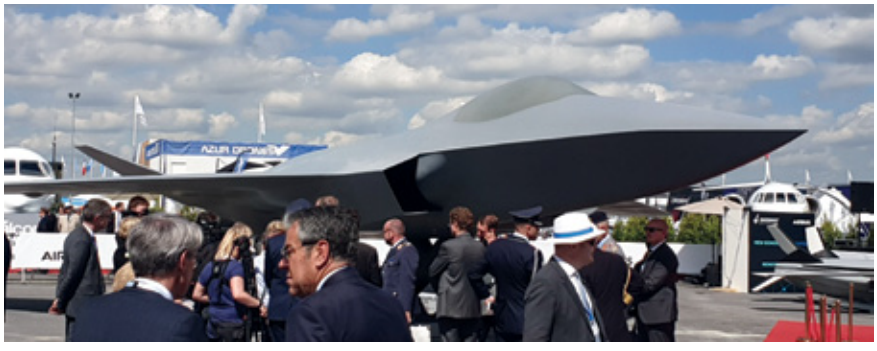
Turkey's next-generation indigenous TF-X combat jet also created waves at the air show and the impressive looking aircraft was part of a US$13 billion Turkish effort to offer a fifth-generation fighter to the international market. Maiden flight of the TF-X is planned for 2025 and service entry slated for 2028. Turkey had signed an agreement with the UK in 2017 to facilitate the joint development of the aircraft noting that BAE Systems was helping with the aircraft design, while Rolls-Royce has teamed with Turkey's Kale Group to work on development of an indigenous engine for the TF-X.

The PAC JF-17 Thunder was one of the only two current generation fighters carrying out flight demonstrations over Le Bourget, June 2019

Very visible with their presence at Le Bourget, were scores of uniformed Pakistani personnel, in support of Pakistan's newly acquired maritime ATR-72 as well as three JF-17 Thunders, and a C-130 *(see separate items on this in the issue)*.

MBDA sprang a surprise, when it showcased a new range of futuristic missile concepts planned for the next generation of European air combat platforms. The new concepts are the result of ongoing studies in its domestic nations. "MBDA's vision for future air armament is exhaustive and ambitious, and we are ready to take on the challenge to deliver to our domestic nations the full sovereignty of their future air combat systems by taking part in the definition and development of the armaments that these systems will operate," said Eric Béranger, CEO of MBDA. Amongst the missiles unveiled were deep strike cruise missiles with advanced systems to penetrate and open breaches in the most efficient of A2AD (Anti Access Area Denial) deployments in the future. MBDA also showcased their future tactical strike weapons with stand-off, networked and compact armaments. These new weapons will be able to saturate enemy defences operating in packs or swarms.

Turkey's next-generation indigenous TF-X fighter full scale mockup at Le Bourget



Mockup of the European Future Combat Air System (FCAS)

An important helicopter type that made its debut at the air show was the new Airbus Helicopters H160M. A full-scale mock-up marked first public display of the new type. The H160M is selected as the new Joint Light Helicopter for the French armed forces and slated for service entry in 2026. To be called 'Cheetah' in French military service, a total of 169 helicopters will be acquired by the army (80), air force (40) and navy (49). The new H160M will replace five different rotorcraft fleets in operation with the French armed forces, being the Gazelle (Army), Alouette III, Dauphin and Panther (Navy) and Fennec (Air Force). The mock-up of the helicopter on display was armed

with an MBDA Sea Venom/AGL anti-ship missile and a 20 mm cannon fitted on each wing pylon. The H160M had been formally unveiled by French Defence Minister Florence Parly during her visit to Airbus Helicopters' Headquarters at Marignane in May 2019.

Airbus stole the limelight from Boeing and took home most of the orders, as was expected in the light of the worldwide grounding of the Max 737 aircraft, but the real focus of the 53rd Paris Air Show was coming of age of the concept of hybrid and electric aircraft. The event saw the launch of *Alice*, the world's first commercial all-electric passenger aircraft. Displayed in prototype form by Israeli firm Eviation, the aircraft will carry nine passengers for up to 650 miles at 10,000ft and 276mph. The aircraft, which has three rear-facing pusher-propellers and a 3,500 kg battery, is expected to enter service in 2022. The aircraft already has its launch customer – US regional carrier Cape Air, which wants as many as 92 aircraft!

Meanwhile, French start-up VoltAero is getting ready to flight test its Cessna 337-based *"Cassio 1"* aircraft, which has its front engine replaced with propellers driven by electric motors. The company, which displayed its "iron bird" mockup incorporating the test hybrid power module at the air show, is also working on the *Cassio 2* prototype, which will have a fully validated propulsion system. The company is confident that the 4-9 seat aircraft, deliveries of which are to begin in 2021-2022, will be employed for commercial flights for point-to-point regional travel and used by private owners as well as air taxi and charter operators.

It were not just start-ups; aviation powerhouses are joining the electric/hybrid bandwagon as well. Rolls-Royce has taken over Siemens' electric and hybrid-electric aerospace propulsion business while United Technologies, which announced a merger with Raytheon days before the Paris Air Show, is working on a hybrid electric project, with the intention of having a mid-sized regional turboprop aircraft, which will have batteries and a 2-megawatt hybrid-electric propulsion system in the air within three years. Company officials believe that certified hybrid-electric regional travel is actually possible within 10 years.

Le Bourget 2019 had Airbus selling more aircraft than Boeing and announcing a new aircraft – the much anticipated A321XLR, which has a range of 4,700 nautical miles with 30% less fuel-burn per seat. There were immediate takers for the aircraft : Air Lease Corporation ordered 27 of the new aircraft on the opening day of the show while Middle East Airlines became launch customer with four of the aircraft. American Airlines ordered 50 XLR aircraft while Indigo Partners signed for 32. Other buyers of the aircraft were Qantas Airways which ordered 10 aircraft, Cebu Pacific Airlines (10 aircraft) and International Airlines Group (IAG,) which wants 14, with an option for 14 more. Flynas signed a memorandum of understanding for 10 A321XLRs and also revised its order to take ten A321neo instead of A320neo aircraft.

Airbus found takers for the A320 and A321 neo as well, with China Airlines, Cebu Pacific Airlines, and Saudi Arabian airlines signing up. Among other orders for the company at the show was one for 14 wide-body A330neos by Virgin Atlantic; the carrier also looking into buying six more of the aircraft. Air Lease Corporation's order also comprises 50 A220-300s and 23 A321neos. JetBlue placed an order for 10 additional A220-300s and also converted 13 existing A321neo orders to the A321XLR. Delta Air Lines placed an order for an additional five A220-100s, taking total orders for the type to 90.

In view of the continued grounding of the its bestselling 737 Max, not a lot was expected from Boeing in terms of new orders during the show, but the company sprung a major surprise on the second day by announcing a deal to deliver 200 737 Max aircraft to IAG. Boeing also announced a few other deals for some of its other aircraft. GE Capital Aviation Services (GECAS) signed an agreement with Boeing for 10 737-800 Boeing Converted Freighters (BCF) while ASL Aviation Holdings signed a memorandum of understanding (MoU) for 20 737-800 BCFs, including 10 firm orders and 10

The lifesaver ! A happy train shuttle system ferried harrowed visitors across the long distances and in high temperatures

Boeing executives 'Turbo', Salil Gupte (President Boeing India) and 'Thom' who briefed the Indian media

The Boeing 787-9

purchase rights. British Airways ordered 18 777-9s with 24 options while Korean Air signed a deal for 30 new 787 Dreamliners. Air Lease Corporation intends to purchase five 787-9 Dreamliners. Qatar Airways announced its intention to buy five more 777 freighters while China Airlines ordered up to six 777 Freighters to modernise its fleet. Turkmenistan Airlines announced that it was buying another 777-200LR to add to the three currently in service.

Boeing also unveiled its 2019 Commercial Market Outlook (CMO), a longer-term forecast that delves deeper into the market for commercial airplanes and services. The newest CMO shows growing passenger volumes and increasing airplane retirements which will drive the need for 44,040 new jets, valued at $6.8 trillion over the next two decades and up 3 percent from a year ago. The global commercial airliner fleet will also sustain the need for aviation services valued at $9.1 trillion, leading to a total commercial market opportunity of $16 trillion through 2038. Of the new deliveries, forecasters say 44 percent will go toward replacing aging aircraft while the rest will cater to traffic growth. Together, the new jets support an industry where passenger traffic will grow an average 4.6 percent and cargo traffic will grow an average 4.2 percent. Factoring in the new airliners that would remain in service, the global commercial fleet is expected to reach 50,660 aircraft by 2038. This is the first time the projected fleet has crested the 50,000 mark.

ATR signed 75 orders, including 17 for the new ATR 42-600, at the event. Meanwhile, Bombardier had a moment of cheer when its flagship Global 7500 aircraft made its debut. Also making its first trip to the biggest air show in the world was Gulfstream Aerospace's G600 business jet

Leonardo turned heads at the event by introducing the Falco Xplorer, its largest-ever Remotely Piloted Air System (RPAS). The drone features a payload capacity of 350kg, is capable of more than 24 hours flight time and has satellite communications capability for beyond-radio-line-of-sight operations, all within a 1.3-ton maximum take-off weight (MTOW).

General Atomics Aeronautical Systems Inc. (GA-ASI) officials announced at the airshow that the company was making steady progress on its MQ-9B SkyGuardian programme, which has the United Kingdom's Royal Air Force as the

Leonardo's new Falco Xplorer

Japan's C-2 and P-1 on static display

launch customer. The RAF's SkyGuardian, which has been named Protector, made the first ever transatlantic flight of a medium-altitude, long endurance aerial drone in July last year. Company President David Alexander said that the company expected military-type certification by the British regulatory authorities in 2023 for the drone, which is the first remotely piloted aircraft (RPA) developed to fly in unsegregated airspace. The drone, which is equipped with detect-and-avoid suite, has attracted international attention, with Belgium gaining US approval to buy four aircraft. In another positive development for the SkyGuardian programme, GA-ASI and L3 Technologies, Inc. announced that they had developed and successfully flight tested a full-band Signals Intelligence (SIGINT) ISR capability for use on the Predator B Remotely Piloted Aircraft System (RPAS).

Japan confidently revealed its high technology capabilities in the defence arena, by displaying two aircraft types. Making its maiden Le Bourget appearance was the C-2 heavy transport aircraft, which is manufactured by Kawasaki Heavy Industries Ltd. The C-2 aircraft on display had made stops in Cambodia and Abu Dhabi, before arriving at Le Bourget. The Japanese Maritime Self Defence (JMSDF) sent two P-1 (Patrol-1) maritime patrol aircraft as participants at the show.

Embraer was present at the 53rd edition of Paris Air Show International with the first KC-390 multi-mission airlift configured to operate with the Brazilian Air Force (FAB). The aircraft, number 004, was in the static area and performed flight demonstrations on the first two days of the show. The KC-390 programme has already reached important milestones, such as receiving Brazil's Civil Aviation Agency's (ANAC) Type Certificate and production of the first series aircraft that performed its first flight in October 2018. To date, the flight test campaign has surpassed 2,200 flight hours.

Back to Airbus, the company presented a broad portfolio of products, technologies and services which "meet the aerospace industry's

Embraer's E-195-E2 commercial airliner at the show

Embraer KC-390

From airliners to tactical transports to fighters to helicopters : the impressive Airbus portfolio

requirements for today and into the future". At this edition of the Show, was celebrated Airbus' 50 years of pioneering progress which has "created a string of world aerospace firsts to drive the industry's transformation". In the flying and static displays at the show, Airbus demonstrated the A350-1000 and a Hi-Fly A380.The static display featured an airBaltic A220-300 and an A330neo flight-test aircraft. In addition, the first A321neo single-aisle aircraft destined for La Compagnie showcased its all-business class cabin with 76 full-flat seats on transatlantic flights. Also present in the static display was the *Vahana* – Airbus' single-passenger (or cargo), all-electric, fully-autonomous, vertical-takeoff-and landing demonstrator. Airbus Helicopters highlighted its modular and versatile military platforms at Le

Magnificent family of airliners from the Airbus portfolio

Lockheed Martin and Airbus reaffirm tanker partnership

With an agreement now in place to explore US military air-refueller tanker opportunities, Airbus and Lockheed Martin senior executives and leaders met for some "tanker talk" during the 2019 Paris Air Show. The Airbus A330 Multi Role Tanker Transport (A330 MRTT) provided an appropriate backdrop for the meeting with (l to r) Alberto Gutierrez, Head of Military Aircraft, Airbus Defence and Space; Michele Evans, Executive Vice President of Lockheed Martin Aeronautics, and Dirk Hoke, CEO of Airbus Defence and Space.

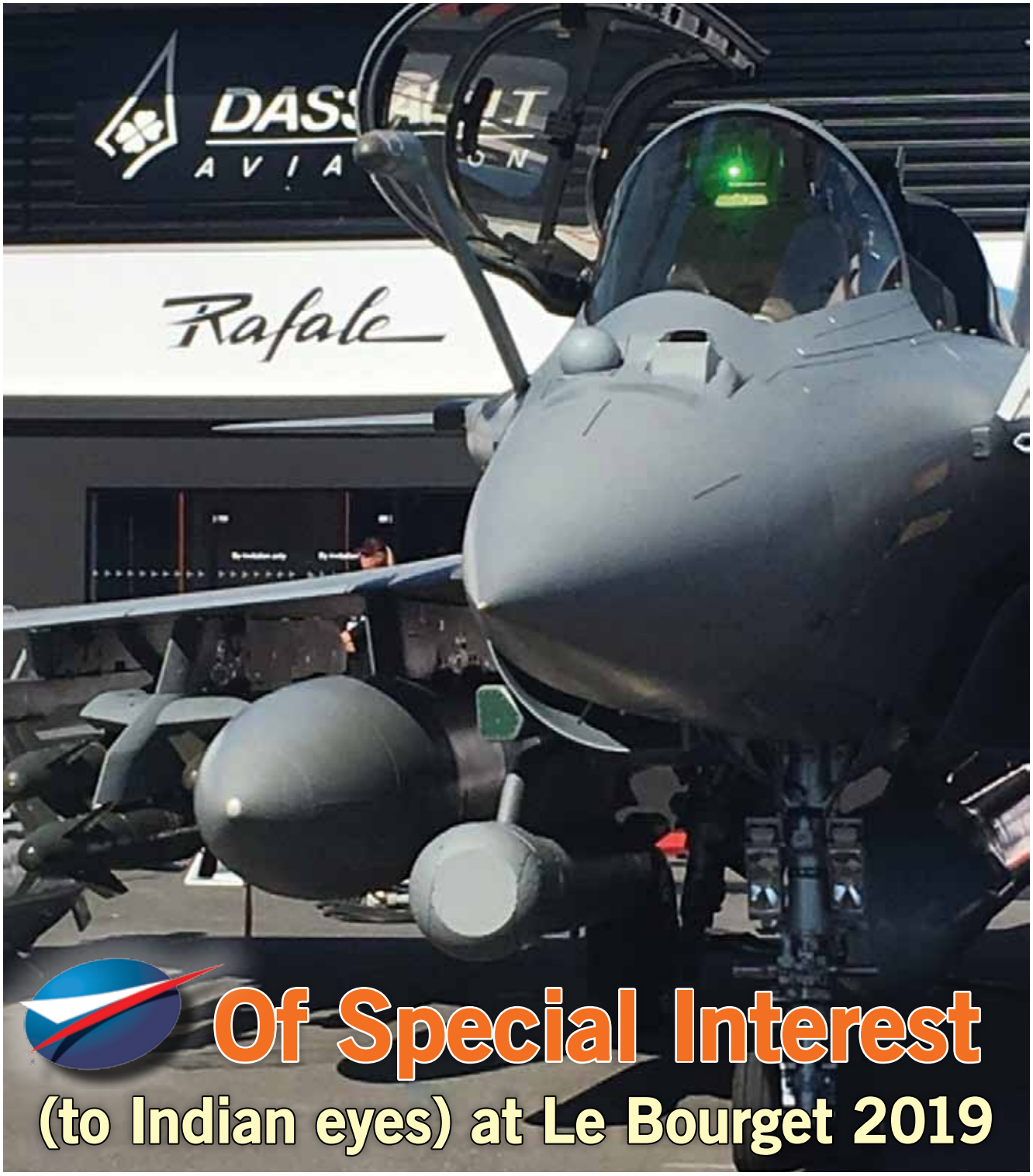
Bourget. Meanwhile, Airbus Defence and Space were unmatched in showcasing their broad product portfolio of military aircraft, space systems, secure communications and drones. One highlight was the "FCAS Experience Centre" where visitors could see what Europe's Future Combat Air System could look like.

Pratt & Whitney announced they had surpassed 17,500 engine deliveries, including auxiliary power units (APUs), to power Airbus and its partners, subsidiaries and joint venture companies. The milestone comes following the production ramp up in Pratt & Whitney GTF engine deliveries to support the Airbus A320neo and A220 programmes. "Half a century of powering Airbus aircraft is a source of pride and a highlight of our own company's 94-year history," stated Pratt & Whitney President Bob Leduc. "Since the early 1970s, our engines have powered nearly every Airbus commercial aircraft introduced into service. When Airbus Industries came on the scene with the A300 – the world's first twin-engine wide-body aircraft – it was clear that a new generation of aircraft was literally taking off. This is where Pratt & Whitney forged its original collaboration with the JT9D engine."

Currently, the focus is on the growing single-aisle market, where Pratt & Whitney and Airbus are working together on the A320neo (new engine option) aircraft family. However, the cooperation on this aircraft's predecessor, the A320 goes back to the mid-80s through the Pratt & Whitney partnership with International Aero Engines (IAE) and launch of the V2500 engine. Since then Pratt & Whitney and its collaborators have delivered more than 7,000 of these engines to Airbus. The V2500 has now achieved more than 100 million aircraft flight hours, and counting, on the single-aisle aircraft.

The Russian industry was well represented with various companies taking part, including UAC with a huge stand

In their traditional space, at entrance of the main hall at Le Bourget, Dassault Aviation showcased their range of aircraft, from fighters to executive jets



Of Special Interest
(to Indian eyes) at Le Bourget 2019

The Very Obvious !

With imminent handover of the first Dassault Rafales to the Indian Air Force just some months away, the cynosure of all eyes, particularly Indian, were the graceful lines and thunderous visage of Dassault's Rafale fighter which dominated the Company's static display outside the main hall at the 53rd Paris Air Show. Strategically positioned, the Rafale was visited by special invitees while the general public were treated to superb aerobatic displays by the *Armée de l'Air* every afternoon.

The first Indian Air Force pilots and engineers selected for Rafale conversion training have already been in France for several months even as other IAF pilots, on Su-30MKIs have cross-flown with French Air Force pilots at the recent *Garuda* Exercise *(see separate article)*. The only evidence of an IAF Rafale at the Show this time was the model amongst a number displayed at the Dassault stand in Hall 2.

Model of the Rafale in IAF markings

Full scale mockup of the NGF at the Dassault static display

New Generation Fighters

Even as this 'next gen' fighter will soon be in India, the Europeans have embarked on the 'sixth' gen with a full scale model of France and Germany's New Generation Fighter (NGF), which has also been referred to as the Future Combat Air System (FCAS), being unveiled in presence of French President Macron at Le Bourget. On the sidelines, Defence Ministers of France, Germany and Spain had initialed a framework package which was followed by joint industrial proposals formalised by Eric Trappier of Dassault and Dirk Hoke of Airbus Defence & Space.

The NGF is the manned element of the *Système de Combat A*érien *du Futur* (SCAF), that aims to develop a "system of systems" to meet air power requirements from 2040, a 6th generation aircraft to replace the present Rafale (and Typhoon) in service. The programme is fairly ambitious, with the demonstrator phase (2019-2021) to be starting point for technology development and an air combat cloud, with the prototype to fly by 2026. According to Eric Trappier "the progress we have achieved on the FCAS programme in recent months is remarkable. It will shape Europe's most decisive military air combat programme for the decades to come and turn out a strong move in constructing Europe's sovereignty".

According to industrial sources, other companies involved in the FCAS programme are engine manufacturer Safran, working alongside MTU Aero Engines, MBDA and Thales, all of whom have been involved with various Indian programmes.

Indian eyes could not help but focus on the SPICE *(Smart, Precise Impact, Cost-Effective)* 2000 which is an Israeli-developed, EO/GPS-guided guidance kit for converting air-droppable unguided bombs into precision guided bombs. A derivative of the *Popeye* (AGM-142 *Have Nap*) air-to-surface missile, the SPICE is a product of Israeli company Rafael Advanced Defense Systems. It achieved initial operational capability during 2003, in Israeli Air Force F-16 squadrons and became a "household" word in India after the IAF's use of these on 26 February 2019 at Balakot.

Opportunities for HAL

Show after show, the Swiss company RUAG have static displayed a Dornier 228 in some hope that this, essentially HAL-manufactured light transport aircraft would attract export orders. Relationship between the two companies has reportedly remained rocky, with various quality control aspects being flagged but the truth of the matter is that this relationship could never work, the essentially Swiss government organisation having gone off on a tangent from its *raison d'être*, that is of supporting Swiss Armed Forces. It is now open knowledge that RUAG is 'pulling out' of the Dornier 228 programme and is looking for buyers, 35 years after the programme was 'sold' by the erstwhile German parent company to the Indian Government. Herein lies the catch.

Hindustan Aeronautics Limited which have now for over 35 years been building the Dornier 228 in several variants at its Kanpur Division, have delivered well over hundred of this versatile aircraft but primarily to Indian defence operators and continues to do so. It is therefore sad commentary that HAL has made little or no impression on those looking for such cost effective aircraft particularly for maritime surveillance.

The RUAG-Dornier 228 NG was parked close to a Saab 340 maritime patrol version while the venerable Viking Twin Otter Guardian 400 is being marketed with great vigour to potential operators. In fact, being touted as "a new intelligence, surveillance, and reconnaissance aircraft", developed in association with Austrian company Airborne Technologies this was seen mounted with a SCAR 15 pod, equipped with a Hensoldt ARGOS II electro-optical infrared (EO/IR) camera.

According to Viking, "the ability to change the aircraft's role rapidly helps to provide potential users with a versatility in the platform that can cover multiple tasks and missions, with reduced operating costs that multiple aircraft would incur". The Viking Twin Otter has been in service with Vietnam's Navy which Service is likely to order additional aircraft including those with floats.

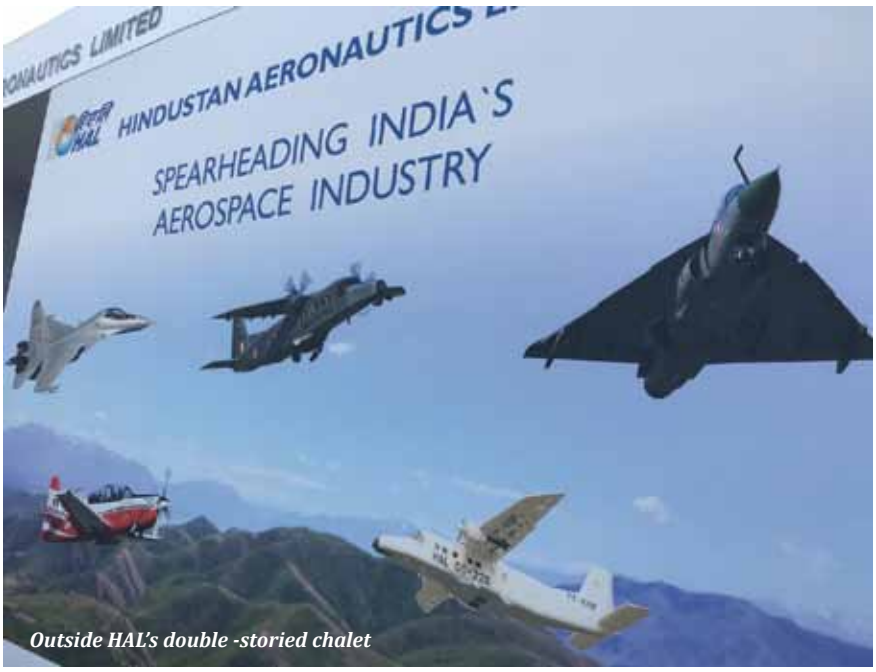
RUAG's Dornier 228NG at Le Bourget

HAL and PAC : a study in contrast

Unfortunately, HAL's presence at the Paris Air Show was restricted to their now customary double chalet, with a fleet of luxury sedans with 'VIP stickers' parked outside. There was little to attempt to showcase HAL's range of products, the Dornier 228 amongst them, with only some images of the type, along with those of the Tejas LCA, brandished on an outside wall.

In sharp contrast was the rather modest PAC chalet, just a little distance away with a small golf cart parked outside. However, there were scores of PAF personnel around, including numbers of pilots and maintenance personnel in support of the three PAC/CAC JF-17 Thunder fighters which took part at the Show. The example on static display also had a range of weaponry that the type is equipped to carry, which attracted much public attention. These JF-17s were from No.2 Squadron *Minhas* based at Masroor (Karachi) and their pilots were amiable in discussions with visitors (including curious Indian journalists).

In fact the JF-17 was the only one of two contemporary fighters carrying out flight displays and demonstrations over the skies of Le Bourget everyday, apart from the Dassault Rafale. The JF-17 was displayed with confidence although one PAF pilot rued that the air space allotted was "too tight for the display which would otherwise have been even more spectacular !"



Outside HAL's double -storied chalet

Thunder over Paris

Young fighter pilots of No.2 (Multi Role) Squadron, PAF

Colourful insignia worn by an ex-No.20 Squadron PAF pilot

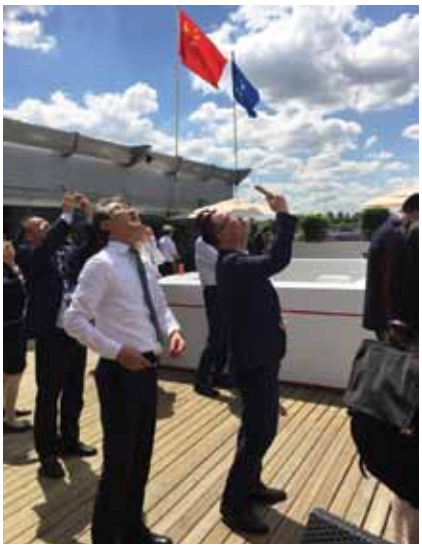
An array of weaponry carried by the Thunder

The JF-17 is jointly developed by the Pakistan Aeronautical Complex (PAC) and Chengdu Aircraft Corporation (CAC) of China, with about 100 such fighters now serving with the Pakistan Air Force in five frontline squadrons and the Combat Commanders School (CCS). These include, besides No.2 Squadron, Nos. 14, 16, 26 and 28 Squadrons, the last providing aircraft for *Exercise Anatolian Eagle* which was taking place in Turkey at almost the same time as the Paris Air Show (*see separate article*).

The first tranche of aircraft were of Block 1 standard which gave way to Block 2 while production at PAC Kamra has progressed to Block 3 which features further avionics advancements including a helmet-mounted display and sight (HMD/S) system, a new single panel multi-functional display (MFD), an active electronically-scanned array (AESA) radar paired with an infrared search and track (IRST) system.

The two-seat version (JF-17B) has been developed for both type conversion training as also enhanced operational capability and first examples are seen in No.16 Squadron markings. Development of the twin-seater was reportedly encouraged by potential export customers and according to authoritative sources, in new contracts signed recently, 26 JF-17Bs will be produced at Kamra in the coming years alongside 50 Block-3 JF-17s.

The JF-17 is now also being operated by the Air Forces of Myanmar and Nigeria while sustained marketing efforts continue to interest countries such as Algeria, Argentina, Qatar, Malaysia, Morocco, Indonesia, Uruguay, Sudan and Zimbabwe. Gauged from the large numbers of delegations visiting the CAC chalet during JF-17 flight demonstrations as also being given detailed briefings around the aircraft on static display at Le Bourget, prospects for Thunders operating in different colours seem very high indeed.



Chinese company executives following the JF-17's flight demonstration

Mockup of the TF-X

The PN ATR-72 MPA

Turkish delights

Meanwhile, even while Pakistani and Turkish fighters were exercising, some distance away to the south-east, the 'Red Crescent' flag flew proudly at Le Bourget with several new Turkish aircraft programmes on display, including the fifth generation TF-X presented as a full scale mockup. According to Turkish Aerospace, its roll out is planned for 2023 and first flight expected in 2026. Turkey has also been developing a new advanced jet trainer, the Hurjet, to replace the current Northrop T-38s in service. Wind tunnel testing has been completed and first flight is expected in 2022. In a significant move, the Turkish authorities have reportedly issued a letter of intent to Eurojet for integration of the EJ-200 in the Hurjet which will clearly give this aircraft supersonic capability.

The Hurjet advanced jet trainer will have an EJ-200 power plant

SpiceJet Bombardier Q400 on static display

Turkish Aerospace has meanwhile completed development of the HurkushB turboprop trainer, with first deliveries to be made shortly. A light attack version Hurkush C is likely to follow. In the area of unmanned vehicles, Turkish Aerospace have developed the Anka-Aksungur UAV can carry a 750-kg payload at altitude of upto 40,000 feet with various indigenously manufactured payloads. There are also several helicopter programmes including the T-625 Gokbey, this 6-tonne rotorcraft making its maiden flight in September 2018.

In passing, the lone aircraft wearing Indian colours at Le Bourget was a Bombardier Q400 90-seater turboprop of SpiceJet which was part of five new aircraft ordered by the airline and scheduled for delivery at end of the Paris Air Show.

Its nearest neighbour at the static display was a Pakistan Navy ATR-72 MPA which after conversion for a maritime role by Rheinland Air Service (RAS) has been transformed into the *Sea Eagle* (*see separate article*). This aircraft too was the object of curious Indian eyes !

Vayu Editorial Team at Paris

Thunder at Le Bourget

View of the JF-17 with weapon options on display (Photo: Vayu, from the Paris Airshow 2019)

Alan Warnes on return of the JF-17 to the Paris Air Show

Three Pakistan Air Force JF-17s were at this year's Paris Air Show, four years after the type first visited the event in 2015 – and a lot has happened to the programme since then.

Right now the last three Block 2s are on the Aircraft Manufacturing Factory (AMF) final assembly line at Pakistan Aeronautical Complex (PAC) Kamra, which will eventually help to equip a seventh operational unit later this year. Meanwhile, the first JF-17 has undergone a major overhaul at PAC Kamra's Aircraft Repair Factory and there is a dual-seat JF-17B, (17-601), undergoing test and evaluation in Pakistan.

A decision from the PAF leadership on a new AESA radar for the Block 3 JF-17s is pending and is expected by November, followed by its first operational sortie early next year. Then, in deals that were signed in late-2017, AMF will assemble 50 Block 3 JF-17s and 26 JF-17Bs. In 2020, the Air Engineering Depot 102 at PAF Base Faisal will start overhauling the fighter's Klimov RD93 powerplant.

There is arguably a lot going on to occupy the minds of PAF leadership and operationally the JF-17 is playing a major part in the defence of Pakistan's skies with six operational squadrons. During the PAF's recent confrontation with the Indian Air Force, known in Pakistan as *Operation Swift Retort*, PAF Chief of the Air Staff Air Chief

Having flown around 100 hours of test and evaluation sorties, the first JF-17B to be delivered to Pakistan was having an air-to-air refuelling system fitted in mid-April. (Photo Alan Warnes)

JF-17 of No. 2 (MR) Squadron (photo: Alan Warnes)

Various weapons with the JF-17 (Photo: Vayu, from the Paris Airshow 2019)

Marshal Mujahid Anwar Khan said that "The aircraft performed very well against the IAF Mirage 2000s and their Mica missiles, as well as the MiG-21 Bison and its R-73 Archer AAMs."

On the export front, the Aviation Industry Corporation of China (AVIC) has delivered six JF-17s (four single-seaters and two dual seaters) to the Myanmar Air Force, while PAC has sold three examples to Nigeria, and these should be delivered after the pilots are trained in Pakistan. Sales and marketing of the jet were split between PAC and China National Aero-Technology Import & Export Corporation (CATIC) in 2015. CATIC is engaged in discussions with Egypt surrounding the Block 3s, while PAC continues to talk to Malaysia.

The production line

More than 100 JF-17s have now come off the AMF assembly line, where the wings, horizontal tail, vertical tail, and forward fuselage, representing 58 percent of the fighter, are built. They are matched with the remaining 42 percent built in Chengdu in China, including the mid- and rear- fuselages that are airfreighted to PAC Kamra. The three fuselage sections are mated at the JF-17 subassembly line and are pushed through on large trollies to one of the four docks in the final assembly facility.

That is when the avionics, wiring, undercarriage, harnesses and Klimov RD93 powerplant are added, while the Martin-Baker Mk.16 ejection seat comes later. The aircraft's air-to-air refueling probes are not necessarily fitted on the assembly line, although all the necessary plumbing has been put in place since the production of Block 2 (aircraft 13-129).

After being towed down to the flight test shed, the newly built JF-17s are put through five functional check flights (FCFs) by one of the four qualified test pilots based at the co-located Test and Evaluation Squadron (TES). Three PAF pilots have qualified at the Boscombe Down-based Empire Test Pilot School for the JF-17, but now most of them go to Xian in China to get their qualifications. When the author met Squadron Leader Ali in April, he was about to test-fly the latest JF-17 to leave the assembly line. He went through a six months training programme in China after flying with two operational JF-17 squadrons. Working alongside him in the

Thunder over the Karakorams (Photo: Air Cdre Hamid Faraz from the PAF Calender)

The array of armament for the JF-17 (Photo: Vayu, from the Paris Airshow 2019)

JF-17s are regular participants at Air Shows(Photo: Jetphotos.net)

flight test shed was Boscombe-qualified Group Captain Imran, who spent two years during the early days of the JF-17 test programme at Chengdu flying the prototypes and was more recently the first JF-17 Combat Commanders School (CCS) commanding officer. He said, "During the FCFs we push the aircraft to the limit, right through the complete envelope, to assess the handling qualities, checking the systems and aircraft performance."

Once the FCFs are completed the PAF then puts the JF-17 through a further check flight and if there are no snags, the aircraft is officially handed over.

PAC Chairman Air Marshal Ahmer Shahzad told the author, "Production of subassemblies has already started for the first two 50 Block 3 aircraft, to be assembled next year, and will be followed by another 12 each in 2021, 2022, 2023, and 2024. We will assemble eight dual-seaters this year, followed by 14 in 2020, and the remaining four in 2021."

Building the JF-17 since 2009 has catapulted PAC into the serious business of fighter production, a feat that not many countries can boast, particularly in Asia. The chairman said he is keen to build on this. The company has already built a high-speed aerial target and is close to the completion of an indigenous UAV.

Thunder at the Zhuhai Airshow (Photo: Hunter Chen)

The Thunder Block 3

The JF-17 Block 3 enhancements will involve new avionics, including a helmet-mounted display and a holographic wide-angle head-up display, better electronic warfare systems with integrated self-protection kit, as well as a missile approach and warning system, an increased payload and more sophisticated weapons like a fifth-generation short-range air-to-air missile. It will be the "ultimate" JF-17, and with an AESA radar will have the capability to employ longer-range weapons and track multiple aircraft.

The decision on a new AESA radar for the Block 3s is expected to be made by the end of the year. There are now three Chinese contenders, which were all shown at last year's Zhuhai Air Show, while Leonardo's Grifo-E is still on the table.

Nanjing Research Institute of Electronics Technology's KLJ-7A is being marketed by China Electronics Technology Group Corporation in air- and liquid-cooling options. The second contender, which was displayed at the Zhuhai Air Show last November along with the two Nanjing examples, comes from Leihua Electronic Technology Research Institute (LETRI), another air-cooling AESA known as the LKF601E. AVIC has thrown its weight behind this option and claims it was the first air-cooling radar. Replacing the JF-17's original KLJ-7 is simply a case of taking out the old system and inserting the new one. The PAF's Flight Test Group is currently working the options.

Weapon options

The PAF's JF-17s are operational with the SD-10 beyond visual range air-to-air missile (BVR) with a data link and initial mid-course guidance, PL-5EII infrared short-range AAM, C-802 anti-shipping missile and a stand-off capability courtesy of its Indigenous Range Extension Kit integrated with the Mk80 series of general-purpose bombs. The PAF Chief of Air Staff recently told the author that the JF-17 is better than many contemporary aircraft in three areas but would not provide any more details, although the air-to-sea mode is undoubtedly one of them.

At IDEF 19, held in Istanbul in early May, an Aselsan source confirmed that deliveries of the first of 50 Aselsan targeting pods for the JF-17s will commence "within a few months," which will provide the JF-17 with a laser-designator capability, working with JTACs on the ground in the air-to-land integration role.

Air Commodore Rashid Habib, JF-17's deputy chief project director, told the audience at the IDEAS 18 Air Power Conference in Karachi, that the JF-17 had flown 40,000 operational hours. He added that the JF-17B would be fitted with a missionised rear cockpit for combat training and operations, a three-axis fly-by-wire kit, and a fifth-generation advanced short-range air-to-air missile.

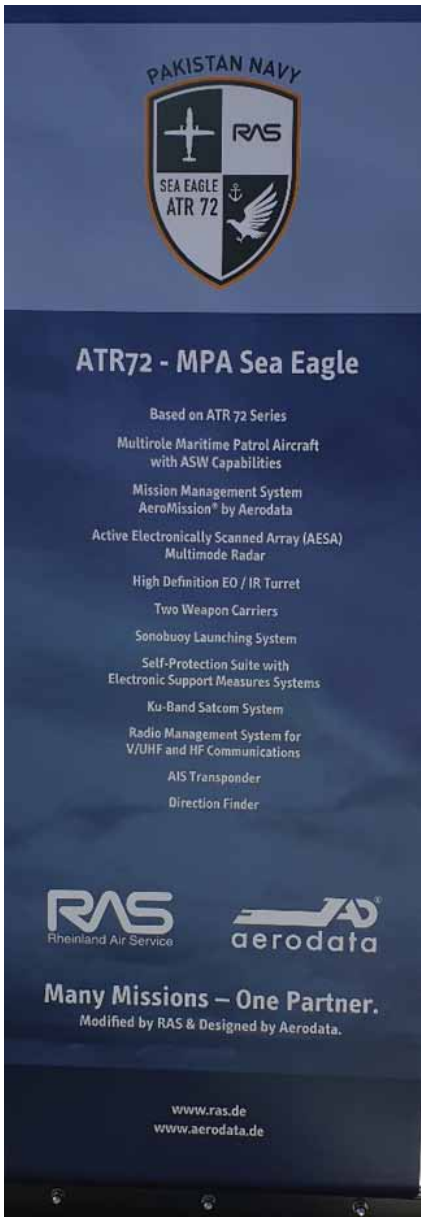
Also at Le Bourget:

Pakistan Navy's Sea Eagle ATR72 MPA

Rheinland Air Service (RAS) and Aerodata were prominent at the Paris Air Show exhibiting a second example of the ATR72 Sea Eagle maritime patrol aircraft (MPA) that the companies have produced for the Pakistan Navy. The first was handed in original configuration around a year ago to begin replacement of the navy's aging Fokker F27 maritime patrollers. A contract for the conversion of two ATR72 MPAs was placed in mid-2016, with further conversions planned. The first two former-airline aircraft were operating with the Pakistan Navy as they originally were before flying to Germany for conversion, while another ATR72 has been acquired for possible modification.

The Sea Eagle is based on an ATR72 regional airliner that has been outfitted by the special mission division of German MRO company RAS at its Mönchengladbach facility. The aircraft's maritime patrol suite was integrated by Braunschweig-based Aerodata, centered around the company's AeroMission mission management system.

Included in the equipment suite are a Leonardo Seaspray 7300 e-scan search radar, FLIR Systems Star Safire III electro-optical/infrared turret, Elettronica electronic support measures, satellite communications, and a sonobuoy launch/receiver system. The aircraft has hardpoints on either side of the forward fuselage for the carriage of torpedoes. The RAS/Aerodata conversion is distinct from the Leonardo-led programme to provide ATR72-600-based P-72A MPAs for the Italian Air Force that have replaced their Atlantics in the maritime role.



Pakistan's Navy earlier operated Breguet Atlantics but retired them in 2012, leaving the Fokkers flying on limited patrol duties in support of longer-range ex-US Navy P-3C Orions.

David Donald

Courtesy: AIN Publications
(Photos: Vayu Aerospace Review)

Israeli Systems & Technologies at Le Bourget'19

IAI unveils new tactical UAV T-Heron

Israel Aerospace Industries (IAI) unveiled its new tactical Unmanned Aerial System (UAS) of the Heron Family: the T-Heron. Designed for tactical missions on the battlefield, the T-Heron is expected to be used extensively by ground troops and coast guards, as well as by other protection forces. Suitable for a variety of payloads, it features the most advanced IAI technologies.

Illustration of the T-Heron (Credit: IAI)

The T-Heron joins IAI's Heron UAS Family, which has 'rich know-how and extensive experience' of 40 years, with 1,700,000 combat flight hours and over 50 operational customers, which use IAI UAS's in a range of missions, environmental conditions and warfare theatres across the globe. The T-Heron features the 'highest levels of flight safety and reliability' and is resistant to extreme weather conditions. Its proven Rotax engine takes it to a maximum altitude of 24,000 feet, speed of 120 knots and supports useful payloads of up to 180 kg. Capable of carrying several payloads concurrently, and equipped with IAI's sensors, the T-Heron complies with global standards, including STANAG 4671 requirements.

IAI ELTA launches Next Gen ELM-2084 MMR Radar

ELTA Systems, a subsidiary of Israel Aerospace Industries (IAI), unveiled the next generation of its ELM-2084 Multi-Mission Radar (MMR) at the Paris Airshow. The operational and combat proven MMR provides air defence capabilities to customers around the world as well as being the radar of *Iron Dome, David's Sling* and IAI's land-based *Barak* weapon systems. The new version, named MS-MMR (Multi-Sensor MMR), fuses additional ELTA sensors to the main MMR system thereby providing an active, passive, and combined Air Situational Picture (ASP). Over the last decade, new types of aerial threats have emerged due to the advancement of low RCS (Radar Cross Section) stealth technology. Platforms such as drones and UAVs, tactical aerial weapons, cruise missiles, ballistic rockets and missiles have created new challenges for air

defence and surveillance systems. This has created a demand for ASP systems to provide higher accuracy, faster update rates and upgraded identification of aerial threats while increasing the need for survivability in the modern battlefield. Operating in S-Band frequency, the MMR provides long-range air defence, air surveillance and fire control capabilities. By fusing the MMR with an additional higher band radar and active IFF and ADS-B sensors and passive SIGINT, EO/IR and LDS (Launch Detector Sensor) sensors, the MS-MMR now provides enhanced classification, identification and discrimination between very close targets even in dense areas and background clutter. The MS-MMR significantly improves the reliability of the ASP and Situational Awareness, and can efficiently handle new types of small, low, slow and hovering RCS threats as well as handling rockets and missiles of varying ranges. Since all the sensors are co-located and integrated at the system level, the MS-MMR provides a single output for all the fused data and greatly simplifies the delivery of the combined target data into C2 ASP networks.

IAI orders Orbit's Airborne Audio Solution for Heron TP

Orbit Communications Systems Ltd. announced that Israel Aerospace Industries have placed a $US1.8 million order for Orbit's Orion airborne audio management systems for integration aboard its next-generation medium-altitude, long-endurance (MALE)

Heron TP unmanned aerial vehicle (UAV). Delivery of the systems is expected later in 2019 and 2020. Orbit's Orion enables essential communication between the UAV and civil Air Traffic Control (ATC) and other ground stations.

Embraer and ELTA launch the P600 AEW

Embraer Defense & Security and ELTA Systems Ltd signed a Strategic Cooperation Agreement to introduce the P600 AEW (Airborne Early Warning). Designed to compete in a new segment of the AEW market, this next generation aircraft is based on the advanced super midsize platform of the Embraer Praetor 600 business jet. The primary sensor of the P600 AEW is the IAI/ELTA 4th generation Digital Active Electronically Scanned Array (AESA) radar with integrated IFF capabilities. Embraer Defense & Security is to provide the air platform, ground support, communications systems and aircraft integration while ELTA is to provide the AEW radar, SIGINT (Signals Intelligence) and other electronic systems and system integration.

The P600 AEW can provide an extended Air Situational Picture by monitoring aerial activity in areas outside ground radar coverage. It can perform various missions such as air defence, early warning, command and control, fighter fleet efficiency, territorial defence, and maritime surveillance. Also, the P600 AEW can be configured with the full range of AEW&C sensor and control systems, including; 4th generation Digital AESA AEW radar, civil and military IFF, ESM/ELINT with Radar Warning Receiver capability, Command & Control, comprehensive communication suite including Data Networks and Satellite Links, and a robust Self Protection Suite (SPS).

"As part of IAI's new strategy, we are ramping up our collaborations with global business entities, leveraging the know-how and technology accumulated over decades of aerospace and defence operations. As the pioneers of the bizjet AEW, ELTA Systems has made large strides over the years towards offering cost effective AEW capabilities for the growing and changing global needs", stated YoavTourgeman, ELTA President & IAI Executive VP. "Our partnership, forged with Embraer Defense & Security, enables us to introduce a new market segment by offering a cost effective midsize bizjet AEW system".

Elbit Hermes 45 debuts at Le Bourget

Elbit Systems' Hermes 45 Small Tactical Unmanned Aircraft System (STUAS) marked its first appearance at the Company's static display area (A-8) at the Paris Airshow 2019. Hermes 45 offers a "unique combination of extended range and duration with point launch and recovery, to and from land and maritime platforms thus enhancing Intelligence, Surveillance, Target Acquisition and Reconnaissance (ISTAR) capabilities at the brigade and division levels and also for naval squadron units." Hermes 45 features flight range of 200km or an extended Beyond Line of Sight range (via

Satellite Communication) and an internal payload bay that supports multi-payload operation, including EO/IR, Marine-Radar, Terrain Dominance, Electronic Warfare (EW) and communications. The Hermes 45 is operated by a two-person crew, is launched from a short onboard platform rail, and recovered by an automated spot landing system.

Rafael unveils SAR feature for Litening and Reccelite EO pods

Rafael Advanced Defense Systems Ltd. unveiled its upgraded fifth generation Litening and Reccelite systems, effectively transforming them from traditional EO pods into EO+, with the addition of a unique SAR feature and the optional application of additional EO+ features, such as (EW, Comm, IRST).This constitutes a revolutionary quantum leap in all-weather, stand-off targeting and reconnaissance pods.

The Litening+ SAR is an advanced, all-weather, stand-off, SAR-optimised targeting pod. Litening is the most popular pod in the world, with over 1900 units already in service, deployed by 27 Air Forces around the world. Rafael teamed with ELTA to equip Litening with a powerful SAR (Synthetic Aperture Radar), adding

significant capabilities to the Litenings's EO, multi-spectral, stand-off pod, significantly expanded wide area coverage and true day/night, all-weather operation. This first-ever addition of SAR to an EO pod solves the EO challenge of target identification when flying above clouds. The high-performance SAR sensor joins Litening's set of high-resolution MWIR, SWIR, and HD color sensors – all incorporated in a single, sophisticated stand-off pod. Reducing pilot workload, Litening + SAR increases mission efficiency through full support of JDAM, LGB and INS/GPS-guided munitions. The pods are equipped with a laser designator, and laser marker for joint missions, as well as an optional Data Link for CAS missions and stand-off ranges.

Reccelite + SAR is one of Rafael's latest game-changers, with the addition of ELTA's powerful SAR (Synthetic Aperture Radar) to the, stand-off Reccelite ISR pod. Overcoming the EO reconnaissance challenge when flying above clouds, the SAR-optimised pod delivers true all-weather, day/night, all-terrain, long-range capabilities, providing a full aerial intelligence picture with high-resolution images. The Reccelite ISR system consists of an airborne ISR pod, a wideband digital Data Link, and a GES (Ground Exploitation System) which can be stationary, mobile, or located on board the aircraft. The powerful SAR radar joins the system's array of advanced, high-resolution NIR, SWIR, MWIR and color sensors, together simultaneously collecting stabilized high-quality multi-spectral imagery from an unlimited field-of-regard.

Scanning modes include Strip, Persistent Wide Area, Gate Keeping and more. Reccelite's mission plan can be uploaded prior to takeoff or uplinked during flight, and either performed automatically, or manually controlled for targets of opportunity. Reccelite is deployed by more than 10 Air Forces around the world, and operational on multiple aircraft types, including the AMX, F-16, F-18, Gripen, Heron 1, Jaguar, Reaper, Tornado, and Typhoon.

UVision unveils the Hero-400EC's Multi-Canister Launcher

UVision Air Ltd. unveiled the Hero-400EC's Multi-Canister Launcher at the Paris Air Show, the new launcher suitable for a wide range of land and naval applications, which thanks to its long range and endurance capabilities, can be launched safely away from enemy lines from a modular multi-tube canister launcher mounted on a range of land or naval platforms. Weighing 650 kg including 6 munitions, the system can also be deployed in Forward Operating Bases and controlled from remote locations. Customers can choose from 4-12 lethal loitering munitions, which can be stored, transported and launched from the sealed canisters, making it a versatile asset on the battlefield.

UVision -Hero-400EC Multi Launcher

The Hero-400EC is a long-range,high-precision loitering munition system with a low acoustic, visual and thermal signature that can locate, track and strike static and moving targets with high accuracy, stealth and minimal collateral damage. Precision strike capabilities, extended endurance of up to 2 hours, and multi-purpose warhead, including concrete piercing, anti-tank, and anti-personnel that handle different types of targets with exceptional accuracy enabling long-range and versatile missions.

Elbit Systems launches Condor MS

Elbit Systems has launched the Condor MS, a new Long Range Oblique Photography (LOROP) system that introduces Multi-Spectral (MS) sensing capability and Artificial Intelligence (AI) analytics to stand-off strategic intelligence gathering missions. Condor MS integrates three high resolution Electro Optic (EO) sensors into the Company's certified and widely operational Condor2 system: Visible and Near Infra-Red (VNIR), Medium-Wave Infrared (MWIR), and Short-Wave Infrared (SWIR). The unique combination of multi-spectral sensing, high level of stabilisation and auto image enhancement enables the new system to dramatically extend coverage area in day, night and adverse weather conditions thereby improving the strategic reconnaissance output while increasing the survivability of the platforms. Deep learning algorithms and precise geo-location enable the Condor MS to identify a large number of targets at extremely high rates, hence significantly shortening the time frame needed to close sensor-to-shooter loops.

Aeronautics Group presents the Orbiter 4

Aeronautics Group presented its wide range of comprehensive defence solutions and UAS platforms, displaying flagship UAV Orbiter 4, a tactical UAV system from the Orbiter family. The unique features of Orbiter 4 includes endurance of more than 20 hours and ability to carry two different payloads at the same time. Alongside its line of UAS's, the company also presented the Pegasus 120: Aeronautics' first multi mission VTOL platform. Relying on its wide knowledge and experience in the field of unmanned aerial solutions, Aeronautics has recently stepped into the field of multi-rotor platforms, with vertical take-off and landing (VTOL) solutions designed especially for defence and security mission. With the ability to carry payloads weighting up to 75 kg, the Pegasus 120 "is ideal for special missions and the Special Forces."

Estonia joins the Spike missile family

At a ceremony in Tallinn, Estonia, the Estonian MoD signed a 40m. Euro Framework agreement with Eurospike (a European Joint Venture between Rafael Advanced Defence Systems, Diehl Defence and Rheinmettal Defence) for the supply of Spike LR ATGMs, launchers and associated maintenance and training. The contract included ICLU (Integrated Control Launch Units) launchers and live Spike rounds. Spike is a cutting-edge precise, multi-platform, multi-mission and multi-range electro-optical missile Family, with capabilities of fire-and-forget, as well as fire, observe and update, allowing attack of hidden targets. Estonia is the 32nd user nation of the SPIKE missile, and the 19th user among the EU and NATO.

Elbit's maritime UAS patrol service for EU

Elbit Systems has started operating maritime UAS patrol services available to the European Union (EU) under a contract between the European Maritime Safety Agency (EMSA) and the Portuguese

company CEiiA. Iceland is the first EU country to use this particular long-range UAS patrol service. The Icelandic maritime authorities based the Hermes 900 Maritime Patrol operation at the Egilsstaðir airport in east of the island, from which maritime UAS patrol has the capability of covering more than half of the Icelandic Exclusive Economic Zone (EEZ).

Rafael's Spice 1000 receives the 'Israel Defence Prize'

President of Israel, Reuven Rivlin, Prime Minister and Minister of Defence Benjamin Netanyahu and Chief of Staff Lt. Gen. Aviv Kochavi, have awarded the *Israel Defence Prize* to projects and operations "that have contributed to the security of Israel and to its qualitative military edge and technological superiority." The *Israel Defence Prize* for 2019 was awarded to the Rafael Spice 1000 weapon system, which is part of the company's wider air-to-surface Spice Family (250, 1000, 2000) of stand-off, autonomous, air-to-ground weapon systems that attack targets with pinpoint accuracy and at high attack volumes, without depending on GPS navigation in GPS-denied environment. The Spice is combat-proven with the Israeli Air Force and is in operational service with a number of international users (including the Indian Air Force).

IAI: Drone Guard to protect Critical Sites

As Unmanned Aerial Systems (UAS) and drones become ever more common they also become potential threats. Whether used by innocent enthusiasts to snoop into a local airport, smuggle drugs or weapons into a prison, or laden with explosive on a terrorist attack, drones are regarded as potential danger for certain critical assets and secured locations. Presently, the means available to regulate and control drone access to protected areas are limited.

Israel Aerospace Industries' (IAI) operationally proven Drone Guard counter-UAS system however meets such needs. The latest version has been optimised for operation in high security environment such as airports, prisons and strategic infrastructures. As a system integrating multiple sensors to detect, classify, identify and track drone targets, the Drone Guard employs a multi-layered approach to "manage drone activity and neutralise those suspected to be dangerous or hostile."

When protecting a secured site such as an airport or other highly secured facility, Drone Guard can be controlled from the operations centres. The system's sensors and effectors may be located in multiple outposts, in fixed or temporarily locations covering the entire premises. Deployment of multiple units enable operators to employ electronic means to effectively jam and 'takeover' or "spoof" suspected drones using low power effectors, thus minimizing the potential of electromagnetic interference. Such an array monitors the entire secured area, both inside and out, effectively detecting and locating drone activity immediately as it appears and even locates their operators beyond the protected perimeter. Such systems also track the activity of drones authorised to operate inside protected areas.

The system relies on radar and Communications Intelligence (COMINT) as the means to detect drone activity in and around the protected area. Some types of radars can even track hovering drones, or drones being prepared for takeoff, by the unique signature emitted by their rotors. The radar used for the Drone Guard is the ELTA ELM-2026B X-band radar, as first line of detection which is robust, based only on the drone movement and not on radio transmission. The radar detects targets in all weather conditions.

The passive COMINT is used to detect and classify drone activity by electromagnetic signals emitted from the drone and ground control units. Based on advanced techniques derived from military systems, Drone Guard intercepts and interprets both familiar signals from commercial systems as well as unfamiliar signals of hacked drones. Drone Guard's COMINT detects such signals from several kilometres, including in situations beyond the line of sight of EO and radar sensors.

Once the drone presence is verified, the radar directs the Electro-Optical (EO) system to identify it, this being the Drone Guard's third sensing channel, to visually verify a target and track it within the line of sight. As a passive sensor, EO can track targets that have minimal radar reflection and no electromagnetic signature.

Electronic countermeasures are basically used against drone's control and navigation channels, using different protocols to 'fend off' from the guarded premises or bring it down safely using cyber 'takeover' and spoofing methods. In a civilian environment the use of electronic countermeasures, such as GPS or communications jamming is restricted, as it may jeopardise air traffic safety, other counter-UAS measures are employed. In such events Drone Guard supports various 'Hard Kill' measures, such as net guns and firearms, having special sights to effectively engage drones when they are in sight.

Employing the latest software defined electronics to provide an agile and adaptable C-UAS platform sets Drone Guard apart from numerous C-UAS systems available in the market. Based on operational lessons, ELTA has tailored Drone Guard to address a wide range of applications, from relatively simple deployments monitoring and alerting drone activity in a civilian area to conduct military C-UAS missions within a challenging electromagnetic environment. "Drone Guard is best prepared to counter present and evolving threats and endure the most challenging situations."

Courtesy : IAI

Meeting Sir Michael Arthur, President, Boeing International

On the very first day of the Show and the very first meeting of the Show, we caught up with an old friend- an old India hand- Sir Michael Arthur: between 2003 and 2007, he was the British High Commissioner to India! From High Commissioner to President Boeing International, he truly has come a long way and it was an absolute delight to catch up and rekindle old memories!

Sir Michael Arthur was appointed President of Boeing International on 22 April 2019, works with Boeing Chairman, President and CEO Dennis Muilenburg and is a member of the Boeing Executive Council, making him the council's first non-US citizen. Sir Michael is responsible for the company's international strategy and corporate operations outside the United States, overseeing 18 regional offices in key global markets. His responsibilities include developing the company's initiatives outside the United States, forming new business and industrial partnerships, overseeing international affairs, enhancing Boeing's local presence and providing global functional support.

Earlier, he was President of Boeing Europe and Managing Director of Boeing United Kingdom and Ireland. He joined the company in September 2014 to lead Boeing in the United Kingdom and Ireland, and took on additional responsibilities for Europe in March 2016. In this role, Sir Michael led the company's European strategy and operations to drive business growth through strengthened regional alignment and improved operating efficiencies. He was also responsible for coordinating all Boeing business activities in the United Kingdom and Ireland.

Before joining Boeing, he spent three decades of international government service with the British Diplomatic Service of the Foreign and Commonwealth Office (FCO) followed by three years as a founding member of a United Kingdom–based business consultancy. He then became Ambassador to Germany and later High Commissioner to India.

Being his first airshow as President Boeing International, Sir Michael Arthur was very enthusiastic with his company's presence at the Paris Airshow 2019 where their theme was '*Innovation, Partnerships and Safety*'. He stated, "We are showcasing our broad range of commercial and defence products, services and technologies here and demonstrating our commitment to innovation, industry partnerships and safety. At our exhibit, visitors can immerse themselves in a large 360-degree theatre and learn more about the company's capabilities throughout the product lifecycle. The interactive highlights Boeing's latest family of aircraft and services and give visitors a first look at the company's vision for the future of mobility. An Air Tahiti Nui 787-9 is demonstrating the breakthrough capabilities and innovations that have made the 787 a favourite of both operators and customers. The 737 Boeing Converted Freighter and passenger air vehicle (PAV) are also on static display. The US Department of Defence is displaying several of our platforms including the AH-64 Apache attack helicopter, the CH-47 Chinook heavy-lift helicopter, the F-15 fighter, the P-8 maritime patrol aircraft and the international air show debut of the KC-46 tanker."

Sir Michael exuded: "Of these platforms, you (India) already have the P-8I which is performing extremely well and the Indian Navy is very happy with this. We hope to get more orders for the P-8 from the Indian Navy. The Apache and Chinooks are soon to be operationalised with the Indian Air Force and Army".

Concerning Boeing's worldwide outlook on the military front, Sir Michael Author stated "We project $2.5 trillion of defence and space opportunities during the next decade as governments modernise military platforms and systems, pursue new technologies and capabilities and accelerate exploration from sea to space. The projected spending – spanning military aircraft, autonomous systems, satellites, spacecraft and other products – continues to be global in nature with 40 percent of expenditures expected to originate outside of the United States. Supporting the defence, space and commercial platforms with lifecycle solutions will fuel a services market valued at $3.1 trillion through 2028".

Dassault Aviation at Le Bourget

Dassault Aviation were virtually on "home ground", presenting their civil and defence wares at the 53rd Paris Air Show. The large Dassault Aviation stand and displays included mockups of the Falcon, Rafale, special-mission Falcon, ATL2, UAVs, FCAS and space vehicles. A 'afale Inside' space offered visitors virtual reality experience. The static display featured the Rafale, Falcon 8X, 900LX, 2000S/LXS and the Falcon 6X cabin. There was also a special exhibit, with a simulator demonstrating operational capabilities of the Rafale. Every afternoon, a Rafale flight demonstration was performed by the French Air Force, while Falcon 8X demonstrations were flown by the company's test pilots. "The 2019 Paris Air Show highlights our preparations for the future: extending the Falcon family (6X), reinforcing our support services, presenting what could be a demonstrator for the Next Generation Fighter (NGF) under the Future Combat Air System (FCAS) and the agreements between Dassault Aviation and Airbus", stated Dassault Aviation Chairman and CEO Éric Trappier.

Dassault Aviation and Airbus SE have delivered a joint industrial proposal to the governments of France and Germany for the first (Demonstrator) Phase of the Future Combat Air System (FCAS) with revealing of the New Generation Fighter and Remote Carriers models on opening day of the 2019 Paris Air Show. This unveiling of by Eric Trappier, Chairman and Chief Executive Officer (CEO) of Dassault Aviation and Dirk Hoke, CEO of Airbus Defence and Space was witnessed by President of the French Republic, Emmanuel Macron, and the French Minister of the Armed Forces, Florence Parly, the German Federal Minister of Defence, Ursula Von Der Leyen and the Spanish Minister of Defence, Margarita Robles. The Demonstrator Phase will cover the period between 2019 and mid-2021 and will serve as starting point for demonstrators and technology development for a New Generation Fighter (NGF), Remote Carriers (RC) and an Air Combat Cloud (ACC) to fly by 2026. The various teaming agreements, which also include the companies MBDA Systems and Thales, contain a defined scope of planning of the first Demonstrator Phase, with working and commercial agreements.

The Rafale on a bright summer day at Le Bourget

In parallel, Safran and MTU are in charge of developing a new engine. "The Joint Concept Study awarded to Dassault Aviation and Airbus in January 2019 was the first step in a fruitful cooperation between both companies. The first Demonstrator Phase marks another decisive step in the Next Generation Weapon System industrial organisation in which the New Generation Fighter, to be built by Dassault and Airbus, with Dassault Aviation as prime contractor, as well as the Remote Carriers and Air Combat Cloud with Airbus as prime contractor, will be corner stone of the Future Combat Air System", stated Eric Trappier, Chairman and Chief Executive Officer of Dassault Aviation.

After initiating the negotiation phase through the delivered proposal, Dassault Aviation and Airbus expect contract award for the first Demonstrator Phase by Q4 2019.

Mock up of the Future Combat Air System (FCAS)

Another angle of the FCAS

Elettronica unveils new EW solutions

The Paris Air Show 2019 offered an opportunity to present the 'completeness' of Elettronica›s offer and its recent evolution. Significant geopolitical changes and new conflicts have reintroduced complex IADS (Integrated Air Defence Systems) to address the increasingly complex RF threats in the avionics environment, highlighting current vulnerabilities and raising the standards required in modern fighter aircraft protection.

Elettronica Group displayed a wide range of solutions for Electronic Warfare (EW), cyber EW, intelligence, and brand new generation of RWR. For almost 70 years, Elettronica has been one of the world's top leaders in EW systems, maintaining high standards of excellence in the technological development process with cutting-edge technologies for mutual and self protection.

The Elettronica Group were at Le Bourget after an intense year of business activity: 2018 brought new orders for € 220m. compared to a total portfolio of € 82m. of which 43% in the avionics sector. During the previous year, the company continued with significant R&D investments worth almost €11 million in self-financing, to which are added further € 20m. of innovation initiatives as part of the acquired programmes. At the European level, an order for the Nato JEWCS (Joint Electronic Warfare Core Staff) programme has a relevant strategic value. Elettronica Group will be a supplier of JEWCS for 4 years, together with Leonardo for the supply of training systems for electronic defence (Land Training System and Maritime Training System). The most important part of this order is upgrading of the NATO training base dedicated to Electronic Warfare.

Elettronica displayed its SISPROS, a new system family of interception, analysis and intelligence, at Le Bourget 2019. Developed for airborne applications, SISPROS benefits from the most modern enabling technologies: *Direct Sampling and Artificial Intelligence*. The combination of those two technologies makes the systems belonging to this family fully digital, highly resistant to interference, adaptive to the electromagnetic environment and reconfigurable via SW to new environments or different platforms.

The increasing diffusion of unmanned avionic platforms, both tactical and HALE/MALE, has meant focus on the technological effort of ELT, supported by the Ministry of Economic Development, to equip this type of aircraft, leading to the development of light weight and low-impact installation solutions. In line with the latest architectural approaches of ELT products, SISPROS systems are also multifunctional and multi-platform, since they can derive the Alarm (RWR) or Surveillance (ESM, ELINT) function only, as a spin-off of the main product, by reconfiguration SW. Finally, family systems are equipped with by-design interconnectivity features, supporting the ability to operate in network-centric configuration, contributing to the integrated and global vision of the scenario.

The latest RWR development of Elettronica, the ELT/162, belongs to this systems family. In addition to the warning one, the product performs a light ISR (Intelligence, Surveillance, Reconnaissance) function on the observed band, providing goniometry, detection, detection of received radar emissions and automatic alert in case of detection of specific signals. In support of ISR/ELINT missions, the ELT/162 can also be configured to provide detailed parameters of a designated transmitter.

Giovanni Carlini of Elettronica at the Show

The Irkut Corporation at Le Bourget 2019

Irkut Corporation (a UAC member) displayed mock-up of their MC-21 aircraft (in model form) and an upgraded procedural simulator for training of flight crews on the MC-21-300 airliner. The simulator has a MC-21 aircraft cabin module which enables different types of training. The simulator has consoles and controls design, display and alarm systems

of the cockpit, upgraded software and hardware system for visualisation of the cockpit.

Irkut is conducting tests of the MC-21-300 aircraft to obtain Russian and European type certificates. Three MC-21-300 aircraft are taking part in flight tests, while on the fourth flight test aircraft, systems are being installed to join the flight tests later in 2019.

Meanwhile, the European Union Aviation Safety Agency (EASA) has completed second session of the MC-21-300 validation programme. During the certification tests EASA experts evaluated the behavior of MC-21-300 aircraft in various modes at altitudes upto 12,000 metres, the flights performed with varying weights. Operation of the integrated aircraft control system in the normal mode has been verified. As Yuri Slyusar, President of UAC stated, "The MC-21-300 is undergoing flight tests in order to obtain Russian and European type certificates. The completion of certification flights by EASA testers is another step in this direction. In parallel, at the Irkutsk Aviation Plant we are increasing production of MC-21-300s for initial customer delivery".

The first certification flights of EASA experts took place in January 2019. In September 2018, EASA test crew had completed a special course in theoretical and practical training, as a result of which they were cleared to fly on MC-21-300 aircraft.

MBDA presents its vision of future air systems

MBDA has presented its vision of the capabilities that will be at the heart of the next generation of European air combat systems. "As threats evolve and access denial strategies become ever more complex, with diversified effects combining surface-to-air and air-to-air assets in large scale, air superiority will need to be created on a local and temporary basis. Aircraft and air effectors will need to be able to enter denied areas, see threats before being seen, force hidden threats to uncover early enough to suppress them and to always react quicker than the adversary."

In these ever faster operations, networked effectors will take an essential part in the combat 'cloud', exchanging tactical information and target co-ordinates in real-time with platforms and other network nodes, in order to carry out the desired operational effects. These will also have to display robust survivability strategies in front of highly evolving threats. The fight will take place not only between platforms but between enemy networks, and only the most agile and adaptable will win. The engagement of these networked effectors will rely on resilience to any form of aggression (eg: Electronic Warfare, Cyber) as well as on rapid decision aids able to compute complex situations.

These concepts cover the whole field of key domains and comprise:

Deep Strike: with cruise missiles using the most advanced options in order to penetrate and open breaches in the most efficient A2AD (Anti Access Area Denial) deployments in the future, for the benefit of friendly forces.

Tactical Strike: with stand-off, networked and compact armament, delivering precision effects but also able to saturate enemy defences thanks to pack or swarm behaviours.

Air-to-Air Combat: with the Meteor which today has no equivalent and will keep its lead and remain a powerful asset for next-generation of fighter aircraft.

Self-Protection: with the 'Hard Kill' anti-missile system that will counter incoming missiles and so provide essential protection during 'stand-in' combat, when soft-kill counter-measures and decoys are no longer sufficient. Such a system is able to reverse the balance of power against saturating defences.

Enablers: for penetration of adversary defences thanks to the 'Remote Carriers' that deliver multiple effects, whether lethal or non-lethal, as well as new services for munitions such as intelligence, targeting, and deception of enemy sensors.

MBDA Remote Carriers are compact, stealthy, co-operate with other armaments and platforms, and can be launched from combat or transport aircraft, or surface ships. They work as capability extenders for the platforms and the armaments that they accompany.

"As it masters these essential technologies as well as assumes all steps in the OODA (Observation, Orientation, Decision, Action) loop, from detection and localisation to damage assessment, MBDA positions itself as the architect of this decision-action chain, which will experience significant breakthroughs in concept and doctrine", according to company officials.

"The Meteor has no equivalent"

MBDA's stand-off weaponry

Rosoboronexport: "market needs attack and multi-purpose helicopters"

Rosoboronexport, a member of Rostec, is expecting a major spike in interest in Russia's military helicopters in wake of the recently concluded International Helicopter Industry Exhibition *HeliRussia 2019*. "We are expecting a growing demand for attack helicopters on a global scale. Rosoboronexport responded to this in a timely manner, figured out its major parameters and now offers to the customers the most advanced designs as proven in combat, the Ka-52 and Mi-28NE. Besides rise in the utility sector, where we have the Ansat and Ka-226T to offer; for production of the latter we have set up a joint venture with India's HAL," stated Director General of Rosoboronexport Alexander Mikheev. "Apart from attack and utility helicopters, other types with high export potential include the combat-transport, military transport and transport Mi-35P, Mi-35M, Mi-17V-5, Mi-171Sh and Mi-26T2. They owe their popularity to outstanding combat and operational performance, demonstrated in combat during anti-terrorist operations conducted by the Russian military. Combat and transport capabilities of Russian helicopters make them unique in many ways. Deployed in almost all regions of the world, they have proven to be suitable for operation in hard-to-access mountainous zones notorious for height variation and temperature fluctuation, as well as tropics and dusty environs", he added.

Rosoboronexport's list of partners includes 70-plus customers in the Middle East, Asia-Pacific, Latin America, Africa, the CIS and Europe. The company has delivered helicopters to army, anti-terrorist, and special purpose units, as well as law enforcement and emergency agencies in a number of foreign countries.

Rostec presents modernised Ansat at Paris

Rostec showcased their state-of-the-art civilian aircraft and engines at the Paris Air Show 2019. Russian civilian helicopters were presented at the biennial exhibition for the first time in 30 years: the multi-purpose Ansat by Russian Helicopters was dramatically showcased.

This light multi-purpose Ansat helicopter manufactured by the Kazan Helicopter Plant has the largest cabin in its class and is extensively used by Russian air medical services. It can also be used for passenger and VIP transport, cargo delivery and environmental monitoring. Two versions of the Ansat helicopter, a medical and a VIP one, were presented at the Paris Air Show, painted for the event with a livery representing both the Russian and French flags.

"Russian civilian helicopters have taken part in the Paris Air Show for the first time since 1989. The Ansat helicopters have already been given high marks at air shows in other regions - contracts have been concluded for supplying 20 machines to China in 2019 and it is planned to supply them to Mexico until 2020. This is the first time these helicopters have been presented in Europe. Moreover, one of the two machines is on upgraded Ansat helicopter with several new design solutions and options," stated Industrial Director of Rostec's Aviation Cluster Anatoly Serdyukov.

The Ansat shown at Paris was equipped with a glass cockpit. The helicopter also has a weather radar, enhanced ground proximity warning module, crash-resistant fuel system, LED lighting tools, plus a wire cutter for wire strike protection. It has modified tail boom fins made of composite materials and bird-strike-resistant heated glass.

SAFRAN AT LE BOURGET

Safran's Patroller in qualification test flights

The Patroller tactical drone, developed and produced in France by Safran Electronics & Defense, has begun final phase of industrial qualification at the Istres flight test centre in southern France. The Patroller has already made more than 220 flights, clearly demonstrating that it meets all assigned criteria: automated takeoff and landing, mission execution, the simultaneous operation of its sensors in real time, the capabilities of its electro-optical and radar payloads, low noise levels, endurance, ease of use and availability. "During these qualification flights, as well as in previous tests, the Patroller tactical drone has proven its ability to meet the challenges of today's missions, by guaranteeing the French Army's technological superiority in theatres of operation, while ensuring low operating costs."

The airframe features a modular design, enabling it to carry a multi-sensor intelligence payload of up to 250 kilogrammes (electro-optical, radar, electronic warfare), tailored to each type of mission. Patroller can carry out missions not only for armies, but also air forces, navies and homeland security forces. The Patroller will shortly participate in maritime surveillance operations as part of the *European Commission's Preparatory Action on Defence Research* (PADR) programme. The Patroller's ground station handles multiple functions: mission planning and management, reconnaissance, location-determination, automatic target tracking, real-time intelligence data fusion and distribution, and onboard simulation for training exercises, all in compliance with the latest NATO standards. The Patroller tactical drone is one of the first systems of this type to be officially certified according to the NATO standard for this class of drone, STANAG 4671. The first Patroller system in the French Army's tactical drone system (SDT) programme, which consists of five drones and two ground stations, will be delivered to the French Defence Procurement Agency (DGA) at the end of 2019.

The Patroller at Safran's outdoor stand at Le Bourget

Safran delivers 1,000th nacelle system

Safran Nacelles marked the delivery of its 1,000th nacelle system that equips the A320neo jetliner built by Airbus to TAP Air Portugal. Safran Nacelles has complete responsibility for the design and integration of nacelles on A320neo jetliners powered by CFM International LEAP-1A engines. In accelerating the nacelle output to meet Airbus' production rate for the twin-engine A320neo, Safran Nacelles utilised its full nacelle system expertise, from conception to manufacturing and delivery, applying Lean Sigma methods, automation and digitalisation.

Safran Nacelles had delivered the initial A320neo nacelle to Airbus in April 2016. Its output reached 440 units in 2018 on the way to achieving 700 plus annually by 2020. The integrated A320neo nacelles are delivered to Airbus A320 final assembly lines from Safran Nacelles' facilities in Toulouse, France; Hamburg, Germany and Mobile, Alabama in the US.

$50 billion in orders for CFM

CFM International announced orders and commitments for more than 1,150 LEAP engines during the Paris Air Show, along with long-term services agreements, for a total value of approximately $50.2 billion at list prices. "It has been an absolutely incredible week. We have had follow-on orders from long-time customers while welcoming new LEAP operators, including IndiGo for the LEAP-1A and the recently announced letter of intent from IAG for 200 Boeing 737 MAX airplanes for which we look forward to finalising the LEAP-1B engine portion of the deal."

Thunders at 'Exercise

Five PAF JF-17 Thunders participated at the Exercise

The latest edition of Turkey's *Anatolian Eagle* Air exercise was held during 17-28 June 2019 at Konya Air Base in the Central Anatolia Region of Turkey. Konya is one of three main Tactical Training Centres in the Western alliance, along with Nellis which hosts *Red Flag* in the USA and the *Maple Flag* held at the Canadian Forces Base Cold Lake, Alberta. There are several exercises under the nomenclature *Anatolian Eagle* which take place at Konya during the year, and it is here that the Pakistan Air Force has regularly participated, earlier with F-16s but this time with the JF-17 Thunder which came from the recently raised No.28 Squadron, home–based at Samungli near Quetta.

Origins of *Anatolian Eagle* go back to the 1980s when the Turkish Air Force embarked on a modernisation programme, and well recognised that the training of its personnel was as vital as having the right equipment. The 3rd Main Jet Base at Konya, which is located on edge of the vast and sparsely populated Konya Plains in Central Anatolia, was chosen as this is considered an ideal location for such exercises, the necessary infrastructure completed in June 2001, only a few days before the start of the first *Anatolian Eagle* exercise, participants being from the Turkish, United States and Israeli Air Forces.

Further expansion was made in 2003 with the introduction of Electronic Warfare (EW) systems, and a dedicated aircraft parking area, the Eagle ramp, was inaugurated in 2008.

The *Anatolian Eagle* exercises are carried out several times a year and Konya has hosted delegations from up to 14 nations, including USA, Europe and the Middle East, as well as NATO. Pakistan has been a regular participant.

The exercises have many similarities with *Red Flag* and "one of its objectives is to provide a realistic operational environment to give inexperienced pilots exposure to being part of a large force in wartime conditions, with the aim of increasing their survivability, especially in the early days of a war. It also provides an opportunity for an exchange of experiences amongst participating aircrew and the facility to improve interoperability between different air forces operating different types of aircraft".

The Exercise takes place over airspace spread over 50,000 square miles, and altitude of up to 50,000ft, Some 70 miles east of Konya. There is also a designated area over the Mediterranean, north of Cyprus, for maritime operations, which allows room for 70 to 80 fighters to operate in safely.

As with *Red Flag* the visiting units form *Blue Force*, and are augmented by

Anatolian Eagle'

the addition of Airborne Early Warning and Control (AEW&C) aircraft, either from Boeing E-7T Peace Eagles of 131 Filo or NATO Boeing E-3A Sentries from NATO's AEW&C Force. Combat Search and Rescue (CSAR) is provided by the 135 Filo, using their Airbus AS532AL Cougars and Bell UH-1H Iroquois.

Red Force is provided by Konya-based 132 Weapons and Tactics Squadron, with their Lockheed Martin F-16 Fighting Falcons, which operate in the Aggressor role. Controlling the exercise is the *White Force*, which develops the scenarios, releases the Air Tasking Orders (ATOs), monitors all missions and analyses the results. Under their auspices Command and Control (C2) of the exercise is provided using the Air Combat Manoeuvring Instrumentation (ACMI) system, which allows the *White Force* to track in real time every aircraft taking part, and to be able to monitor such parameters as their altitude and airspeed.

Fundamentally the *Blue Force* are given targets to attack in the Redlands using Combined Air Operations (COMAO), which are defended by the *Red Force* with aircraft and ground-based systems.

The Anatolian Eagle facilities are located in one area on the Western side of the base, with each Force having its own buildings within the complex; *Blue Force* has three buildings whilst *Red* and *White* have one each. Only members of the respective Force are allowed in their buildings, all situated

Fighting Falcons at Konya

The Turkish Air Force *(Turk Hava Kuvvetleri)* are one of the largest operators of the F-16 Fighting Falcon, after the US Air Force. Over the years, some 240 of this aircraft type (Block 30/40/50) were received, including considerable numbers built by the Turkish Aerospace Industries (TAI) which also supplied 46 Turkish built F-16s to the Egyptian Air Force in 1993-1995.

The F-16s are operated by twelve Turkish squadrons including 132nd *(Dagger)* which has been designated as a weapons and tactics training squadron, at the 3rd Main Jet Base, Konya. ***(Vayu Editorial Team)***

close to the main briefing room, while nearby are accommodation blocks and other social facilities.

Various operations, some real time, are analysed and lessons learnt applied to the exercise making it as realistic as possible. Dynamic Targeting (DT), which includes attack on targets not originally included in the deliberate targeting process, and Time Sensitive Targeting (TST), which are targets requiring immediate response because they pose danger to 'friendly forces' or are highly lucrative, fleeting targets of opportunity are often mandated.

As in other, similar, air exercises, the first week of every exercise is devoted to briefings and local familiarisation flights and missions flown in the next two weeks, by day and night in all weather conditions. At the end there is a final mission and then the mass briefing, with *Blue Forces* then flying home, their spares and various logistic support equipment being airlifted by transport aircraft.

The exercise in June 2019 had participants from the United States, Azerbaijan, Italy, Qatar, NATO, Pakistan, Jordan apart from the host nation Turkey. The latter had 600 personnel and there were another 450 from other Air Forces.

The largest number of aircraft were, logically, from the host nation, the Turkish Air Force deploying F-4Es Phantoms, F-16s, CN-235, C-130, C-160, AS-532 Cougar and E7T AEW aircraft. The USAF sent six F-15Es, the Royal Jordanian Air Force three F-16s, the Italian Air Force three AMXs the Qatar Air Force one each C-17 and C-130, NATO provided a E-3A while the Pakistan Air Force brought five JF-17s (*cover story*). Azerbaijan sent a small Observers team and the Turkish Navy deployed two frigates and an assault boat.

As Lt Col Jaina Donberg, commanding the USAF 49th Fighter Squadron observed, "When we train together, we will be better prepared to respond to any crisis or contingency. By training together face-to-face and in the air, we're building those lasting relationships, which will make us more effective in combat".

"This is a unique opportunity to train in a forward operating location in Turkey, as well as integrate, from mission planning, briefing, execution and debriefing with our partner and allied nations," concluded Donberg.

Exercise 'Anatolian Eagle' is an air enthusiasts paradise, particularly the opportunity given for real time photography. The superb images in this *Vayu* special article were taken by the team of Onur Kurc and Tayfun Yasar who were conducted around the flight line and aprons by the Turkish Air Force and given full access to 'shoot' to their heart's content. Readers of the *Vayu* are presented this result of their professionalism.

Text and photos : Onur Kurc and Tayfun Yasar

Italian Air Force AMX

PAF Thunder

F-4E, F-16s and F-15E fly in formation

PAF JF-17 on the flight line

A pair of PAF JF-17s formate with a Turkish Air Force F-4E Phantom

Phantom and F-5s in close formation

Classic shot of the F-4E Phantom

An impressive flightline at Konya

A USAF F-15E touches down after a sortie

Phantom F-4E back from its mission

Exotic paint scheme on the F-16

An F-15E takes off while an F-16 awaits clearance

Turkish F-4Es and F-5s in sync

Unveiled ! Thales TrUE AI approach to Artificial Intelligence

The digital revolution affords a glimpse of the true potential of IoT, Cybersecurity, Big Data and Artificial Intelligence–and the threats they could pose! Of these four digital technology pillars, none are more evocative as Artificial Intelligence. Humans tend to antropomorphise abstract concepts, to give them a voice and a face, and some have been more popularised in fiction as an existential threat, with the notion of machines rising against humans. This year, at the Paris Air Show, Thales pulled back the curtain to provide a glimpse of how AI should actually be viewed, not with distrust but with an understanding of how it should be: transparent, understandable and ethical. Thales have unveiled the TrUE AI approach.

The Thales TrUE AI approach stands for *Transparent AI,* where users can see the data used to arrive at a conclusion. *Understandable AI,* that which can explain and justify the results and finally an *Ethical AI,* that follows objective standards protocols, laws, and human rights. This approach permeated the Group's revelation at the Paris Air Show 2019, by seeking to glean an AI that puts the human back in control.

To demonstrate this, visitors were taken through a journey to discover how AI would make the world more secure, more efficient and most importantly, put the human at the centre. The journey will begin by asking you a simple question: "As a child, what did you dream of becoming when you grew up? To answer this, we will show you the world through the eyes of a Fighter Pilot, an Air Force General, a Globetrotting Traveler, an Airline Captain, an Astronaut and an Airspace Manager. How their world is transformed through the Thales TrUE AI approach, and how our customers, the people who make the world go around, are helped to think smarter, act faster and make critical decisions in an environment where there exists no margin of error because lives are often at stake."

"Why AI combined with optronics is the fighter pilot's best digital partner"

You are a fighter pilot taking off on a critical strike mission.
The tactical situation on the ground is evolving so quickly that the allied forces requesting fire support are unable to provide the enemy artillery positioning.
But they need help—and fast !

The good news is that you have what you need to do the job. That is because you have the unique combination of targeting and tactical recce pod from Thales with embedded AI. The quasi invisible moving targets that you need to neutralise are now visible – day or night, in colour and high resolution and from 7,000 meters high, and your weapons will be guided with the exact precision.

"The new pod designed by Thales is the fighter pilot's best possible partner aboard" stated Emmanuel Vialle, a former fighter pilot and now Thales product line manager for airborne optronics. "I can act faster and smarter. AI combined to optronics solutions, provides me with an unmatched visible colour and infrared image quality, andwith real-time data analysis for automatic target detection and recognition".

So how does this new Thales solution—the pilot's digital partner—help in actual combat? Let's go back to that strike mission and hear how Emmanel Vialle explains why Thales capacities makes such a difference.

"Overflying the area of interest, I first use the Permanent Vision which brings me a clear awareness of the environment through the pod's imagery integrated in a 3D mapping display. As I have no precise ideas of the enemy positions, I start big data collection: taking thousands of pictures in a few minutes".

"Thanks to the embedded AI, the pod gives me real-time analysis of the optronics images to detect the position of the target vehicles and shows it on my cockpit displays. The data flood is transformed into a series of immediately-actionable sets of information in seconds (compared to hours in the current operations). So, I have a precise global picture of the updated tactical situation".

"Thanks to connectivity, I immediately share that critical imagery with the support ground forces and with command and control. In response, I am tasked to engage the enemy vehicles that are now positively identified".

Thales increases the operational effectiveness of forces tenfold by providing them with the ability to analyse changing situations in real time and by providing options for mission reconfiguration. Pilots and command can to do better what is planned and do well despite the unexpected (seize opportunities, or reconfigure in the event of attrition / adverse manoeuvre).

"Thales new optronic pod is a true breakthrough and there is nothing like it around" Emmanuel Vialle concludes, "When fighter pilots try it for the first time, they say, 'Wow! it really allows a much better understanding of the tactical situation so we can identify the target in optimal conditions and speed'".

Thales leadership in providing this unique critical success factor to fighter missions is the result of fifty years of optronics experience and leading expertise in digital technologies including AI, Big Data and Connectivity. The solution is multi-platform and "plug and fly" for fighter aircraft from a variety of manufacturers. "It is the 'connected sensor' that we needed for true connected collaborative combat, to operate and adapt simultaneously", Emmanuel Vialle concludes with a knowing smile.

26 two-seater JF-17Bs for the PAF

Air Marshal Ahmer Shahzad, chairman of Pakistan Aeronautical Complex (PAC) Kamra, has recently confirmed that the contract for 26 two-seater JF-17Bs, signed in late 2017, will lead to assembly of the first eight platforms at Kamra during the second half of 2019, followed by another 14 in 2020 with the last four in 2021. As reported elsewhere, the PAF's JF-17Bs will be fitted with air-to-air refueling systems, the first of which arrived in Pakistan in March 2018 and commenced aerial refueling trials in mid-2019. The programme, being carried out by the Pakistan Air Force's Flight Test Group will be boosted by the arrival of a second two-seater. The PAF plans to shortly start inducting the first JF-17Bs which will streamline conversion training of JF-17 pilots, who are currently flying Mirages, F-16s or F-7PGs before progressing to the new fighter. The JF-17B is also expected to further boost the export marketing drive which is being shared between PAC and the Aviation Industry Corporation of China (AVIC).

New PAF F-16 squadron

A fifth Pakistan Air Force F-16 squadron has been formed at PAF Base Sargodha. No.29 Squadron is described as "an aggressor squadron operated by the co-located Airpower Centre for Excellence (ACE)". It has been suggested that the unit played a major part in the PAF's *Operation Swift Retort* on 27 February 2019.

More Su-57s and Mi-28NMs for VKS

Russian President Vladimir Putin has announced that the VKS is to acquire 76 Su-57 fighters and 100 modernised Mi-28NM helicopters by 2028. He confirmed that while the state armament programme calls for procurement of 16 Su-57s by 2028, a 20% reduction in the cost of the aircraft and its weapon systems will allow for larger number to be acquired.

Turkey receives first batch of S-400s

As part of the contract signed between Turkey and Russia, the first batch of Russia's S-400 missile defence systems were delivered to Turkey, arriving in that country on 12 July at Murted airbase in Ankara. In a statement, Turkey's Undersecretariat for Defence Industries (SSM) stated that Russia would supply four S-400 missile batteries to Turkey which decision has however unnerved NATO member countries. The deliveries are bound to escalate tensions with the US which has warned Turkey that there would be "real and negative" consequences including denial of advanced weapon systems including the F-35.

Future of F-35s for Turkey

After making an initial investment of $195 million, Turkey had ordered 100 F-35As, many to be assembled domestically by Turkish Aircraft Industries, which is an integral part of the JSF

supply chain. A permanent embargo could be "disastrous for both sides" as Turkish F-35s could well be held back in the United States for years or sold to other customers. If Turkey is "expelled" from the programme altogether; the loss to Turkish industry could be measured in billions of dollars and worldwide production of the aircraft would certainly suffer.

Russia offers Su-57 to Turkey ?

In wake of the current spat between the United States and Turkey, arising from the latter's decision to acquire the Russian S-400 Triumf mobile air defence system, there is speculation that Russia has offered its next generation Su-57 fighter to Turkey. In 2018, US Congress had proposed halt to the sale of Lockheed Martin's F-35s to Turkey because of the Russian-made missile systems ordered by this NATO partner country.

Turkish Navy receives TB2 UAVs

Five *Baykar Makina Bayraktar TB2 Insansiz Hava Araclari/Silahli Insansiz Hava Araclari* (IHA/S/HA, unmanned aerial vehicles have been handed over to the *Turk Deniz Kuvvetleri Komutanlığı* (Turnish Naval Forces Command) as part of an order for ten of the type. The UAVs were delivered in January to the Canakkale UAV Flight, which operates these from the civil airport at Canakkale, adjacent to the naval base.

Poland's interest in Lightning IIs

The Polish Government has made public its intention of selecting the F-35A Lightning II to replace its Soviet-era combat aircraft fleet. Minister of National Defence Mariusz Blaszczak revealed that a letter of request (LOR) has been sent to the US Government for purchase of 32 F-35As along with a logistics and training package. Blaszczak said Poland would supplant post-Soviet equipment in the Polish Air Force with the most modern [types]", replacing the 29 MiG-29s and 18 Su-22s that still remain in service. Poland's Deputy Defence Minister had earlier said that the conceptual phase of their *Harpia* future fighter programme had been completed and that deliveries of new aircraft should begin in 2024.

Swedish Air Force Gripen C/Ds

Seeking to expand its combat air strength, the Swedish Air Force is finalising long term plans including retention of its fleet of JAS 39C/D fighters even as the new Gripen Es are to be delivered shortly. Under the plan, up to 60 of the earlier Gripen variants would continue in service until they are replaced by an all-new combat aircraft in the late 2030s.

Saab offers Finland Gripens and GlobalEye

Saab's comprehensive Gripen offer to Finland, submitted in January 2019, includes two GlobalEye Airborne Early Warning and Control (AEW&C) aircraft. The GlobalEye provides 24/7 capability for airspace and ground surveillance, increasing Finland's situational awareness and provide for increased pre-warning time, supporting protection of the nation's territorial integrity.

More F-16s for Iraq

The Iraqi Air Force has received its next batch of F-16IQs, being five of 36 aircraft ordered, of which 24 are single-seat Block 52 F-16Cs and 12 twin-seat F-16Ds. Foreign Military Sales (FMS) orders for two batches of 18 aircraft each were placed in December 2011 and April 2013. Iraqi pilots began training on the type in August 2012 and the first pair of F-16Cs, plus two F-16Ds, were delivered to Balad AB in July 2015. Further deliveries to Iraq took place in January, August and November 2016, followed by additional batches in March and September 2017. Meanwhile, a further batch of four Korean-origin T-50IQs has been delivered to the Iraqi Air Force, with 204 Flying Training Squadron. Iraq has ordered 24 from South Korea and the latest arrivals bring total deliveries to 22.

F-16 Block 72s to Morocco, Bahrain and Slovakia

Meanwhile, the US State Department has approved sale of 25 F-16 Block 72s to Morocco along with upgrades for the country's existing fleet of 23 F-16s Block 52 to F-16V configuration. Earlier, Bahrain became the first Block 70 F-16V operator in June 2018 and Slovakia signed a letter of agreement in December 2018 for 14 similar aircraft.

NATO Tiger meet at Mont-de-Marsan

'Tiger' squadrons from various Air Forces of NATO congregated at *Base Aérienne* 118 Mont de Marsan in France on 12 May 2019 for the annual joint NATO Tiger Meet (NTM) exercise, hosted by the resident *Escadron de Chasse* (EC) 3/30 'Lorraine'. Rafales are also operated by *Escadron de Soutien Technique Aéronautique* (ESTA, Aeronautical Technical Support Squadron 15/30 'Chalosse, the largest constituent unit of the 30e Escadre, which oversees servicing, maintenance and repair for all aircraft stationed at Mont-de-Marsan *(see article in this issue)*.

Su-30Ks to Angola

The final two of 12 Su-30K fighters were delivered to the *Força Aérea Nacional de Angola* (FANA, National Air Force of Angola) in April 2019. These former Indian Air Force fighters had been overhauled and upgraded by the 558 ARZ in conjunction with Russia's Rosoboronexport, to Su-30SM standard, providing compatibility with Kh-31A anti-ship, Kh-31P anti-radar and R-77 air-to-air missiles.

Romania for more F-16s

Romanian Defence Minister Gabriel-Beniamin Les has announced plans to purchase five more second-hand, modernised F-16 fighters from Portugal, including four single-seat F-16AMs and a single two-seat F-16BM. Meanwhile, Vice Admiral

Mathias Winter, director of the Joint Strike Fighter programme, recently identified Romania (alongside Greece, Spain and Poland) as "future potential Foreign Military Sales customer for the F-35".

RAF P-8A Poseidons

The first Boeing P-8A Poseidon MRA Mk.1 for the RAF will be handed over in October 2019 at Naval Air Station Jacksonville, Florida, before delivery to the UK early next year. The RAF has ordered nine of the type, for operation by Nos. 120 and 201 Squadrons at RAF Lossiemouth in Scotland. An additional P-8 operational flight trainer (OFT) is also to be provided.

Kawasaki P-1 and C-2 at Paris Air Show

The Kawasaki C-2 strategic transport made its public debut at Paris, appearing in the static park alongside its public stablemate, the P-1 maritime patrol aircraft (in picture below). Though the two aircraft have a very different appearance and mission, they share a number design elements including the same wing and cockpit windows.

The pair formed the centrepiece of a major Japanese commitment to the Show involving some 65 defence personnel. The JASDF operates eight C-2s and eventually could order upto 30 numbers. One of the prototype C-2s, designated LRX, has been modified as an experimental signals intelligence (SIGINT) aircraft. Meanwhile, the P-1 has performed very well in Japan Maritime Self-Defense Force service, "with considerably better range, performance, and sensing capability than the Lockheed Martin P-3 Orion it will replace." There will be 21 P-1s in service which number could well be increased upto 70 in the future. The C-2 is powered by two General Electric CF6 turbofans, while the P-1 is powered by four IHI Corporate F7 engines.

More Yak-130s for Belarus

Four more examples of the Yak-130 have been delivered to the Belarusian Air Force and Air Defence Corps, being handed over to Military Unit 19764 at the 116th Guards Attack Air Base at Lida recently. The first batch of four Yak-130s had been delivered to Belarus in 2015, with the latest arrivals bringing the total in service to 12.

Pampas for Paraguay

The Argentine government have offered six IA-63 Pamba III jet trainer and light attack aircraft to Paraguay. The *Fuerza Aérea Paraguaya* (FAP, Paraguayan Air Force) is seeking replacements for its retired EMB-326GB Xavantes, withdrawn over 10 years back. However, the FAP lacks the funds to re-equip its force, currently operating a handful of EMB-312-T-27 Tucanos as its sole combat type.

Bolivia considers Pampa III

The Argentine Government is to deliver a single IA-63 Pampa III jet trainer to the *Fuerza Aerea Boliviana* (FAB, Bolivian Air Force) in 2019, such transfer being part of an agreement under which Bolivia will supply Argentina with natural gas. The Pampa III meets an FAB requirement to re-equip and replace its T-33 trainers, retired in July 2017. Currently, the FAB operates a fleet of six K-8 trainers that constitutes its combat-capable jet force.

French Air Force 'tactical' A400Ms

The *Armée de l'Air* has received its 15th A400M, first to be delivered to 'tactical standard' which configuration permits the airlifter to operate from unprepared airstrips. The A400Ms will operates from *Base Aérienne* 123 at Orléans-Bricy. The Air force expects to add additional capabilities to the fleet this autumn, including the ability to drop heavy loads of up to 16 tons, and in-flight refuelling from the central hose, mainly for the benefit of other A400M and Transall transports. France is to receive 25 in the end of 2025.

More upgraded Tu-95MSMs

Beriev Aircraft Company has delivered two more upgraded Tu-95MSM bombers to the VKS, being flown from Taganrog to Engels. The Tu-95MSM is retrofitted with new Novella-021 radar, flight control system, inertial navigation system, astronavigation system and navigation computer. Other improved items include a new satellite navigation receiver and data display system with five cockpit LCDs. The Meteor-NM self-defence suite is upgraded to NM2 standard, the modernisation being undertaken alongside major overhauls.

Brazilian Air Force receives first KC-390

Embraer delivered the first KC-390 tanker-transport to the *Forca Aerea Brasileira* in June, five years after finalising the production contract, with a second example to follow by end of the year, for a total for 28 such aircraft. The first operational unit of the FAB will be the 1° *Grupo de Transporte de Tropa* (1° GTT, 1st Troop Transport Group) at Anapolis.

Argentina receives Super Étendards

The *Comando de Aviación Naval Argentina*, (*COAN*, Argentine Naval Aviation) has received five Super Étendard *Modernisé* (SEM) fighters purchased from France at a cost of $15m. The former French Navy jets arrived in the port of Bahia Blanca abroad the cargo ship *Lily Auerback*. The SEMs will be operated by the 2º *Escuadrilla Aeronaval de Caza y Ataque* (2nd Naval Aviation Fighter and Attack Squadron) at *Base Aeronaval Comandante Espora*. The squadron's existing fleet of ten Super Étendards were grounded in 2011 owing to lack of spares.

24 more E-2D Hawkeyes for USN

Northrop Grumman has been awarded a $3.2 billion fixed-price contract for 24 additional E-2D Advanced Hawkeye Airborne Early Warning & Control aircraft to the US Navy. The 24 full-rate production aircraft for the US Navy included in the five-year contract are expected to be completed in August 2026. The contract covers production lots seven through eleven, which will be delivered from Northrop Grumman's Advanced Hawkeye final assembly

line in Melbourne, Florida. Northrop Grumman had previously delivered 37 E-2D Advanced Hawkeyes to the US Navy, completing all major production milestones on time. In September 2018, the US State Department announced the potential sale of up to nine E-2D Advanced Hawkeyes to the Japan Air Self Defense Force.

First RCAF C295

The first Airbus C295 for the Royal Canadian Air Force's (RCAF) Fixed Wing Search and Rescue Aircraft Replacement (FWSAR) programme, has made its maiden flight and will be delivered by the end of 2019. The RCAF have ordered 16 C295 aircraft with all In-Service Support elements including training and engineering services, the construction of a new Training Centre in Comox, British Columbia, and maintenance and support services.

USAF LAA programme

The USAF is expected to award its Light Attack Aircraft (LAA) contract shortly after the programme entered the pre-solicitation notification phase. The USAF intends to buy three A-29 Super Tucanos (seen above in Afghan service) and three AT-6B Wolverines, while a pre-solicitation notification for similar number of AT-6s from Textron Aviation was also expected. While the Super Tucanos will enter service with the Air Force Special Operations Command (AFSOC) at Hurlburt Field, Florida, the Wolverines will be operated by Air Combat Command at Nellis Air Force Base, Nevada. In third phase of the Light Attack Aircraft programme, the USAF will also consider jets, helicopters and unmanned aircraft systems for light attack and close air support roles. The LAA "will provide an affordable, non-developmental aircraft intended to operate globally in the types of irregular warfare environments that have characterised combat operations over the past 25 years."

PAC Super Mushshaks in Azerbaijan

Azerbaijan's Defence Ministry has announced that its air force has begun operating the Super Mushshak basic trainer acquired from the Pakistan Aeronautical Complex. A contract for ten such trainers was signed in July 2017 and the type entered service last November, by which time five had been delivered. In the picture above are seen the 'contract for sale' certificate being exchanged at PAC Kamra.

Qatar for more AH-64Es

Qatar plans to acquire another 24 AH-64E attack helicopters to join its first batch of 24, deliveries of which began at Boeing's Mesa, Arizona, facility in March 2019. As well as the Apache Guardians, the Qatar Emiri Air Force (QEAF) is to receive eight AN/ APG-78 Longbow fire-control radars, plus weapons, including 2,500 AGM-114R Hellfire air-to-ground missiles.

More Black Hawks to Afghanistan

The US Army Security Assistance Command has delivered a further two former US Army UH-60As to the Afghan Air Force after completion of major refurbishment. The Black Hawks were air lifted in an Antonov Airlines An-124 to Afghanistan, these latest aircraft bringing total deliveries to 36 with plans to ultimately transfer 159 UH-60As to the AAF. Meanwhile, the Indian Government has delivered another two (of four additional) Mi-24Vs to the Afghan Air Force (AAF) in mid-May, these purchased from Belarus and refurbished before being transported to Kabul. According to the Indian government, these will replace four Mi-35s donated to the AAF by India in 2015.

Black Hawks for Albania

Albania is to receive three second-hand UH-60 helicopters from the US, this acquisition as part of a US military aid package that was signed off during the Defence Minister's visit to the USA. Albanian personnel will begin training on the Black Hawk with the New Jersey National Guard in 2019.

Poland receives four AW101s

Leonardo will supply the Polish Ministry of National Defence with four AW101 maritime multi-role helicopters. The Merlins are configured for anti-submarine warfare and combat search and

rescue and will be supplied together with a logistics and training package, with PZL-Swidnik acting as prime contractor. Deliveries to the *Marynarka Wojenna* (Polish Navy) are due to be completed by 2022 and the new rotorcraft will replace the last six ageing Mi-14 helicopters that currently serve with the 'Darlowo' *Grupa Lotnicza* (air group) based at Darlowo.

Egyptian Apaches operate at sea

AH-64D Apaches of the Arab Republic of Egypt Air Force have operated from the Egyptian Navy's *Mistral*-class amphibious assault ship *Anwar El* Sadat (L1020) during the *Medusa* 8 exercise in April. The manoeuvres involved forces from Cyprus, Egypt and Greece and both Egyptian AH-64Ds and Hellenic Army Aviation AH-64DHAs (as well as Hellenic Army CH-47Ds) flew from the warship. The vessel was originally built in France as the *Sevastopol* for the Russian Navy, before sanctions imposed precluded its transfer. Meanwhile, Leonardo Helicopters have secured an Egyptian order to supply around 20 AW149 battlefield helicopters, selected in preference to the NH90. The nine-tonne rotorcraft will be operated on behalf of the Egyptian Navy.

Australian Tiger ARH contract

The Australian Department of Defence has awarded a five-year contract extension to Airbus Australia Pacific for through life support (TLS) of the Australian Army's Airbus Helicopters EC665 Tiger Armed Reconnaissance Helicopters (ARH). The Australian

Army has 22 Tigers, in service with the 1st Aviation Regiment in Darwin, Northern Territory (161 and 162 Reconnaissance Squadrons) and with the School of Army Aviation at Oakey, Queensland. Minister for Defence Christopher Pyne said the Tiger, which has been in service with the Australian Army since December 2004, has matured into a "critical asset" for the Australian Defence Force.

Sikorsky VH-92A Presidential helicopters

Sikorsky, a Lockheed Martin company, will build six production VH-92A Presidential Helicopters under a contract from the US Navy, which are part of the 23 aircraft programme for the US Marine Corps. Under terms of the contract, known as Low Rate Initial Production (LRIP) Lot 1, Sikorsky will begin deliveries of six VH-92A helicopters in 2021, the remaining production aircraft to be delivered in 2022 and 2023.

IAG issues LOI for 200 Boeing Max airliners

Boeing's 737 Max programme received a significant vote of confidence from one of the world's most influential airlines, as International Airlines Group (IAG) signed a letter of intent covering 200 Max 8s and Max 10s worth more than $24 billion at list prices. Appearing at the Paris show with Boeing Company CEO Dennis Muilenburg and Boeing CEO Kevin McAllister, IAG CEO Willie Walsh said the group would place the new Max jets mainly with subsidiaries British Airways, Vueling, and Level and operate them primarily out of London Gatwick Airport.

Cebu Pacific orders 31 Airbus airliners

Cebu Pacific signed an MoU at the Paris Air Show for 31 Airbus airliners:16 A330neos, 10 A321XLRs, and five A320neos. This also includes options on another 10 A321neos. Cebu Pacific, informally known as Cebu Pac, becomes one of the launch airlines for the newly launched 4,700-nm range A321XLR. Cebu Pacific will start receiving the Rolls-Royce Trent 7000-powered A330-900s in 2021 and the A321XLRs from 2024. The airline revealed the new wide bodies will have a high-density single-class configuration of 460 seats or 5.5 percent more seats than its current A330ceos.

AirAsia orders CFM engines for A321neos

AirAsia and CFM International have finalised an agreement for the purchase of 200 Leap-1A engines to power the airline's 100 Airbus A321neos. AirAsia has been a CFM customer for nearly 20 years, having placed its initial order for 400 Leap-1A engines to power A320neos in June 2011. It took delivery of its first Leap-powered A320neo in 2016 and now operates 39, in addition to 191 CFM56-5B-powered A320ceos.

Development of the A321XLR

It is speculated that Airbus might launch an even longer-range variant of the A321neo, to be known as the A321XLR. There are reports that Airbus has already signed up customers for the A321XLR, although it has yet to be launched publicly. Recent reports have United Airlines and IndiGo being amongst the carriers considering this new variant, with Icelandair also mentioned for replacing the current Boeing 757s. The A321LR is a longer-range and higher-payload development of the A321neo seating 206 passengers in two-class or 244 in single-class, "designed to enable airlines to open new long-range routes and offer a more efficient midsize platform."

Airbus 12,000th aircraft

Airbus celebrated delivery of its 12,000th aircraft over its 50-year history on 20 May 2019. This was an A220-100, assembled in Mirabel, Canada and handed over to US-based Delta Air Lines, the carrier having received its first A220 in October 2018. Delta is the first US airline to operate the A220 and is the largest A220 customer, with a firm order for 90 such aircraft.

Meanwhile, there are orders and commitments for more than 230 A220s, with ground-breaking for a new A220 manufacturing facility in Mobile, Alabama and expansion at the Mirabel manufacturing facility. Airbus Canada has delivered more aircraft in its first year than the total delivered up to July 2018, when it took lead of the programme.

Nordic Aviation Capital LOI for 105 ATR 72-600s

ATR have signed an LOI with Nordic Aviation Capital (NAC) for up to 105 ATR 72-600s. The deal covers 35 firm ATR 72-600s, with options for a further 35 and purchase rights for yet another 35. NAC is "fully committed" to take on the firm orders covered in the LOI, and deliveries of the initial 35 aircraft will begin in 2020 and run up to 2025. The Copenhagen-based leasing company has firm dates on the options, while no timing is attached to the purchase rights.

Air Antilles orders Viking 400s

Air Antilles has placed an order for two Viking Twin Otter 400 twin turboprops, making the Guadeloupe, French West Indies airline the first commercial operator of the Series 400 in the Caribbean. To be delivered later this year, the Twin Otters will be configured for 19 passengers and replace two de Havilland Series 300 aircraft currently in service with Air Antilles.

DHC Dash 8-400 to Kazakhstan

The newly renamed Company De Havilland of Canada has delivered the first Dash 8-400 turboprop to Kazakhstan's Qazaq Air, just after parent company Longview Capital took control of the programme from Bombardier on 1 June. TAG Angola Airlines is the customer for a previously announced order for six of the turboprops. While De Havilland of Canada remains tied to a land lease deal at the Dash 8's production site in Downsview, Canada until 2023, it plans to "explore all options" relating to the location of final assembly. The company expects to deliver the 600th Dash 8-400 from Downsview "very soon".

Emirates spreads 777X deliveries, changes 787 order

Emirates has reportedly looked at spreading out deliveries of the Boeing 777X over a longer period of time and will likely switch to the 787-9 from the larger -10 for which it had placed a preliminary order in 2017. The changes to the order are triggered by Airbus' decision to terminate the A380 programme and as part of which Emirates' outstanding A380 orders have been greatly reduced.

Emirates had ordered 150 Boeing 777Xs at the 2015 Dubai Airshow and signed up for 40 787-10s two years later. Unlike the 777X commitment, the 787 deal was never a firm order and now has lapsed, according to Clark. As part of its agreement with Airbus, Emirates agreed to take 40 A330-900s and 30 A350-900s instead, with the first aircraft arriving next year. Emirates' 777X order represents close to half of that model's firm order backlog, which currently stands at 344 aircraft.

Emirates 777-200LR retrofits

Emirates has completed reconfiguration of a tenth Boeing 777-200LR, completing a $150 million programme converting the airliners from three to two class cabins featuring wider business class seats in a 2-2-2 format and a fully modified economy class cabin. The reconfiguration of the ten aircraft was completed fully in-house at Emirates Engineering's facilities in Dubai, with over 160,000

man-hours carried on the project, working with more than 30 suppliers and handling over 2,700 spare parts. The first 777-200LR with the new configuration was rolled out for commercial service in March 2018 and over the course of the next 12 months, Emirates completed conversion of the remaining nine aircraft. Emirates is also set to complete the phasing out of the 777-300 from service.

Lion Air's A330-900

The first Airbus A330-900 for Indonesian carrier Lion Air was rolled out at Toulouse in early May, and is to be leased by the Indonesian carrier from BOC Aviation, the first of ten A330-900s that will come from the lessor. Meanwhile, Air Mauritius recently took delivery of its first A330-900, which alongside its two A350-900s, makes it the first airline to operate both Airbus' twin-jet widebodies.

Eurofighter, Eurojet and NETMA in 'Long Term Evolution'

Eurofighter Jagdflugzeug GmbH, Eurojet Turbo GmbH and NETMA, the NATO Eurofighter & Tornado Management Agency, have signed contracts together worth €53.7 million to support long-term development of the Eurofighter Typhoon combat aircraft. This study will be engaged in Long Term Evolution (LTE) of the aircraft and its EJ200 engine, spanning a total of 19 months for the aircraft and 9 months for the engine elements. "This will underpin the future of Eurofighter by identifying a suite of technology enhancements for the Weapons System infrastructure and the engine that will ensure the aircraft remains operationally effective and can continue to spearhead the Partner Nations' air forces for the decades to come".

According to Clemens Linden, CEO of Eurojet, in terms of the EJ200 engine, the focus is on four key areas: thrust growth; range and persistence with increased parts life; survivability as well as control system enhancements.

Saab to join UK's Tempest programme ?

According to well-informed aerospace observers, Saab is considering a high level of cooperation with British industry should Sweden decide to join the UK's Tempest next-generation combat aircraft development. Pointing out the company's successful role on the T-X jet trainer as a "co-designer and co-project leader," with Boeing, CEO Haken Bushke hinted that Saab was looking for a similar level of cooperation, noting that the company would not merely work on the Tempest as "consultants selling man-hours."

Sweden has shown significant interest in joining Tempest since it was launched at the 2018 Farnborough Airshow, with BAE Systems revealing later that year that it was in a "deepening dialogue" with Saab. Since then, the Swedish defense company carried out a 6 billion Krona ($650 million) rights issue giving it additional capital to support its research and development programmes for support work in conjunction with the UK.

Third Gripen E airborne

Maiden flight of the third Gripen E aircraft (39-10) took place at Linkoping on 10 June. Flown by Saab experimental test pilot Jakob Hogberg, the single-engined fighter follows two previous

examples, which began flight testing in June 2017 and November 2018 respectively. The Gripen Demo airframe is also due to resume flights in the near future in support of the E-model programme, having recently received updates, including the installation of a new wide area display in the rear cockpit.

Eddy de la Motte, Saab's head of business unit Gripen E/F, said the company aims to have eight of the new-generation aircraft flying before the end of 2019, including four production examples that are now in final assembly in Linköping. Launch customer Swedish Air Force will receive 60 Gripen Es, with the first export customer, Brazil to get 36 aircraft, comprising 28 single-seaters and eight two-seaters.

"Large global market" for Boeing T-X

Boeing has forecast a large global market for the T-X which has been selected to replace the USAF's Northrop T-38 Trainer. Boeing vice-president Thom Breckenridge has reiterated that the Company and programme partner Saab are clear that there is a market for upto 2,600 units over its lifetime, which includes 1,000 examples for the US armed forces. The T-X could well be chosen for roles "much beyond its advanced jet trainer origins."

Safran Tech TP demonstrator

Safran Helicopter Engines made the first ground run of its Tech TP turboprop technology demonstrator engine on 12 June at its facility in Tarnos, France. The Tech TP is based on the Ardiden 3 turboshaft and was developed as part of the EU Horizon 2020 research and innovation programme. Tech TP aims to validate new technologies to deliver an engine that is 15 percent more fuel efficient and emits fewer CO_2 emissions than current engines while producing between 1,700 shp and 2,000 shp. It builds on the design of the EASA-certified Ardiden 3C and 3G engines that have completed more than 10,000 hours of testing. The 3G powers the Russian Kamov Ka-62, while the 3C/WZ16 powers the Chinese Avicopter AC352. More than 250 Ardiden 1 engines are already in service and have flown more than 200,000 hours in Indian airframes, including the HAL Dhruv ALH *(photo)*, the LCH and LUH.

Boeing adds Embraer KC-390 to its range

Boeing is to add the Embraer KC-390 tactical transport aircraft to its range of aircraft types, working on this programme with Embraer, which will result in the companies jointly developing and marketing the aircraft. This is linked to discussions between the two for Boeing to acquire an 80 percent stake in Embraer's commercial aircraft business.

AEW&C version of Tu-214

The VKS is planning to induct an airborne early warning and control (AEW&C) version of the Tu-214 airliner, whose cost is reportedly lesser than the A-100 currently in development. Meanwhile, an additional Ilyushin Il-76MD-90A military transport has been delivered to the VKS from the Aviastar factory at Ulyanovsk, the airlifter joining the 18th Military Transport Aviation Division's 235th Military Transport Aviation Regiment at Ulyanovsk.

Maiden flight of MiG-35UB

A new production two-seat MiG-35UB, which made its maiden flight on 21 April is reported to be the first destined for the VKS. The test sortie took place at the P A Voronin Production

Centre at Lukhovitsy-Tretyakovo, outside Moscow. The prototype MiG-35UB had flown in December 2016 and the new example is the first two-seat pre-production aircraft, ordered under a contract signed in February 2017. A contract for six production MiG-35S/UBs for the VKS was placed last August and current plans call for some 24 to be delivered.

New F-16 production line in South Carolina

Comprehensive tooling and equipment at Lockheed Martin's Fort Worth, Texas facility has been transferred to a newly refurbished hangar in Greenville, South Carolina where production of Block-70 F-16s is to continue. The Fort Worth facility will thereafter concentrate on F-35 Lightning II production. Lockheed says more than 400 new jobs will be created to support the F-16 production line in Greenville as well as hundreds more in the supply chain. According to Lockheed Martin, Block 70 and Block 72 F-16s will be equipped with Northrop Grumman's APG-83 advanced active electronically scanned array radar, a new avionics architecture, an advanced datatink, an auto ground collision avoidance system, and structural upgrades to extend the structural life of the aircraft by more than 50%.

De Havilland Canada in re-dux

The de Havilland name has returned to aircraft manufacturing with completion of the $300 million sale of the Dash 8 programme by Bombardier to Canada's Longview Aircraft Capital. Production of the Q400 regional turboprop and support for the Dash 8-100/200/300 has been transferred to De Havilland Aircraft of Canada, a new subsidiary of Longview. The new company will continue to produce the Q400, renamed as the Dash 8-400, at the site under land-lease agreements that extend to 2023. The parent company of Viking Air, Longview has a long association with Bombardier and the de Havilland Canada name. In 2005 and 2006, Viking acquired the type certificates for all out-of-production de Havilland Canada types, from the DHC-1 Chipmunk to the DHC-7 Dash 7. In 2007, the company restarted production of the DHC-6 Twin Ottter with the upgraded Series 400.

Mitsubishi to acquire Bombardier RJ programme

Mitsubishi Heavy Industries, Ltd. and Bombardier Inc. have entered into a definitive agreement, whereby MHI will acquire Bombardier's regional jet programme for $550 million. Under the agreement, Bombardier's net beneficial interest in the Regional Aircraft Securitisation Programme (RASPRO), which is valued at approximately $180 million will be transferred to MHI.

Lockheed Martin teams with Rafael

Lockheed Martin and Rafael Advanced Defense Systems have signed a teaming agreement to jointly develop, market, manufacture and support Rafael's Smart, Precise Impact and Cost-Effective (SPICE) guidance kits for US sale. SPICE is a family of stand-off, autonomous, air-to-surface weapon systems. The teaming agreement covers the SPICE 1000 (1,000 pound/453 kilogram weight class) and SPICE 2000 (2,000 pound/907 kilogram weight class) kit variants.

French joint light helicopter programme accelerated

Launch of the Joint Light Helicopter (*Hélicoptère Interarmées Léger*; HIL) programme has been brought forward to 2021, in which the Airbus Helicopters' H160 was selected during 2017. Earlier Launch of the programme will result in earlier deliveries of the first H160Ms to the French Armed Forces in 2026. The multi mission H160 is designed to perform missions ranging from commando infiltration to air intercept, fire support and anti-ship warfare, meeting needs of the army, the navy and the air force.

Mi-38 tested in extreme conditions

The Mi-38 helicopter, equipped with new TV7-117V engines, an integrated digital flight-navigation system with data display on five LCD displays and an protected explosion-proof fuel system has completed testing in conditions of extremely high temperatures and high altitude. The Mi-38 carried out more than 50 flights in the city of Astrakhan, with high altitude tests conducted at Mount Elbrus.

Rafael's AI for SPICE-250

Israel's Rafael Advanced Defense Systems have successfully tested and demonstrated a new ATR (Automatic Target Recognition) capability for its SPICE-250 air-to-surface munition. This is part of the family of stand-off, autonomous, air-to-ground weapon systems that attack targets with pinpoint accuracy and at high attack volumes, without depending on GPS navigation in GPS-denied environments. SPICE-250 has a standoff range of 100 kilometers, and can be equipped with either general purpose or penetration 75kg class warhead.

The newly-unveiled ATR feature enables SPICE-250 to effectively imbibe specific target characteristics ahead of strike, using advanced AI and deep-learning technologies. During flight, the pilot selects the target type to be attacked and allocates a target to each weapon. The weapons are launched towards the vicinity of the targets, using their INS for initial navigation. When approaching the target area, the weapons use the ATR mode for detection and recognition of the targets. Each weapon homes-in on the pre-defined target, either autonomously or with a human-in-the-loop, aided by the ATR algorithm.

GA-ASI's Gray Eagle Extended Range training

The US Army has completed its New Equipment Training (NET) at Fort Campbell, Kentucky for the MQ-1C ER Gray Eagle Extended Range. The training covered new maintenance procedures, manuals and ground support equipment associated with the MQ-1C ER, which is a new Unmanned Aircraft System (UAS) produced by General Atomics Aeronautical Systems, Inc. (GA-ASI).

SkyGuardian surpasses 100 test flights

The MQ-9B SkyGuardian Remotely Piloted Aircraft (RPA), designed and developed by General Atomics Aeronautical Systems, Inc. (GA-ASI) has now made more than 100 test flights as development continues towards its first delivery to the Royal Air Force (RAF) as part of the Protector RG Mk1 programme. Since making its first flight in November 2016, GA-ASI has carried out a range of testing including long endurance flights becoming the first Medium-altitude, Long-range RPA to perform a trans-Atlantic flight in July 2018. A second company-owned SkyGuardian is supporting the development.

Raytheon and UTC Aerospace in "Merger of Equals"

Raytheon Company and United Technologies Corp. have entered into an agreement to combine "in an all-stock merger of equals," creating a premier systems provider with advanced technologies to

address rapidly growing segments within aerospace and defence. The combined company, which will be named Raytheon Technologies Corporation, will offer expanded technology and R&D capabilities to deliver innovative and cost-effective solutions aligned with customer priorities and the national defense strategies of the US and its allies and "friends".

500th Electro-Optical Targeting System for the F-35

Lockheed Martin have delivered the 500th Electro-Optical Targeting System (EOTS), all these delivered on time or ahead of schedule to support aircraft production and sustainment requirements. F-35 EOTS is the world's first sensor to combine forward-looking infrared and infrared search and track functionality to provide F-35 pilots with precise air-to-air and air-to-ground targeting capability. "EOTS allows aircrews to identify areas of interest, perform reconnaissance and precisely deliver laser and GPS-guided weapons".

Franco-German industrial cooperation for ultra-lightweight missile

Diehl Defence and Safran Electronics & Defence have signed an agreement for development of a tactical air-to-ground weapon system for flying platforms. Based on experience gathered in recent missions, the particularly lightweight weapon system, called HUSSAR is to combine the benefits of a larger load with the capability to even engage time sensitive targets. The 'scalable effects' warhead will be optimised for the engagement of stationary and moving targets while avoiding collateral damage in complex mission scenarios. An innovative navigation platform in conjunction with various seeker options, including semi-active laser sensor, will enable highly precise target engagement. HUSSAR will be carried by a smart multi-launcher which will considerably increase typical aircraft load out with up to 8 effectors.

MBDA and Lockheed Martin proposal for TLVS

The TLVS bidder's consortium, an MBDA Deutschland and Lockheed Martin joint venture, has submitted its proposal to the German Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw) to develop, test and deliver TLVS, Germany's future Integrated Air and Missile Defense (IAMD) system. The tender proposes an efficient four-phased approach that includes development, integration, testing and delivery of a fielded multi-mission system. The fielded unit will deliver new capabilities and significant performance enhancements well beyond the MEADS programme and all known systems.

Lockheed Martin awarded contract for ATACMS missiles

Lockheed Martin has received a $561.8 million production contract for Army Tactical Missile System (ATACMS) missiles for the US Army and Foreign Military Sales (FMS) customers. This comprises new ATACMS rounds, as well as upgrading several previous-variant ATACMS as part of the Service Life Extension Programme (SLEP III). Both the SLEP and new ATACMS rounds will be produced at Lockheed Martin's Precision Fires Production Center of Excellence in Camden, Arkansas.

Rostec demonstrates Korsar drone

Roselectronics holding company (part of Rostec) has publically demonstrated its new reconnaissance drone Korsar, designed by Lutch R&D of Roselectronics holding which consists of several separate UAVs and a control station. The UAV is designed for all-

weather aerial terrain reconnaissance, patrol and observation flights, and aerial photography. Korsar can fly at altitudes exceeding 5000 meters, out of the range of small arms fire and many man-portable air-defence systems. Its efficient engine allows the drone to make a continuous flight of up to 8 hours.

Rheinmetall and BAE Systems in JV

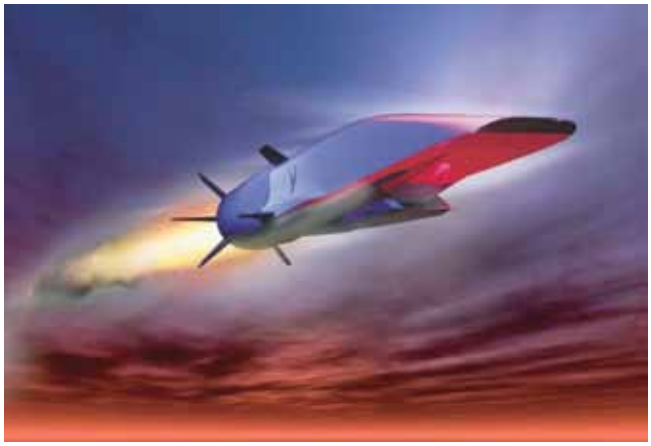
Rheinmetall and BAE Systems have launched a new and independent UK-based joint venture (JV) for military vehicle design, manufacture and support, known as Rheinmetall BAE Systems Land (RBSL). Headquartered in Telford in the West Midlands, the JV is well positioned for future growth. RBSL intends to play a major role in manufacturing the Boxer 8x8 for the British Army's Mechanised Infantry Vehicle (MIV) programme and other strategic combat vehicle programmes, while also providing support to the British Army's in-service bridging and armoured vehicle fleets.

GA-ASI teams with SkyGuardian Canada

Team SkyGuardian, which include General Atomics Aeronautical Systems, Inc. (GA-ASI), CAE Canada, MDA, and L3 WESCAM are expanding more Canadian companies to support the MQ-9B SkyGuardian to fulfill Canada's Remotely Piloted Aircraft System (RPAS) requirements. Team SkyGuardian presents Canadian industry with business opportunities in the Canadian RPAS Project and across the global fleet of more than 400 MQ-9 aircraft flying throughout the world.

Northrop, Raytheon developing hypersonic weapons

Raytheon and Northrop Grumman have combined to jointly offer scramjet-powered tactical missile systems, also known as hypersonic missiles. Northrop will develop, produce and integrate scramjet engines on Raytheon's air-breathing hypersonic weapons. Air-breathing scramjets are usually rocket boosted to supersonic speeds, before the scramjet engine is ignited so that the vehicle can cruise at up to Mach 5 and above (the definition of hypersonic) in the upper atmosphere. This differs from boost/glide hypersonic weapons, which are gliders propelled to above the atmosphere and



then skip off it for range. Northrop's lineage in hypersonic scramjet missile development goes back to NASA's hydrogen-fuelled X-43 (Hyper-X) technology demonstrator, which first flew in 2004.

Saab and FMV agreement on Carl-Gustaf M4

Saab and the Swedish Defence Materiel Administration (FMV) will provide the Swedish Armed Forces with the Carl-Gustaf M4, the framework agreement allowing FMV to place orders during a ten-year period. An initial order for Carl-Gustaf M4 weapons, has been placed with deliveries taking place during 2020-2023. The Carl-Gustaf M4 is the latest version of the portable, shoulder-launched, multi-role weapon system, building on the system's proven capabilities, offering higher degree of accuracy, lighter construction and compatibility with future innovations.

Naval Group and SNC corvettes for Romania

Romania has selected Naval Group and its partner Santierul Naval Constanta (SNC) to build four new *Gowind* multi-mission corvettes, to modernise the T22 frigates and to create a maintenance centre and a training centre. The *Gowind* design has already been chosen by several countries. The platform and its combat system including the Setis combat management system (CMS) offer a comprehensive set of state-of-the-art NATO-standard combat-proven capabilities for anti-surface warfare (ASuW), anti-submarine warfare (ASW) and anti-air warfare (AAW).

US Coast Guard order Saab Sea Giraffe MMR

Saab has received an additional order from the US Navy for its Sea Giraffe Multi Mode Radar (MMR) for the Coast Guard's offshore patrol cutter. This exercises an option on an existing contract which was initially awarded in 2017 and includes multiple line item options for additional Sea Giraffe MMR systems. The initial contract covers manufacturing, inspection, testing and delivery of the radars, which will be deployed on the Coast Guard's *Heritage*-class offshore patrol cutter. Deliveries will take place between 2020 and 2021.

Fincantieri and Naval Group in JV

Fincantieri and Naval Group have signed an Alliance Cooperation Agreement, which sets out operational terms for the incorporation of a 50/50 owned joint venture.

The agreement embodies contents of the 'Poseidon' project and paves the way towards a broader alliance aimed at "reinforcing their military naval cooperation and creating a more efficient and competitive European shipbuilding industry."

Guided artillery projectiles by Boeing and Nammo

Boeing and Nammo will jointly develop and produce the next generation of extended range artillery projectiles. "The partnership is a result of the growing need by US and allied forces to address the range gap between their own artillery systems and those operated by potential adversaries." The US Army places introduction of long range precision fire as highest acquisition priority, with several allies interested to acquire similar capabilities. The development is to be carried out by Nammo at Raufoss in Norway and by Boeing's Phantom Works advanced research division.

Nammo agreement with Norwegian Armed Forces

Nammo has signed a four-year framework agreement with the Norwegian Defence Logistics Organisation (NDLO) for ammunition deliveries to the Norwegian Armed Forces. The agreement will support Norway's efforts to improve its levels of training and operational readiness and sets the terms for a series of subsequent agreements between Nammo and the NDLO. The first of these was also signed during a ceremony at Oslo's historic Akershus fortress, and outlines the expected deliveries to the Norwegian Armed Forces over the coming four years.

D-Day stripes for Belgain C-130

During the June 1944 Normandy landings (D-Day), the Belgian Air Force participated alongside the British Royal Air Force, with its 349 and 350 squadrons created in 1941-42. After World War II, they became part of the newly formed Belgian Air Force, and currently fly F-16s. Both squadrons had special D-Day black and white invasion stripes to commemorate the 75th D-Day anniversary in June 2019.

At the same time, the 15th Wing of the Belgian Air Force, currently at Melsbroek AB, had a Lockheed C-130H painted with the black-and-white invasion stripes and then participated in commemoration flights over Normandy in June 2019.

Text and photo: Joris van Boven

Lightning IIs streak to Europe

F-35s on extended deployment

On 23 May 2019, a squadron of F-35A Lightning II fighters landed at the Aviano Air Base in Italy, the start of deployment to Europe that will last through the summer. The F-35s of 421 Fighter Squadron, based at Hill AFB in Utah, first took part in exercise *Astral Knight* which also involved coalition forces from Croatia, Italy and Slovenia, flying defensive counter-air missions, protecting the coast line from aircraft and cruise missile threats. After the exercise, they were transferred to Spangdahlem Air Base in Germany, as part of a European Deterrence Initiative theatre security package, intended to reassure allies of US support, and to deter potential adversaries on a rotational basis. It was the 421 Squadron's first extended deployment to Germany, the F-35s previously deployed to RAF Lakenheath in the United Kingdom and to Okinawa Air Base in Japan.

421 Fighter Squadron is the latest unit operating with F-35 aircraft which they received in multiple phases starting in November 2018 and since then, two to three aircraft per month are being added. The squadron is deployed to Germany together with other active duty and reserve squadrons with personnel of the 466 Fighter Squadron and the 388 Maintenance Group.

As Lt. Col. Richard Orzechowski, commander of 421 Fighter Squadron stated, "The entire 421 Ops and Maintenance team are extremely excited for this deployment. As the final 388 Fighter Wing squadron to transition to the F-35A, we've been able to leverage experiences of the 4 Fighter Squadron and 34 Fighter Squadron and take this squadron on the road in just six months after getting our first jets. The deployment consists of over 300 people, including 26 pilots and 12 aircraft. The deployment will help identify potential problems, particularly with communication, that might arise while working with other US and partner-nation aircraft, so that real-world operations are as seamless as possible."

In the short time that F-35s have been deployed to Europe, the fighters already visited Italy, Spain, Norway, Finland and France, and expected to visit more partner countries during the summer. "One of the things that we were doing here was working on interoperability with US aircraft as well as partner aircraft. We've connected with the Italians and the Norwegians over Datalink," stated Lt. Col. Orzechowski. The data and lessons learned are shared with others as well. "It's really cool to have feedback make its way from the field to the test process, and to observe Lockheed Martin and the Programme Field Office pull that together to enhance capability. We communicate with all the F-35 squadrons.... but we're still developing, we're still learning. Whenever we have a lesson learned, we try and share that with as many of the other F-35 units as is possible," stated Orzechowski.

Pilots prepare for deployment by imbibing the after action reports of other deployments to Europe to learn from their experiences, the maintenance team worked hard to get the F-35s in the best possible condition for the oceanic crossing. "We've exercised it at Hill AFB, to be ready to be deployed and to be combat ready," stated Col. Michael Miles, 388 Maintenance Group commander. "Planning and moving a dozen aircraft, hundreds of airmen, and hundreds of thousands of pounds of equipment is testament to the drive and training of Hill's fighter wings"

One of the biggest challenges in a deployment is maintenance and spare parts. "The Maintenance Group has prepared what they call a Deployable Spares Package, including the parts that they think they will need. This is a big challenge, as not all spare parts can be brought at once, and have to be resupplied in time." Col. Miles clarified,

"The F-35s deployed downrange, as well as those currently in Europe, have top priority within the Air Force for spare parts when needed. The F-35 is a challenging aircraft to pick up and move because of the amount of equipment fifth-generation maintenance requires, : good preparation when deployed in combat. "This experience will allow our younger airmen to see how we put a whole deployment together and will make them stronger, particularly as we move forward with combat operations in the F-35." There is room for improvement especially matching the high demand for parts such as the canopies, lights and "things that you would have expected to last longer." Fortunately, deployed aircraft can be maintained with the Lockheed Martin global supply chain, and with European partners like Italy.

Article by Jeroen van Veenendaal– DutchAviationPhoto.com
Photos by Roelof-Jan Gort and Jeroen van Veenendaal.

The new exercise in Southern Europe
"Astral Knight 2019"

Astral Knight 2019, the US Air Forces in Europe-led exercise was held in southern Europe during the first week of June 2019. This four day exercise was first of its kind and involved US and coalition forces to operate from locations in Italy, Germany, Slovenia and Croatia. Personnel from the United States worked together with service members from Italy, Slovenia and Croatia at the main operating base Aviano Air Base in the North-East of Italy, with the Adriatic Sea being the area of operations.

The exercise was a combination of air and missile defence operations focused on defence of key areas. Astral Knight 2019 involved flight operations and computer-assisted scenarios with the aim to enhance command and control integration, coordination and interoperability of air, land and sea capabilities. In addition, there were overlapping operations with integrated air and missile defence systems. This integrated offensive and defensive measures to create a comprehensive combined force, preventing the enemy

USAF F-35s were exercised for the first time in Southern Europe, along with F-16s and other fighters from Italy, Germany, Slovenia and Croatia

from effectively employing its offensive air and missile weapons. In an environment where adversaries are rapidly strengthening air and missile threat capabilities with new manned and unmanned aircraft systems, stealthy cruise missiles, hypersonic glide vehicles, plus advanced ballistic missiles, it becomes very important to maintain high quality integrated air missile defences.

The United States Army's 10th Army Air and Missile Defence Command had installed several Patriot surface-to-air missile systems in Slovenia and created required training scenarios. Flying out of the home bases were Italian Air Force F-35s, Eurofighter Typhoons and a Gulfstream G550 providing Airborne Early Warning. Flying out of Zadar Air Base, near the Adriatic Sea were Croatian Air Force MiG-21s which were relocated for the exercise from their home base in Zagreb-Pleso. Operating from Aviano Air Base were F-16s from the 31st Fighter Wing joined by 12 F-35s from 421st Fighter Squadron and 466th Fighter Squadron, home-based at Hill Air Force Base. There were KC-135s flying from both Aviano and Spangdahlem in Germany, to provide air-to-air refuelling, as well as E-3s providing airborne early warning and control.

Squadron Commander of the 421st Fighter Squadron and F-35 fighter pilot Lt. Col. Orzechowski stated, "This is a great opportunity for us to practice our interoperability with our allies as well as the other participants from the US.

This was the first *Astral Knight* and new scenarios will be available in the coming years and ensure that more NATO allies and partners will join the exercise adding to the complexity and possibilities of sharing information among member states.

Text and photos: Erik Bruijns

The Marina Militare

Training Italian Navy Aviators

The main roles of *Maristaeli Luni* are to provide logistical support, training and standardisation of crews for the two *Gruppo Elicoterri*. In addition, they support ship-embarked aircraft and those deployed in operational theatres. The main tasks of the two *Gruppo Elicoterri* are to maintain the operational readiness of air and maintenance crews and their aircraft, operating primarily in the anti-surface and anti-submarine roles. The units also support the 1st San Marco Regiment, an amphibious unit of the Italian Navy.

The MMI operates a total of 18 EH-101s in three versions. Six are in the Anti-Surface/Submarine Warfare (ASuW/ASW) configuration, locally designated SH-101A. Four are in the Airborne Early Warning (AEW) configuration and are locally known as the EH-101A, some eight airframes in the Amphibious Support Helicopter (ASH) configuration, and known as the UH-101A.

In 2000, the MMI placed an order for 46 NFH90 and 10 NH90TTH helicopters to replace the Agusta-Bell AB-212 in service with the Italian Navy since April 1976. Designated the SH-90A and MH-90A, these state-of-the-art helicopters bosted capabilities of the Italian Navy.

Navy training

Delivered in 2011, the Full Mission Flight Simulator (FMFS) and Rear Crew Trainer (RCT) provide complete training environment for EH-101 crews of all versions, enabling both student pilots and experienced crews to familiarise and maintain efficiency with the aircraft. In addition, it allows crews to practice emergency cockpit procedures, night-vision goggle training, ship deck landings and tactical mission training. The RCT part of the simulator replicates rear cabin of

Flying in close formation low over the sea is key for the Gruppo Elicoterri

the Anti-Surface Warfare (ASW/ASuW) version of the EH-101 and is used to teach and maintain tactical crews in operating the sensors, avionics and other systems in the aircraft. The FMFS and RCT can both be used independently or can be networked to offer a realistic mission training environment for the EH-101 pilots and sensor operators. Unlike EH-101 crews, the NH Industries SH-90 crews at Luni do not have a simulator on base and therefore have to use one of NH Industries' simulators.

Maristaeli Luni also operates a "helo-dunker". The building that houses the Survival Training Centre has a large swimming pool with the helo-dunker being used for underwater escape training. A mock-up of a helicopter cockpit and cabin is suspended from a large steel girder which can be plunged into the pool and then flipped over in a variety of positions. It is used to train crews to escape from a helicopter in an upside-down position after impacting with the water in simulated accidents. Responsible for the Survival Training Centre, Commander Rambelli explained that "Once a year, pilots and crew need to go through the training course to stay current on their survival capabilities. The two-day course consists of a theoretical part and a 'wet' part, where pilots and crew get hands on training. We train 450 to 500 pilots and crew members every year and have over 20 years of experience". The initial training of new pilots and crew takes four days for the Navy and three days for the Air Force. "We not only train Italian Navy aircrew but we have a wide range of operators such as Air Force, Polizia, Carabinieri, Coast Guard and also Leonardo crew apart from aircrew of foreign countries. The Hellenic Navy has been training in our facility from many years and as of February 2019, we started training the Qatar Navy as they are in the process of acquiring the NH-90. This is a multi-year training programme which we have started for them".

Text and photos:
Erik Bruijns and Mark de Greeuw

The authors would like to thank the Italian Navy for their help in preparing this article. A special thanks goes out to Commander Fossati, NAS Luni executive Officer and all the men and women of 1° Gruppo Elicoterri and 5° Gruppo Elicoterri.

Both types of helicopters in service with the Italian Navy

To provide compatibility with the EH-101 helicopters, the Italian Navy selected the General Electric T700-T6E1 turbo-shaft engine

"Every man a Tiger" !

NATO Tiger Meet 2019

The NATO Tiger Meet this year was hosted by the French unit *Escadron de Chasse* 3/30 'Lorraine' from 13 to 24 May at the French airbase Mont de Marsan in south west France .This exercise is not merely about team spirit and traditions which are being propagated but it also imparts quality skills in defence personnel required to tackle modern encounters during various conflicts. Mont de Marsan is the most important knowledge centre for the Dassault Rafale deployment in France. Operational tactics with this type and the Dassault Mirage 2000D are performed daily at the airbase. There are also few operational units on Mont de Marsan that are part of *Escadron de Chasse* 30.

With the aim of "sharing experiences, increasing interoperability," exemplary values and team spirit as a guiding principle, the NATO Tiger Meet has developed into an important exercise within NATO over more than 50 years. The tradition teaches that participating squadrons, whether they are flying airplanes or helicopters, are always present in well-known tiger colours. The squadron emblem of all these participants is the 'tiger'. The NATO Tiger Association is a collection of military units from NATO member states. Since 1961, the organisation has been conducting the NATO Tiger Meet every year.

The story of the Tiger Meet began on 19 July 1961, when three Tiger squadrons met at the British airbase RAF Woodbridge which was used at that time by the US Air Force. The units that participated then were the Royal Air Force No. 74 Squadron with the Lightning, EC 1/12 *Cambresis* with the Super Mystère B2 and the 79th Tactical Fighter Squadron with the F-100 Super Sabre. During the Cold War, in context of international tensions, the French Minister of Defence Pierre Messmer had held a meeting to promote solidarity between the NATO units and to improve the quality of operational deployment.

Rafale of EC3/30, painted as a 'Dark smoking Tiger'

Luftwaffe Tornado IDS

The exercise commander of NATO *Tiger Meet 2019* was Lieutenant Colonel Hugues Fouquet. This 55th edition of the exercise was conducted at the French airbase BA118 Mont de Marsan and for the French Air Force, the famous SPA-162 *Tigre*, the 3rd flight of the Escadron de Chasse 3/30 *Lorraine*, was the reason for designating this unit as a Tiger Unit within NATO's Tiger Association. By integrating SPA-162 in *Lorraine* in 2016, this unit too became a member of the Tiger community.

Every year, the NATO Tiger Meet has a specific theme according to which the coloured tails of the aircraft are matched. For this year, it was the 75th anniversary of the landing in Normandy during D-Day. To pay tribute, the guest squadron EC 3/30 *Lorraine* had painted a Rafale with theme of the *Dark Smoking Tiger*, which symbolises operations which unit *Lorraine* performed during that historic day on the Normandy coast on 6 June 1944. That morning, twelve Douglas Bostons belonging to 342 Squadron of the French Free Air Force *(Forces Aériennes Françaises Libres)* which is currently referred to as EC 3/30 *Lorraine* flew to Normandy

French Mirage 2000

The Mirage 'Tiger'

for their historical mission at low altitudes over the beaches of Normandy so as to lay a long and dense smokescreen. This smokescreen was a great success, because it shielded the landing units against German bombing on the beaches. The French flew more than 25 km along the Cotentin coast to the mouth of the Vire River. "*The Dark Smoking Tiger* emerged from darkness of the night and gusted the wind of freedom over France." It symbolised union of the Tiger spirit and mythical legacy of the Free French Forces who entered France as first of the liberation troops. Because of this message and symbolism, it is not surprising that colour scheme of the guest unit was chosen as the best "paint job" during this NATO Tiger Meet.

Traditionally, trophies are awarded every year to the participating units in different categories. The main prize that can be won is the *Silver Tiger,* which was taken home this year by Portuguese from 301 E squadron. The trophy for the best performing unit during the exercises and the trophy for the best painted aircraft were both won by EC 3/30 *Lorraine*. This year, the Tiger Games were won by ECE 1/30 *Côte d'Argent.* The most beautiful uniform was worn by the crew members of the Austrian 1 JTS. Finally, prize for the best skid was won by the French helicopter unit EHRA 3 of the 3 RHC. This exercise provides a golden opportunity to pilots to deepen their knowledge on different aircraft

Portugese F-16

Spanish Hornet

French Gazelle

types. That is why each unit usually brings some two-seaters which allows foreign pilots to fly in each other's aircraft during the missions.

One of the most important objectives of the NATO Tiger Meet is the exchange or transfer of knowledge between different participating countries. Different scenarios are created during preparations which are suitable for both young and experienced pilots. Depending on the scenario, participants take part in both the Allied Air Force *(Blue Air)* and the Aggressor *(Red Air)*. During missions, combat aircraft are equipped with chaff and flare pods and interference equipment to simulate air operations as realistically as possible. In this way, the scenarios come very close to actual operations. The current training location of the NTM in France provided the French Air Force an opportunity to test its new equipment and aircraft.

A typical day

A typical flight day during the NATO *Tiger Meet* is made of two large components : large combined flights often planned in the morning and this is called COMAO *(Composite Air Operations)*. During this several sub missions are flown with every participant having an own mission and role within the complete scenario. This year, theme of the COMAO scenarios emphatically was on the planning of a large-scale international *Entry Force* of more than thirty to forty combat aircraft. An *Entry Force* is that fleet of aircraft and helicopters which penetrate enemy territory at start of a campaign. Well-known examples for such type of missions could be *Operation Desert* Storm in Iraq in 1991 and *Operation Allied Force* in Kosovo in 1999. During the NTM 2019, there was training given on the planning of such types of missions and especially on leading these missions.

Second flight of the day consisted of the basic and advanced flights. During this shadow wave, the participants of the Tiger Meet flew missions that matched their own or the level of their team, missions with or against aircraft of other types. These missions often consisted of In Visual Range battles against other types of combat aircraft than their own types.

Same New Tigers

The NATO Tiger Meet this year witnessed participation of some southwest European countries for the first time. Apart from these new members, the exercise also saw participation from the French squadrons ECE 1/30 with the Rafale and Mirage 2000 and EC 3/30 with the Rafale, the Belgian 31 Squadron with the F-16 Fighting Falcon, the Italian 12° Gruppo with the EF2000 Eurofighter, the Spanish Ala 15 with the EF-18 Hornet, the German TaktLwG-51 with the Tornado IDS and ECR, the Austrian 1 JTS with the Saab 105 and finally, Esquadron 301 from Portugal with the F-16 Fighting Falcon. In addition, a number of EE 3/8 Alpha-Jets were also used in the "aggressor role."

For electronic warfare, a Learjet from the German GFD was used. The entire exercise was guided from the air by two E-3 AWACS from NATO and the French Air Force. In addition to the exercise with combat aircraft, units with helicopters were also active during the NATO Tiger Meet. The participating helicopter units this year were the Italian 21° Gruppo with the HH212, the British No. 230 Squadron with two Pumas, the French EHRA 3 with the Gazelle, the British 814 NAS with the Merlin and finally, 5 RHC with the EC665 Tigre HAP. Overall, more than 1500 personnel were involved in the entire Tiger Meet.

Text: Alex van Noye and Joris van Boven
Photos: Alex van Noye

The Rafale gets going!

The Air Force of El Salvador

Fuerza Aérea de El Salvador (FAS) was formed in 1923 (a decade before the Indian Air Force) as the *Flotilla Aérea Salvadoreña*. The FAS, with much help from the USA, was shortly to be built up as a relatively large and potent air arm whose combat element post Second World War consisted of FG-1D Corsairs and Harvards and later F-51 Mustang fighter bombers and B-26 interdictor bombers.

The jet-age in El Salvador started in the early seventies with the delivery of eighteen MD450 Ouragans and five CM170 *Tzukits* from Israel. The Ouragans (which type also served with the French, Indian and Israeli air forces) were intensively used during the civil war against FMLN guerilla groups between 1980 and 1982. However, the FLMN managed to destroy several Ouragans in counter attacks, necessitating the FAS to acquire new aircraft. The first of 15 Cessna (O)A-37 Dragonfly were delivered from the USA. Currently, the FAS has 14 A-37s in its fleet.

The Air Force today

The *Centro de Educación e Instrucción Militar Aeronáutico (CIMA),* or The Centre for Education and Military Aeronautical Instruction (CIMA) was established on 16 July 1987. Besides the EAM, the CIMA also incorporates the Technical School (*Escuela Técnica de Aviación/ETAM*) and the School of Military Aeronautical Perfection (*Escuela de Perfeccionamiento Aeronáutico Militar/EPAM*).

ENAER T-35A Pillán at Ilopango

IAI202 Pegaso acquired from Israel in 2008, is seen at Ilopango

The EAM uses a single ENAER T-35A Pillán and three ENAER T-35B-3 Pillán for their basic training syllabus. Originally, seven were delivered from the late nineties (2xT-35A and 5xT-35B-3) but three were lost in accidents. The aircraft were to gradually replace the MS893-235GTA *Rallyes* that were in use since 1979, but two of these aircraft are still in the fleet as well as single T-41. Trainee pilots start with 20 hours on simulators before transiting to the Rallye. After 20-30 hours on this type, another 20 hours of simulator time is needed, this time for the T-35, and final training is done on the single Ce337G.

For rotary wing training, the EAM has four Schweitzer TH-300C Halcón helicopters that have been in service since 1986. Helicopter pilots start with 20 hours on a TH-300 simulator before moving to the helicopters themselves. Each pilot must complete a combined 50 hours of training on both simulator and TH-300 before moving to the next level.

After basic training, fixed wing pilots either go to the *Grupo de Transporte* flying the IAI202 and BT-67, or the *Grupo Caza y Bombardeo* flying A-37s. Helicopter pilots move to the *Grupo de Helicopteres* flying a variety of types.

The Bell 412EP has been in service with the FAS since 2001

The *Primera Brigada Aérea,* founded under its current designation in 1994, consists of two units: the *Grupo de Helicopteres* and the *Grupo de Transporte*. The FAS has operated several types of C-47 Dakotas since the sixties and currently two of four delivered have been converted into Basler BT-67s. One of them is in operational storage while the other recently had an incident and is awaiting final checks to re-enter service.

Main tasks of the BT-67s are transportation, support for the Special Forces and drug interdiction missions. For this task, the aircraft is fitted with FLIR and machine guns. For training and liaison duties the *Grupo de Transporte* uses two Ce210s and a single RC114.

O-2 for liaison duties and training

The *Grupo de Helicopteres* has several types. Five Bell 412EPs are used, one for VIP-duties, eight MD500Es and nine UH-1Hs. Besides a single Bell 206 and Bell 407 are used for Government VIP flights. Most of the UH-1Hs are awaiting upgrade to UH-1H-II standard.

'Operations Torogoz and Gavilan' in Timbuktu

Despite the fact that FAS has limited funds and operational capacity, it has had strong participation in peace operations in Mali, under the *United Nations Multidimensional Integrated Stabilization Mission in Mali (MINUSMA)*. Three MD500Es, 13 pilots and 90 other personnel are based at Timbuktu supporting the Quick Reaction Forces operating from there. The operation is called *Torogoz* named after El Salvador's national bird and now in its fourth rotation since 2015: *Torogoz IV*. More recently, the FAS deployed three more MD500s to Mali. In December 2018, it shipped the helicopters to Gao, replacing the four German Tigres that had earlier left in 2018. The deployment, named *Gavilan I,* brings the total of FAS personnel involved in Mali to over 200.

The Grupo de Helicopteres at Ilopango flies eight MD500Es, of which six are currently stationed in Mali for the United Nations Multidimensional Integrated Stabilization Mission in Mali (MINUSMA)

Segunda Brigada Aérea

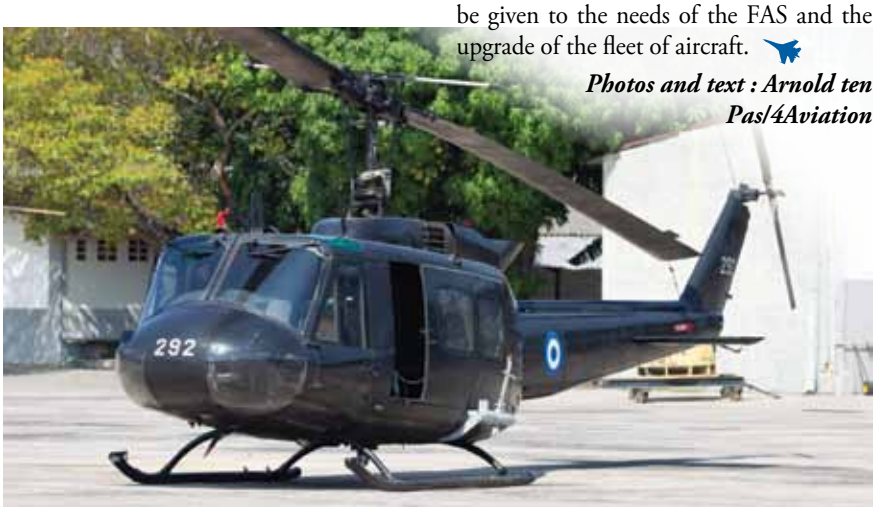
After finishing training at the CIMA, fixed wing pilots selected for the A-37 are transferred to the B.A. de Comalapa, where the *Segunda Brigada Aérea* (Second Flying Brigade) is based. This was formed in 1968, shortly before the '100-hour war'. Generally, new pilots need about 40 hours of conversion on the A-37 before they are fully operational. Besides the A-37, the unit flies six number of O-2s for liaison duties and training.

El Salvador has been flying the (O)A-37 Dragón from 1982, when 15 aircraft where delivered from the United States, while another 10 aircraft were delivered from Chile a couple of years ago.

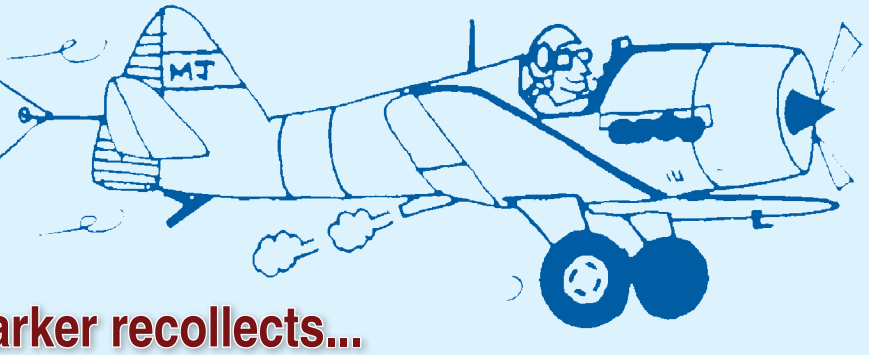
The Future

In September 2016, it was announced that the FAS wanted to upgrade its UH-1H helicopters to UH-1H-II standard but of the current fleet, only one was upgraded and that too was lost in an accident in November 2016. The A-37s are in urgent need of replacement but are still rendering their services as the current government has not found a successor yet. With the newly elected President, hopes are that more attention will be given to the needs of the FAS and the upgrade of the fleet of aircraft.

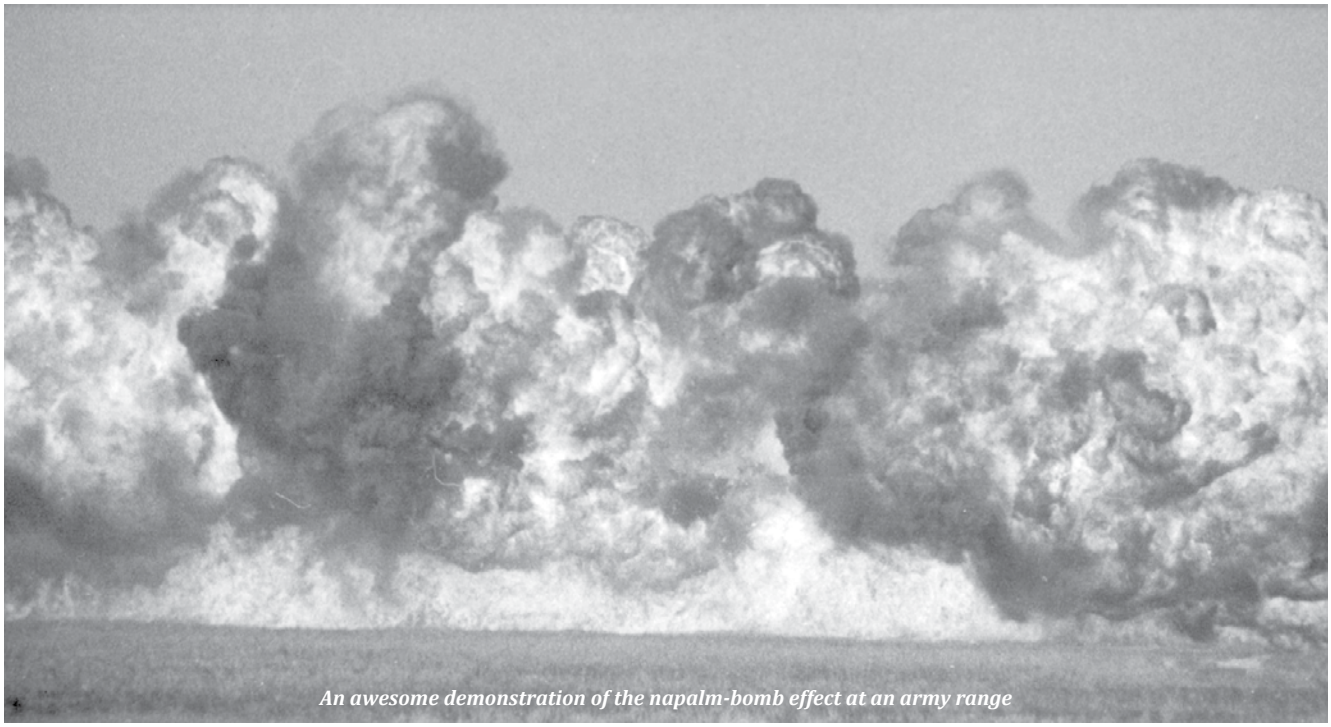
Photos and text : Arnold ten Pas/4Aviation



The UH-1H has been flying for the FAS for many years although only a few remain in service today



Air Vice Marshal Cecil Parker recollects...



An awesome demonstration of the napalm-bomb effect at an army range

ON A WING AND A PRAYER

In the sixties a decision was taken to introduce the napalm bomb into the Indian Air Force armament inventory. The ongoing Vietnam War however gave 'napalm' an ugly connotation, hence in the IAF it was referred to by another name. My squadron, equipped with the famous Hunter, carried out the ground/flight trials and inducted the weapon which was to be carried on the inboard pylons in lieu of the 230 gln fuel tank. Being a visually spectacular sight when dropped low, fast and in formation, we were much in demand for all Fire Power Demonstrations (FPD) thereafter.

On 14 September 1970, I had taken a detachment of eight Hunter Mk. 56A aircraft from our base at Hindan (near Ghaziabad) to Agra to be the grand finale at the FPD at the army range at Babina located a few km south-west of Jhansi. Flying in two sections of four aircraft, each one was to drop a pair of 100 gln FTF containers (inboard pylons) while our normal 100 gln fuel tanks were fitted on the outboard pylons. On the actual day widespread bad weather with low cloud prevented participating aircraft from all other bases from taking off. We were the only formation able to fly VMC low level below cloud and on scheduled TOT (Time over Target) I was able to give our SOP (Standard Operating Procedure) R/T (Radio Tx) call, 'Lightning Drop, Drop NOW'. At that moment, unknown to us, only 15 FTF containers actually hit the ground.

At the time of drop I had felt my right wing pull sharply downward and to my surprise I saw the starboard FTF container still on the inboard pylon. There had never been a case of a 'single' hang-up before. Being a FPD there was no possibility of my returning to try and dislodge the container over the target and from the cockpit there was no way to disarm the weapon or close the electro-mechanical system that operated the release mechanism. In any case, with seven other aircraft formating on me below 8/8 cloud cover at low level, there was little I could do except head for Agra avoiding any built-up area on route. Once in sight of Agra, I handed over lead to my deputy, explained the problem to the ATC (Air Traffic Control) and decided to land

last. However, Agra had other ideas; ATC informed me that they were 'not equipped' to handle an aircraft with a single live napalm hang-up and since I had the fuel, I should divert to my parent base at Hindan. Meanwhile with all the other seven aircraft (including my wingman) having landed safely, I was free to concentrate on my predicament but I must confess to having felt somewhat lonely.

Hindan ATC promptly asked me to 'hold' over Tilpat Range (close to Delhi) which was inactive that day. For the next few minutes I tried everything I knew (and much that I didn't) to try and dislodge the bomb over Tilpat. Despite use of the inboard jettison switch and all combinations/permutations of IAS (speed), 'G', configuration and attitude, the bomb continued to hang there on 'a wing and a prayer'. Meanwhile Hindan, which had only a single Runway and was a diversionary airfield for other aircraft, was reluctant to accept this 'lone live bomber' and some very high level 'lightning' calls must have been exchanged between HQ WAC, IAF (Western Air Command), Air Headquarters and the DGCA (Director General of Civil Aviation). Having emptied my two outboard tanks and down to 'Bingo' I was now running low on fuel. I was not merely lonely but beginning to feel also positively unwanted!

The new international 10/28 R/W at Delhi airport (Palam) had just been constructed but had neither been handed/ taken over or been commissioned. I was finally given the choice of bringing the jet down on this R/W away from any built up area or ejecting over Tilpat range; the decision was left to me. Being already a member of the caterpillar club, I contemplated the possibility of fresh membership in the Martin Baker Club! In the landing configuration down to 150 kts, the aircraft was askew (skidding) but still flyable with controls in 'power' hence I decided not to jettison the empty outboard fuel tanks. I only hoped that no sudden hydraulic failure would put my controls into 'manual' in which case the jet would no longer be controllable and I would have to eject. Keeping this option in mind I chose to make a 'high' approach for R/W 28; besides, if I was destined to terminate in a 'ball of fire' at least it would be away from the terminal buildings and other structures. At one stage I even toyed with the idea of a 'hard' touch-and- go' but the unknown hazards of an asymmetric roller take-off were even more daunting than a three-tank landing!

IAF Hunters in formation

With the nose off-set, as in a severe crosswind approach, and the control column well into my left thigh I managed the smoothest touch down in my life while anxiously watching for the drop of the FTF container, being also mentally prepared to try and accelerate away from the expected ' blazing inferno'. It however continued to hang there tenaciously while I used the entire 10,000 feet of R/W to VERY VERY gently bring the aircraft to a stop. In the far distance I could see an IAF 'reception committee' which no doubt included some anxious 'brass' and (I suspect) some disappointed photographers! Since the onlookers kept their distance, I began to feel not merely lonely and unwanted but abandoned too!

After switching off the engine and making the seat safe I jumped out in time to see a heptr touch down. I was more than delighted to observe our squadron 'spanner' and technical airmen from the unit disembark and race towards me. Once the bomb trolley was placed under the rogue napalm, the 'reception committee' arrived in time to see a hard tap on the side of the pylon release the container onto the cradle where it was disarmed. Amazingly the holding claw was in the open position! The subsequent C of I found no technical malfunction and had to deduce that this half-ton FTF container had continued to remain suspended due to 'friction and air pressure' despite the bomb-release/ jettison button having operated the electro-mechanical release mechanism correctly. After refuelling I flew the aircraft back to Hindan where, reunited with my squadron lads in the bar, we thrashed out several theories as to how and why this unexpected incident did not graduate to an accident. Later that night the AOC-in-C WAC IAF rang me to compliment the squadron on a superb napalm drop at the FPD, but surprisingly made no mention of the IAF's first (and only) ' external asymmetric-load landing of a Hunter'!

Early next morning Air Marshal Minoo Engineer, AOC-in-C WAC IAF arrived at my squadron to give me a personal shabaash. After listening to 'Witness No 1's version, he opened his brief case and extracted an 'imported' bottle the contents of which (he assured me) would cure any feelings of ever being lonely, unwanted or abandoned!

(Published in 1998 and updated in May 2019).

25 Years Back

From Vayu Aerospace Review Issue IV/1994

Continuing Russian arms for India

Russia has reiterated that it would not ignore its "traditional" arms market in India, stating that it was in Moscow's interest to retain the level of defence cooperation achieved with New Delhi over the years. Yuri Yarov, Russian Deputy Prime Minister and co-chairman of the Indo-Russian Joint Commission, said India would continue to acquire Russian arms. 'We have reached an agreement in principle on this issue" and categorically said that as a policy, Moscow would supply arms to India.

Confirming this, the Indian Prime Minister, Mr PV Narasimha Rao, has said that India and Russia would work together to overcome disruptions in the supply of defence spares and that they had agreed on several measures to remove the 'bottlenecks" in bilateral trade. India and Russia would also cooperate in upgrading the IAF's MiG-21 fighters, some 170 of them, and the upgradation programme is expected to make them "combat worthy", well into the next century.

Tatas and SIA to establish new Airline

A reflection on the size of the proposed Tata-Singapore Airlines (SIA) tie-up in India is the initial capitalisation of between Rs 450 crore and Rs 900 crore. Views of the SIA corporate director, Mathew Samuels indicate that the joint venture envisages a 50:50 stake for Tata Industries and SIA. In early July 1994 SIA announced an interest in setting up a private airline in India with Tata Industries, by end 1995.

International airport at Bangalore

The Civil Aviation Ministry has agreed to the establishment of a new airport of International standards at Bangalore with private sector participation on the "build, own and operate" basis. This followed a meeting between the Railway Minister, CK Jaffer Sharief and the Civil Avaition Minister, Ghulam Nabi Azad in New Delhi.

Nine ATOs seek scheduled status

Nine privately owned startup domestic airlines in India have applied to the Directotrate General of Civil Aviation for licenses to operate as scheduled airlines. Applications had been submitted by Archana Airways. Choice Air, Damania Airways, East West Airlines, Jet Airways, Modiluft, NEPC Airlines, Rajair and Sahara India Airlines. Another eight so-called air-taxi operators did not apply, possibly because of the tough criteria that must be met to qualify for scheduled airline status.

IAF Chief visits Russia

Air Chief Marshal SK Kaul accompanied by Air Marshal SR Deshpande, the Deputy Chief, visited Russia on an official six-day visit from 24 July 1994. Gen Victor Samoilov confirmed that Air Marshal Kaul had discussed the possibility of buying more MiG-29 and new Su-30 fighters. He said the Indian Air Chief had personally flown a Su-30 at an airbase near Moscow and "was pleased" with its performance. Speaking to reporters at the end of Air Marshal SK Kaul's visit to Russia, Gen Samoilov said the Indian air chief's talks in Moscow concentrated on product support and modernisation of Russian combat aircraft sold to India or manufactured locally under Russian licence.

Singapore orders 18 F-16s

Singapore has ordered 18 Lockheed F-16C/Ds for delivery between March and November 1998. The F-16 was selected over the McDonnell Douglas F-18C/D because it is "…the most cost-effective aircraft for our defence and security needs" according to the Singapore Defence Ministry. The 18 F-16s (eight single-seat F-16Cs and ten two seat F-16Ds) will be to the latest Block 50D/52D production standard, which includes an uprated engine, improved radar, enhanced cockpit displays and increased weapons capability.

UAE order more Mirage 2000s

Dassault is close to a deal to sell 12 Mirage 2000-5 fighters to the United Arab Emirates (UAE). The move follows an agreement by the UAE to sell 13 older Mirage F1s to Spain. The UAE operates Mirage 2000s in the interception and reconnaissance roles, the two squadrons in Abu Dhabi colours, reportrdly mostly flown by seconded PAF aircew.

Jordan seeks F-16s

Jordan has requested the supply of Lockheed F-16 fighters as a "sop" for its participation in the Middle East peace processes. The Royal Jordanian Air Force is presently operating 33 Mirage F.1C/Es and 70 F-5E/Fs and attempts to acquire aircraft such as the Dassault Mirage 2000 and Panavia Tornado have been undermined by lack of funds.

Vayu's 20th anniversary

Marking completion of the 20th year of its publication, the November-December 1994 issue will be a very special one. Lavishly illustrated and in full-colour, the journal will have some fifty per cent more pages and will include exclusive articles on current and project aerospace activities in the vibrant sub-continent of South Asia. *The Vayu Aerospace Review* has long been regarded as the most authoritative of aerospace journals in India and is received by those in the professions as also Government and industry – the "Policy makers and Decision Takers" !

Tale Spin

Bael Gadi to the Moon

Images from the internet

As India (and much of the world) exult in launch of the *Chandrayan II* (India's second lunar exploration mission), it is hard to envisage that four decades back ISRO had begun space exploration very modestly (and very Indian-like) indeed. While the *Chandrayan II* continues on its way to the moon, twitter also went into space with images of how it all began, with a bullock cart transporting India's first communication satellite APPLE to the launch site in 1981.

Indians (with bullocks) on Mars next ?

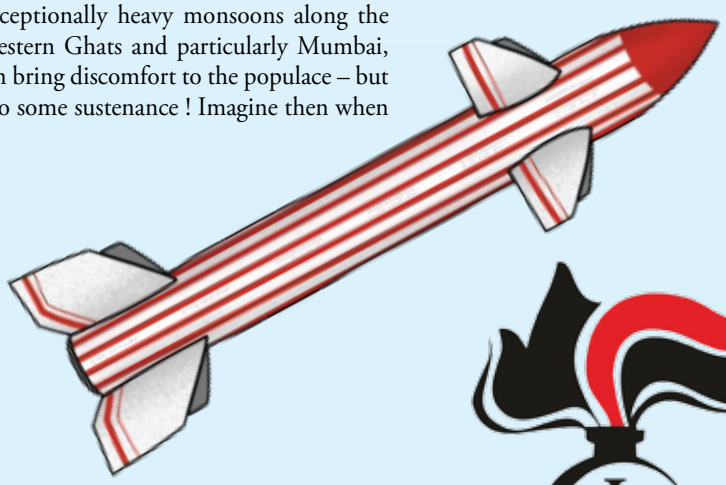
Raining cats (fish)

Exceptionally heavy monsoons along the Western Ghats and particularly Mumbai, can bring discomfort to the populace – but also some sustenance ! Imagine then when it did not rain cats and dogs at Juhu airport near Santa Cruz – but this time, catfish ! The runway at this busy heliport teemed with aquatic life on this day in early July, and fishermen had to be called in to collect the slithering intruders, some being three feet long.

Fishermen's haven !

AAM in the barn

You've got to be kidding ! Police investigating extremist groups in northern Italy discovered an air-to-air, beyond visual range missile apart from automatic assault rifles and rocket launchers. This Super 530D missile, in perfect working condition, was hidden in a barn, without explosive charge but "re-armable by people specialised in this field", said the astonished police. But surely the BVR missile needs a launch aircraft too?



Keep looking, brave Carabinieri !

Aliens are like 'pasta' ?

Ugh, enough to put one off from ever eating 'Italian' again. There is this study by researchers from the university of Illinois at Urbana-Champaign, which indicates that life on Mars is likely to resemble fettuccine – flat, ribbon like pasta. In this study, the team collected Sulfuri cables from Mammoth Hot Springs in Yellowstone National Park and hilariously, actually used pasta forks to collect the required samples !

Surely, they are also vegetarian ?

Afterburner

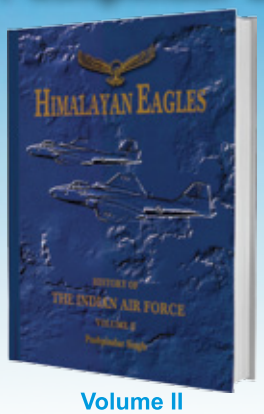
THE IAF's HISTORY ENSHRINED

HIMALAYAN EAGLES

by Pushpindar Singh

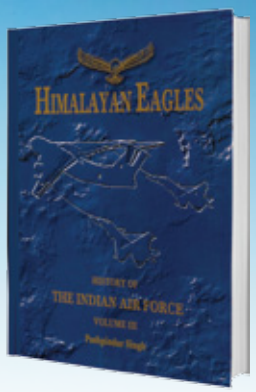
Volume I

Foundation



Volume II

Consolidation and Expansion



Volume III

World Air Power

IAF Squadron Histories

by Pushpindar Singh

- Tigers in the Sky
- Tusker Charge
- Dragon Fire
- The Battle Axes
- The Fighting Fourteen
- When Lightnings Strike
- First Supersonics
- Black Archers
- Valiant to the Last

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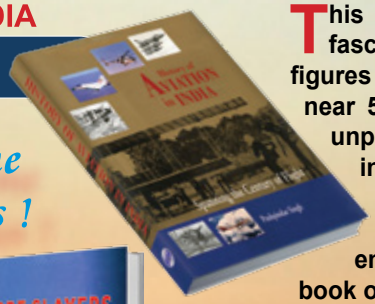
HISTORY OF AVIATION IN INDIA

Spanning the Century of Flight
by Pushpindar Singh



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