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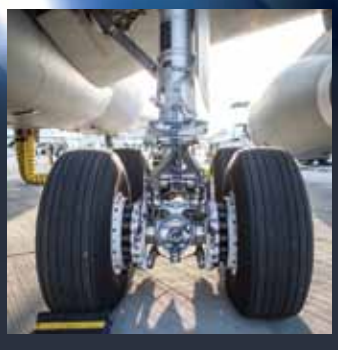

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Cover : A Limited Series Production (LSP) Tejas LCA pulls out of a loop during an air display at Aero India 2017 (photo: Angad Singh)

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COMMENTARY

Reforming India's Defence Establishment

Let's not worry too much about Nirmala Sitharaman's lacking in experience to be the defence minister. For all their experience AK Antony and Manohar Parrikar were failures. In our system, no minister is expected to have expert knowledge of the subject he/she is allotted. A good minister is someone who sets goals, takes decisions, has sound judgment, listens, learns from experience, and has authority within the government.

Sitharaman shone as a BJP spokesperson, is an articulate, hard working and dogged person. However, she is a political lightweight and her authority stems from the trust of Prime Minister Narendra Modi. And these qualities will not be enough in dealing with the major portfolio she has been entrusted with in the recent Cabinet reshuffle. As a commerce minister, Sitharaman's task was to supervise well-established policies of a ministry that ran reasonably well. Outcomes in trade policy, FDI etc were not within the control of the minister or the government of India anyway; external factors played a key role. But as defence minister, Sitharaman's task is larger. Not only does she have to run a ministry, which deals with more than a million people and whose budget is nearly Rs 360,000 crore, but to run it well, she needs to carry out deep reforms and restructuring of the ministry.

The Indian ministry of defence (MOD) is obsolete, its public sector units and ordnance factories dysfunctional, it runs a military whose organisation is outdated. Worse is the barely concealed hostility between the civilians who run it and the military personnel who have to implement its policies without having an effective role in formulating them. The agenda for reform is vast and has been outlined by several committees since 1990. Unfortunately, it has been subverted by the bureaucracy. Sadly, as Antony and Parrikar showed, the political heads of the ministry, responsible to the Cabinet Committee on Security, have failed in their job to discipline them. The Group of Ministers of the BJP-led NDA-I government recommended a range of measures to integrate the civilian and military parts of the MoD. The babus simply changed the nomenclature and declared that the decision had been implemented. So, today, the head quarter of the Indian Army is the Integrated Headquarters of the Ministry of Defence (Army). As for their main recommendation, seconded in 2012 by the Naresh Chandra Committee, to appoint a Chief of Defence Staff (CDS), it has got lost.

The generalist bureaucracy lacks the expertise to advise the government, so they spend their time in preventing those who can, the uniformed military from doing so. Only if the problem of the inexpert bureaucracy is fixed can we move to the stage of reforming the ministry and restructuring the armed forces. Efforts to do so otherwise are doomed. India has been trying to reform the MOD since the constitution of the Arun Singh Committee in 1990. This has been through two key reforms – the integration of the civil and military components of the MOD and the appointment of a CDS — which would, in turn unlock a whole slew of reforms including the creation of theatre commands.

Sitharaman's initial remarks suggest that she, like Parrikar, will be more focused on acquisitions and will seek to promote Indian manufacture of weapons systems. This is all for the good, but it cannot be achieved overnight. Also it requires systematic and deep reform in the way defence planning, acquisitions, R&D and manufacturing are linked. Fixing manufacturing and acquisitions alone will not work. She needs to urgently tackle the need to reorganise India's sprawling military to make them an effective fighting unit for 21st century warfare, where challenges range from nuclear armed adversaries to proxy jihadis. This means shedding flab, integrating commands, getting them to work as a single unit with the civilians and so on.

She will confront a wall of vested interests who do not want any reform because, like all bureaucratic organisations, they are afraid they will lose out on change. It is the task of the political boss to knock their heads and change things. Sitharaman needs to first understand the nature of the challenge, get the support of her boss and push the reforms throught irrespective of who is on board or not in her ministry.

Manoj Joshi in Hindustan Times

Bold moves in the MoD

If the much-anticipated reshuffle of the Union council of ministers did not quite shake the earth, it did not lack drama either. The elevation of Nirmala Sitharaman to the Cabinet as the defence minister is remarkable. For the first time, two women will sit on India's Cabinet committee on security. This is a big step for not just Sitharaman but for women in general. The BJP's sense of political control finds reflection in the dismissive ease with which the reshuffle has left the BJP's allies out. The latest ally, JD(U), has effectively been told to expect forbearance in one state rather than indulgent hospitality across the land.

Some non-performers have been sent packing from the council of ministers, but we would be hard put to say all. While political calculations are clearly visible in bringing in ministers from Karnataka, Madhya Pradesh, Kerala and Bihar, the message underlying the induction of four former civil servants — two former IAS officers, one former diplomat and a former policeman — is twofold: it encourages ambitious bureaucrats to cultivate their political masters and tells political activists who aspire to rise up the ranks that there are more ways to the upper echelons of political power than the royal road of hard work among the people.

The allocation of portfolios is such that competent people man the important ministries. However, synergy of the kind that was expected by bringing related ministries under the same minister, such as power and coal under Piyush Goyal in the past, has been given the go-by. What is common between petroleum and skill development? The only sensible assumption is that these seeming irrational combinations would be undone in yet another reshuffle sooner rather than later.

The new council of ministers begins its work with lots on its platter: revive economic momentum and build foreign partnerships in a world where the strongest power has turned fickle and the foremost rising power patronises, one, a dictator who claims to have a hydrogen bomb and no qualms about using it, and, two, a nation that describes India as the enemy.

From The Economic Times

The light fighter : a case study of dysfunctional procurement

Among many other things, the new Defence Minister, Nirmala Sitharaman, would do well to study the long-running procurement of a single-engine, light fighter for the Indian Air Force (IAF) to understand how dysfunctional procurement hamstrings the military. Friday's


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announcement by Swedish company, Saab, and the Adani Group to build the Gripen E single-engine fighter in India; which followed a similar tie-up in June between US major, Lockheed Martin, and Tata Advanced Systems Ltd to build the F-16 Block 70 fighter and has brought the wheel full circle from 1999 when the IAF demanded 126 combat aircraft to replace its fleet of MiG-21 and MiG-27 light fighters. It was originally hoped that the Tejas light combat aircraft would replace the MiGs. However, it was nowhere in sight during the Kargil conflict (1999). So the IAF decided to supplement its three-squadron fleet of Mirage 2000 multi-role fighters, which had performed well during Kargil. French vendor, Dassault, proposed shifting the Mirage 2000 production line to India. The idea was that if, after building the IAF's immediate requirement of 126 fighters, the Tejas was not yet available, it would be easy to build more Mirage 2000-5s.

But in 2002, burnt by the *Tehelka* sting, the government shied away from single-vendor procurement and ordered a global tender. Washington, driving for a closer relationship with India, cleared the F-16 for sale to New Delhi, the Russians offered their new MiG-29M and Saab of Sweden jumped in with its Gripen light fighter. With the simple Mirage 2000-5 solution scuppered, the IAF took two years to issue a Request for Information (RFI) to these four fighter vendors in 2004. Three years later, when the IAF issued its tender, the original plan to build an affordable, single-engine, light fighter was officially dead. Boeing had joined the fray with an offer for its F/A-18E/F Super Hornet, and the Eurofighter GmbH consortium had offered the Typhoon, both heavy fighters. Dassault, furious at losing out on an assured order and having to compete in a global procurement, dropped its offer of the Mirage 2000-5 and fielded the Rafale instead. This was now the "medium multirole combat aircraft" (MMRCA) contest between a smorgasbord of dissimilar fighters – heavy, twin-engine fighters competing with medium, single-engine ones.

Predictably, the IAF did what air forces do and finally picked the Rafale – the most expensive heavy fighter in the fray. With a price tag that neither the United Progressive Alliance nor the National Democratic Alliance was willing to pay, the government has bought 36 Rafales for a mind-boggling Euro 7.87 billion. That is one-and-a-half times what was budgeted for 126 MMRCA. And the IAF, down to just 33 squadrons against the 42 needed to handle a China-Pakistan collusive threat, has gone back to the start line. Thankfully, the new RFI specifies a single-engine fighter that must be built in India by the private sector. But now there are fresh questions. Will there be space for the Tejas, which is now close to completion? And can novice aerospace companies like TASL and the Adanis graduate straight to assembling complex fighters?

Ajai Shukla in the *Business Standard*

More bang per bloke

Decidedly welcome and long overdue is the government's going ahead with the most significant re-jig of the Army since Independence. It will take some two years to "feel" the full effect of the implementation of 65 of the 99 "accepted" recommendations of the committee headed by Lt Gen DB Shekatkar. Hopefully the outcome will be more realistic, cost-effective manpower-related expenditure. That would translate into more funds being available for weapons and equipment. The exercise will subsequently be extended to the Air Force, Navy and certain inter-services organisations. Yet another 99 recommendations, generally pertaining to allied entities, are also due for consideration.

For some decades now military experts had pointed to manpower reform being critical to bridging the unmanageable gap between expenditure under the revenue and capital heads. That eventually the government has mustered the guts to "bite the bullet" must be hailed as the NDA government's most significant contribution to boosting the national security exercise. Over the next two years some 57,000 Army personnel will be redeployed, archaic organisations like military farms scrapped and the Army Postal Service will be trimmed in urban areas. Such organisations were set up in the colonial era when civil services were non-existent: for example milk production before the "white revolution".

There would be quite a few other support services that could be secured from the civil sector, the days of the forces having their in-house systems are long over. It is however critical, as the Shekatkar panel has itself stressed, that the reforms be carried out in a comprehensive manner. Any tinkering or piecemeal action would be counter-productive.

From The Statesman

MIAF Arjan Singh DFC

Arjan Singh, Marshal of the Indian Air Force, who has passed away was much more than a soldier. His elevation as the first Sikh to head the Air Force was a profound statement in itself, reflective of the easy confidence of the emerging Indian state as also a robust reaffirmation of the Indian armed forces as the most secular institution in the Republic. It need be recalled that it was the time when the post-Nehru India was still trying to recover its pace and rhythm. Soon after his appointment as the Air Chief, the young Indian State found itself sucked into an unwanted and unnecessary war with Pakistan. Arjan Singh's calm and competent stewardship of the Air Force not only put paid to Ayub Khan's gross miscalculations, he and the men under his command helped the nation recover from the humiliation of the 1962 war.

Personal bravery as a pilot, leading his men from the front, understanding and negotiating the needs of higher command, building a rapport with the bureaucrats and political leaders, gaining their trust, inducing in them a confidence, all came together when he led the Air Force in the 1965 war. He was leadership — inspiring, daring and dazzling — personified. Air Chief Arjan Singh's brilliant stewardship raised the bar for military leadership in the 1971 conflict.

After retiring at 50, Arjan Singh changed into a fine public servant. He served as the Lt Governor of Delhi, as also a diplomat. He transformed himself into a concerned citizen and became a wise elder, whose advice and wisdom were sought by successive governments. Till his very last he remained a watchful observer of the ex-servicemen's interests. That he would sell his personal property to fund a Trust for Air Force ex-servicemen was a natural step in a life anchored in personal probity and commitment to public welfare. While the nation mourns the loss of this outstanding son of Punjab, a great soldier and a patriot extraordinary, the story of his life would continue to be an inspiration for our nation in times of confusion and conflict. RIP MIAF Arjan Singh DFC!

From The Tribune

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Admiral Arun Prakash on the need for urgent national security reforms

A "security dilemma" in international relations represents a situation in which accretion of power – military and economic – by a state generates fear amongst its rivals, leading to tensions, a possible arms race and the possibility of conflict. India's acquisition of power is based on its nuclear arsenal, a modern but under-equipped military with 1.5 million personnel under arms and a defence expenditure of $60 billion. And yet, far from striking fear, India often fails to evoke respect in its Asian neighbourhood.

The Economist weekly, in a 2013 article titled "Can India Become a Great Power", seemed to put its finger on the reason: "India has the world's 4th largest military," it said, "and yet its political class shows little sign of knowing or caring how the country's military clout should be deployed." Warning India against "an unstable but dangerous Pakistan and a swaggering and intimidating China", it observed: "The absence of a strategic culture and the distrust between civilian-run ministries and the armed forces has undermined military effectiveness."

Such remarks are generally dismissed in New Delhi, as being rooted in Western biases against India. In this case, however, the British journal was only reiterating what Indian defence commentators have been saying for decades. India's deteriorating neighbourhood situation requires us to

reflect on "cause and effect" relationships. How, for example, has a smaller and weaker Pakistan sustained a war on India for three decades by infiltrating armed fighters across our borders to wreak death and destruction with impunity? How does Pakistan keep the pot boiling in the Kashmir Valley, almost at will, without fear of repercussions?

In the case of China, despite our diplomats rejoicing over a series of bilateral agreements, protocols and confidence-building measures signed between 1993 and 2013, what emboldens China's People's Liberation Army to offer provocation and offence at will, through repeated violations of the Line of Actual Control? In the Doklam stand-off, what made Chinese officials as well as the media indulge in boorish invective in an attempt to intimidate India?

In international relations, as in the jungle, even the perception of weakness can provoke base and predatory instincts of unscrupulous rivals. Has India, notwithstanding its nuclear arsenal, military muscle and economic and demographic strengths, conveyed an impression to its adversaries of a weak, diffident and irresolute nation? And has it, thereby, tempted them into bellicose adventurism and brinksmanship? If so, this is the fall-out of sustained political indifference that has eroded the credibility of our national security posture. Of numerous areas of neglect, I cite just three.

One, the top-ranking officer in India's higher defence organisation is the Chairman, Chiefs of Staff Committee, who is also a key functionary in the nuclear command chain. Currently, this is a part-time post, tenanted by one of the three Service Chiefs in rotation, with short, random tenures. Experience has proved this to be an absurd and ineffective model, which impacts on the credibility of our deterrent posture. Successive governments have clung to this system, ignoring repeated recommendations that either this post be made permanent or be replaced by a Chief of Defence Staff.

Two, the US manages its forces worldwide through six joint military commands, while China reorganised its forces in 2014 into five geographic commands, each with integrated army, navy and air force components.

The Indian military, however, remains in a World War II time-warp, and is organised into 19 unwieldy commands, of which only two are joint and 17 single service, with no two HQs in the same location. Again, India's failure to implement reforms and integrate the three services means that our soldiers will be denied the synergy and combat effectiveness that jointness has brought to every modern military. A recent report of the Comptroller and Auditor General pinpointing material shortages of imported hardware and ordnance highlights the multiple challenges that our military face.

The last issue that detracts from the credibility of India's security edifice is the civil-military dissonance and bureaucratic functioning of South Block that has stalled military modernisation. The roots of this discord lie in the fact that the 100 per cent civilian Ministry of Defence (MoD) and the service HQs work in separate compartments and no government has mustered the will to buck the bureaucracy and integrate them.

Each of these shortcomings is a 'self-goal' by the Indian state. In 2001, a Group of Ministers of the then National Democratic Alliance government had recommended a comprehensive revamp of the national security structure. A decade later, the United Progressive Alliance government received a similar set of recommendations from a committee convened by the cabinet. The first was implemented superficially and the second vanished without trace in the bureaucratic maw. Even while Indian Parliament has rarely lifted a finger in the cause of national security, China's military and the Pakistani deep state keenly observe the Indian scene and are taking full advantage of our egregious neglect.

The onus for the nation's security rests squarely on the Prime Minister, who must ensure that responsibility for defence is assigned to a full-time Defence Minister and not the MoD bureaucracy, as is the default practice. By lifting the current embargo on meeting his service chiefs, the Prime Minister can set the tone for better civil-military relations and avail of first-hand, authentic military advice and consultation.

Such are the demands of party politics and election campaigning that even the best of *Raksha Mantris* (Defence Ministers) have been overwhelmed by their political obligations. A credible national security organisation demands a 24x7 Minister, unburdened by demands of electoral politics. Even if a political lightweight, it is far more important that the RM finds the time and the mental capacity to remedy neglected long-term security planning and strategy. *[Ms. Nirmala Sitharaman has just been appointed as Defence Minister in the Cabinet re-shuffle of 3 September 2017]*

Both the Kashmir and Doklam crises are putting India's defence preparedness and resolve to severe test, especially in the absence of a full-time Defence Minister. There is no question that we must stand firm while working towards a modus vivendi on both fronts. However, it is time we stopped tempting fate and, late though it is, initiated national security reforms with urgency.

Defence Deals may repair India-Russia Ties

A $10.5 billion arms and equipment deal helped to arrest the recent drift in the 'special and privileged' strategic partnership, observes Brigadier Gurmeet Kanwal

Defence Ministers Arun Jaitley (then) and General Sergey Shoigu jointly chaired the 17th meeting of the India-Russia Inter-governmental Commission on Military-technical Cooperation on 21-23 June 2017, in Moscow. The two sides agreed on a roadmap and signed a protocol to take defence cooperation to a higher level through the joint development of future weapons systems and military equipment, enhanced joint training and the exchange of visits.

According to news reports, India will acquire arms and equipment worth $10.5 billion (Rs 67,604 crore) from Russia including five S-400 Triumf advanced air defence missile systems, four *Admiral Grigorivich*-class frigates

India will procure four Project 11356R/M (Admiral Grigorovich-class) frigates from Russia

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(*see Vayu IV/2017*) and 200 Kamov Ka-226T light helicopters. Russia will also lease another nuclear-powered attack submarine to India after INS *Chakra*. Jaitley also invited Russian companies to participate in defence manufacture in India as part of the government's 'Make in India' policy.

The meeting helped to arrest the recent drift in the relationship that has been described as a 'special and privileged' strategic partnership since 2000. India's new policy to diversify its sources of defence procurement, especially its reliance on Western weapons platforms, despite their greater cost, had not been received well in Russia and the relationship had tended to deteriorate into a transactional rather than a strategic one.

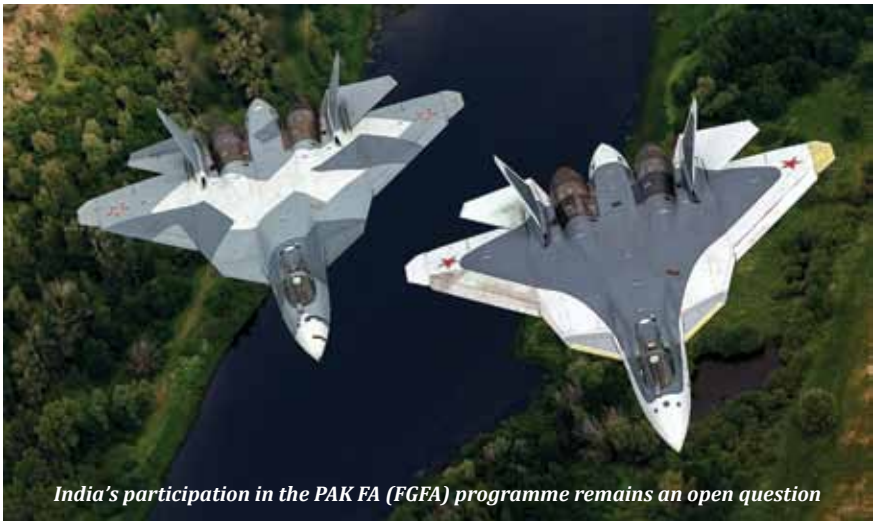
The special relationship with Russia goes back to the time India got its Independence. The erstwhile Soviet Union and its successor State Russia have stood by India on Jammu and Kashmir over several difficult decades. The Russians have vetoed one-sided UN Security Council resolutions on this issue many times.

The Indo-Soviet treaty of 'peace, friendship and cooperation', signed before the 1971 War with Pakistan, stood India in good stead. Though the agreement was not a military alliance, India was perceived by the United States and its Western allies to have joined the Soviet camp. The 1971 agreement signalled the de facto end of non-alignment, which John Foster Dulles, the US Secretary of State (1953 to 1959), had called 'immoral'.

As part of its foreign policy, India in turn did not lag behind in supporting Soviet or Russian positions. But now, an era of 'Cold Peace' appears to have dawned over Eastern Europe and Putin's Russia has begun to gradually drift towards China and its ally Pakistan.

However, this is a relationship on the rebound and may not amount to much in the long run. Owing to Russia's apprehension about China's military assertiveness, the China-Russia strategic partnership is unlikely to gather momentum despite the US 'pivot' or strategy of re-balancing to the Indo-Pacific and the growing India-US strategic partnership.

Without doubt India's acquisition of weapons and defence equipment from Russia has been the most enduring part of the India-Russia strategic partnership. Almost 70 per cent of India's defence acquisitions are still sourced from abroad, mainly from Russia, which had provided several high-tech weapons platforms to India when India was still subject to technology denial regimes. Civil nuclear cooperation between the two countries has a long history. Russia gave India nuclear submarines on lease and has also provided assistance for the development of ISRO's cryogenic rocket engine.



India's participation in the PAK FA (FGFA) programme remains an open question

State-of-the-art combat aircraft, including the MiG-25 strategic reconnaissance aircraft, were sold to India. The two countries cooperated on the Russian GPS satellite system called GLONASS. The Russians had offered India the S-300/S-300V BMD system as far back as the mid-1990s.

During the December 2014 summit meeting between Prime Minister Narendra Modi and President Vladimir Putin, Russia agreed to supply 12 nuclear power reactors over the next 20 years. Russia also supports India's quest for membership of the Nuclear Suppliers Group and related international bodies.

The Soviet Union sold over many decades high-tech weapons and defence equipment to India at 'friendship prices' and even on the basis of barter trade, as India did not have sufficient foreign exchange reserves. However, military-technical cooperation remained a buyer-seller, patron-client relationship.

While fighter aircraft and main battle tanks were manufactured under licence in India, no transfer of technology ever took place and India's defence technology base remained low. The co-production of the BrahMos supersonic cruise missile is the only example of a successful joint venture.

However, Russia's defence production has declined by almost 90 per cent in five years following collapse of the Soviet Union, which had an adverse impact on India's defence procurement. India found it difficult to obtain spare parts, get its equipment overhauled and seek upgrades. There were unacceptable time and cost overruns in executing pending orders, the five-year delay and three-fold cost escalation in the acquisition of the aircraft carrier INS *Vikramaditya* (formerly *Admiral Gorshkov*) being a major example.

These challenges are now gradually being overcome, but the Russian defence industry has fallen behind the West in the development of cutting edge weapons technologies. A new concern is about the techno-commercial feasibility of the joint development and production of the fifth generation fighter aircraft tentatively called PAK FA or PMF and more recently given the formal Russian designation Sukhoi Su-57.

The Indian perspective for future defence technology cooperation will be shaped by PM Modi's drive to 'Make in India' with ToT. Russian OEMs will need to demonstrate their competitiveness and enter into strategic partnerships by way of joint ventures with Indian public and private sector companies to bid for future contracts in keeping with the Defence Procurement Procedure 2016.

If they are nimble enough to rival the western multinationals, India-Russia military-technical co-operation would still have a bounce back.

Brigadier Gurmeet Kanwal (retd)

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Nirmala Sitharaman is new Defence Minister of India

Nirmala Sitharaman is India's new Defence Minister, taking charge of her portfolio on 7 September 2017. In her first official statement as Defence Minister, she said her priorities were military preparedness, 'Make in India' and the welfare of soldiers and their families. "My priority will definitely be the armed forces preparedness. It is important that the Indian armed forces receive the attention in terms of giving them every endowment and equipment necessary for them to perform their duty with the best of equipment available," she said after assuming charge.

She took over as cabinet minister for defence from finance minister Arun Jaitley who was holding additional charge since March 2017 after his predecessor Manohar Parrikar took over as CM of Goa. "I shall attend to all the long pending issues and in consultation and the Prime Minister and the Cabinet Committee on Security (CCS) ensure that those pending issues are resolved," Ms. Sitharaman stated.

Nirmala Sitharaman was earlier Minister of State for Commerce and Industry with independent charge. As a Rajya Sabha member, she represents Karnataka in Parliament, had joined the BJP in 2006 and was enlisted as one of the party spokespersons in March 2010. Hailing from Musiri, Tiruchirappalli district in Tamil Nadu, her father was with the Indian Railways and outside the political sphere, Sitharaman has worked with the Agricultural Engineers Association in the UK and also served briefly with the BBC World Service.

New Defence Minister fast tracks projects

On assuming charge, the new Defence Minister has initiated stringent policies to hasten key defence procurement matters. The Defence Acquisition Council (DAC) will now meet every two weeks to clear projects that are in the pipeline. "Special emphasis was laid by the Minister on the need to step up the pace of acquisition proposals. Towards ensuring time bound and speedy disposal, it has been decided to hold DAC meetings on a fortnightly basis," according to a Defence Ministry statement. The Defence Minister has reportedly begun daily meetings with the three service chiefs even as India's armed forces are currently challenged by shortage of armoured vehicles, multi-role fighters, submarines, warships and, critically, ammunition. Nirmala Sitharaman is "looking for valuable inputs from the Service Chiefs prioritising the requirement," and the daily morning meetings with the three Service Chiefs and separately

with the Defence Secretary have been formatted as a new practice for quick decision making.

As per observers, major procurement programmes that are to be prioritised during Sitharaman›s tenure include selection of single-engine fighters for the air force, carrier-borne fighters for the navy, new submarines (Project P75I), howitzers, as also procurement of various air defence missiles including S-400 missile defence systems. A decision is also due on the next generation fighter which concerns the indigenous AMCA as also possible co-production of fifth generation fighter aircraft with Russia. On 11 September, Defence Minister Nirmala Sitharaman reportedly met with Chief of the Air Force Birender Singh Dhanoa and reviewed present status of the IAF. Interestingly, the first operational Air Force Station she visited was Uttarlai where a MiG-21 Bison Squadron is based *(see photo above)*.

Saab and Adani sign Joint Venture agreement

As has been expected for some time, Swedish company Saab formally announced its joint venture with the Adani Group to manufacture the Gripen E fighters in India under the Defence Ministry's $10 billion single-engine fighter jet procurement programme. This was on 1 September 2017 in New Delhi, some two months after Lockheed Martin had announced its joint venture

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The Hindustan Turboprop Trainer-40 (HTT-40) is an initiative under "Make in India" by HAL with an internal funding support. The aircraft took to skies for the maiden sortie at HAL airport, Bengaluru, on June 17, 2016. The indigenous content on HTT-40 is close to 80% and almost 50% of the components on HTT-40 are manufactured by private players of the Indian aerospace ecosystem.

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partnership with Tata Advanced Systems for producing the F-16 in India. Late last year, the Indian Air Force issued an initial request for information to select international aerospace companies to confirm their interest for producing single-engine fighters in India. It is learnt that subsequently, the Defence Ministry narrowed down the choice to Saab's Gripen E and Lockheed Martin's F-16 Block 70. "We will be building a new fighter with the latest technology … We believe we have a strong partnership that could enable and fulfil the requirements of the government," stated Håkan Buskhe, CEO and President of Saab. "Saab is looking for long-term partnership and willing to transfer technology and skills. Gripen will be offered to the Indian government as one of the best solution for India's single engine fighter aircraft," re-iterated Gautam Adani, Chairman, Adani Group, announcing the joint venture.

Saab AB, which has already received $5 billion worth of orders for the Gripen, is planning to establish a comprehensive production and assembly line in India to co-produce the aircraft under the 'Make in India' programme. The Gripen is presently in first line service not only with the Swedish but also the air forces of Hungary, Thailand, South Africa and the Czech Republic and, shortly Brazil. Swedish Prime Minister Stefan Lofven had earlier met Prime Minister Narendra Modi and specific presentations thereafter made by Saab to the MoD and the IAF.

IAF wants 36 more Rafales

According to sources in New Delhi, the Indian Air Force is keen on placing follow-up orders for 36 additional Dassault Rafale multirole fighters. The Indian government and Dassault Aviation had earlier signed a Euro 7.87 billion agreement for the procurement of 36 Rafale multirole fighters in September 2016. Delivery of the first of these fighters is expected to begin in November 2019 and will be completed by the middle of 2022.

The IAF has reportedly made "some presentations" on the operational need for the additional 36 Rafale fighters, arguing that a follow-up order would "just cost around 60 percent of the original acquisition and induction price." The IAF's first Rafale squadron will reportedly be based at Hashimara in North Bengal, the second squadron slated to be based at Ambala and both IAF bases will be able to accommodate an additional squadron each, which "will cut down the induction costs". According to an IAF

spokesman, the Rafale, armed with Meteor BVR missiles and possibly the air launched variant of the BrahMos cruise missile, will be "a huge factor" in augmenting India's air power. According to other sources, there are strong views that additional Rafales will be far more cost-effective than going in for the long delayed FGFA project with Russia.

Boeing India JV for manufacturing F/A-18 Super Hornets

US defence major Boeing have offered to set up a manufacturing facility in India for production of its F/A-18 Super Hornet aircraft, "if the company gets contracts for their supply". Specifically aiming at the Navy's planned acquisition of 57 multi-role carrier-borne fighters (MRCBF), Boeing said that the F/A-18 Super Hornet would be "the ideal choice" for the Indian Navy's future carrier. "We are talking about creating a next generation facility in India. We think the Super Hornet is the most advanced aircraft that India could manufacture which will lead to the next generation of aircraft that India will design and build here," said Dan Gillian, Vice President of Boeing's F/A 18 programme.

He said the F/A-18 Super Hornet will not require any modifications to operate from Indian carriers and will have lowest cost per hour flight ratio compared to other such platforms. The Navy's RFI, dated 17 January 2017 stated that the aircraft are "intended as day-and-night capable, all-weather, multi-role, deck-based combat aircraft which can be used for air defence, air-to-surface operations, buddy refuelling, reconnaissance etc. from IN aircraft carriers". At present, the Indian Navy operates 45 MiG-29Ks, which have reportedly faced serviceability issues.

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LM on F-16s 'made in India'

Lockheed Martin has offered to eventually build all future F-16s at a proposed plant in India if it "wins a bigger order to supply the Indian Air Force" under Prime Minister Narendra Modi's 'Make-in-India' plan. In India recently, Randall L. Howard, who leads F-16 business development, said that Lockheed Martin is offering to make India the global F-16 production centre, so eventually it will make the aircraft not just for India, "but also for other countries."

The Company is closing its F-16 production line at Forth Worth, Texas and will service new orders from a new facility at Greenville, South Carolina. On their plan to eventually build the F-16 in India, Howard stated. "Our next customer, which we believe to be very soon ... we will produce those aircraft out of that (Greenville) facility," he said. "But as you look beyond that, the

opportunity is to then move all of that into India and that's what's being proposed ... to have a single production line in India that would service the new production requirements of global demand, the global market." LM and Tata Advanced Systems had signed an agreement to set up a JV for the purpose (*see Vayu IV/2017*).

Indian Army cleared for Apaches

The Indian Army has long pursued the acquisition of dedicated attack as also commando assault helicopters for its Air Corps, which has since its inception operated a fleet of HAL Chetaks, Cheetahs and Cheetals, which have been recently augmented by increasing numbers of HAL Dhruv ALHs as also its armed version the Rudra. Even as Army Aviation awaits first tranches of the light combat helicopter (LCH), the Defence Acquisition Council (DAC) on 17 August has cleared the acquisition of 6 Boeing AH-64 Apache attack helicopters fir it although the Army's requirement is for a total of 39 of the same. The Government of India had earlier placed orders for 22 Apaches and 15 CH-47F Chinooks from Boeing in 2015 *(see Vayu Issue V/2015)*. The Boeing AH-64 Apache is equipped with nose-mounted sensor suite for target acquisition, night vision systems, four hardpoints mounted on stub-wing pylons capable of carrying Hellfire missiles and Hydra 70 rocket pods (*see article by Brigadier Gurmeet Kanwal in this Issue*).

Navy RFIs on helicopters

The Indian Navy is continuing the process of identifying various helicopter types to meet its urgent requirement for 123 naval multi-role helicopters (NMRHs), with anti-submarine warfare capabilities, as well as 111 armed naval light utility helicopters (NUHs) for operation from decks of warships. The requirement, estimated at over $ 5 billion, will be executed under the new 'strategic partnership' (SP) policy according to the 'Make in India' framework.

For the two helicopter projects, the government has sought responses from various OEMs via RFIs issued who would then be given formal tenders or RFPs (request for proposals) to submit their technical and commercial offers. With Indian strategic partners to be selected in a parallel process, this could take several years for the final contracts to be implemented. Even the long-pending initial procurement of 16 Sikorsky S-70B multi-role helicopters

(see representative picture) has not progressed, the Navy currently grappling with a limited number of 11 obsolescent Kamov Ka-28 and 17 Sea Kings to be deployed alongside its existing fleet of 140 warships. The Navy wants twin-engine NUHs to replace its ageing fleet of single-engined HAL Chetaks, the NUHs markedly different from Army/IAF light utility helicopters as they need wheeled landing gears, sea optimisation, foldable blades and specific dimensions to fit into the limited space hangars.

Arun Jaitley launches LCH production...

Then Defence Minister Arun Jaitley visiting Bangalore on 26 August 2017 launched several new schemes and infrastructure projects involving India's biggest defence public sector undertakings. At Hindustan Aeronautics Limited, he launched the limited series production of the twin-engine light combat helicopter (LCH) which features a narrow fuselage and tandem configuration for pilot/co-pilot or weapons system operator *(photo above).*

...“dedicates” Hawk-i

Mr. Jaitley also dedicated the weaponised and upgraded Hawk-i (for India), advanced jet trainer. The Hawk-i, which has been upgraded with indigenously designed avionics and other systems, marks a departure for HAL from the conventional process of developing weapons based on the requirements of India's armed forces. The Hawk-i was developed without any formal orders but will now be offered both to the IAF and IN as also for limited export. Mr. Jaitley thereafter visited BEML at Kolar and in Bengaluru and later Bharat Electronics Limited (BEL) where he inaugurated the BEL 'Academy for Excellence' and the EMC test facility, the first-of-its-kind in the country.

41 more Dhruvs ordered

In addition to the 32 Dhruv ALHs earlier ordered by the Indian Navy and Coast Guard in March 2017, Hindustan Aeronautics Ltd has signed a Rs 6,100 crore contract for the supply of 40 more Advanced Light Helicopters to the Indian Army plus one to the Indian Navy on 4 September 2017. The contracts will be executed in a period of 60 months as per the contract. “The latest order reflects the trust on HAL's capabilities and gives an impetus to the Make-in-India campaign. It reposes faith of Indian Defence forces in indigenous ALH which has been serving them with distinction for a long time,” stated HAL CMD T Suvarna Raju.

Additional Hawks for IAF and IN

While HAL's Bangalore Complex has completed production of 99 Hawk Mk.132s under license from BAE Systems, the 100th Hawk (known as Hawk-i) was a company-funded initiative. Further production of Hawks by HAL is awaiting MoD sanction and will reportedly be for 37 more of the aircraft, 20 for the IAF (essentially to equip the *Surya Kiran* Formation Aerobatic team) and 17 for the Indian Navy, which already has 17 Hawks in service.

India, Japan Defence Cooperation

Visiting Japan in the first week of September 2017, Arun Jaitley (who handed over the Defence portfolio to Nirmala Sitharaman on his return), met with his Japanese counterpart Itsunori Onodera and held wide-ranging talks. As part of the annual India-Japan Defence Ministerial Dialogue in Tokyo, subjects included the supply of the US-2i amphibious aircraft to the Indian Navy (*image above*). India and Japan also agreed to ramp up counter-terror cooperation, besides deepening engagement among navies, air forces and ground forces of the two countries. "The Ministers exchanged views and ideas with the aim to further strengthen defence and security cooperation under the framework of the 'Japan-India Special Strategic and Global Partnership' ".

The Governments of India and Japan have agreed to commence technical discussions for research collaboration in the areas of Unmanned Ground Vehicles and Robotics. Seeking to further intensify naval cooperation, Onodera expressed his intention to have state-of-the-art Japanese assets, including those on P-1 maritime patrol aircraft to participate in next year's trilateral Malabar naval exercise which also involves the US Navy. "The two sides will consider inclusion of Anti-Submarine Warfare (ASW) training to expand cooperation. In addition the ministers agreed to pursue exchanges and training by ASW aviation units. The Japanese side proposed to invite Indian Navy personnel to mine-countermeasures training held by it, (even while China has reacted angrily to reports that Japan plans to sell weapons to India at cheaper prices, saying that such a move) "is disgraceful". At the talks, the two sides also welcomed the constructive engagement between Japan's Acquisition, Technology and Logistic Agency (ATLA) and India's Defence Research and Development Organisation (DRDO).

Japanese Prime Minister in India

Following Arun Jaitley's visit to Japan, the Japanese Prime Minister Shinzo Abe and his wife Akie visited India in mid-September 2017, essentially to Ahmedabad, where he was hosted by Indian Prime Minister Narendra Modi. Amongst various announcements made were that for a proposed 'bullet train' from Ahmedabad to Mumbai which will dramatically reduce the time taken for the 500 km run between the two cities. Japan has extended a soft loan for the Rs 1.10-lakh crore project, which is conceptualised as a joint venture between Indian Railways and Japan's Shinkansen Technology. Lauding Japan, Mr Modi said "the country was a friend in deed as it gave a loan of Rs 88,000 crore at 0.1 per cent interest for the project".

Mr Abe's visit was to enhance economic and technological collaboration between the two nations, the two leaders reviewing progress of the multi-pronged cooperation between India and Japan within the framework of a 'Special Strategic and Global Partnership' and set its future course. Japanese firms are expected to invest Rs 5 lakh crore in India over the next few years. Japan is already India's highest overseas development assistance (ODA) partner and the country's third largest investor.

India and Japan signed 15 memoranda of understanding (MoUs) on bilateral relations, defence and security cooperation and on supporting each other for a permanent seat on the United Nations' expanded Security Council. The two countries are committed to align Japan's *Free and Open Indo-Pacific Strategy* with India's *Act East Policy* through enhanced maritime security cooperation, improved connectivity in the wider Indo-Pacific region, strengthening cooperation with ASEAN, and promoting discussions between strategists and experts of the two countries.

US Defence Secretary in India

US Defence Secretary Jim Mattis was in India from 25 September 2017 for a three-day visit, the first by a Cabinet member of the Trump administration. After delegation level discussions between the two Ministers, the two countries also resolved to eradicate

terrorist safe heavens across the globe."There can be no tolerance of terrorist safe heavens. As global leaders, India and the US resolve to work together to eradicate this scourge," Mattis said in his statement. With increasing Chinese presence in the region, both sides put great emphasis in expanding their expanding maritime cooperation. India has already extended a $3-billion aid to Afghanistan and also provides training to its military and other assistance. "India will continue its development and medical assistance in Afghanistan. However, Defence Minister Nirmala Sitharaman stated that, "There shall not be any boots on the ground from India

Technology transfer issues with US defence firms

According to reports (including those from Reuters), US defence firms offering to set up production lines in India "want stronger assurances they will not have to part with proprietary technology", according to a business lobby group's letter to India's Defence Minister.

These companies are also stressing that they would not be held liable for defects in products manufactured in collaboration with local partners. This is particularly relevant in the case of US Companies Lockheed Martin and Boeing who are both preparing to respond to official RFIs from the Government of India. While Lockheed Martin has plans to re-locate its F-16 production line to India, Boeing too are reportedly keen to co-produce the F/A-18 Super Hornet not only for the Indian Navy but the Air Force as well, the latter to meet the envisaged requirement for more twin-engined fighters.

It is reported that the US-India Business Council (USIBC) sent this communication to the Indian Defence Ministry on 3 August seeking a guarantee that US firms would retain control over sensitive technology - even as joint venture junior partners. "Control of proprietary technologies is a major consideration for all companies exploring public and private defence partnerships," as per the business lobby, which represents 400 firms. "To allow foreign OEMs to provide the most advanced technologies, the partnership arrangement between an Indian owned 'strategic partner' company and a foreign OEM needs to provide an opportunity for the foreign OEM to retain control over its proprietary technology".

CAG flags limitations of IAF mid-air refuellers

In a startling report recently presented to parliament, the Comptroller and Auditor General (CAG) have flagged major problems faced by the Indian Air Force in operating and expanding its fleet of mid-air refueling aircraft. The IAF operates six Ilyushin Il-78 aerial refuellers procured in 2003-04 at a unit price of Rs 132 crore but the follow on order for more of these or another type has yet to be finalised. Giving further details of the problem, the CAG focused on the lack of hangarage, limited runway lengths and few dedicated refuelling corridors. There was also "poor maintenance support from the OEM", adversely impacting operations. The desired serviceability of the Il-78 fleet should be 70% by IAF's own standards, but it was only 49% during 2010-16.

Easing FDI in Defence

The government of India is reportedly re-examining existing norms on foreign direct investment (FDI) in the defence sector by allowing up to 100 per cent foreign equity in the production of battle tanks, military transport aircraft and armoured vehicles. "This is going to be the most liberal FDI policy. The idea is to attract Rs35,000 crore investment in the defence sector in the next five years, based on the Defence Ministry's objective to go for self-reliance and reduce import dependence," according to a reliable source. It has also been reported that 76 per cent FDI will be allowed under the automatic route for fighter aircraft and helicopters and 51 per cent for submarines and warships.

The government has held a series of dialogues with the Indian industry and foreign original equipment manufacturers (OEMs) on this important matter. The Defence Ministry has come around to the fact that unless there is large-scale FDI entering the Indian defence market, there will be no real transfer of technology. "Only if the OEMs are allowed to invest over 51 per cent, do they get ownership. And in defence, ownership is important as it involves controlling the technology. If there is no ownership, there will be no technology," the official rued. This is expected to boost inflow of investments from companies such as Airbus, Boeing, Naval Group, Saab, Lockheed Martin and others that are offering programmes to India. It is reiterated that by having 'control and ownership', which is possible only if they are allowed to invest over 49 per cent, there will be an improvement in FDI in defence sector.

Kalyani-Rafael JV for Spike missiles

Israel's Rafael Defense Systems Ltd has formed a joint venture with the Kalyani Group to produce Spike anti-tank guided missiles for the Indian armed forces as also possibly export to specific Asian countries. Kalyani Rafael Advanced Systems Pvt. Ltd has been set up with an investment of Rs 60-70 crore, with the Kalyani Group holding 51% equity and the Israeli partner the rest. "This is the first private sector facility which will become a missile house," stated the Group chairman Baba Kalyani. "We will start producing these missiles for Indian armed forces and we will be seeking government permission to export these to South-East Asian countries including Myanmar, Vietnam, Philippines, Indonesia. These are the potential markets for us." The facility will be 90% localised and parts will be procured locally in Hyderabad. It will create about 300 direct jobs and 1,000 indirect jobs," Kalyani added. "The establishment of this facility is a sign of our commitment to walk the talk in terms of partnering with Indian industry towards indigenous manufacture," said Rafael president and CEO Yoav Har-Even.

Upgrade of MBTs, ICVs, AD guns

The MoD has approved projects worth thousands of crores to augment the fighting capability of its tanks and infantry combat vehicles, following a recent CAG report which revealed major deficiencies in the military's battle readiness. The projects approved include ammunition for more than 1,500 Russian-origin BMP-2/2K infantry combat vehicles, missiles for 3,000 T-90/T-72 tanks and millions of rounds for L-70 air defence guns, according to officials. The army's operational and technical parameters require the new missile should have a "hit probability greater than 90% on a standard NATO tank." The army's proposal says, "As the design of the existing INVAR missile has been optimised both in terms of range and depth of penetration, it is imperative to upgrade to next generation missiles with enhanced capability."

The army's T-90 fleet will be equipped with armoured fighting vehicle protection and counter measure system' at a cost of around Rs 2,500 crore. The T-90 fleet will be equipped with 1,200-1,500 HP modular engines "to cater for high battle field agility." The army has a requirement for 2,011 such engines.

Another significant project relates to buying 3.3 lakh rounds of ammunition for the L-70 air defence gun systems over the next 12 years. According to a spokesman, "With increase in air threat envelope and multiplicity of threat platforms, there's a requirement to enhance the lethality and accuracy of the present ammunition of L-70 gun." The defence ministry has sought Rs 20,000 crore from the government to accelerate the military's modernisation.

L&T awaits "massive defence projects"

After winning its biggest defence contract in May 2017, Larsen and Toubro (L&T) is planning to bid for $28 billion worth of orders, including for warships and submarines, as the Government of India "breaks with tradition to embrace private, local suppliers. The new defence purchase policy allows non-state local firms to compete for orders from the military which would help the nation's biggest engineering firm to become more ambitious," said Jayant Patil, head of L&T's defence business. The company is building on its success with a $700-million order for artillery guns received in May, "unprecedented in size for a local contractor". L&T has so far invested as much as Rs 8,000 crore building nine defence plants across the country. It will partner with South Korea's Hanwah Techwin Co to make the artillery guns *(see photograph.)*

India-Russia military exercise INDRA 2017

India and Russia have begun discussions to work out modalities for conducting their first tri-service military exercise INDRA 2017 during October 2017 in Russia. This will be India's first bilateral military exercise with any country involving all three services. The Final Planning Conference (FPC) of exercise is to be held in Russia to finalise all logistical issues and modalities.

The 2017 INDRA exercise will primarily focus on achieving coordination between forces of two countries in tri- services integrated theatre command scenario. The aim of exercise is to carry out joint exercises for suppression of international terrorist activities under United Nations mandate. The Indian Army will send about 350 soldiers from infantry, artillery and armoured units, the Indian Navy is sending two ships, stealth frigate INS *Satpura* and anti-submarine warfare (ASW) corvette INS *Kadmatt*, along with two on-board helicopters. The Indian Air Force is likely to send some fighters as well. The headquarters of Integrated Defence Staff under Defence Ministry is the Indian co-ordinating agency.

Indian Army Cadre Review

In improving career prospects for Indian Army junior commissioned officers (JCOs) and other ranks in the around 1.2-million strong Army, the government has proposed a major cadre review. The increase in number of higher ranks for the Army, which also has around 41,000 officers, will be implemented in phased manner over a five-year period from 2018 to 2022. "While this will be carried out without an actual increase in the Army's overall prescribed manpower, it will not apply to any new raisings of battalions separately approved by the government," said an official. The cadre review will see 479 new Subedar Major posts being added to the existing 5,500 in the Army, while there will be 7,769 new Subedars (existing 44,546) and 13,466 Naib Subedars (existing 41,014). The force will also get 58,493 new Havildars (existing 2,10,656) and 64,930 Naiks (2,03,259). "The review was needed as there has been a sharp increase in the induction of advanced weapon systems and new technologies in the Army," said the official.

INS *Kalvari* delivered to Indian Navy

The first of the *Scorpene*-class submarines, INS *Kalvari*, was formally delivered to the Indian Navy by Mazagon Dock Shipbuilders Limited on 21 September 2017. Kalvari which is named after the dreaded tiger shark, is equipped with state-of-the-art technology, including superior stealth features such as "advanced acoustic silencing techniques", low radiated noise and the ability to launch a crippling attack on the enemy using precision guided weapons. The delivery of INS *Kalvari* built under the Rs 23,652 crore 'Project-75' is significant because the Navy currently has just 13 ageing diesel-electric submarines, with just half of them operational at any given time. The force needs at least 18 conventional submarines. India also has two nuclear-powered submarines, INS *Arihant* and INS *Chakra*, but the latter does not have nuclear-tipped ballistic missiles because it has been acquired on lease from Russia. The Navy needs some six nuclear-powered attack subs (SSNs) and four nuclear-powered subs with nuclear-tipped missiles (SSBNs).

A&N Command to be augmented

The government has plans to augment the Tri-Service Command in the Andaman and Nicobar Islands to strengthen its military reach in the Bay of Bengal as also counterbalance growing Chinese ambitions in the region. This joint command of the army, air force and navy was set up in the country's south-eastern islands some 16 years ago. Reportedly, work has started to augment the command that has its headquarters in Port Blair which could be placed under

the proposed permanent Chairman of the Chief of Staff Committee (COSC). These will include expansion of the runways and other facilities at naval air stations in North Andaman's Shibpur and, deep south at Campbell bay in Great Nicobar so as to permit operations of jet fighters and large MR/ASW aircraft. These airfields are currently limited for use by Dornier 228s and Mi-17 helicopters, the southernmost station, INS *Baaz* at Campbell Bay barely 150km from Indonesia's Banda Aceh *(see picture)*. There are also plans to dredge the bay for heavier warships and install a robust radar network. The Air Force Station at Car Nicobar will also reportedly be expanded to house fighter squadrons for extended periods.

First LR-SAM for Indian Navy

On 27 August 2017 the first LR-SAM Missile manufactured in India was presented by then Defence Minister Arun Jaitley to the Indian Navy. The missile has been subject of collaboration between India's DRDO and Israel Aerospace Industries (IAI), which would be integrated with the Indian Navy's warships. As Boaz Levi, IAI's Executive Vice President and General Manager of Systems, Missiles & Space Group said, "The delivery of the first missile manufactured in India to India's defence arms is a technological dream come true. It is another exciting step in the many-years collaboration between IAI, India's government, India's DRDO and other partners and one that reflects a technological and engineering effort of the highest level."

Indian Coast Guard expansion plans

The government has approved a Rs 31,748 crore "definitive five-year action programme for the Coast Guard", whose role has become crucial ever since the 26/11 terror strikes in Mumbai in 2008. Plans are afoot to augment the Coast Guard in terms of offshore patrol vessels, boats, helicopters, aircraft and critical operational infrastructure. The aim is to make the Coast Guard a 175-ship and 110-aircraft force by 2022 to plug operational gaps and strengthen its capabilities to safeguard coastal security, island territories, offshore assets and marine environment as well as undertake anti-piracy, anti-smuggling, oil-spill and pollution-control operations.

At present, the Coast Guard currently has 130 "surface units" in the shape of 60 ships (offshore patrol vessels, fast patrol vessels and pollution-control vessels), 18 hovercraft, and 52 smaller interceptor boats/craft. The air component presently includes 39 HAL-Dornier 228 maritime patrol aircraft, (in photo) 19 Chetak helicopters and four HAL-Dhruv advanced light helicopters. While 16 more HAL Dhruv ALHs have have already been ordered, the procurement of 14 twin-engined helicopters is in the final stages and these are likely to be from Airbus Helicopters.

ICGS *Shaurya* commissioned

Indian Coast Guard Ship *Shaurya*, fifth in the series of six 105m Offshore Patrol Vessels (OPVs) was commissioned at Goa by Dharmendra Pradhan, the Minister of State for Petroleum and

Natural Gas on 12 August 2017 in the presence of Director General Rajendra Singh, Director General Indian Coast Guard, CMD Goa Shipyard Limited and other senior dignitaries of the Central and State Government. The *Shaurya* is a 105 metres OPV, designed and built by Goa Shipyard Ltd and is fitted with state-of-the-art navigation and communication equipment, sensors and systems including 30 mm CRN 91 naval gun, integrated bridge system (IBS), Integrated Machinery Control System (IMCS), Power Management System (PMS) and High Power External Fire Fighting System. The ship is designed to carry on board one light helicopter and five high speed boats including two quick reaction inflatable boats for swift boarding operations.

Indo-Bangla Coast Guard 'Table Top Exercise 2017'

The first Indo-Bangla joint Table Top Exercise was held at Coast Guard Regional headquarter (NE), Kolkata in end-July bolstering Indo-Bangla joint search and rescue operations in the Bay of Bengal. IG Kuldip Singh Sheoran, the Coast Guard Regional Commander (NE) stated, "The Bay of Bengal is a hotspot of maritime trade and ships of both countries remain at risk because of cyclones in the region. A strong SAR setup is the need for the hour." The two day exercise took the participants through a simulated Mass Rescue Operation in the Bay and SAR at sea, which is a complex mechanism involving many stake holders and foreign nations.

MMMA and Dornier Hangars at Bhubaneshwar

Director General Indian Coast Guard Rajendra Singh, inaugurated the MMMA (Multi Mission Maritime Aircraft) and Dornier Hangar at Coast Guard Air Enclave, Bhubaneswar on 1 September 2017 in presence of Additional Director General KC Pande, Coast Guard Commander (Eastern Seaboard) and Inspector General Kuldeep Singh Sheoran, Commander Coast Guard Region (North East). This will strengthen the maritime and coastal security off the eastern Indian coastline. Assistance rendered by Indian Coast

Guard during natural disaster and calamities, search and rescue efforts, protection and preservation of maritime environment and endangered species off the Odisha coast were highlighted.

ICGS *Varuna* handed over to Sri Lanka

Director General Indian Coast Guard, Rajendra Singh, formally handed over ICGS *Varuna* to Rear Admiral Samantha Wimalathunge Director General Sri Lanka Coast Guard during a ceremony on 5 September 2017 at Kochi, where Rear Admiral SS Ranasinghe, Chief of Staff, Sri Lanka Navy was also present. The handing over of the ICG OPV to Government of Sri Lanka for training and surveillance purposes is part of India's continuing efforts for cementing the historical and cultural ties between the two countries. India had earlier handed over to Sri Lanka two OPVs of the Indian Coast Guard: *Varaha* in April 2006 and *Vigraha* in August 2008.

IAF allots 11 more acres to AAI at Leh airport

The strategically-important Leh civil airport expansion project has made headway with the Indian Air Force recently handing over 11.8 acres under its possession to the Airport Authority of India

(AAI). Under the plan, the number aircraft parking bays will go up to five from the existing two, removing the bottleneck for additional flights. Once the expansion project gets completed, the upgraded infrastructure will cater to around 600 peak hour passengers at a given time which is currently at only 250 passengers.

Civilian flights at Hindon

The Indian Air Force has also agreed to allow the use of its Air Force Station at Hindon for civilian flights under the government's regional connectivity scheme (RCS), according to Civil Aviation Secretary RN Choubey. The move will help take the load off Delhi's present international airport at Palam, which is facing capacity issues. The Hindon airbase will serve as "second" airport in the NCR for flights operating under the RCS.

IndiGo goes Regional

InterGlobe Aviation Ltd, which owns India's biggest domestic airline IndiGo, is to start regional air services from November 2017 and progressively expand its route network over the next years. The airline, which hitherto only operated Airbus A320s, surprised observers in May 2017 when it ordered 50 ATR 72-600 regional turboprop aircraft for regional operations. The induction of these aircraft is slated to begin in November, with services initially in south India. IndiGo is working to hire employees, including pilots, engineers and cabin crew, for flying on the regional routes. South India will come as a natural fit for IndiGo as three airlines—Air Costa, Air Carnival and Air Pegasus—which ran ATR and Embraer operations in this region have been grounded over the past 18 months.

IndiGo expects to deploy about seven aircraft by March 2018 but could speed up capacity induction to 20 ATRs by December 2018. Meanwhile, competitors in the fray, SpiceJet Ltd has also announced its third daily direct flight under the UDAN scheme for regional connectivity from Hyderabad to Pondicherry and back, starting 16 August. With a fleet of 20 Bombardier Q400s, it has already won 11 UDAN routes to unserved airports of Adampur, Kandla, Pondicherry and Jaisalmer, besides Porbandar and Kanpur. Air India's regional flights under Alliance Air are being expanded under UDAN and will become a 20-aircraft operation by early 2018 and Air Deccan also launched operations in September with a 19-seater Beechcraft aircraft.

Problems with A320 neo engines

IndiGo's Airbus A320 new engine option (neo) fleet has faced problems with its Pratt & Whitney (PW) engines powering these aircraft. The low-cost carrier (LCC) currently has 22 A320 neos with nine of them reportedly grounded. Implementation of GST from 1 July has also led to some confusion over the import of replacement engines which further added to the problem.

Both IndiGo and GoAir use the combination of PW engines on A320 neos and owing to continuous trouble with these engines, the US engine manufacturer was replacing and/or rectifying them. "PW is facing this issue on the A320 neos globally. Due to this, it is unable to supply replacement engines at the required pace. Also, there are some changes in the modifications that were being carried out on the replacement engines. So, the result is that the airlines using the A320 neo with PW engines are suffering," according to a spokesperson.

Air Asia India operations

Low cost carrier Air Asia India, a joint venture between Tata Sons and Air Asia Berhad, has reported an increase in its net losses by 19.3% year on year to Rs 24.4 crore for the quarter ended 30 June, as a result of significant increase in fuel cost, aircraft lease

rentals and staff cost. However, the airline also reported a record increase in revenues and capacity addition during the quarter. The airline follows the calender year as its financial year. The airline has a fleet of 11 aircraft which it plans to increase to 14 by the end of the current year. According to Amar Abrol, CEO Air Asia India, the low cost carrier is expected to start its international operations by flying to the Asean countries where its parent company Air Asia Berhad has large presence.

Jet Airways cutting costs

Jet Airways (India) Ltd has directed some 200 of its junior pilots to go on unpaid leave for 10 days a month, resulting in a 30% reduction in their salaries, as the airline seeks to cut costs amid weaker demand for travel to Gulf countries, officials have said. The airline has made some interim arrangements to balance its cost structure, a spokesperson for Jet Airways stated. In a circular, the airline said the company, over the past few months "has been intensely focussed on fleet and network rationalisation and working on cost efficiencies." In the fourth quarter ended 31 March, the airline reported a 91% decline in profit as higher revenue was more than offset by costlier fuel, lower airfares and weak demand from the Gulf region, a key market. To contain costs, the airline is also looking to sub-lease its smaller aircraft to a regional airline as they do not align with Jet's premium push.

Go Air goes international

Private low-cost carrier Go Air proposes to begin international air services from October 2017, according to Managing Director Jeh Wadia, who added that initially the airline would fly to the destinations of Asia and review the destinations within the region. Go Air, which had ordered 143 Airbus A320neo aircraft to add to the existing 24 airliner fleet, has taken delivery of five of them only. "There are issues with the engine for which the deliveries are getting delayed", Wadia said. To a query whether the airline was keen to look at the divestment of Air India like its competitor IndiGo, Wadia said "We have no interest". He also denied any plans of an IPO.

Chandigarh Airport to reduce ops

Chandigarh airport will curtail daily flight operation timings starting 3 October for reasons of upgradation and repairs, a move being opposed by airlines, which said they did not get adequate advance notice. The Federation of Indian Airlines opposed the plan and asked the Indian Air Force to shift renovation timings to night to minimise impact. Runway work will result in restricted operating hours, according to the federation as in fact various airlines had planned to increase daily flights from 74 to 84 in the winter schedule and closure every afternoon will affect 28 flights. Reduction in operation timings will lead to a 35-40% drop in passengers and flights, the federation said. The federation suggested Chandigarh follow the model adopted at Amritsar airport, where the runway work was carried out between 8 pm and 5:30 am for a year, without affecting scheduled operations.

Bird Group interested in Air India subsidiary

Civil Aviation Secretary R N Choubey has said that the Ministry of Civil Aviation has received Bird Group's expression of interest in the ground handling subsidiary of Air India, the second aviation industry player to do so since the national carrier is up for disinvestment. This is following IndiGo's interest on the foreign arm of the national carrier soon after the Cabinet gave its "in-principle" nod for its disinvestment.

A Bird Group spokesperson said the company has written to the government with an interest in Air India's ground handling arm Air India Transport Services Limited (AITSL). The spokesperson said AITSL would sit well with their business model. The Ankur Bhatia-led Bird Group, which handles ground handling activities at seven airports, including Delhi, Mumbai, Bengaluru and Kochi, has also urged the government to divest Air India subsidiaries separately.

Air India launches direct flights to Copenhagen

On 16 September 2017, Air India launched its direct flight from the national capital to Copenhagen, the eleventh destination for the airline in Europe, describing this as connecting 'Maharaja with the Mermaid'! The national carrier has been expanding its international operations and has started services to overseas destinations, including Washington DC and Stockholm so far this year. This Air India flight will be operated with a Dreamliner aircraft thrice a week on Tuesday, Thursday and Saturday.

Boeing's new facility in Bengaluru

The Minister-of-State for Civil Aviation Jayant Sinha, inaugurated Boeing's additional new facility at the Boeing India Engineering and Technology Centre (BIETC) in Bengaluru on 21 September 2017, which will "enable Boeing to focus on technology areas such as data analytics, internet-of-things, avionics, aerospace design, manufacturing, testing and research, to support Boeing products and systems more efficiently in India and around the world." This centre also includes laboratories for research to support next-gen innovations in aerospace.

"As a source for innovative and cutting-edge engineering, India offers us tremendous growth potential," said Pratyush Kumar, President, Boeing India. "This is a winning formula for India and our own global growth strategy for improved productivity, enhanced engineering efficiency and cost advantage, while focusing on quality."

ALDS collaborate with Rosoboronexport

Ashok Leyland Defence Systems (ALDS) has signed a Memorandum of Understanding (MOU) on Cooperation with Russia's Rosoboronexport, on the sidelines of the International Military Technical Forum *Army 2017* held at Kubinka, near Moscow, on 25 August 2017. The Indian delegation was led by Ashok Gupta, Secretary (Defence Production) Government of India. Rosoboronexport (ROE) is the only state organisation in Russia for export of the entire range of military products and technologies, representing Russian companies who are manufacturers of Infantry Fighting Vehicles and Main Battle Tanks, currently working with the Indian Army. ELCOM Group is emerging as a significant player in strategic electronics, avionics and tactical communication globally. Ashok Leyland is one of the world largest manufacturer of vehicles and has been a supplier of Logistics and Special Role Vehicles to the Indian Army for the past 25 years.

C-130J simulator training centre

Mahindra Defence Systems dedicated the C-130J Super Hercules simulator training centre at a commemorative event at the Air Force base at Hindon on 30 August 2017. With a full motion simulator, the C-130J training facility offers complete training solution of training aircrew who operate the C-130J special operations aircraft acquired from Lockheed Martin in 2011. This will provide qualitative and quantitative training to hone tactical and operational skills of C-130J pilots, combat system operators and loadmasters to conduct special operations across National and International boundaries. "The commencement of formal training on the C-130J Weapons Systems Trainer demonstrates our commitment to meet the defence needs of the Indian Government," said Phil Shaw, CEO Lockheed Martin India.

BEL wins D&B top PSU Award 2017

Navratna defence PSU Bharat Electronics Limited (BEL) has won Dun and Bradstreet India's top PSU Award 2017 in the Manufacturing: Medium and Light Engineering Sector category. M M Joshi, Executive Director (National Marketing), BEL, received the award on behalf of BEL from Neeraj Kumar Gupta, Secretary, Department of Investment & Public Asset Management, Ministry of Finance, at an awards ceremony held at New Delhi on 25 July 2017.

BEL's Academy for Excellence, advanced testing facilities

Then Defence Minister Arun Jaitley inaugurated an Academy for Excellence and two state-of-the-art testing facilities, EMC Test facility and Near Field Antenna Test Range at the Bengaluru Unit of Navratna Defence PSU Bharat Electronics Limited (BEL). The BEL Academy for Excellence with its sprawling complex spread over six acres is built at a cost of Rs 47 cr, to address the training needs of not only BEL employees, but also its customers and vendors/ partners, especially MSMEs/SMEs. This institution, which will be affiliated to national/international universities, will also cater to the skill development initiatives of the Central Government.

IAF Chief visits Australia

Air Chief Marshal Birender Singh Dhanoa, CAS IAF visited Australia on an official visit from 19 to 22 September 2017, which was "intended to further strengthen the existing defence cooperation between the Air Forces of the two countries". During his stay, he had official discussions with his counterpart and other senior officers of the Royal Australian Air Force on "security challenges being faced by the two forces in the current geopolitical scenario and explore ways to deepen defence cooperation." As a historic aside, it would be recalled that the Indian and Australian Air Forces operated Vengeance dive bombers alongside during the 2nd Burma Campaign in 1944 and the two air arms have exercised together in the 1960s including at 'Shiksha' in 1963 when the RAAF sent some Canberra bombers to Eastern Indian air bases. The two air arms currently operate variants of the BAE Systems Hawk advanced jet trainer *(see news items)*.

New Chairman for Air India

Rajiv Bansal has taken over as Chairman/Managing Director of Air India. Mr Bansal is from the Nagaland cadre of the 1988 batch and is taking over as Air India CMD at a time when the government is working on the modalities for the disinvestment of the loss-making national carrier. He had earlier served at the civil aviation ministry between 2006 and 2008.

Lt Gen Abhay Krishna appointed GOC-in-C Eastern Command

Lt Gen Abhay Krishna has been appointed GOC-in-C Eastern Command and took over from the outgoing incumbent Lt Gen Praveen Bakshi on 1 August 2017. A gallantry award winner in counter insurgency in Manipur, Lt Gen Abhay Krishna commanded a Rashtriya Rifles Battalion in the Kashmir valley. A thorough professional, he has served two tenures as UN observer, in Mozambique & Rawanda and another in Burundi. He has served four tenures along the Line of Actual Control on the Northern Borders. He commanded an infantry battalion in Sikkim, was responsible for planning operations as BGS III Corps in the North East Sector and later commanded an infantry division and a Corps in the same area. After a posting in the South Western Command, he now assumes the responsibility of the Eastern Theatre.

Lt Gen Cherish Mathson is GOC-in-C South Western Command

Lieutenant General Cherish Mathson took over as GOC-in-C South Western Command at Jaipur on 2 August. An alumnus of Sainik School, Trivandrum (Kerala), he was commissioned into the Garhwal Rifles in June 1980. He is a graduate from the Defence Services Staff College, Wellington and has attended various important career courses, which include Senior Command Course at Army War College, Mhow and Long Defence Management Course at Secunderabad, besides attending the National Defence College Course at New Delhi and in the Republic of South Africa. The General Officer has considerable experience in varied operational assignments including the Trivandrum Brigade in an amphibious role, an Infantry Division in Southern Theatre and a Strike Corps part of the Southern Command.

Air Marshal Hemant Narayan Bhagwat is AOA

Air Marshal Hemant Narayan Bhagwat took over as Air Officer-in-Charge Administration, IAF on 1 August 2017. Commissioned in administrative branch of the IAF in 1981, he served as an Air Traffic control Officer in three different operational bases of the IAF, the Air Officer qualified as Parachute Jump Instructor and served in instructional capacity for fifteen years. During his paratrooping career, he undertook over 2400 live parachute jumps in combat as well as sports profile from twenty different types of aircraft. He has also served as Chief Instructor of the Paratroopers' Training School, Agra and was leader of IAF Skydiving Team, *Akashganga* for several years. Besides para jumps in all parts of the country, he also participated in several international para exercises including in USA, South Africa, Sri Lanka and Seychelles and is senior most active parachute jump instructor of the IAF.

Rafale International / GIFAS / NARC commit to 'Make in India' with more than 100 French SMEs

RAFALE INTERNATIONAL

DASSAULT AVIATION • SAFRAN • THALES

Rafale International consisting of Dassault Aviation, Safran and Thales have met more than 100 French SMEs in two-days Business-to Business events. These events held with Indian officials took place in Paris on 19 September along with the GIFAS, the French Aerospace Industries Association, and on 21 September in Bordeaux, under patronage of the NARC Nouvelle-Aquitaine Regional Council *(Conseil régional de Nouvelle-Aquitaine)*.

BPI France and French MOD *(Direction Générale de l'Armement)* took part in both events. On these occasions, Rafale International and their partners presented their vision on how best to contribute to the 'Make in India' policy and highlighted opportunities arising for French SMEs to invest and set up production activities in India alongside Dassault Aviation, Safran and Thales in the frame the Rafale offset programme.

Various Indian Embassy representatives emphasised the critical importance of the Make in India policy and the foreign investment policy for the Indian aerospace and defence sectors and attended both networking B2B lunches in Paris and in Bordeaux to answer questions from participating companies.

Under the 'Make in India' initiative, these seminars have presented business opportunities aimed at enhancing the ties between the French and the Indian aerospace communities in order to define cooperation domains between both industries and pave the way towards building up an aero-defence manufacturing eco-system in India, matching the highest standards in this field.

The technological know-how and competences of Dassault Aviation and its partners confirmed by the success of the Rafale Aircraft, will benefit to French partners having the capacity to reinforce their expertise in developing and manufacturing defence platforms and systems for the profit of both French and Indian aerospace and defence industries.

"Encouraging and supporting French SMEs to come to India is a key condition to participate to the success of the 'Make in India' " initiative of Prime Minister Modi and will benefit both French and Indian Industries. Creating new opportunities of collaboration and work towards establishing a full-fledged aero-defence manufacturing eco-system in India will highly contribute to reinforce Indo French cooperation for SMEs of the aerospace and defence sector and will pave the way for the French SMEs and Indian SMEs to benefit Dassault Aviation, Safran and Thales products and technologies portfolios opening worldwide market," stated Eric Trappier, Dassault Aviation Chairman and CEO and GIFAS Chairman.

RÉGION Nouvelle-Aquitaine

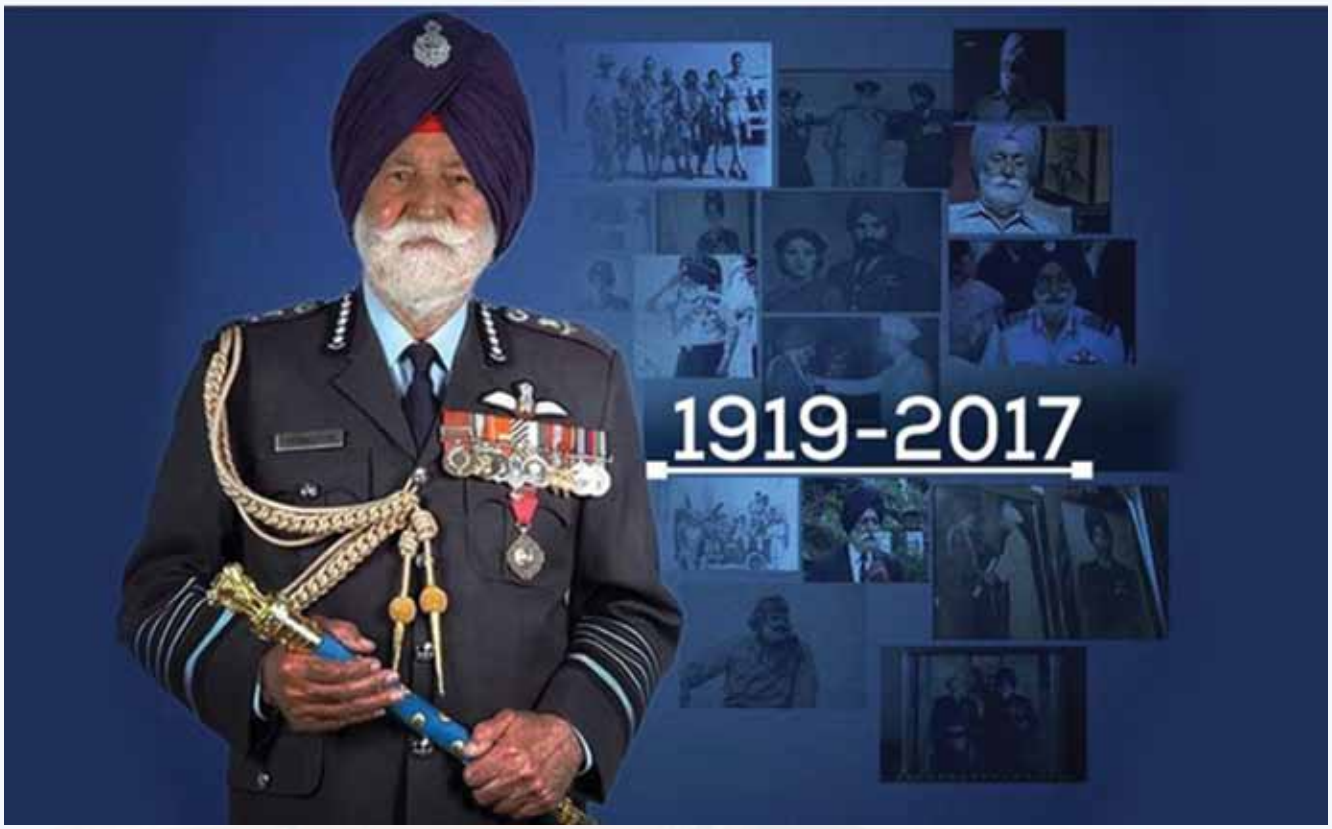
GIFAS

Aircraft from Dassault Aviation have been an integral part of Indian defence forces for over six decades. The first Dassault aircraft, Toofani was supplied to India in 1953, followed by the Mystere IVA, the naval Alize, the Jaguar (manufactured under license by HAL), and the Mirage 2000. These aircraft have contributed to Indian sovereignty all along and the Mirage 2000 fighter aircraft continues to be the IAF's 'cutting edge' till date. 36 Rafale fighter aircraft were ordered in September 2016 to equip the Indian Air Force.

Rafale at Aero India 2017 (photo: Angad Singh)

The Great Marshal

Tribute from a Naval Aviator



Marshal of the Air Force Arjan Singh sadly passed away on the 16 September at the age of 98 years. One felt sad because being a Naval Aviator, we also have always had very close association with the IAF, like that of an extended family. The Marshal was a legend in his lifetime for every aviator irrespective of his colour of uniform. He had retired in 1969, but not before he had become an inspiration for many school children who recall the 1965 war of India with Pakistan. My own mind clock went back 52 years to September 1965.

Many of us who lived close to the Indo-Pak border witnessed shades of the 1965 war with Pakistan. There was much action on the Western Front but the Eastern front was no less tense. There was no electronic media those days, in fact our own village did not even have electricity. 40+ kilometres from Bagdogra IAF base very close to Taibpur NDB, our village Thakurganj was vulnerable to air strikes by PAF from East Pakistan air bases. The civil air defence was active throughout the bordering districts. Being close to two important air bases, i.e. Kalaikunda and Bagdogra, very often the ear-penetrating siren sounds would mean that we laid down wherever we were : but there was no black out at nights since there was no electricity !

There being no electronic media and extremely meagre access to print media, the radio was only source of information. There was general belief that BBC's Hindi Service would be first to report of war news impartially. Elders and younger ones in the village would huddle around radios sets and the tension would mount in an atmosphere of pin drop silence. There were often mention of action on the Western borders but not so much of the East where we were supposedly also vulnerable. One would often hear names of Gen JN Choudhury, the Army Chief and (then) Air Marshal Arjan Singh, Chief of the Air Staff. Their statements, that our warriors had the wherewithal needed to beat Pakistan forces if they tried any misadventure, was cause for cheer amongst us listeners.

It was the second week September 1965 that the news of both Air Forces attacking each other's airfields in the eastern sector came about. We heard about Sabre jets and our own Canberra bombers, Hunters and Folland Gnats participating in action. As BBC's Hindi service reported, both Air Forces surprised each other by ground attacks and flew some counter chase by fighters. One recalls that the siren went of one evening while we were at the school football field. We automatically dropped

ourselves on the ground and closed our ears. Then there was series of loud noise (apparently jet fighters), we looked up in more of inquisitiveness to see a low flying fighter aircraft. Being a student of Class 8, 'type of aircraft' did not make much sense. But the sight was breath taking and made one's adrenaline flow very rapidly. Later, the all clear siren was sounded and we returned home. At night our most dependable BBC Hindi service and AIR announced that attempts to bomb our airfields by PAF fighter bombers from Dacca or Jessore or Lalmunirhat had been repulsed by IAF fighters from Kalaikunda or Bagdogra. Our village was too insignificant to find mention of overflights by tail chasing aircraft. Irrespective, we assumed that it would have been the same incident which we witnessed that evening while playing football. Subsequent statements by the CAS, Air Marshal Arjan Singh in some local newspapers were very inspirational, giving confidence to us living on the borders.

This incident changed the course that I steered in my life thereafter. A hidden desire to become a fighter pilot had been ignited. If at all I get an opportunity I must fly a fighter aircraft. That was an impressionable age and the Air Chief's message had generated that desire !

Subsequently, at Ranchi, exposure to the Air Wing NCC, both junior and senior division, certificates A1, A2 and B, aero-modelling and gliding etc were manifestations of this desire. Apart from pursuing academics one was preparing to become possibly an 'Air Warrior'.

While at college, an opportunity to apply for Naval Aviation came my way. My able guide, the OC of NCC air wing, then Flt Lt Vincent Mendonce (Mandy to his friends), encouraged me a lot. The rest is history. Rigorous IAF training, selection to join the fighter stream and later opportunity to become a carrier borne pilot flying Sea Harriers after having flown the Sea Hawks and Vampires was as if rehearsals were turning into real life drama. One also had the great fortune of flying as a student at FTW Hakimpet with likes of Flt Lts Massey and Ganapathy (both VrCs of 1971). One was fortunate to become a QFI and instruct at the AFA as the first Naval Instructor on Kirans.

My strong desire to meet Air Marshal (then) Arjan Singh, who ignited the flame of aviation in me, seemed to remain limited to functions and ceremonials only. Finally my day came for an one to one encounter with the towering legend, Marshal of the IAF, very appropriately in an IAF aircraft ! It was at the Bangalore air show of 2011, when I was posted at the HQ IDS in Delhi. It was thanks to the IAF again, that I got more than my share of flying in various fighter types which were being evaluated for the MMRCA programme. Obviously and rightly, the IAF senior hierarchy would not fly the competing aircraft since a team of ASTE was doing the evaluation. Being a naval pilot I was better placed to fly in public view.

I got an opportunity to fly in the Saab Gripen that morning at Yelahanka. After flying the Gripen sortie, I did not see any more opportunity for any other sortie having earlier flown the Super Hornet. I decided to return to Delhi but it was too late to change the programme, for my return since the Avro earmarked for me was to arrive only next day. Air Marshal 'Ike' Iyer, a dear friend from our QFIng days at AFA, was AOC-in-C Training Command. When I mentioned about my intention to return to Delhi the same day, he looked at his watch and said "The Marshal of the IAF is flying back in his Embraer, why not seek his permission and go with him?" I shot off to airport immediately and sat with AOC-in-C till the great legend arrived. I gave the best Naval salute of my career to the Marshal and requested his permission to take passage in his aircraft. I received very heartening response " Ho Ho Ho Ho, my brother naval aviator, all brethren can fly in my company". I rushed to board the aircraft after giving my details to the Captain of the aircraft who was waiting to receive the Marshal.

Up in the air I walked upto the cockpit, as Captain of the aircraft seemed to have known me and mentioned a few names of my friends in the IAF. Naval Aviators have great bonhomie with the IAF, they being the alma mater of flying profession. It was very normal feature those days for senior aviators to get a feel of aircraft at the co pilot's seat while the Captain retained overriding control at all times. I enquired if I could try my hand. The Captain was kind enough to let me come on the right seat. I managed to progress the flight till descent into Delhi had been established. We then heard a very commanding voice in the cockpit. It was the Marshal. He quipped "I was wondering as to why the aircraft was flying smoothly while there is turbulence in the descent!" I got the hint, jumped out of the right side seat and handed controls to the Great Marshal and made a hasty retreat to my seat in the cabin.

I was pleasantly surprised with the smooth touch down at Palam with the legendary Marshal at the controls or "quality at the controls".

There will be no Marshal like you, legendary Arjan Singh sir. Your Chief's tenure during the 1965 war made me dream to fly at an early age. As I saluted his mortal remains at Brar Square in Delhi Cantonment on 18 September, fallen in a column along with my friends, former AOC-in-Cs. I whispered "Marshal, Rest In Peace, you have inspired many of us who stand here and pay our respect, there will no other Marshal Arjan Singhs".

Just then 3 Sukhoi Su-30s flew over in 'Missing Man' formation…….

Last salute to Marshal of the IAF from a Naval Aviator and former 'Grey Eagle'…….

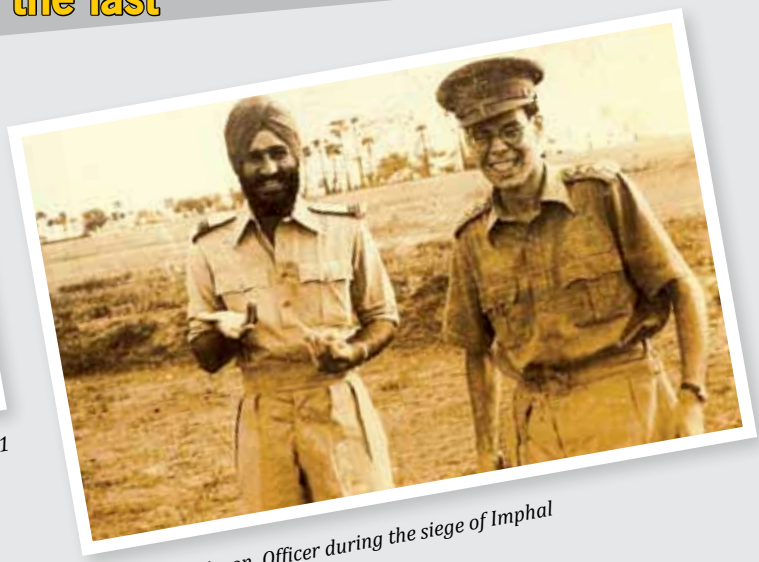
Vice Admiral Shekhar Sinha(Retd),

'Missing man' formation flown by Su-30MKIs of No. 220 Squadron

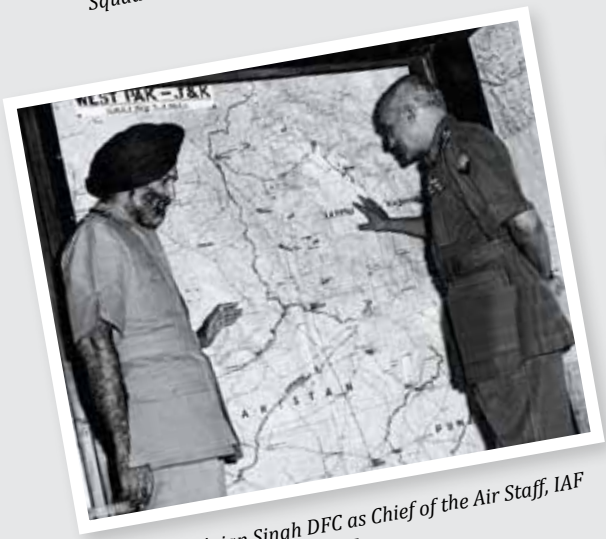
The Great Marshal and his Air Force

Some images from 1944 till the last

Sqn Ldr Arjan Singh with Hurricane Mk.I and officers of No.1 Squadron ('Tigers') at Imphal in 1944



With Army Liason Officer during the siege of Imphal



Air Marshal Arjan Singh DFC as Chief of the Air Staff, IAF during the September 1965 War

After the ceasefire, with his opposite number, recent adversary and former colleague, Air Marshal Nur Khan, CAS PAF at Peshawar

Reminiscing in his study, Marshal of the Air Force Arjan Singh with models of the Hurricane and Spitfire, amongst the 60 aircraft types he flew during his service, in war and peace

The last salute ! Marshal of the Air Force Arjan Singh at the Air Force Day Parade at Hindon in 2016

Chief Speak !

Air Chief Marshal Birender Singh Dhanoa, CAS IAF on

Six fighter types of the Indian Air Force on parade

"Joint Operations and Indigenisation"*

The IAF is often blamed for not participating whole heartedly in joint operations and (supporting) indigenisation. As regards Joint Operations, one has to commence with a historical perspective.

Operations in 1948, 1962, 1965, 1971

During the 1948 Kashmir Operations, there were limitations imposed on the use of air power by a higher political directive immediately after independence, and this is not to be misconstrued as lack of jointness. Offensive air action was limited owing to restrictions imposed by (the then Governor General) Lord Louis Mountbatten and senior British officers, lest the war between the two new nations escalate.

In the 1948 Kashmir Operations (the RIAF's) Nos. 7, 8, 10 & 12 Squadrons participated. The Operations were limited to direct support of troops and there was no air interdiction outside own artillery range. There was no interdiction of (vital) bridges (Kohala for example) and thus the Army did not count much on the IAF's support.

During the 1962 Indo-China War, the IAF was not inducted into the conflict due to fear of escalation, as there was no defence against retaliatory action by the Chinese. The IAF was only employed to carry out supplies to forward posts in Ladakh and NEFA. Helicopters were employed in the air maintenance role. Transport aircraft were used in improving reinforcement of troops and to fly AMX-13 tanks to Chushul.

In 1965, the Army and the IAF fought their own wars, with the latter pitching in when called upon. In fact, Akhnoor was saved due to the lightning response to a call for close air support to stop the attacking Pak armour, which was carried out with aplomb by the IAF fighters. The IAF flew about 1400 of a total 3927 sorties in the west for offensive air support to the army. Of these, only 482 sorties were planned at the JAAOC level.

Air Chief Marshal PC Lal later observed: "Having had some responsibility for all this, I must confess that the air war became a somewhat hit-and-miss affair that depended heavily on finding targets of opportunity for its success."

On the other hand, Lt General Harbaksh Singh (then GOC-in-C Western Command) mentioned in his 'War Dispatches' that joint organisations did not work properly because "professionally 'Below Standard' army officers manned GLO Type 'B' & 'C's and out of the authorised total of 43 Ground Liaison Officers, the army had only 12".

He further stated that "Having suffered a rebuff in the Khem Karan Sector, the enemy's ace 1st Armoured Division with Patton tanks was able to transfer, by railways, two Regiments of tanks through the plains of Lahore without any interference from our Air Force. They inducted these in the Sialkot Sector. "This was because we had not carried out a joint appreciation on the enemy's course of action".

Again, as observed by Air Chief Marshal PC Lal, in 1965 "On the Army's side the notion persisted that it would fight on its own, with the Air Force providing only an occasional bonus: and in the Air Force (where I was the Vice Chief), we thought of fighting mainly an air war against the PAF and what we considered to be strategic

targets, assigning relatively low priority on support to the Army. Separate plans were hastily drawn up by each service with no joint consultation worth the name and again no tasks were envisaged for the Navy".

Jointness

Long reach of the IAF is augmented by mid-air refueling such as seen here with Il-78MKI and Jaguar strike fighters

To correct our deficiencies in jointness, by 1971 the IAF had realigned its geographical boundaries with Army Commands : Western Commands of the Army and the Air Force and South Western Commands of the Army and the Air Force were similar in geographies. Directorate of Joint Operations was formed at Air Headquarters headed by an Air Commodore. Advance Headquarters were co-located with Army Commands. TAC were formed alongside Corps HQ and FACs were placed along with Battalion Headquarters. Similar organisations called MAO and MEAF were placed alongside Naval formations. The 1971 war was won not individually but jointly. Some spectacular demonstrations of jointness were seen in the Tangail paradrop, heli-bridging in East Pakistan (Sylhet) and large percentage of CSFO missions on both fronts.

Kargil 1999

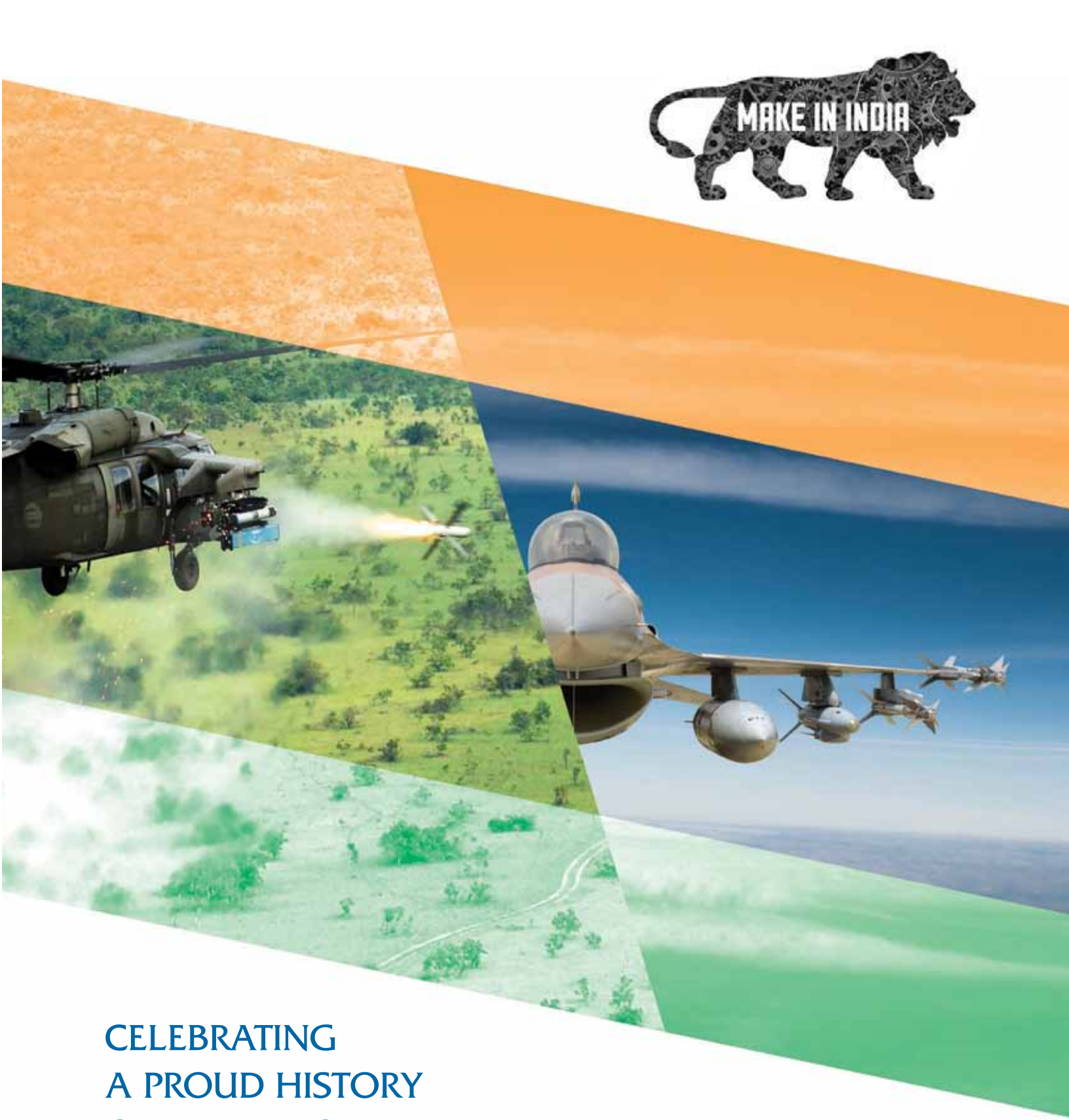
The Kargil War in 1999 was a surprise with the Army not realising that it was not a handful of terrorists, but a sizeable portion of Pak Infantry and Artillery which was executing the plan. This was in spite of aerial photographs taken by the ARC that located six Pakistani military helicopters on our side of the LoC on 17 May. The analysis failed to reach Army Headquarters until 19 May with the IAF not being in the picture. In a cabinet level meeting on 18 May, the then Foreign Minister Jaswant Singh was instrumental in denying permission to use Air Power in the conflict for fear of escalation.

Upgraded Mirage 2000(TI)

But a more important factor needs understanding when using Air Power in view of its potential consequences. All armed conflicts contain elements and processes of escalation – the first artillery shell fired is an escalation, and so is the use of tanks, etc. Use of combat air power is not any different. The critical factor is that when we escalate the level of war, or the employment of components of military power, the type of weapons and so on, we must carefully assess the implications and likely responses of the enemy. It would be reasonable to accept that the enemy would also try to escalate, at least to similar levels if not more than that, if it can, to cope with the higher level of violence and/or changed nature of conflict and its effect. An ability to deal with the situation where own advantage is maintained or even maximised further is the critical factor in ensuring escalation dominance. Thus, the CAS would have been less than responsible if he had not catered for a possible/ probable response by Pakistan to the use of IAF combat power. After all, Pakistan having completely mobilised by 14 May and being fully deployed in 48 hrs *(as per Air Commodore Kaiser Tufail)* could have launched its aggression. Its possible choices in response to IAF combat operations would have been to use its own combat air against Indian Army targets in J&K, or expand the conflict to attacking IAF bases in J&K, and beyond that to those in the rest of India. We obviously then would have slid into a full-scale war *(as per Air Commodore Jasjit Singh).*

Some significant issues related to such an eventuality deserve our attention. One of them is the generation of a great deal of heat, though not much light, regarding the issue of the Air Force stressing that political authorisation must be obtained before combat air power is used in conflict. Many people have interpreted this as a failure of 'jointness' and others have used this controversy to justify the creation of theatre commands.

It is in the context of escalation, that the Air Force requires notice to place its formations on alert, moving forces wherever required. But the sheer act of placing the Air Force on operational alert also has major domestic and international political implications and this makes it necessary for the political leaders to authorise it. In an emergency, of course, the Air Force can



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react quickly, and the then Air Chief had offered to commence combat air operation in as little as six hours.

Attack Helicopters

Work horse of the IAF's rotorcraft fleet is the Mi-17, some operated for ground attack with unguided rockets

But what was the Army demanding ? They wanted attack helicopters (Mi-35). These attack helicopters could not operate at these altitudes because they were not designed for it. They also wanted armed helicopters (Mi-17s with unguided rockets) to assist in throwing back what was believed to be infiltration by militants. But helicopters, especially those using unguided rockets, are extremely vulnerable to modern ground fire since they need to come to less than 1000 metres range of the targets and even overfly soldiers firing small arms and Rocket Propelled Grenade (RPG) launcher type of weapons. It is worth recalling that nearly 30 US helicopters were damaged to the extent that they had to abort their mission in the 2003 Iraq War (at Kabala) as a consequence of such strikes. The IAF requested for clearance from the Government for use of combat air power in close proximity to the borders, and suggested that fixed wing assets were more suitable given the nature of the terrain and expected opposition.

To quote Air Marshal Narayan Menon in his book 'Kargil–10 Years After', these were incorrectly brushed aside as 'non-cooperation' or 'lack of jointness' by Army officers. Helicopters in the high mountains are even more vulnerable since the resonance of their rotor blades give their location away many minutes before they are anywhere near their targets.

Involving combat Air Power thus demands decision-making by the political executive on the advice of the military at every step. At the CCS meeting on 24-25 May 1999, the then Prime Minister, while authorising combat Air Power, had designated 26 May as the date for the IAF to commence operations.

Professional approach

The intention is not to boast of our capabilities, but we entered the conflict in a professional manner. As the situation started to deteriorate during the middle of May, the IAF began reconnaissance and surveillance flights and also training for the unique conditions in which it would have to fight once the government gave the green signal. Innovation and out-of-box thinking were the need of the hour. For the first time MiG-21s carried out GPS-assisted bombing at night over mountainous terrain and the newly procured Litening pods meant for Jaguars were operationalised on the Mirage 2000 as the integration time was comparatively less.

To quote General VP Malik, the then COAS, Air Land Ops was the thrust area during Kargil. He paid the highest compliment in his book to the Indian Air Force when he concluded that the IAF

IAF C-130J Super Hercules demonstrates rough-field abilities (photo: Angad Singh)


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influenced the war at the strategic level. He affirms: "As the magnitude of the intrusion became clear, it became necessary to employ air power for various purposes: to support ground operations; to carry out reconnaissance to interdict enemy supply routes and logistics bases; to destroy enemy footholds; and most importantly, to establish strategic and tactical superiority over the enemy".

Command Structures

However, post these wars, the Indian Army found the necessity of increasing its Command (structure) with Western Command being divided into Northern and Western and South Western into South Western and Southern. To ensure integration, the IAF created additional Advance HQs with the newly formed Commands but maintained its own Operational Commands to ensure centralised planning and decentralised execution. Today, we have Advance Headquarters at all Operational Army Commands and TACs at all Corps Headquarters. In addition, we also have hundreds of FACs to be mobilised, should hostilities break out.

The IAF *yojna* is prepared for a two-year period jointly with both the Army and Navy.

Today, we have two squadrons of fighters modified and dedicated for maritime role, more than 100 aircraft dedicated for CSFO with others also directly or indirectly for Air Land Operations : the most expensive Special Weapons such as Harpoon anti-ship and SFW for anti-ship and anti armour roles. At Air Force, Army and Naval Headquarters (ACAS level), we have the Joint Operations Committee Meetings (JOCOM) which integrates us and provides higher directions for joint operational plans. To execute joint operations at the Andaman & Nicobar Command (ANC), a theatre command has been formed with appropriate contribution by the IAF as the deployed forces are too far from the mainland to be able to assist operations against Pakistan or China.

We today have voice communication between the Services. Data connectivity will be available once DCN operationalises and a more seamless communication will be available once the Army's and Navy's integral networks stabilise.

The IAF's 'big stick' : HAL-built Su-30MKI with Ilyushin Il-78MKI

Dedicated for maritime strike are modified Jaguars and Su-30MKIs

Jaguar Maritimes lineup for formation take off

Indigenisation

As regards indigenisation, it needs reiteration that you can walk without technology, you can sail or swim with some technology, but you cannot fly without technology. If a vehicle or a ship comes to a halt you can get out of it and tow it. From an aircraft either you eject with a total loss of a machine – or die.

The standards set for aerospace are therefore, exacting.

Secondly, do we have the luxury of time?

Brazil signed a contract for 36 new generation Gripen aircraft in September 2015 for deliveries starting in 2019. The bottom line is they have no enemies, there is no inordinate hurry; so development can take its time, whereas we have two nuclear-armed neighbours with whom we have fought wars.

In a situation wherein you enjoy tremendous asymmetry and are able to project power anywhere in the region, should you get delayed, the adversary is not


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HAL's HTT-40 turboprop trainer is being offered to the IAF for basic flying training (photo: Angad Singh)

in a position to threaten you. Then, once again, we have the luxury of time.

So what are the options for us with two nuclear armed adversaries?

If there are going to be no wars, we can wait for the indigenous solution to come in its time, or we start replacing low end weapons first with indigenously developed ones, while we import the best to defeat the enemy. That is exactly what we have followed in all fields.

As (examples) in the acquisition of radars, we got the indigenous Rohini to replace the P-18s radars, the indigenous Arudhra to complement our medium power radars and finally we will get the mountain radars and the long range surveillance radars. In weapons, we started with 1000 lbs bombs, then indigenously manufactured 250/450 kg high speed bombs; now we are testing the indigenous anti tank missiles i.e Helina, the Astra air-to-air missiles and Gautam and Gaurav laser guided bombs.

HAL's light combat helicopter (LCH) is now cleared for productionisation

As for indigenious-developed aircraft, earlier we had the HF-24, now the Tejas LCA and in the future the AMCA. As for surface-to-air missiles, there is the Akash, now MRSAM in collaboration with Israel and finally the LRSAM. In helicopters, from licence manufacture of Cheetah/Chetak, now Dhruv ALH, and in future the LCH and LUH.

Thus, in every field we have a road map for indigenisation. But when we ask for top of the line weapons for the high end fight, we are often accused as being against indigenous platforms or weapons.

Some people say we should get indigenous platforms in large numbers, quoting Stalin who said "quantity has a quality of its own". One has to remember that, firstly, in air combat the asymmetry is quite stark. In 1982 Lebanon conflict, the ratio of losses was 85:2 in favour of the Israelis : can we afford a victory that may turn out to be Pyrrhic ?

What ails our indigenous drive is the quality control in manufacturing, which has shown an improvement over the years but we (still) have miles to go.

It is stressed that the IAF does not pay only lip service to indigenisation. We have paid with the lives of our test pilots and engineers. Since independence,

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The Dassault Rafale will give the IAF a tremendous boost in operational capability

17 pilots and engineers have died in air accidents during testing and evaluation of the indigenous Marut, Kiran, Ajeet, Saras and AWACS prototype aircraft.

In conclusion, it is re-iterated that the IAF is committed to both joint operations and indigenisation. All future conventional wars are invariably decided in the air. If you lose the air battle, there is no way you can succeed on the ground or over the sea against a conventional enemy. Air is one dimension that extends over both land and sea. Rome built roads to become a land power and subsequently Britannia ruled the waves through its sea power. But post the Second World War, the pre-eminence of air power against a conventional enemy has been firmly established.

The problem lies in the fact that both land and naval forces need air power to achieve their military objectives. The Air Force does not require direct support of either of the two services. The IAF is a multi-sector force and new aircraft like the Rafale are omni-role in their capability. You cannot tie this down to any one sector, unless you are limited by geography, wherein assets in a geographical area cannot be applied in another akin to the US theatre commands.

The Tejas light combat aircraft has just entered service with the IAF

The IAF fights to achieve the stated military objectives. In 1971, the objective was to liberate Bangladesh; so once the requisite air superiority was achieved, all sorties were flown towards close air support. Even air defence missions were stopped. In Kargil, the objective was to recapture posts occupied by the enemy; so again, most missions were battlefield air strikes.

No nation can afford to become a great power without having indigenous capability. The IAF fully supports it, but this has to be a step-by-step approach and critical items required have to be imported, if need be. The Government's push towards defence manufacturing in the private sector is a welcome step. This will compete with the public sector like it happened in telecom and create an eco system for manufacturing in the aerospace sector – the kind of fillip the automobile industry got with advent of the Maruti car.

***Adapted from the 'Air Chief Marshal LM Katre Memorial Lecture' delivered by Air Chief Marshal BS Dhanoa, Chief of the Air Staff on 9 September 2017 at Bangalore.**

SU-30MKI

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Ground Realities

Not so long back, India had prided in its Air Force which was three times the size of its western adversary, the Pakistan Air Force and possessed a far more modern combat aircraft inventory than that of China's. Sadly, this has changed in the last two decades. The IAF is today down to some 32 combat squadrons, vis-a-vis the authorised 42, and the IAF's edge over the PAF is at an all-time low ratio of 1.5:1, instead of the desired 3:1.

China has an increasing number of state-of-the-art indigenously developed aircraft programmes which include two stealth fighter aircraft, a modern heavy transport aircraft and two attack helicopter types already in service. With China's defence budget being over three times that of India's, they will continue to pull away and surge ahead. Meanwhile, the IAF's acquisition plans have been mired by slow decision making and the very long delayed development of the indigenous Tejas LCA.

At the current pace, it may take the IAF another 15 years to reach the authorised 42 combat squadrons strength. A two-pronged approach is thus required to get back on track : drive hard the 'Make in India' plan, and accelerate procurement of already selected systems.

IAF current combat assets

The IAF's top-of-the-line air dominance fighter, with significant ability for surface strike, is the Sukhoi Su-30MKI, with 272 on order and already some 230 in service as on date. Three squadrons of MiG-29s are being upgraded jointly with Russia to UPG standards, as are 50 plus Dassault Mirage 2000 aircraft, brought up to Mirage 2000-5 Mk.2 standards with modern avionics and new weapons. The IAF has six squadrons of the Jaguar DPSA and two of

The IAF's fleet of Mirage 2000s are being upgraded to 'I' standards

The EMB 145 as platform for DRDO's AEW&C programme (photo: Angad Singh)

the MiG-27UPG dedicated strike aircraft, and both these types have been upgraded. 125 MiG-21Bisons (less attrition) are presently retained in front line service but will have all gone by 2025. The indigenous Light Combat Aircraft was meant to replace the large numbers of MiG-21s, but three decades after the programme began, the first IAF squadron with Tejas Mk. I aircraft has only recently been formed, to be full squadron strength only by end 2018.

Amongst the IAF's strategic assets are three Beriev A-50 platform-based EL/W-2090 Phalcon AWACS and two more are on order. The DRDO have worked on their own AEW&C programme involving EMB 145s and two have been handed over. Other force multipliers are in the shape of Ilyushin Il-78 mid-air refuellers, but the present strength is grossly inadequate for the IAF's operational tasks.

India's Armed Forces operate IAI Searcher II and Heron UAVs for reconnaissance and surveillance while numbers of IAI's Harpy anti-radar loitering munition are reportedly in the inventory.

DRDO's Centre for Airborne Systems (CABS) is developing Embraer EMB-145 regional jet-based AEW&C with a dorsal-mounted Active Array Antenna Unit (AAAU). The DRDO is also developing a Medium Altitude Long Endurance (MALE) UAV 'Rustom' to supplement Heron UAVs in service. Then they are developing the AURA (Autonomous Unmanned Research Aircraft) an Unmanned Combat Air Vehicle (UCAV) which will be a tactical stealth aircraft built largely with composites, and capable of delivering laser-guided strike weapons.

The Transport Fleet

One hundred Antonov An-32 medium transport aircraft remain workhorses of the IAF and have recently benefitted from an avionics upgrade (some aircraft also have been assigned a bombing role). The few remaining Avro (HS)748s are being used for communications duties, replacement for these same being sought, with the Airbus C-295 as its identified successor. There are 17 Ilyushin Il-76 strategic airlifters, augmented by ten Boeing

An IAF Boeing C-17 Globemaster III strategic heavy airlifter

C-17 Globemaster IIIs (an additional aircraft was just ordered). The IAF has five Lockheed C-130J Super Hercules for special operations and these will be joined by another six in the near future. 56 C-295Ws are reportedly to replace the HS-748 fleet, the first 16 of which will come from the Airbus plant in Spain with the remaining 40 to be built in India by a consortium of Airbus Defence and Space and Tata Advanced Systems.

The HAL-Dornier 228 light transport aircraft serves in the light logistics and staff transport role while large numbers are employed for multi-engine conversion training.

Flying Training

The Indian Air Force has selected the Pilatus PC-7 Mk.II for stage I basic flying training and these are planned to be augmented by the indigenous HTT-40 after its clearance for service. Pilots proceed to Stage II on the HAL Kiran Mk.II and then after selection move to Stage III on the HAL-BAE Hawk Mk 132 advanced jet trainer. The Hawk is also being assigned a combat role even as the IAF's formation aerobatic team *Surya Kiran* have also converted to the Hawk.

Pilatus PC-7 MK.II

Helicopters

HAL-built Chetak and Cheetah light utility helicopters (and the re-engined variant Cheetal) are being augmented by HAL Dhruv ALHs, while early version Mil Mi-8 and Mi-17 medium lift helicopter are being supplanted by modern variants, the Mi-171V, and Mi-17V5. The IAF's heavy lift Mi-26 helicopters and Mil Mi-25/35 attack helicopters await supplementing by Boeing Chinooks and Apaches in the near future. The Kamov Ka-226T has been selected to become India's Light Utility Helicopter to replace the Chetak and Cheetah with a plant in India to manufacture 140 of these. However, HAL have developed their Light Utility Helicopter (LUH) and are preparing to produce 187 of these for the IAF and Army.

The IAF has ordered some 65 HAL Dhruv ALH and some numbers of HAL Light Combat Helicopters (LCH) plus 38 Rudras (the Weapon System Integrated (WSI) variant). The IAF has recently sent out a request for information (RFI) for an unmanned combat air vehicle (UCAV) with low radar cross-section, high service ceiling, 925 km range and capability to carry precision-guided weapons in an internal weapons bay.

Fighter aircraft upgrades

The Su-30MKI serves in very large numbers with the IAF and some are being modified to carry strategic weapons including the BrahMos supersonic cruise missile and possibly in the future, nuclear-capable Nirbhay cruise missiles. Initially, 40 aircraft are to be modernised with Active Electronically Scanned Array (AESA) radar, new generation onboard computers and modern Electronic Warfare (EW) suite.

Then the MiG-29 : after upgradation, this type has increased multi-role capability, with more internal and external fuel, an aerial refuelling probe, new avionics including the Zhuk-M radar and advanced air-to-air missiles. As for the Mirage 2000(I) upgrade, this gives the French-origin multirole fighter a RDY-2 radar, new mission computers, a glass cockpit, helmet-mounted sight, EW systems and MICA missiles, while its airframe life is also being enhanced by 20 years.

Sukhoi Su-30MKI (photo: Angad Singh)

A number of Jaguars are being upgraded to DARIN III standard

HAL-built Jaguars are being upgraded to the DARIN III standard, and incorporate a multi-mode radar, new avionics architecture including the mission computer, engine and flight instrument system, solid state digital video recording system, solid state flight data recorder, additional inertial global positioning system, better electric power source, an autopilot and Radar Warning Receiver. The DARIN III Jaguar will have two MFDs and a modern head-up display. All Jaguars will be upgraded by December 2017 and with life extension, will serve the IAF till 2035.

In the IAF's original plans, some 14 LCA squadrons, with 294 aircraft, were to replace the MiG-21s in service. However, owing to the long gestation period and performance shortfalls, the IAF has ordered 40 Tejas LCA Mk.Is and, instead of waiting for the LCA Mk.II, has projected requirements for 83 Mk.IAs. While the Mk.I will receive Final Operational Configuration (FOC) in 2018, the Tejas Mk.IA is to be equipped with AESA radar, an EW suite and mid-air refuelling probe. Meanwhile, work is in progress to reduce the LCA's weight, with some modifications for easier service maintainability. The Tejas Mk II was to have the more powerful F414-GE-INS6 engine with 98 kN of thrust, the 'Uttam' AESA radar to be developed by DRDO with a foreign partner under selection and a new EW suite and modern glass cockpit. The IAF had committed to procure an initial 105 Tejas Mk IIs, but induction into service in 2022 seems unrealistic.

The MMRCA requirement was the consequence of continued delays in the LCA programme and after nearly 15 years of evaluation, the Dassault Rafale was ordered, but the programme was changed with the original requirement for 126 reduced to only 36 'flyaway' aircraft. This has meant that there will be a considerable shortfall in the IAF's inventory for new-gen fighters: the IAF requires nearly 500 new combat aircraft by 2030 to compensate for phasing out of existing fighter and to make up for the existing shortfalls. This has spurred the Government to seek new single-engine fighters. On 3 January 2017, Defence Minister Manohar Parrikar had announced plans for a competition to deliver hundreds of new single engine fighters, Made-in-India. The Lockheed Martin F-16 Block 70 and Saab Gripen E are obvious contenders, the selected type to be built in India with an Indian company nominated as the 'strategic partner'.

The FGFA and AMCA

HAL has been involved in developing the FGFA (Fifth Generation Fighter Aircraft), a derivative of the Sukhoi PAK-FA, as a joint programme with the Russians. In parallel, as a follow-on to the LCA programme, the Aeronautical Development Agency (ADA) have been working on their 5th generation

The Tejas LCA has now entered series production at HAL's Bangalore Complex

The Reality

The long delayed timelines in getting the LCA into operational service has greatly affected the IAF's planning and in turn, its operational capability. To replace the phased out MiG-21s/27s and to make good the shortfall of 9-10 squadrons would require large allotment of funds. On an average, a midsized fighter aircraft will cost US$ 50 million. To acquire some 15 squadrons of these over next 10 years, US$ 14 billion will be required for the new aircraft, weapons and ground infrastructure adding up to much more.

With the LCA still far from its fully operational state, ADA needs to choose a global partner for its ambitious AMCA programme, certainly for core technologies, but this should be linked to 'Make in India' initiatives with either the French (Rafale), or with selected single-engine fighter aircraft OEMs: Americans (F-16) or Swedes (JAS-39).

In the budget 2016-17, US$ 41 billion were earmarked for defence, but most of that meant for new acquisitions was taken away to meet committed liabilities for earlier procurements. India must plan not only for stand-alone confrontation with either China or Pakistan, but also a two-front war with Sino-Pak collusion. Thus, the IAF's combat strength should in fact be projected at 45-50 squadrons. This is the reality !

Rudra: the armed ALH

stealth multi-role Advanced Medium Combat Aircraft (AMCA). Projected as a 20 ton-class aircraft, this would replace the legacy Jaguar, Mirage 2000 and MiG-29s from the early 2030s. The IAF requires around 250 AMCAs.

Army and Naval Air Arms

In reality there are another four air arms in India, including those of the Army, Navy, Coast Guard and Border Security Force. The Indian Army currently has some 150 helicopters comprising the HAL Chetak-Cheetah, Dhruv ALH, and Rudra, more of the latter with 114 HAL LCHs also on order. The Indian Army has also requested for 39 Apache helicopters but a final decision has still to be taken in this regard.

The Indian Navy's requirement for large numbers of multirole helicopters, to replace the current Sea Kings is assuming urgency as is its need for new utility helicopters to replace the present Chetaks. There are a score of Kamov Ka-28s and Ka-31 AEW helicopters in its inventory.

The Navy has for long operated fighters for its aircraft carriers, and after phase out of the VTOL Sea Harriers, has now some 45 MiG-29Ks for operation from its sole aircraft carrier. With another due for commissioning in a few years, the Government has recently issued an RFI for 57 carrier borne fighters.

For the long range maritime patrol/ ASW task, the Navy operates the modern Boeing P-8I Poseidon, an initial eight to be followed by another four. There are eight Tupolev Tu-142Ms (now retiring) and five Ilyushin Il-38s, plus nearly 40 HAL-Dornier 228s for maritime reconnaissance, anti-submarine warfare and Information Warfare tasks.

Air Marshal Anil Chopra (retd.)

Indian Navy MiG-29 KUB takes off from Dabolim (photo: Angad Singh)

‘Flying Daggers’ Fly Again

Resurrection of No.45 Squadron, Indian Air Force

As Indian tradition has it, and before No.45 Squadron, the ‘Flying Daggers’ was officially resurrected in the Indian Air Force, there was a multi-religious ceremony at HAL’s airfield in Bangalore when a Pandit, Granthi, Maulvi and Priest chanted prayers for the success of this unit and its new fighter aircraft type inducted by the IAF. Thus, on 1 July 2016, No.45 Squadron officially returned to the IAF’s order-of-battle, albeit still in nascent stage with only a handful of ADA-designed, HAL-built Tejas Mk.1 light combat aircraft in its inventory. These were Series Production (SP) 1 and 2, which have followed the production of seventeen earlier LCAs built since the programme began in late 1983. Of these, two had been ‘Technology Demonstrators’, five were ‘Prototype Vehicles’, eight ‘Limited Series Production’ LCAs while two were ‘Naval Prototypes’.

The first Commanding Officer of No.45 Squadron in its new *avataar* is Gp Capt Madhav Rangachari, an experimental test pilot but also having considerable operational experience on the Mirage 2000 and MiG-21 variants. It is interesting that the last fighter type that No.45 Squadron operationally flew some 14 years earlier was the MiG-21bis with which it was equipped before being number plated in 2002.

Going back six decades, the first fighter type which equipped No.45 Squadron on raising at Palam on 20 November 1959 was the Vampire FB Mk.52 twin-boomed fighter-bomber and the rapidity with which it was ‘operationalised’ under the command of Sqn Ldr MS Grewal was demonstrated when within two months of raising, its entire strength of sixteen Vampires flew in four boxes of four aircraft each over Rajpath during Republic Day on 26 January 1960. No.45 Squadron continued to be based at Palam and also provided an aerial escort to President

Multi-faith prayers for the Squadron

Painting of IAF Vampires in action over Chhamb, September 1965 (by Deb Gohain)

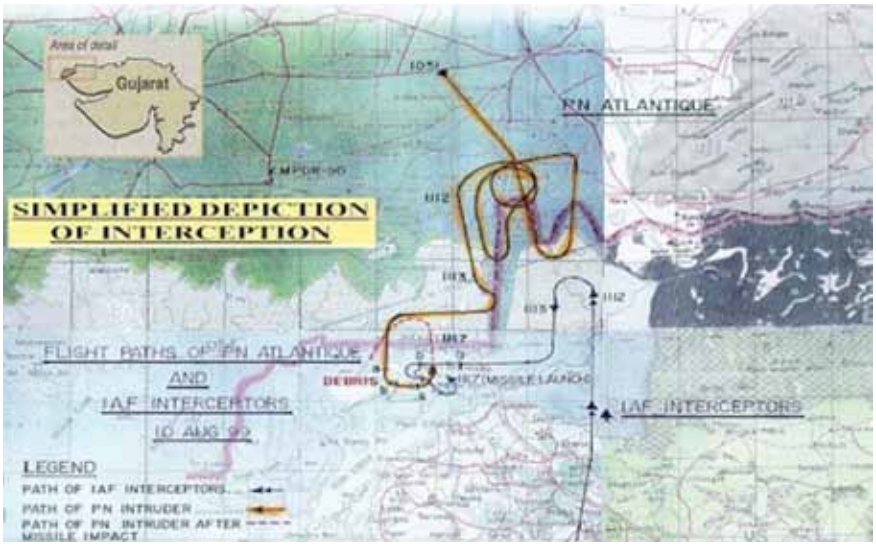
Nasser of Egypt when he visited India that winter.

In October 1962, on eve of the frontier war with China, the Squadron moved to Adampur in the Punjab and thereafter Sarsawa before being moved to Poona in February 1964, entrusted with the task of operational training. It was No.45 Squadron's fate to be located at Pathankot on the Punjab. Kashmir border on the eve of the Indo-Pakistan War of September 1965 and in fact they were first into action on 1 September 1965, launched at very short notice to blunt the massive Pakistani armoured thrust in the Chhamb-Jaurian sector.

The first formation of four Vampires was led by the CO Sqn Ldr SK Dahar, which targeted invading enemy armour with rockets and cannon even while a second formation followed them. However, by this time PAF Sabres had been vectored into the area and the obsolescent Vampires were no match, four of them being shot down. The mantle was thereafter assumed by the more modern Hunters and Mysteres of the IAF, and the Vampires were withdrawn to Hindon for secondary tasks.

After the war, No.45 Squadron was re-equipped with the supersonic MiG-21FL in February 1966 and based at Chandigarh where it remained for the next seven years even while it was tasked for operational conversion training even as the IAF was receiving increasing numbers of this tailed-delta supersonic fighter. During the December 1971 Indo-Pak war, the squadron now commanded by Wg Cdr SK Anand, was assigned the task of air defence of Chandigarh with detachments at Amritsar and Pathankot. MiG-21FLs provided top cover to IAF Sukhoi Su-7s on offensive air missions, including those against the major PAF base at Sargodha. Towards the end of the war, on 17 December 1971 a pair of MiG-21s intercepted enemy Sabres but unfortunately one MiG-21 was hit during combat, the pilot ejecting and being captured as a POW.

In July 1973, No.45 Squadron moved to Bareilly to continue its role as an operational conversion unit before moving east to Hashimara in the Dooars in May 1978 and then back across the country to Jamnagar on the Gulf of Kutch where it was re-equipped with the MiG-21bis in April 1982. The Squadron remained at



Gp Capt Madhav Rangachari in cockpit of Tejas LCA

Production of Tejas LCA Mk.1s at HAL Bangalore is being stepped up

Air Marshal Jasbir Singh Walia, Air Marshal RKS Bhaduria with Gp Capt Madhav Rangchari at Bangalore

Following the religious ceremony at Bangalore's HAL airfield on 1 July 2016, Gp Capt Madhav Rangachari, CO No.45 Squadron met with Air Marshal Jasbir Singh Walia, AOC-in-C Southern Air Command, Air Marshal RKS Bhaduria, DCAS, T Suvarna Raju Chairman, HAL and Dr S Christopher, head of the DRDO. According to Chairman HAL, production of the Tejas LCA Mk.1 is being ramped up at two dedicated production lines at Bangalore even as Prime Minister Narendra Modi tweeted that this is a matter of "unparalleled pride and happiness … this illustrates our skills and strengths to enhance indigenous defence manufacturing".

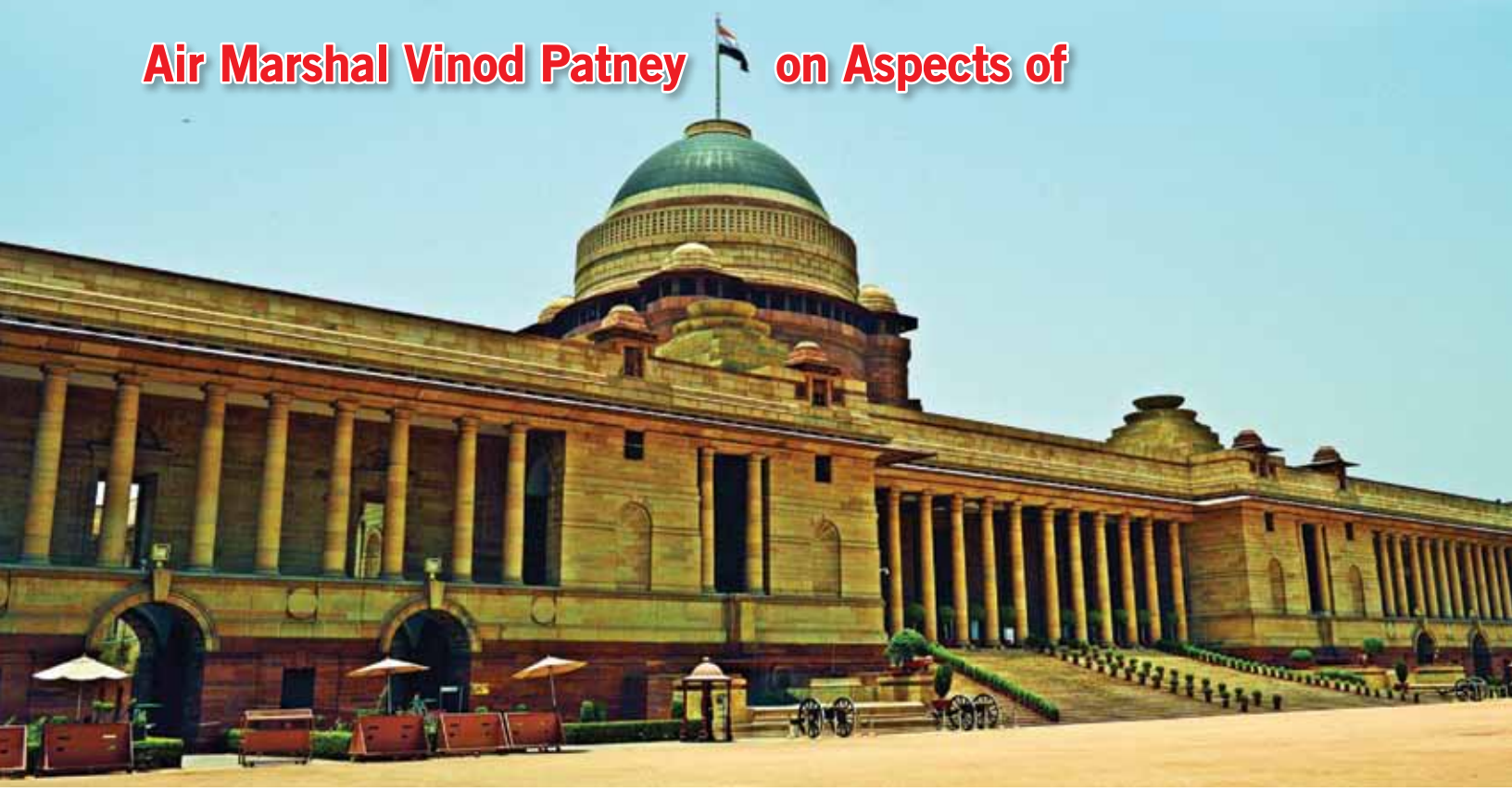
Over the next 12 months HAL produced and delivered five LCA Mk.1s to the Indian Air Force at Bangalore and it is projected that by end-March 2018, a total of 10-12 LCAs would have been handed over, all single-seaters and in the following F.Y., the remaining 4-6 single-seaters and four twin-seaters would be produced. Thus it would only be by end 2018, that No.45 Squadron could conceivably move to its permanent base at Sulur (near Coimbatore) with its full unit establishment.

this western extreme of India for the next decade, completing its tour at Naliya when two of its MiG-21s intercepted and shot down an intruding Pakistan Navy Atlantic over the disputed Sir Creek on 10 August 1999 (*see official map representation*).

Owing to increasing obsolescence of the type, the MiG-21bis squadrons were gradually phased out and No.45 Squadron too was affected, being number plated in 2002, and so remaining in suspended animation till its resurrection fourteen years later.

Line up of Tejas LCA Mk.1s (photo by Deb Rana)

Air Marshal Vinod Patney on Aspects of



Higher Defence Organisation in India

Changes required in the Higher Defence Organisation of our country have been subject of constant debate, with many - and diverse - views continuing to be aired. A common denominator seems to be dissatisfaction with the existing state of affairs. The need to improve on existing templates is a laudable thought, but does it require major surgery? Also, must we be taken in by examples of systems obtained from other countries, or should we seek solutions that are more appropriate to our circumstances? Should we blindly ape what others do or use our genius to fashion systems that are more applicable to our needs? What are the changes that could be introduced to advantage? This article addresses these questions and more, the views expressed being personal, not parochial and based on lifetime experiences of my service in the Indian Air Force.

Before any form of surgery on our defence organisation is countenanced, it is pertinent to pinpoint facts in the prevailing system. We have won all the wars we have fought, sans the 1962 border war, and that is by itself sufficient proof of the soundness of our organisation. If a military organisation is essentially established to prepare the armed forces to win wars, our system has stood the test of time. In 1962, our problem was the lack of intelligence and intent, compounded by inadequate preparation resulting in the Chinese taking us by surprise. Possibly, we were also unsure as how to wage that type of warfare. The fact is that no different manner of higher defence organisation would have turned defeat into victory. It is thus logical to conclude that the wars that we have fought since Independence do not make a case for any major change in our organisation.

However, there certainly are areas of concern that should be addressed. Our procurement system is painfully sluggish and laboured. Jointness amongst our services could be improved, relations and mutual confidence between the services and the Ministry of Defence should improve. Perhaps one possible cause of the present state of affairs is inadequate understanding of the other(s) point of view and, maybe, even some doubt of intentions. However, the solution to bring about improvements stare us starkly in the face. We need greater understanding and appreciation of these differing viewpoints, and we must not ever forget that we are on the same side. To my mind, it is a mental challenge and not an organisational limitation. We can, by clear intent, make the system work much better, which is what we should do.

The ongoing debate on higher defence management largely deals with three issues: the armed forces becoming part of the government and active participants in decision making. Also, for greater understanding to develop, officers from the armed forces should occupy berths in the civilian hierarchy and vice versa. This should be done at both middle and senior levels.

Then, the need for a Chief of Defence Staff (CDS) or a Permanent Chairman

Chiefs of Staff Committee (PCCOSC), with his duties and responsibilities clearly defined.

And then of late, the debate whether we should adopt the 'Theatre Command' system in India. These issues require rational review as also civil and military interaction.

Civil-Military Interaction

Proposals regarding cross postings appear attractive and have some merit as these will promote better understanding as long as there is mutual desire to cooperate and some personalities do not undermine the system. We have to be selective in determining the berths that such deputationists could occupy. More importantly, it is not desirable for those posted from outside the system to be given decision making responsibilities as they would lack basic knowledge and instinctive understanding of the systems in vogue. The best is that they would provide in-house domain knowledge, which will be of benefit unless the advice rendered is only subjective which could certainly happen. Still, the deputationists may find the 'work culture' somewhat alien and will have to get used to a new work ethos on joining the new organisation and, again, when they revert to their parent service. Another drawback is that as the deputationists eventually revert to their parent service, they may choose to air only partial views. The proposal to introduce deputationists has its limitations, but the advantage of ready availability of professional advice has considerable value and should be encouraged, with the personnel cautioned of the pitfalls and guided to overcome these. The great plus point of the proposal is that it can be readily implemented without introducing any major changes and the system can easily be modified - or even abandoned - at will. Another aspect that could be considered is that where ever independent advice from more experienced officers is needed, it may be advisable to elicit the help of recently retired senior officers whose knowledge is still current but who may not always agree with the views of their erstwhile service.

Another issue is the advisability of making service officers as part of governance and giving them decision-making responsibilities that are presently the exclusive domain of civil servants. The thought process behind this proposal is that service officers with their professional knowledge will understand various needs better and thereby hasten decision-making processes, particularly in the procurement of hardware. Here, three issues merit examination. Firstly, supposed inefficiencies cannot be overcome by mere change from civilian to service officers manning and even heading berths in the Ministry of Defence. The system in vogue is tried and tested and as improvement progresses, it must remain an ongoing process, as major changes could be counter-productive. Secondly and more importantly, the essential requirement is training for the particular post and continuity in the post and not one who holds it. It is recommended that a high percentage of civil servants in the Ministry of Defence be given sufficient exposure to the armed forces either when they join, say by spending a year or two in armed force units, or whilst in service. This will foster greater understanding of service systems and requirements. Thirdly, and most importantly, conscious efforts should be made to better understand "the other side of the picture" which will foster the belief that all are "on the same side" and working in an individual manner towards a common goal. The tendency to be eschewed is the belief that appointment to a particular post makes for instant expertise. Seeking advice and understanding is not demeaning; in fact, it is a natural necessity.

Ultimate Civil-Military interaction is captured in this photo of Prime Minister Narendra Modi with senior armed forces officers and senior bureaucrats on board INS Vikramaditya during a Combined Commanders Conference

For better interaction between service and civil functionaries, major changes in the MoD's organisation may not be warranted, but incremental improvements should be a continuous process. Above all, it must be emphasised that all those involved should recognise that an organisation cannot function better than the capabilities of the people manning it.

Chief of Defence Staff (CDS)

It is obvious that the terms 'CDS' and 'PCCOSC' Permanent Chairman Chief of Staff Committee are interchangeable and imply that both designations will carry similar responsibilities. The CDS will be supported by the existing Integrated Defence Staff (IDS) and the extant duties of IDS will devolve on the CDS. The suggested duties of the CDS will broadly include such responsibilities as being the single-point of contact for military advice on matters military and administering the Strategic Force Command (SFC). Whenever other Tri-service commands such as Special Operations Command, Cyber Command or Space Command are established, the Commanders of all these Commands will report to the CDS. Besides, the CDS and his staff would ensure greater efficiency and effectiveness in the planning process including procurement and operational planning. Fostering greater jointness amongst the services would also be his responsibility.

As per existing norms, the Integrated Defence Staff (IDS) report to the Chairman Chiefs of Staff Committee (COSC) as do the Commander SFC and the Tri-service Andaman and Nicobar Command. One difference is that unlike the proposed CDS, the Chairman COSC would not be designated as the single point of contact

on military matters. The Chairman is also a rotational appointment and rapid changes have occurred in the past, such changes having been viewed by some as militating against the minimum desired tenure to permit continuity. However, it is argued that the system has been operating for many years and the very experienced Chairman COSC, backed by many three and two-star officers and a considerable staff that comprise the IDS, should not have any difficulty to undertake additional responsibilities. Hence, it is opined that the current system should be left unchanged for the present. As and when new tri-service commands are established, the institution of a Permanent Chairman makes sense as he would then be required to oversee and control functioning of the tri-service commands to meet the needs of all three services. The Chairman COSC may find the workload of overseeing the work of three or four additional commands whilst retaining the responsibilities of his parent service as excessive. The question whether the task of PCCOSC should also include the responsibilities mentioned above needs to be addressed.

CDS as single point for Military Advice

On the face of it, seeking professional advice from a single source on all military issues appears to presume existence of one person with inherent super human powers of in-depth understanding of all issues concerning the armed forces. This is beyond what can be expected of a mere mortal! The concept is flawed as we are in an age of specialisation and even super specialisation, and whilst generalists have their place, it will always be prudent to seek advice from those best qualified to provide this, particularly so in case of operational plans which holds true too for recommending defence equipment procurements. Of course, corporate decision making has many advantages. A single individual cannot be contacted in every case. If the manner of single source for advice is adopted, the CDS would often have to seek professional guidance from others. His recommendations would be based on secondhand information and if a discussion ensues or supplementary issues arise, the CDS will be hard pressed to make the best views available. It should also be recognised that, in the absence of adequate data, which is often the case, one has to rely on intuition which is itself the result of firsthand experience. There is no substitute for experience. Be that as it may, it is also more than likely that views of the CDS would be biased perhaps even unintentionally. We can and should do better. Each Service has its core competencies, a fact to be accepted by all. Within each Service there are sub specialisations and in each case, there will probably be more than one expert. Even the head of a particular service often seeks the views of more than one individual, discusses the pros and cons of differing thoughts before arriving at a plan or a recommended course of action. If this obtains in a single service environment, the situation would be far more complex in inter Service considerations.

Another issue merits consideration. The CDS would obviously be from one of the three Services and it is inadvisable to make him responsible for the conduct of operations, which should remain in the realm of individual services. This cannot be over emphasised. The CDS would seek views from heads of the three Services and he would naturally be more agreeable and amenable to advice from those NOT of his parent service. Differences of opinion could arise where his thinking is considerably different from that of the head of his own parent service. A piquant situation could certainly then arise, one which must be avoided.

The concept of the CDS providing a single point of advice should be considered as being "still born".

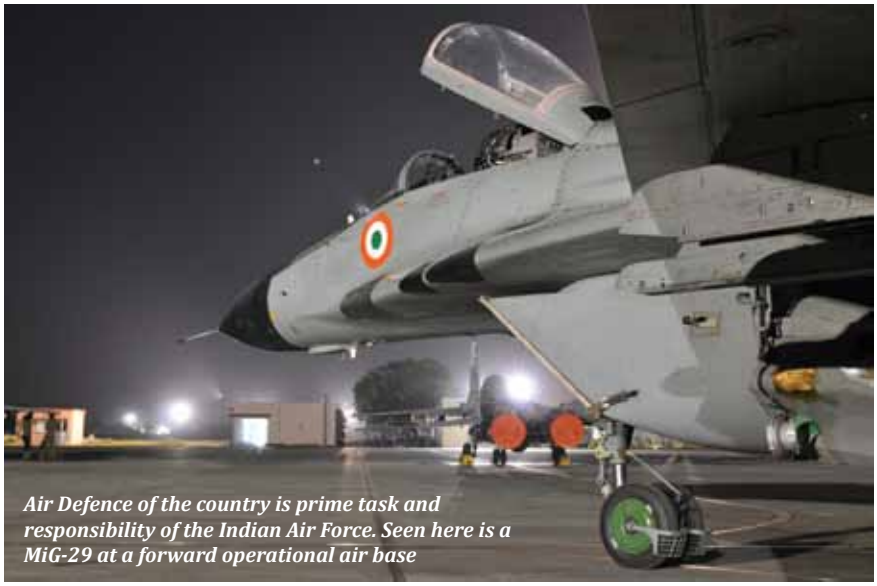
Strategic Force Command

The Strategic Force Command draws support from all three Services but there is also need for administrative control and administrative support to the Command. As it would be somewhat problematic for the Commander SFC to deal with all three heads of the Services, his reporting to the Chairman COSC or CDS or PCCOSC stands to reason. However, it is a moot point as to whether any form of operational control should be exercised by Chairman COSC. In our system, for very good reasons, we have clear separation between the control and conduct of conventional operations on one hand and the preparation, God forbid, for a nuclear war on the other. It is imperative that the separation be maintained. The two are very distinct levels of conflict and must be dealt with separately. We must shun the thought that use of a nuclear weapon is a possible extension of conventional military conflict. In our scenario, the sole purpose of nuclear weapons is to deter the use of such weapons against us, which must remain the cardinal principle. Again, for good reasons, all security attached to matters nuclear must be of a decidedly higher order and we should do whatever possible to ensure that the systems we adopt are such that no classified information is compromised even inadvertently. Hence it is strongly recommended that the operational control of Commander SFC should be exercised by either the National Security Adviser or the Executive Council of the National Command Authority. In fact it would be advisable if Commander SFC is invited to become part of the Executive Council.

Efficacy of the Planning Process

The IDS was intended to form the staff of the CDS, but even without a CDS, the IDS reports to the Chairman COSC and it has been so some 16 years since the IDS was created (October 2001). By now the teething problems should really have been over and the organisation well-honed to oversee inter service issues. However, and unfortunately, the organisation has morphed into an entity by itself instead of using the great expertise posted to it to iron

Agni V strategic ballistic missile during a Republic Day parade in New Delhi



Air Defence of the country is prime task and responsibility of the Indian Air Force. Seen here is a MiG-29 at a forward operational air base

out inter service differences. The greatest contribution that IDS can now make is to find solutions to vexing problems that will be acceptable to all. They must also help find common ground when there are serious differences of opinion, which has largely eluded us.

The Defence Intelligence Agency (DIA) of the IDS has done good work in providing Joint Intelligence Assessments. It is now a respected organisation. The IDS has also been successful in finalising a 'Defence Space Vision'. Many Joint Committees have been created for better functional efficiency. Some air defence issues have found solutions. A Joint Doctrine for the Services has also been released. All these are not seriously contentious issues. For instance, the doctrine does not carry a high security grading and must be guarded in its approach. If a doctrine is defined as a set of beliefs, it has little value in formulating either procurement or operational plans. At best it can lay down broad concepts and basic principles on the conduct of operations. But, is a doctrine always implementable? The answer is possibly in the negative. No doctrine can cater to varied contingences and can never be a diktat on how to wage wars. Security considerations will prohibit this. Again, the release of a Joint Doctrine does not automatically imply that it is a stepping stone to establishment of the CDS and/or of Theatre Commands. At best, finalising a Joint Doctrine is a small step and, maybe, it shows that on issues that do not pertain to procurement or operations, unanimity of views of the three services can be obtained even if it is time consuming. All the same, there is an element of inadequacy in it.

The major task of the IDS should be to fashion and control the procurement system and to formulate operational plans. Over the years, the IDS has worked hard to streamline the procurement process, has introduced checks and procedures to ensure that the Defence Procurement Procedure is adhered to. On many occasions, it has made sure that a common approach and recommendations are presented to the Defence Acquisition Council. Some good work has also been done towards finding commonality in equipment purchases and in making a single approach to the vendors. As a positive fallout, independent approaches by different services for the same equipment, as has often happened in the past should not occur again.

Still, the IDS does little to formulate the requirements of the Services. The Long Term Perspective Plans of the Army, Navy, Air Force are worked out by the individual service supposedly on the basis of Net Assessments prepared by the concerned Directorate in IDS and the plans forwarded to the IDS. The IDS merely collates these and produces a document titled the *Long-Term Integrated Perspective Plan* (LTIPP), intended to be a joint plan on the basis of which purchase proposals can be readied. As it is, the IDS does not examine whether the proposals in the individual plans are indeed based on net assessments, nor in the integrated plan are there any recommendations made on prioritisation of purchases. There is little application of mind. Different views are not sought and thereafter examined to arrive at concrete and studied recommendations that can be defended. There is little examination as to whether the purchases sought by different services are conducive to joint operational plans. In this way, the authority of the services is not undermined, but the LTIPP can hardly be called a *joint plan*.

The major limitation in this system is that a joint procurement plan cannot be made on the basis of individual appreciations of what the net assessment forecasts. The starting point has to be joint planning. A systematic approach towards this end is needed. It is recommended that each Service is tasked to work out, in cogent

The Boeing AH-64 Apache attack helicopter was ordered by the Indian Air Force several years back and of late, also by the Indian Army. This is prime example of a muddle in doctrines and careless directions from the political level (see article in this Issue)

The IAF's fleet of C-130 Super Hercules are essentially employed for insertion of Army Special Forces in critical areas (photo: Angad Singh)

terms, its capabilities whilst operating on its own and in conjunction with the other service(s). This really must be the first step. Thereafter joint planning should be carried out for the contingencies that flow out of the net assessment or any other contingency. Such joint planning should carry the commitment of each service that they will be able to effect what they say they can. That will make the planning more meaningful as there will be an inherent if quasi guarantee of success. The implicit understanding should be that if it becomes necessary to put the plans into practice, no service will make excuses for performance qualitatively short of what was projected earlier as its capabilities. Accountability must be ensured and planning will thus be more realistic. More importantly, it will be a joint plan and point the way towards training requirements. Of course, this will be an involved process and a continuous one but the results will be worthwhile. The plans will automatically throw up immediate procurement needs and prioritisation of procurements in the years ahead. Most importantly, the operational plans and subsequently arrived at procurement plans will have the concurrence of all three services. If we are to attenuate inter service rivalry, the start should be with operational planning that is based on reality rather than imagined capabilities and requirements. Good jointness will be a byproduct that will strengthen with time. Joint formulation of strategy and tactics and the consequent operational planning cannot but foster better understanding - and better jointness.

Some could argue that the procedure suggested is much too simplistic while warfare is far more complex. The author wholeheartedly agrees. For security reasons, details have been omitted. Also, as the system is fielded and begins to operate, improvements will suggest themselves. The planning system is an evolutionary process, but it bears mention that everyone accepts that joint planning is a pre-requisite for effective prosecution of a modern war and progressive modernisation is essential. The procedure outlined earlier meets both requirements. A logical approach has been recommended: first plan and let the planning process determine on procurement priorities. It must be again emphasised that the planning process has to be complex, dynamic and continual. Security aspects of joint prosecutors of plans, each Service carrying out the assigned role, can be handled without any hassles. Security considerations will arise, but as the planning is carried out jointly and the prosecution of plans devolved to individual services, the security issue can be contained. Again as there will probably be many plans and sub plans for each contingency, security is strengthened as the choice of plan to adopt will be taken at the last moment. A full time planning team is needed and the work of this team will be as important during peace as during war.

The procedure outlined above has not been attempted so far and is likely to face strong resistance. Possibly a Governmental push may be required. It has often been mooted that a Government push is needed to introduce changes in Higher Defence Organisation, but the author argues that a push towards joint planning will work better. Not only planning for possible wars and how to prosecute them is the *raison d'etre* of the armed forces, but also the plans generated and the manner in which the wars should be fought will automatically present the most suitable and optimum organisation. Such a study will be based on inputs that are more germane to the armed forces and are as realistic as possible, as

Jointmanship in action : Indian Air Force Il-78MKI flight refuels Indian Navy Sea Harriers (since phased out) with MiG-29K in the foreground

opposed to expressions of imaginary needs and fears. And then perhaps too, no real changes will be required!

When the IDS was created some 16 years ago, it was hoped that better inter-Service cooperation would be achieved. Unfortunately that has not happened. Turf battles continue even within the IDS. Considering that even after so many years of its existence and a manning level of some 300 officers drawn from all three services, headed by an officer of Vice Chief status supported by 5 officers of three star PSO status and 24 two star officers, the IDS remains riddled with many shortcomings as mentioned above. Possibly the problem is neither administrative nor organisational?Apparently, the indispensability of jointness needs to be re-considered.

Jointness in the Armed Forces

Innumerable articles have been written - and discussions held - on the lack of jointness in the armed forces and the overriding need to institutionlise this. Unfortunately, jointness has different connotations for different people. Remedies abound but jointness has remained elusive. It was always thought that with premier institutions like the National Defence Academy, Defence Services Staff College and the other inter service organisations, greater understanding would occur and jointness would automatically follow. Such optimistic thoughts have been belied. We have been unable to get rid of 'turf war's in spite of the fact that greater bonhomie amongst the services has been brought about by joint training institutions, but real jointness is a long way off.

Of course, there have been occasions when the Services have been in agreement and put up joint recommendations, but essentially these relate to administrative issues like pay commission awards and the like.

The history of conflicts since India's Independence shows that the level of cooperation should really have been much better. For example, in the Kashmir War of 1947-48, despite the Prime Minister's advice to the Army Chief the on the importance of Skardu, his air counterpart was not informed and this delayed in supplies being air-dropped to the besieged and beleaguered garrison. The result was surrender and the consequent massacre of the garrison. In 1962, while the Government did not permit use of combat air power which had been deployed and was fully ready for any contingency, the phenomenal and back-breaking effort by the air transport fleet was wasted owing to poor selection of dropping zones especially at Longju and Tangdhar. Their unsuitability was conveyed by the AOC-in-C to the Corps Commander but the former was over-ruled.

There was little joint planning before and during the 1965 Indo-Pak War. The IAF leadership was not aware of the Army's plan and could not mesh its plan with that of the Army. Possibly, this resulted in fizzling out of the rapid advance by the Army in the Lahore sector on 6 September 1965. The air effort was available for supporting the land forces, but the demands were either not raised or were rejected by the JAAOCs. This resulted in under utilisation of aircraft to around one sortie per aircraft per day against a planning figure and availability of 3 sorties, per aircraft, per day.

Similarly, in 1987, during the Jaffna University heli-drop soon after induction of the Indian Peace Keeping Force (IPKF) into Sri Lanka was a disaster and resulted in very heavy and avoidable casualties mainly because of the lack of joint planning. The situation remarkably changed after the setting up of HQ IPKF at Madras and of an Air Force Cell therein.

All this is very regrettable as one should have expected that lessons were learnt after every conflict and cooperation would progressively improve. Some improvements did take place as in the case of the 1971

Seen at a fire power demonstration in the Pokhran ranges are senior officers of the Indian Navy and Air Force (including the then C-in-C Strategic Forces Command)

Mi-8 and Mi-17 of the IAF demonstrating heli-drop of commandos

War and Kargil 1999, but, largely, an unsatisfactory situation continues to prevail. This is in spite of the IDS experiment, spread over 16 years and also the setting up of the Unified Andaman and Nicobar Command (ANC).

Three issues militate against better jointness amongst the services. Firstly, there is lack of adequate understanding of the operational thinking, strengths and limitations of the other services. This is particularly true on awareness about Air Force capabilities, which are not that well appreciated and hence expectations are not realistic. What makes matters worse is that air power is inherently difficult to comprehend. When the Air Force reports that it is unable to perform a task, this is sometimes mistaken as the Air Force not wanting to do so. It is a fact that the Air Force has always come forward to support the Army or Navy but at times this is not appreciated. On the other hand, the ubiquitous nature of air power per se is understood and there is clamour for an 'Air Force' as part of every Service! This goes against the basic principle in the utilisation of air power: *the unity of command*. Jointness will remain elusive unless such cardinal issues are fully understood.

Secondly, in spite of so many years of seeking jointness, the roles and missions of individual Services have not been defined and core competencies not yet been stipulated. This must be done immediately, an essential pre-requisite. Three independent Services have been created because they have different attributes and core competencies. In the absence of stipulations of core competencies and defined roles, attempts to encroach upon one another's domain will continue. Such attempts, often without informing the concerned service, cannot but create bad blood akin to poaching on the territory of a sister service. 'Must guard one's turf' has become the refrain. Once again, it is the Air Force that bears the major brunt of 'attempted encroachment'. Once the core competencies and roles and missions of each service are well defined and enforced, hopefully by a governmental fiat, 'attempted encroachments' should cease. *In view of the author, a Governmental order stipulating the core competencies and roles and missions of each service will be the single most important remedy to bring about jointness*. With better jointness, better cooperation and coordination will follow.

Long range strike component of the Indian Air Force includes these Jaguars

Mirage 2000TH of the Indian Air Force over the high Himalayas

Possibly a fourth factor is the desire to have all support functions under one's own command. It is but obvious that such an approach is not conducive to enhanced jointness.

Implicit in the four factors as described is the remedy to right the wrongs. One issue that will probably transcend all others to bring about jointness is joint planning. The basis of joint planning has to be recognition of core competencies and understanding of roles and missions of each service. Again, this factor cannot be reiterated or re-emphasised often enough. Joint planning will also bring to light the availability of resources and an understanding of how and why the 'poverty' should be shared. It is obviously a foregone conclusion that we must fight together. Some 15 years ago the author had opined that *far more important than planning for joint operations is joint planning for operations*. This is not verbal jugglery but an important factor. The author still stands by this and argues that joint planning is the single most important aspect for inter service cooperation. In some circumstances, a single service operation is the best option, indeed a valid operation of war as long as it is the result of joint planning. Continuous joint planning will bring about meaningful jointness.

Thirdly, by its very nature, air power has a vital role to play, often the decisive role, in all types of operations. As a result, this dimension is much in demand, but the Service that needs air power most often enough does not recognise that the Air Force's capability is *finite*. It could happen that at times air effort is not available to the required extent, for which there can be many reasons: availability, weather, need for prioritisation of available effort, and so on. This lacuna is particularly germane to the IAF. However, this is not so well appreciated and bad blood is created. Worse, there is that clamour for air power under one's own command. What is not recognised is that if air assets sought by another service are made available to the Air Force, better availability and utilisation will result as flying operations are without doubt core competency of the Air Force. With duplication, command and control issues and air space management issues raise their nefarious head and could then cause many more disagreements.

True flexibility of Air Power is the ability to switch forces from one theatre to the other in sub-continental terms

Responsibility for low level air defence of land forces in the field is with the Army

The rationale–or otherwise–of Theatre Commands

There were two occasions in independent India where a Unified Command system was adopted, the first during the IPKF operations in 1987. In the very early days, the Army Commander elected to task the Air Force for a helicopter drop of Army personnel at Jaffna University. The Air Force element was against it as, "far too risky," but were overruled. In this operation, all helicopters were damaged and tragically a large number of lives were lost. Almost immediately thereafter, an Air Component Commander was positioned to take charge of deployment and for tasking of air assets. The Air Force continued to support operations over the next two years but under the control of the Air Commander. The 'Unified Command System' was a failure and was discontinued.

Now on establishment of the Unified Andaman and Nicobar Command (ANC), set up in October 2001. One of the objectives was also to establish the viability of a Theatre Command, but the experience of its functioning over the last 16 years does not give much confidence that a Theatre Command system will really be of benefit.

This Unified Command has not succeeded in fostering jointness and reportedly, inter service rivalry is as strong as ever before. Personnel of each service have to follow the rules of the parent service even if they are markedly different from those of the Service. Commonality has not been ensured.

Amphibious assault exercise in the Andaman & Nicobar Islands

Authority of the Commander-in-Chief is undermined in that he can try disciplinary cases only of personnel of his parent Service. The personnel of the other services would be tried by a more senior officer of that Service in the Command but if the case has to be referred to someone senior, it goes to respective Service HQs. Such a situation is not conducive to good discipline. There is no combined maintenance organisation and each service keeps its own. A common communication system does not exist. Service HQs, possibly perforce, have to deal with the Component Commanders directly bypassing the HQs of the Command. Land continues to be controlled by the parent service and permission has to be sought from the HQs of the Service concerned for any planned utilisation, with permission being granted seldom.

However, the major lacuna is in the operational arena. The Command has a clearly stipulated task but little means to meet the requirement. The forces deployed are meagre and it is a moot point if the augmentation of forces, in terms of how many and when they can be expected, is inadequate. The C-in-C does not have enough forces under his command to plan and conduct operational exercises and test the mettle of his personnel: one wonders how the Command will fare in war! Such 'poverty sharing' will be a regular feature if other Theatre Commands are introduced. It will be difficult to carry out meaningful training and operational planning with many such commands.

It is recommended that such form of Unified Command be disbanded and we revert to the earlier system of placing forces under the concerned geographical commands. In this way, geographical commands will just have additional responsibilities but will retain the freedom to work out contingency planning and training schedules as substantially greater force levels will be available. If even after 16 years, there are such drawbacks in the functioning of this Command, it behoves us to reconsider the setting up of a Unified ANC and to seek other solutions.

Any organisation or proposed organisation should be based on perceived needs. It is generally accepted that whilst we must prepare for a major war to create a deterrent capability, the types of conflicts in the near future are likely to be of short duration or even near continuous, event-based, low-level, sub-conventional operations. For such a contingency a mammoth organisation like the Theatre Command is a gross overkill.

Conventional wisdom suggests that if a major war were to break out today, it would be sharp, intense and last for some 15 days or so. In such wars, air power will have a defining role. Such wars demand concentration of air power at different locations at different times for different roles. The radii of action of modern day aircraft can be as much as 1500-2000 kms or more. This requires the ability, and maybe the need, to hit targets at long distances rapidly and repeatedly, and also the ability to hit targets in the operational area of responsibility of more than one Command. The aircraft will probably have to transcend geographical zones of other Commands. Deployment of aircraft may have to be changed repeatedly, from one sector to another, depending on progress of the operations. History records as to how all this and more was done in previous conflicts, even when our capability was nowhere near as strong as it is today. The situation becomes more complex if we take into consideration the actions carried out by the adversary. Air defence and offensive operations have to be conducted with effective synergy.

All this leads to the irrefutable conclusion that air operations are markedly different from those of the other two services in terms of expanse of areas of interest and rapidity with which operations can be mounted. Strategic agility is a byword for air power. Unity of Command with devolution of control is an essential characteristic for effective use of air power and this must be respected.

Trio of Sukhoi Su-30MKIs carrying out retarded bomb attack during a fire power demonstration

The preceding elaboration of the nature and characteristics of airpower should not give the impression that the Air Force will fight its own war. Far from it. It needs to be emphatically reiterated that joint planning is the name of the game. The Joint Plan will include the aforementioned tasks for the Air Force but not preclude other tasks. A Theatre Command system will introduce one more level in the control of air power and place a spanner in its flexibility, that of the service which has most to offer. Most importantly, piecemeal use of air power has never yielded good results. This is particularly true when the forces available are less than what is required. There have been occasions in the past when the control and tasking of particular aircraft in short supply was carried out directly by Air HQ. There can be other reasons too when Air HQ will elect to exercise direct control over designated forces.

The unmistakable conclusion therefore is that a Theatre Command system will serve no useful purpose but would only impede and atrophy the capability and potential of air power, particularly in our context.

In conclusion, the author finds no justification for introducing either a CDS or Theatre Command. Indeed the argument is contra-indicated. The essential need is for better joint planning that may have to be enforced by the Government. At the same time, a cardinal requirement is that the Government must take it upon itself to stipulate the core competencies and roles and missions of the three services.

There are so many other issues demanding attention of the Government and the Armed Forces. Modernisation requirements are urgent as is the need to have clear policies on space, cyber-space, special forces etc. These are weighty issues that should be addressed on topmost priority. Unnecessary impediments and roadblocks like discussions and polemics on CDS/Theatre Commands should be abandoned once and for all. We need improvements in our Higher Defence Organisation, and not going off on tangents.

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Roar over the Mountains

The LCH cleared for production

Designed and developed for seamless airborne operations in support of ground troops at high altitudes (operational ceiling limit of 6,500 metres), maiden flight of the Hindustan Aeronautics Limited (HAL) Light Combat Helicopter (LCH) took place over 7 years back, on 29 March 2010 marking successful culmination of three years of design and development efforts by the Rotary Wing Research & Design Centre (RWRDC) of HAL's Helicopter Complex. Informally named 'Tiger Bird,' perhaps inspired by the exceptional high agility of the prototype, the LCH is presently undergoing weapons integration work to meet the requirements of the Indian Air Force and the Indian Army, which have a projected need of 64 and 114 units respectively. The LCH is being developed as a dedicated attack helicopter derived from the Dhruv Advanced Light Helicopter (ALH), and is fitted with weapons and special mission systems. The helicopter had earlier achieved the distinction of being the first attack helicopter to land at Siachen, doing so with "usable payload and fuel."

The LCH inherits many technical features of the Dhruv including its rotor system transmission, power plant, hydraulics, IADS, and avionics. The features that are unique to LCH are its sleek and narrow fuselage, crashworthy tri-cycle landing gear, tandem cockpit, self-sealing fuel tanks, aerofoil shaped stub wings for weapons, armour protection, Nuclear, Biological, Chemical (NBC) protection and low visibility features which make the LCH "lethal, agile and survivable." Notably the flight controls and hydraulics of Dhruv have been re-designed for the LCH.

The helicopter is powered by two HAL/Turbomeca Shakti turboshaft engines, each of which can generate up to 871 kW and run for up to 3,000 hours without maintenance and feature a Full Authority Digital Electronic Control (FADEC) system. The LCH has a cruise speed of 260 km/h, a maximum speed of 275 km/h and a climb rate of 12 m/s, as well as a ferry range of 700 km. As apparent, survivability will be primarily ensured by tactical elements of speed and surprise with natural mountainous terrain offering protection to this highly agile platform.

Fitted with a chin-mounted Nexter M621 20 mm cannon on a THL-20 turret (firing rate: 800 rounds/minute), LCH armament also includes 70 mm rockets (successfully fired at the 2016 *Iron Fist* firepower demonstration) and guided air-to-air/air-to-ground weapons on the stub wings. MBDA PARS3 and indigenous Helina with a range up to 7 km are favoured for the type's anti-armour weapon, with Rafael's Spike ATGM also a likely contender. MBDA's Mistral-2 AAMs are carried to ensure self-protection against hostile aircraft.

The helicopter has day/night targeting systems for the crew including helmet mounted sights and an Elbit Compact Multi-Purpose Advanced Stabilisation System (CoMPASS) electro-optical turret, licence built in India by Bharat Electronics Limited. The CoMPASS turret includes a CCD camera, third generation 3-5 µm Forward-Looking Infra-Red (FLIR) sensor, Laser Range Finder (LRF), and Laser Designator (LD). The LRF and LD facilitate measurement of range to the target and guidance for the laser guided missiles respectively. A Digital Video Recorder will enable detailed mission debriefing. The turret gun is controlled by the Helmet Mounted Sight (HMS) of the gunner, who along with the pilot, receives adequate inputs from Multi Function Displays (MFD) of the 'glass cockpit.' The LCH will also be fitted with a Saab Self-Protection Suite consisting of radar/laser warning receivers and Missile Approach Warning Systems (MAWS) and Countermeasures Dispensing System (CMDS). It is also planned to integrate IR/laser jammers on the helicopter.

Another addition is a Data Link for Network-Centric Warfare (NCW) operations facilitating transfer of the mission data to the other airborne platforms and ground stations operating in the network, thus facilitating force multiplication. NCW in particular will facilitate coordinated air strikes by fixed wing aircraft like the Mirage 2000 and rotary wing platforms in short predetermined intervals, thereby maximising battle damage. The LCH is designed for low detection (visual, aural, radar and infrared) and includes armour protection of critical areas.

A 30 minute dry running capability of the gear box is a built in-feature to survive damage to the transmission system, and crashworthiness features are built into the wheeled landing gear and main structure while dual redundant systems also enhance survivability of the helicopter in battlefield environments. The performance features of the LCH including rate of climb, cruise speed, service ceiling are comparable with those of contemporary helicopter types such as the Agusta A129 Mangusta and Airbus HC Tiger. Development costs of the LCH have been "relatively low" compared to those of other helicopter types in its class, ensuring lower programme and unit costs. "LCH design is optimised to ensure ease of maintenance with improved reliability of all the on-board systems to keep the life cycle operating costs low as well," stated a HAL designer.

Sayan Majumdar
Photos: Angad Singh

"Ugly Duckling, Swan or a Hunt Bird in hand?"

An open source assessment of the JF-17 Thunder

by Prof Prodyut Das

The assessment of a rival's warplane suffers from a primary lacunae in that the information is secret. There is perforce reliance on secondary sources but this is inevitably heavily dosed with rivalry, jealousy, envy, disdain, NIH (not invented here!) racialism and similar human failings. The task therefore becomes difficult and the output subjective. To illustrate my observation I will mention the case of two very well known warplanes.

The existence of the Mitsubishi Reisen (Zero) first came into US knowledge almost a year before Pearl Harbour. The American Volunteer Group (AVG) *Flying Tigers* sent back reports from China of an astonishing Japanese fighter with unimaginable maneuverability and range. The US experts discounted these frontline reports because such a fighter could not exist. One can sympathise with the experts. Going by their lights such an aircraft could not be designed. They did not know that the Japanese had got rid of everything which the West would consider "essential": armour, bullet proof windscreen, self sealing tanks, radios, etc to produce the ultimate dogfighter that swept

Flying the Flag! Early model JF-17 shows off the colours

everything before it. It is an illustration of how human emotions cloud judgment that when the first wrecks were examined after Pearl Harbour much time was spent and much evident satisfaction gained on "identifying" what part of the Zero was copied from which American aircraft! In fact this copy allegation was so sustained that much later, Jiro Hirokoshi, the Zero's Chief Designer was to say, perhaps with testiness and Japanese style "The Zero was a copy of all the aircraft before it!" Even today there is a persistent view that the Zero had erred by sacrificing protection for performance. This misses an important point. Battle damage resistance would have improved pilot survivality but given the Zero's phenomenal long range and the fact that it operated over the ocean and over tropical jungles, did Japan have the resources to ensure pilot recovery? Without pilot recovery battle damage resistance is less meaningful. Note that when the fighting was over the homeland, the later versions of the Zero was given a fair measure of battle damage resistance – it was not all *Bushido* and *Banzai* as is popularly believed. The real weakness in the Zero was that it had to fight an enemy industrially ten times as big. Putting it in another way, if Japan had the Corsair and the Hellcat and it was the US which had the Zero, the outcome would still be the same. This, by the way, is an argument for maintaining large forces. It pays in the long run.

One would think that things would have improved with time but the MiG-21 case is illustrative. To the Indian Air Force, used to the fit and finish of the Mystere IVA, the MiG-21 was "brute force supersonics" possibly because it was at the time of its induction the most powerful fighter in IAF service. The truth is both the MiG-21 and the Su-7 were the lowest powered aircraft in their categories, though one must add the Soviet aircraft often had no exact equivalent because they were designed for different scenarios. In 1966, an Iraqi MiG-21F-13 defected to Israel and very soon afterwards a leading US Aviation Magazine carried a very detailed examination of the aircraft. Much of the focus was on the poor fit and finish of the aircraft and the mushroom head rivets (discoloured) used in the rear fuselage. The three shock, two position translating cone intake (the mighty EE Lightning had a fixed cone and encountered intake buzz problems during development) and the semi encapsulated SK ejection seat (surely the best for high altitude supersonic ejection) must have been covered, but the overriding impression one carried away was of gaps and discoloured rivets on the aeronautical equivalent of a combine harvester. Generally, the MiG-21's lack of the F–104 and F–4 Phantom level of avionics and long range missiles were disparaged. Unfortunately, the Vietnam War started in earnest soon after and it was the Americans who had to go back to school - the excellent *Red Flag*, the F-15 and F-16 being a typical energetic US effort to correct things.

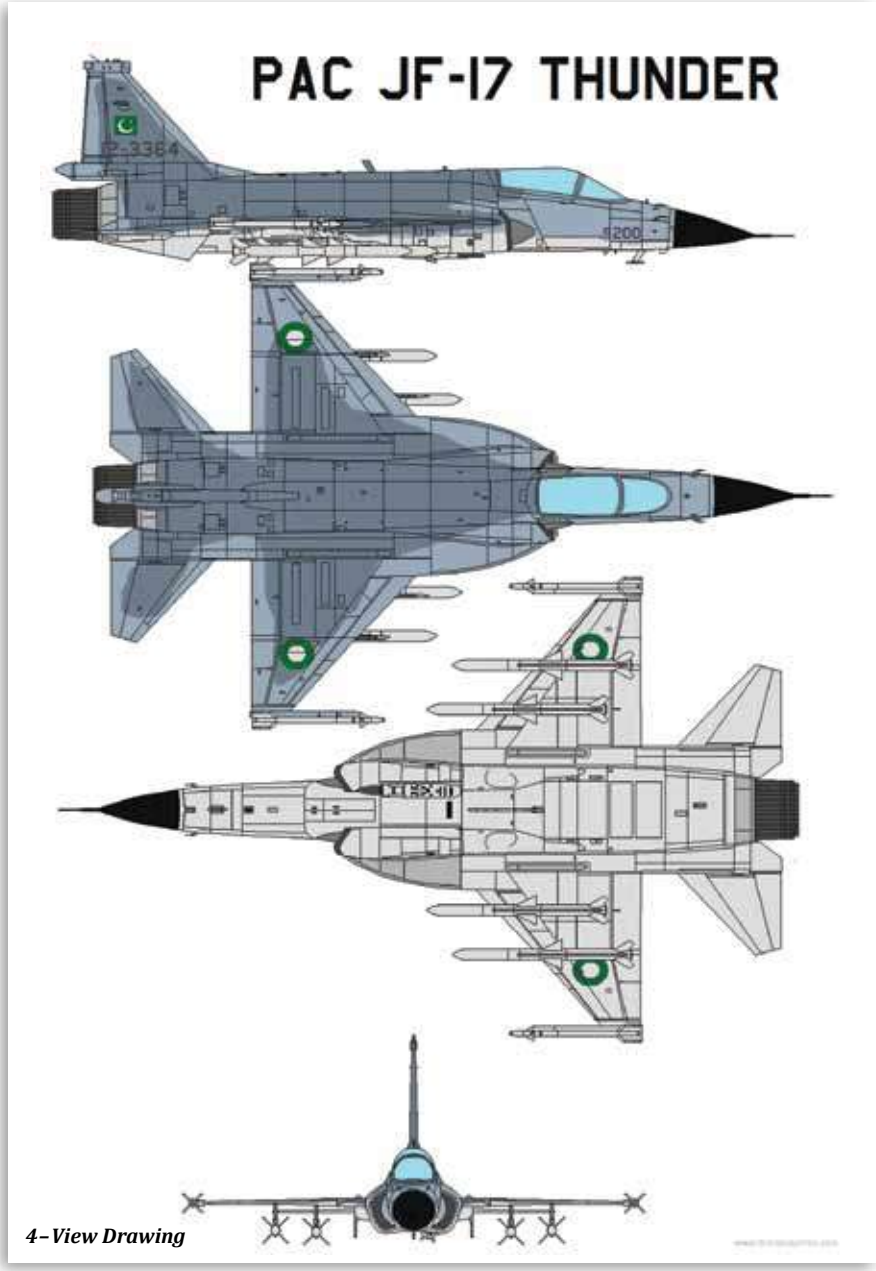
The point of citing the above is to accept that assessing a rival's warplane is difficult not only because of the lack of information but also because of the "schooling", one has gone through. I sometimes envy the Chinese in that they generally know less English and being "unschooled", look at things in their own pragmatic Chinese way.

With that as both a caution and as disclaiming any infallibility, the following is a very personal assessment of the Sino–Pak JF-17.

Enter the (JF-17) Dragon

Wikepedia carries a review of the JF-17 *Xiaolong* (Fierce Dragon) with several pages of references. The figures cited below are drawn from this review and I will presume that the reader has access to the Net to avoid total repetition. I am therefore confining myself to a commentary. Because both aircraft originated as MiG-21 replacements, comparison with the LCA is inevitable.

The Chinese have made so many MiG-21 based derivatives that one can be forgiven for initially thinking it was yet another derivative



4–View Drawing

with a nose job like the Qiang JiJi 5, surely one of the ugliest jets I ever wish to see. This impression is quickly corrected by looking at the Table.

The JF-17 is no MiG-21 clone. It is altogether a more potent aircraft, reminiscent of the Northrop F-20 Tigershark. Allthough Yang Wei, the Chief Designer, did not have access to the F-20, he may have had opportunity to examine ex-Vietnam Air Force F-5A aircraft or airframes and why not : only an arrogant fool will not "flatter" a good piece of engineering by imitating? Mitchell of Spitfire fame was "inspired" by the Heinkel He-70 Blitz's graceful lines and Yang Wei may have been similarly "inspired" by Welko Gasich/Lee Begin's work on the F-5/F-20 series. Northrop of course threw the game away by adding 80 percent more power and 20 percent more weight without changing the wing which remained the same as the F-5 series. The figures of the wing loading speak for themselves. Digressing for a moment, one sees the same reluctance in BAE to design a proper light strike aircraft using perhaps the Hawk systems in a Gnat derived airframe (see *Vayu III/2016* 'Going against the Wind') instead of trying to fob off native Air Forces with an inappropriate airframe too big for the job.

It would seem that the JF-17's talented chief designer Yang Wei carefully studied the F-20 concepts and made very well thought out "nips and tucks" type bespoke tailoring of the F-20 design so that the JF-17 did not carry an extra ounce of fat or skin. Comparing the lengths, the JF-17 is 0.53 metres longer but that is largely the difference between the F404 and the RD33 engine lengths. The empty weight of the JF-17 is 622 kgs heavier, but again if you factor in the weight differences of the two engine types and the additional 5.8 sq.mts of wing area that the Sino-Pak fighter carries, the weight is commendable. The weights indicate that either the weight control supervision on the JF-17 was up to US/International design standards or Yang Wei had enough domain expertise to tell the powerful PLAAF faction where they got off regarding equipment fit standards of the JF-17 ! One can recount that whenever the US Navy wanted any additional equipment on the little A-4, Douglas's Ed Heinmann would reputedly take off fuel of weight equal to the additional equipment requested. Of such stories is aviation lore made. One final point on weights that should make us think: The JF-17 is a larger aircraft with a heavier engine and with an all metal structure and yet it is "as near as dammit" the same weight as the largely composite and smaller Tejas LCA Mk.1. That is an indication of how much we have erred and how much we could correct.

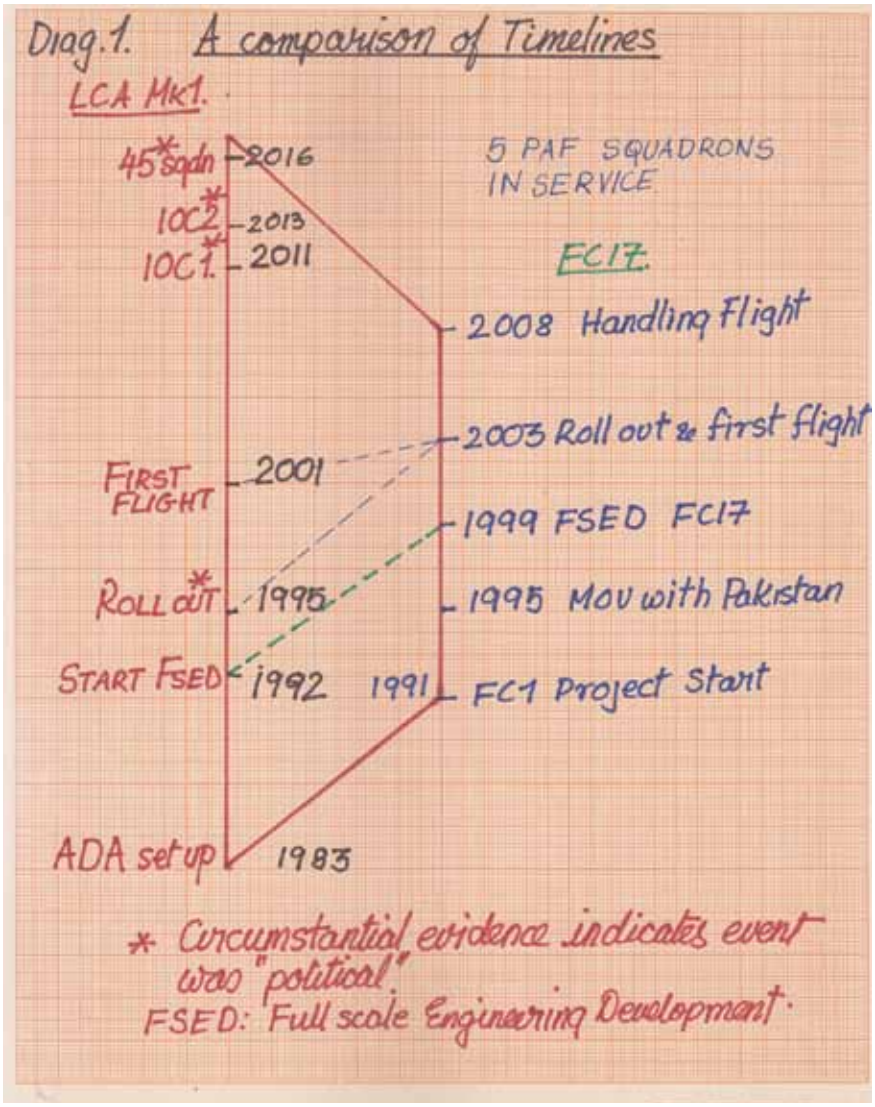
Having accomplished his weight control, Wang Wei pulled off the first of his two *coups de main* in that the generally conservative approach to the Northrop- like design was modified to a mid wing layout of increased wing area. Despite the weight penalty of longer undercarriage struts and ring frames to carry through the wing bending loads (an additional 42 kilos somehow comes to mind for the frames) it cured several big problems. The F-20 suffered in that though the warload was increased by twenty percent, the low wing meant that fitting the store and the ground clearance certifications must have been nail biting. The mid wing of the JF-17 avoided this easily and the larger wing area meant that the high induced drag of the F-20s in high g turn and the increased CD_o caused by the higher AoA, was lowered and dog fighting and general handling improved significantly. The F-20 gave the later F-16s a hard time during fly off competition and the JF-17 should be very much better. One

will also note that sweet handling aircraft e.g. Hunter, MiG-21 and the Lightning were mid wing layouts which reduces or eliminates roll coupling and the JF-17 too is a beneficiary.

The second of his *coups de main* was introduction of the DSI after seven years of parallel preliminary work. DSI reduced weight and drag. Summing up: it would appear that a very competent airframe has been designed on the lines of the Northrop F-20 but as with the F-22/F-31 resemblance, the Chinese design somehow manages to look more elegant and dainty! There has been some gloating references on the Indian Net circles to the fact that Yang Wei has been recently severely criticised for the shortcomings of the J-20 (AMCA team beware!).The gloaters have missed the significant point. Weapons development programmes are of national importance and there is no room for fellowship if things are not delivered. "You fail; you go" is the grim rule for running successful programmes – that is, of course, outside of India.

Programme Management: Hare and Tortoise

The Diagram (on the right) shows the difference between timelines of the JF-17 and the LCA. The Sino-Pak team started eight years after India's and reached where we are today (i.e. a virtual handling flight of some aircraft) ten years ago (*nota bene!)*. To rub the salt in properly, they did it at one third to one fifth the cost calculated at



JF-17 on Display

Present Day Value (PDV). The following is my conjecture as to how they did this :

❖ They chose an utterly conventional layout. That way they could "decouple" any delay of FBW development.

❖ They chose no "glamorous" technology and were almost sanction proof from the word 'go.' Being all–metal, the prototypes could be built faster: the shop floor people were dealing with a material they knew from infancy–and also airframes could be modified faster if things did not work out as predicted. Remembering Boeing's problems with production of the 787's composites, it is clear that the Chinese, by choosing all metal, could focus entirely on the airframe development without being harassed by *how* to do it. As they say in the backwoods "if you are up to your ass in alligators it is difficult to remember that what you had actually set out to do is to drain the swamp!"

❖ The Chinese chose a pitch–only FBW. This is less "advanced" than a four channel all-axis FBW system. There is a size limit below which FBW becomes "doubtful". To illustrate: would you fit FBW onto a Cessna 172 club trainer? Theoretically yes but in actuality the FBW weight and complexity would kill the bird. In my view an aircraft like the LCA is just teetering on the brink of this size limit. The "pitch only" FBW is a very good example of an "appropriate engineering" approach. If you think about it, pitch control benefits maximum from FBW in reducing trim drag; roll and yaw have less scope for "improvements" in performance. The Chinese solution is not "brochure glamorous" or exciting but as the inventors of the Panhard-Levassor gearbox said so long ago "*C'est brutal mais ce Marche*!": it is rough but it works! As if to add insult to our injury, the Chinese FBW software was written in C++ and not the more elegant ADA language. What makes one pensive is not what they have done but the indication is that the Chinese have reached a stage where they are very respectfully examining what is going on and then instead of being overawed, are doing their own thing. It is this arrogant (and I use it as a compliment!) self confidence that must be noted carefully in assessing any Chinese defence technology product.

The emphasis is on flying

The Chinese flew the first JF-17 prototype on 25 August 2003 i.e. within four years of funds being sanctioned. They had little faith in that if you calculated enough you would get the thing right first time! Once the third prototype (09/04/2004) was flying they built another three introducing a modified LERX (which needed enlarging) an enlarged inlet (the RD 33 was smoking like a juvenile delinquent!) and the second significant improvement, a diverter-less supersonic intake (DSI) with the first modified prototype flying on 28/04/2006. It must be acknowledged, howsoever grudgingly, that the Chinese/Pakistani team got their fighter in Squadron service in two iterations, six prototypes and within seven years of funding. The alarm bells are ringing here! We are being out developed and the advantage of a big economy is being neutralised by Pakistan through sheer efficiency and better organisation!

The LCA Mk.1 still needs major redesign of about 35-40 per cent before it will be fit for service. I guess that the slow production is a cover to buy time to effect the changes. Those readers who have noted the dramatic cover of *Vayu I/2017* with the LCA will have noticed (and disapproved of) the deep boundary layer diverter plates and the bleed off channels (which would have reduced the local lift fields). The Chinese were working on the DSI since 1997 and introduced it in 2004, claiming reduction in weight, cost and drag. Seventeen years after its first flight the LCA fore fuselage and merging of the intake bulges with the centre fuselage still requires considerable

Shorter landings ensured by parachute-braking

refining. It is bemusing to compare with the undershot of the JF-17 (*Vayu III/2016 p 94*). Similarly if one compares the front views of the two aircraft, the LCA's excess of re-entrant corners and deep channels indicate excess wetted areas and drags. Out of curiosity I estimated the distance from the rear pressure bulkhead and the tip of the radome for the two aircraft and the JF-17's figures are 5382 mm compared to the LCA's 4661 mm. If correct, it indicates the effort and care taken ab initio in getting the forebody drag right. Visually, the cross sections of the LCA's forebody have a squarer section compared to the JF-17's and this increased cross section will tell on the transonic drag. Incidentally the JF-17's radome works out to 690mm compared to 648mm of the LCA, both in the plane of the antennae but the longer nose length compensates.

The Avionics

Reading so far one would think it was the Chinese who had done everything but that would be injustice to Pakistan's contribution. Though clearly the Chinese were in the driver's seat w.r.t. the airframe, Pakistan played a very competent and independent role in the development of the JF-17 particularly in customising the aircraft for PAF use. Using its better networking and contacts with the West, Pakistan took what amounted to an independent charge of the avionics development for its aircraft, the Chinese going in for their own aggregates which were always on offer to Pakistan. It is noteworthy for example that Pakistan chose a Martin Baker PK 16LE seat over the Chinese model. Though the Chinese had launched the JF-17 project in 1991 Pakistan came on board in 1995 and the funding for the actual aircraft development was signed as a contract in 1999. Hit by sanctions (as with us) the Chinese/Pakistan decided to decouple the avionics development in 1999 and it speaks well of the level of teamwork and the "can do" spirit that both sides were willing to re-engineer the design as and when needed. It will again be noted that choosing an all metal structure for prototypes must have been a great help Today, with its West Asian connections Pakistan or perhaps the PAF is an "owner" of the project and bids fair to do a good job of marketing. They did what we should have done with the PAK/FA. Given our experience with the DARIN mods, clearly

The Russian RD-93 powers the Sino-Pak JF-17

the expertise and ability were not lacking, but aims and organisation were.

The JF-17 Blocks 1 and 2 equipment fit is more than adequate for the job : HOTAS, MFD/EFIS, Holographic HUD, HUMS, VHF,UHF, ATE. The leading edge and trailing edge flaps are computer controlled to ensure controllability at high AoA. The FBW of *production* machines has quadruplex FBW in pitch and duplex in roll and yaw. The defensive aids include RWR, MAWS with 360^0 scan, chaff flare dispenser and there is provision for a jammer. Block 3 design was finalised in September 2016. The only sardonic cheer for us is having got a decent fit, the PAF is now trying to load it with 'goodies' such as IR targeting systems etc. God speed is my wish !

Propulsion factors

Soviet-origin engines were always derided in the West. One remembers that when HAL was trying to see if the HF-24 could be fitted with the Tyumanskii RD-9F the story (probably untrue) went around that the engine was so surge prone that it would flame out on the test bench if someone so much as coughed at the other end of the Bangalore factory. The actual reason was that the Compressor stress limit was Mach 1.4 and the Soviets point blank (naturally!) refused to redesign it for Mach 2 which was our "must have" specifications at that point of time. Shows how fashions dictate 'sacred' specifications and opportunities are lost. I mention the RD-9F case because when the Chinese laid their hands on the RD-9F, they re-engineered the first stage of the compressor, put in a variable angle inlet stator, completely redesigned the hot section and put in a new afterburner stabiliser of reduced losses. It is possible that the variable inlet stator details were inspired by the close examination of the wrecked J.79s available to the Chinese during the Vietnam era. The fact is that the Chinese Wopen 6 of F-6 fighters did not give the PAF any more than the usual problems in service. This tradition of sensible engineering to or improve a base product means that the Taihang WS 13 based on the RD 93 will probably emerge as an acceptable engine though it may not have the 4,000 hr service life demanded of Western engines. Such design targets are dishonest for countries like us. It is much better to design for quick engine change.

The cost and the prices

Cost consciousness is important because if there is a significant lowering in the cost of projects, as has happened with the JF-17, it means that there is more money

The PAF now has four operational JF-17 Squadrons plus a flight with the CCS

to go around for other projects : bullet proof jackets or Infantry assist vehicles for example. Unchecked spending without results can cause a "drought" which will wither other possible and vital projects. The current asking price for the JF-17 is roughly $25 million which works out to $3800 per kg compared to the $17,000-$21,000 per kg for current Western aircraft. The usual explanation is that these prices are "political/ friendship" prices. This is wrong. One's own considerable experience in the Industry confirms the following:

The only cost really known for certain is the RM (raw materials) and the BOC (bought out complete) costs. When it comes to labour costs, escalation starts from the shop floor with the supervisor and goes right up the chain though everyone concerned will scream blue murder and horror at the merest suggestion of downwards revisions.

When it comes to overheads it runs riot and again figures are padded up just to be safe. In the absence of competition, this practice is safe but drives up project costs which finally affect local development. In technology transfer, a five-fold reduction in costs is usual.

This is not the entire picture. Owing to our colonial past there were rules that were actually designed so that India would NOT develop a local aeronautical capability. Some of these were:

An import duty structure that allowed complete aircraft to be duty free, accessories had a substantial duty and raw materials were prohibitively taxed. A system of 'aircraft quality materials' (AQM) was the norm where the sources of this AQM was invariably from the 'Home Country.'

These laws – and there were many – may or may not have been repealed but the spirit lives on and the bureaucracy with nothing to gain and not tamed by the national leadership, staunchly obstructs any attempt to reform. One will hear many arguments for maintaining status quo but there has been little reasoned debate as was done in China and Russia who do not have this anachronism. Finally with PSUs operating at a cost plus 15 percent basis and western weapons suppliers with a stock of horror stories if any initiative is inimical to their interests, it is us who have been "schooled" into believing what should be the price of warplanes. The Sino-Pak prices are realistic and have scope for further reduction.

JF-17 in action, purportedly in the north-west frontier region

An estimate of performance

Readers are referred to *Vayu I/2015* in which I had said that the LCA Mk.1 would not be able to outperform the JF-17 as a fighter. It can be used as a strike aircraft but the outcome of any dogfight would be in favour of the JF-17. I have not seen anything in the past two years that needs me to make a drastic revision of that view. The only parameter the LCA Mk1 *potentially* is superior to the JF-17 is in TO performance The JF-17 will need a 25% longer run but even that difference will be reduced as this is not corrected for the CD^o and the reported lower engine installation efficiency for the LCA. Readers may raise the point that an aircraft with a sprightlier take off should perform better but this is not so because at combat speeds the CD^o drag of the LCA will be much higher. Incidentally I did compare the TO values for the LCA and the Harrier and assuming equally efficient intake design and CD^{o}s. The LCA should be marginally better/similar to the Harrier in the STO mode. If the Navy's disappointment is purely technical, then the weight and drag problem in the LCA is still significant.

What perhaps HAL should do is to take a deep breath and clean up the entire fore fuselage with particular attention to the blending of the front fuselage with the mid fuselage. The clutter is visible from afar and must be worse in detail! If ADA is ready with the DSI (only if!) it should be brought forward. They should do it in metal to begin with so as to get the prototype right quickly rather than have a nice sub project of making it in composites. With the clean up and the weight reduced the LCA stands a very good chance but not as things stand at the moment. *C'ne marche pas!* The LCA is unlikely to be cleared for serious series production until 2019-2020 – if that !

Like the LCA, the JF-17 was a MiG-21 replacement but it is now something more – nearer to a F-16 supplement at one fifth/one sixth the price and no threats of being sanctioned in which the PAF has much experience. It has potential to become "fashionable" i.e. over equipped. What the JF-17 lacks it does not need and Pakistan should leave the aircraft well enough alone. In summing up,

♦ The LCA has the *potential* to have significantly better field performance even at the current empty weight of 6650kg.

♦ In low level OAS the small size and the 5 percent better fuel fraction (internal fuel/ installed cold thrust) the LCA may be a better choice.

♦ In any close combat as of the present the LCA is inferior. (*See Vayu I/2015*)

♦ Owing to more power and a bigger (by about 52 mm) antennae the JF-17 is the better BVR platform but I think it is stupid to fit BVRs simply and just because they can be fitted on an aircraft of this size. BVR capability is a specialised capability which ruins general capabilities to install.

♦ The current availability (raw figures) of the JF-17 is 113hrs/aircraft/year as of 2016. There has been two accidents in 19,000 hrs which is close to the 1 per 10,000 hrs for 'bedded down' equipment and indicates reliability,

Production is now of the Block 2 and about 90 airframes are delivered or are on the slipway.

At this point of time, the JF-17 is the better aircraft and the LCA is not even achieving its potential in the areas where it has the potential to be better. Sadly the comparisons are academic. At this point, the PAF can fly 200-250 OAS sorties per day with the JF-17. The LCA … ?

And as for Exports

Any Asian product is bad mouthed. The twelve Hindustan HT-2s supplied to Ghana were routinely disparaged by the foreign instructors seconded to the GAF. The sturdiness, low prices and the fact that they served the IAF for over thirty years "faults and all" was overlooked. The more recent case of the ALH could be reference. This is to be expected. The Chinese are in a better position. Over the years they have exported fair numbers to European, African and Asian customers and have acquired useful skills in marketing, selling and *sustaining* a product on the field. The JF-17 has attracted the attention of about 21 customers with Myanmar, Nigeria and Saudi Arabia as confirmed operators. The weak link was the RD33/93 engine being of Russian origin but if the Russians refuse the engine because of fears of the JF-17 cannibalising MiG-29 sales, they have little choice because the Chinese will develop the WS13 Taihang. Even if the TBOs are not quite upto the "international standards" their prices will be extremely attractive and international standards are not an operational necessity. I would not have minded buying the JF-17 myself for the IAF! The Chinese have exported over two thousand aircraft and the JF-17 bids fair to add to those numbers and customers list.

The reason why

The JF-17 is either an unremarkable warplane or a coolly brilliant piece of engineering improvisation superbly managed. The judgment will depend on one's 'schooling' but what cannot be denied is that the Sino Pak team has already raised five squadrons on the type. There is an old adage "An engineer is a person who can do for sixpence which any fool can do for six shillings". The JF-17 demonstrates that the LCA's so called "technical superiority" has been its undoing and if we confine ourselves up to correct the technical shortcomings of the LCA Mk.1 then we shall be setting ourselves up to fail with the AMCA. The present situation is bleak and near collapse. I do not see any evidence of the energy and the interested management that is the vital need of the hour.

PAF JF-17 Thunder at a Zhuhai Air Show in China

The organisation for effective development is not the present topic but that is the crux. What the Sino/Pak team achieved with the JF-17 they can do in AFVs and submarines and rifles and every item required in warfare. We shall be out resourced and out timed – and out gunned! India's weapons development programmes are in the "fire and forget" mode which will not work in a hundred years. By preoccupation with other "priorities", the politicians, the bureaucracy and the armed forces have abdicated their role of leadership in weapons development to the technocrats.. None of the above, singly, can manage weapons anymore than the blind men could "see" the elephant. Yet the solution lies in them working as a team with respect for the undoubted competence that there is in each organisation. Unthinkable in our bureaucracy–dominated committees, Pakistan had serving Air Marshals in charge of the JF-17 project who reported directly to the Air Chief whereas we had the IAF actually "shorted out" so that the LCA project could be "fast tracked"! The cheek of this ! So left to themselves the technical people went on a technical picnic !

The Armed Forces responses have been studied and are clumsy rather than moral (why did they accept pressure when things were obviously out of control and so much was at stake?) Recall Air Marshal Dowding's stand just before the Battle of Britain: he stood up to that old steamroller Churchill (of course he paid the price!)The bureaucracy's sniping of the military must stop forth with! This tribal warfare between the bureaucracy and the forces has to be tamed and yoked by the political leadership. The country must form a WEDOG (weapons development group) so that realistic threat scenarios are generated for 'say' the next ten years in that we need to become sanctions independent. China used its large armed forces and its nuclear deterrent to buy the vital ten years it needed. Given our large armed forces and our nuclear capability, we have those ten years. We have the expertise to do so-but only if we work in a team. Realistic threat identification will lead to realistic specifications. Realistic specifications will reduce technical challenges and prioritise weapons programmes. Close monitoring will stop the shocking wastage and ensure timeliness. We may yet surprise the world!

India's LCA

Table 1.

Parameters	JF-17	F.20	LCA Mk1	F-16	F.7
Length	14.93	14.4	13.2	14.52	13.86
Target Volume	1.34	1.03	1.0	1.44	0.866
Wing Area	24.4	18.6	37	27.87	23
Empty Weight	6586	5964	6580	6857	5275
Internal Fuel (KG)	2350	2450	2458	3162	2080
DisposableLoad	5914	6510	6680	9200	3825
Wing Loading Clean/MTO	312/ 512	485/ 670	256/ 356	372/ 576	306/408
Fuel Fraction	0.45	0.5	0.502	0.47	0.47
Dish Dia. (estimate)	690mm	n.a	648	n.a	n.a
Nose Tip to rear pressure bulkhead	5382	n.a.	4661	n.a.	n.a.
TO Run	1.27	1.84	1.0	1.49	0.91

- Pakistan has an excellent replacement for the F-7
- The LCA's 10% higher disposable load should be noticed. With drag reduction and weight improvement it should be quite respectable but there is no evidence of any timely addressing of these long pending tasks.

Table 2: LCA Costs (Rs. Crore unless otherwise stated) and PDV (present day value)

Phases	Date	Amount	PDV	Remarks
1	1983	560	17,920	
2	1993	1628	16512	FSED
3	2001	3302	15172	
4	2009	2475	5305	
	Total		54,969	
JF 17 project	1998	$ 500m=2250 Crore	13,065	Equally shared by Pakistan and China

Note: The above does not include Rs 1729 sanctioned by the Navy (2003) for the NLCA PDV (Rs. 6512 crores)

This excludes Rs. 4353 (2432+1921) PDV Rs. 9331 crores sanctioned for LCA Mk2.

If we further ignore the Rs 560 crores sanctioned in 1983 the comparison of costs on the common base of PDV is:

LCA (16512+15172+5305)= **36,989**

JF-17 (13,065)= **13065**

Financially we are being ' resourced" by at least at a rate of 2.83 :1.

Readers will be interested to compare that the entire XST/F-117 stealth development programme was funded in 1973-1978 to the tune of 4997 crores PDV in small stages to produce the required cutting edge technology aircraft. Unless financial management is tightened we will not have funds for local development. [all in Rs. crore]

India's Fifth Generation Fighter

Air Marshal M Matheswaran on The Need for Hard and Pragmatic Decisions

India's effectiveness as a major power and a rising great power depends greatly on its ability to project deterrence and influence from its military power. Modern military capability is critically dependent on the nation's aerospace capability, which is demonstrated through the nation's ability to design, develop and manufacture its own fighter aircraft, with most of its ingredients within the country. While India has achieved significant technological progress in various fields, its military continues to be heavily dependent on imports, most of all at the cutting edge fighter aircraft technologies.

The highlight of the 2017 Republic Day fly-past was the flight by three LCAs, our fourth generation fighter aircraft, the culmination of more than three decades of work. Yet, much of the LCA continues to be import dependent. In the context of a renewed effort at indigenisation through 'Make in India', it is time for us to review our past programmes and make appropriate corrections in order to achieve our fighter aircraft capability as a reality. This is even more compelling from a security perspective, when we see the rapid progress made by China in this area, in particular with their Fifth generation aircraft progressing towards operational reality.

While India has produced many fighter aircraft under licence in the last 60 years, there have been just two indigenous fighters that have been designed, developed, and produced within the country. The first fighter was the HF-24 Marut, which was designed in the late 1950s and early 1960s. Prime Minister Nehru displayed visionary approach to bring in the legendary German aircraft designer, Dr Kurt Tank, to head the design effort for India. He not only brought his core team, but with their assistance created an exceptional design capability for HAL in a short span of time. It is another mater that the country squandered that wealth of capability and experience created. The HF-24 was an exceptionally advanced design for its time. Dr Kurt Tank's leadership and programme management was outstanding. At a time when technical wherewithal in India was extremely limited, he ensured that the programme was managed very efficiently. The first flight of the prototype took just four years from the drawing board, and the series production commenced in less than 10 years. Contrast this with 16 years for the first flight of the LCA, and more than three decades for establishing its series production, albeit incomplete as the SOP (Standard of Preparation) of the aircraft is still not frozen due to incomplete development process.

Successful fighter aircraft programmes in various countries flow from efficient programme management. This includes strong interface between the user, industry, and the development agencies. Fundamentally, the programme management needs to be done by the user as it is important to synergise the conflicting pulls of costs, impractical development aspirations, and most importantly operational necessities of the user. It is very important to achieve the right balance with the cost of the programme, technology development time frames, operational urgencies, and technological continuities with previous programmes in the context of experience and research data base. Success of these principles are clearly evident in the China's programmes of JF-17 (a programme that commenced with LCA, but has already clocked more than 5000 hours of operational flying with more than

HAL HF-24 Marut

ADA Tejas LCA

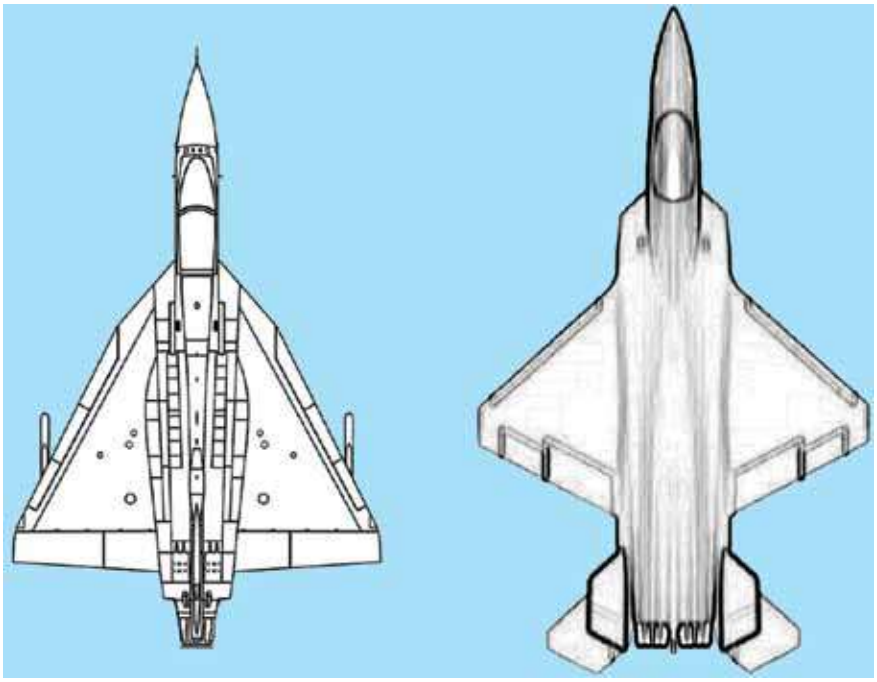
four squadrons in operational service), J-10, J-11, and now their J-20/J-31 Sweden's Gripen; French Rafale; etc. All of these aircraft were contemporaries in development with the LCA, but have entered operational service decade ago.

The LCA has suffered primarily from poor programme management, besides a host of other technological issues. The HF-24 aircraft, in spite of its under-powered engines, had acquitted itself well in the 1971 war. Despite this the aircraft was phased out prematurely in the early 1980s. One of the primarily reasons was lack of any support for further development and derivative work on this excellent design. As a result, the decade of 1970s was a lost decade where much of the HF-24 experience was lost or squandered away. The world over nations and aerospace industries build on experiences gained from one fighter aircraft programme to another. In India's case, the HF-24 and the LCA had nothing in common.

The LCA's development was driven more by the DRDO than the user, the IAF. Moreover, the industry (HAL), which should really have been the main driver and the lead agency, was pushed into a subsidiary role. ADA (Aeronautical Development Agency) was created as a separate Society to coordinate the interactions between various agencies to develop the LCA. ADA was effectively made another DRDO vehicle that took charge of the LCA programme. This relegated the critical roles of the user (Indian Air Force) and the industry (HAL) into secondary ones with adverse impact on the overall programme management. The net result is that the LCA has taken excessively long time, has exceeded budgetary provisions, and most importantly, has failed to meet the user's critical operational requirements. In order to get away from the criticism of poor programme management, ADA has subsequently sought to address the deficiencies in performance through infusion of imported technologies in radar, weapons, and sensors. But this cannot address the basic performance non-compliance which flow from poor design decisions implemented right in the beginning.

Lessons for the AMCA

There are many lessons to be learnt from the LCA experience and these need to be



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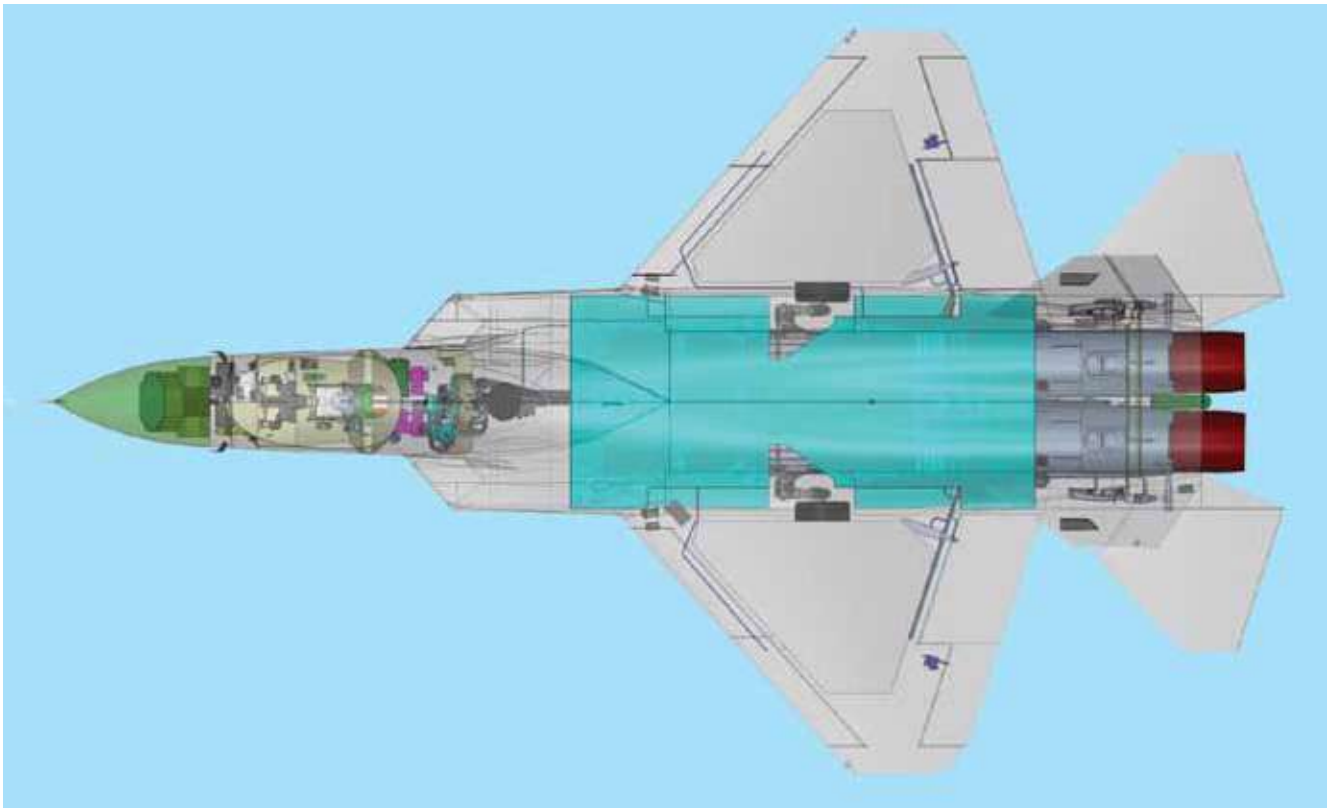


implemented for future programmes like the Advanced Medium Combat Aircraft (AMCA). The most important lesson is the fact that ADA should be restructured to run a programme efficiently with cost, operational, and national imperatives in a well balanced manner. It also needs to be well integrated with the industry. This can only be done by the user or user's representative. All over the world, the user or the military service takes over the programme management immediately after the technology demonstration phase.

For example, the USAF's fifth generation fighter F-22, was managed by the USAF-appointed programme manager for its entire 18 years of development time after first two years of technology demonstration phase by the industry, namely Lockheed Martin.

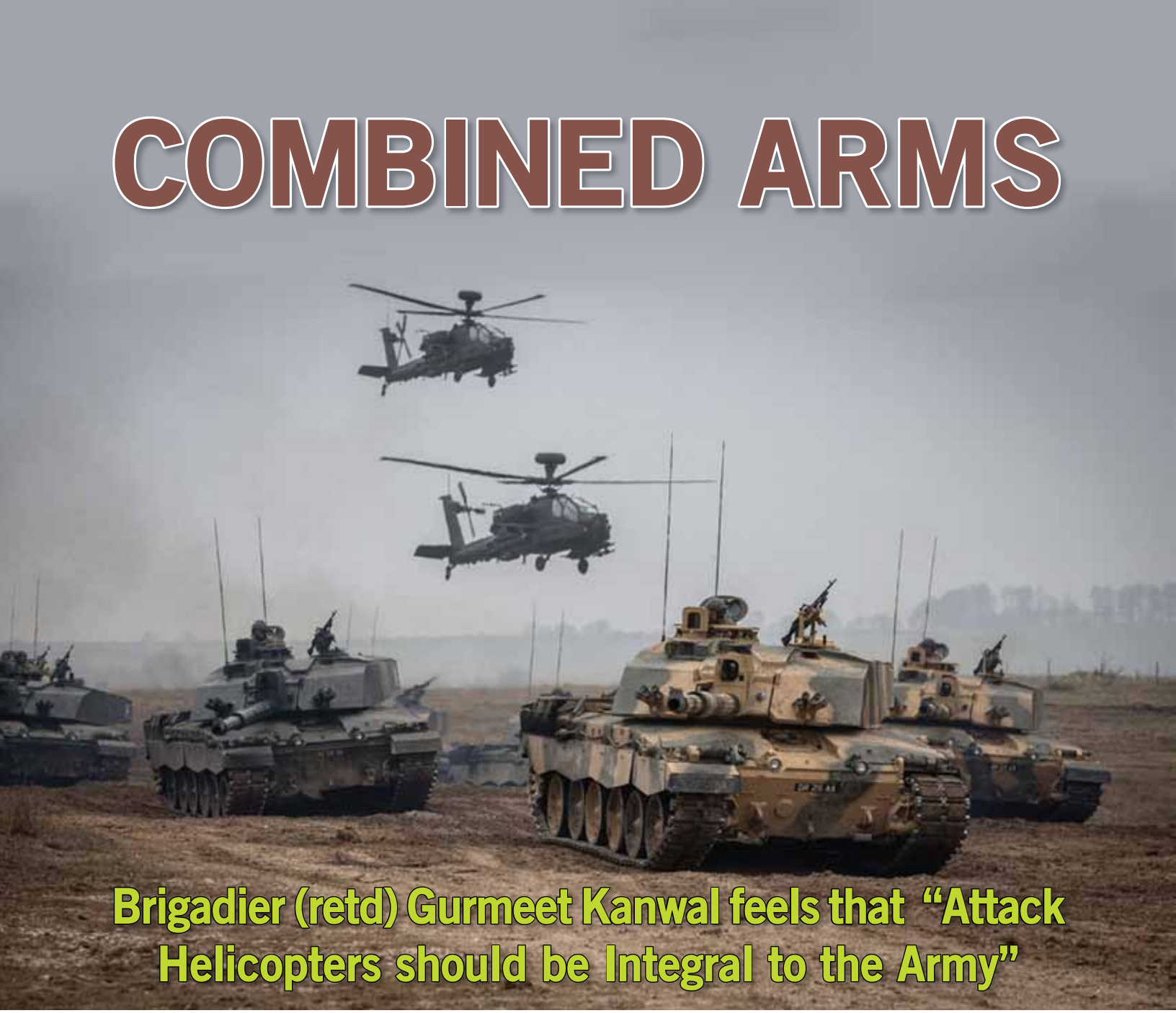
Although the LCA programme made some significant achievements, it is still largely an inefficient and an incomplete fighter aircraft programme. This style of programme management has been too costly and inefficient for India. India now intends to move on to the next generation fighter aircraft programme, the AMCA. If we need to address various problems, we must adopt the following recommendations, which will establish a viable fighter aircraft industry and capability through the 'Make in India' strategy. These are listed below:

- ADA (Aeronautical Development Agency) has to be restructured as a *National Fighter Aircraft Design and Development agency,* and should be headed by a professional with Air Force operational experience. He must have a long tenure, and must have the freedom to take operational, technological, and financial decisions in order to achieve time-bound, cost efficient, and operationally compliant programme management.
- ADA would of course be manned with scientists, military experts, engineers, and finance and management professionals. ADA must be closely coupled with the industry for achieving development and production efficiencies. It must also have allied research laboratories and specialist industries closely coupled with commitment for sub product design and development.
- Assistance from foreign OEMs must be strategically selected with long-term and risk-sharing partnership. For example, if the GOI chooses a single-engine fighter for manufacture of at least 200 aircraft for the IAF, this OEM should be so chosen that India gains strategically on a long-term basis. This OEM should be involved in assisting ADA and the industry in developing, manufacturing, and exporting derivative models of the LCA. It will then be a 50% risk-sharing partner for the development, manufacture, and sale of the AMCA under ADA's program management.
- The AMCA must become India's FGFA, and be IAF's main stay over the next 20-30 years. Derivatives of the AMCA will meet the navy's requirements, as well could become the basis of India's export drive.
- The AMCA programme should lead to indigenisation of aerospace materials, aggregates, radars, avionics, sensors, weapon systems, communications, components, and complete control of all its algorithms. The development of aero engine capability can be followed up subsequently, as this would take much longer time, face more hurdles, and incur significantly higher costs.

In summary, it is evident that the current manner of fighter aircraft programme management has been a failure. In order to achieve a success in our 'Make in India' strategy, the next generation fighter aircraft development (AMCA) must undergo significant change through restructuring of ADA and placing it under the control of a user led professional programme management.

This was also the most critical recommendation made by the author in the report on 'Aeronautics' submitted in 2014 to the Defence Minister. It is reiterated to the new Defence Minister, the Hon'ble Nirmala Sitharaman.

COMBINED ARMS



Brigadier (retd) Gurmeet Kanwal feels that "Attack Helicopters should be Integral to the Army"

'The Army has not fully grasped the value and appropriate employment of air power primarily because the Air Force itself has been ambivalent in its doctrines'.
Jaswant Singh, former Defence, External Affairs and Finance Minister

'Air power dominates the battlefield and must be employed concentrated to achieve maximum synergy… In the inter-Services context, this eminently profound article of faith has been allowed to acquire an extended meaning of single-service ownership of all air assets'.
General Shankar Roy chowdhury, former COAS

Acquisition of Attack Helicopters

In September 2015, the Cabinet Committee on Security (CCS) approved the acquisition of 22 AH-64 Apache attack helicopters and 15 CH-47 Chinook heavy lift helicopters from the United States (US) for approximately US$ 2.5 billion. The contract signed at that time gave India an option to buy 11 Apaches and four Chinooks in addition. It was reported in end-August 2017 that India had exercised the option and decided to acquire six additional Apaches.

While the first lot of 22 Apaches will go to the Indian Air Force (IAF) to replace its ageing Mi-35 attack helicopter fleet, the six additional Apaches will go to the Army Aviation Corps. This move is in accordance with the UPA government's decision to accept the army's long-standing demand that attack helicopters should be integral to it. AK Antony, then Defence Minister, had directed that the next set of Apaches should be given to the army. The army is reported

to have projected a total requirement of 39 attack helicopters to support offensive and defensive operations, particularly the operations of its three Strike Corps.

Air Power as a Force Multiplier in Conventional Conflict

Are these acquisitions in order? Is it desirable for both the army and the air force to be equipped with attack helicopters? In order to answer these questions, it is necessary to first analysethe role played by air power – comprising fighter-ground attack (FGA) aircraft, attack helicopters and combat drones or UCAVs – on the modern battlefield.

Employed in a synergistic manner in conjunction with the ground forces, air power can be a substantive force multiplier that can pave the way for victory. Interdiction of targets in depth and the provision of sustained close air support (CAS, also referred to as battlefield air strikes or BAS) to the ground forces are now part and parcel of the tactics, techniques and procedures (TTPs) of conventional combat on land.

The capacity to execute joint 'AirLand' operations is considerably enhanced by the ability of the air force to mass firepower quickly and deliver a wide range of weapons at the point of decision. In Gulf War II, the US armed forces had raised CAS/BAS to the level of a fine art. Air-to-ground strikes were whistled in more frequently than in any other war and were delivered with alacrity in an unbelievable response time of 15 to 20 minutes.

A US Army AH-64D Apache on exercise in Europe alongside a Danish Leopard 2 battle tank (photo: Forsvaret)

The Jaguar is one the IAF's primary FGA assets and would be crucial in supporting land forces in addition to conducting independent deep penetration strikes (photo: Angad Singh)

Hence, the importance of battlefield air strikes in modern wars must not be underrated. A few missions of FGA aircraft and attack helicopters can deliver more ordnance by way of 1,000 lb. bombs – some of them equipped with precision guidance for terminal homing – in a few minutes on an objective selected for capture than the 18 guns of a 155 mm Bofors medium artillery regiment can deliver in 20 to 30 minutes.

During adverse operational situations, particularly in fast-flowing mechanised operations in the plains, accurate air force and attack helicopter strikes can save the day. The Battle of Longewala during the 1971 war with Pakistan, where a Pakistani armour thrust was brought to a grinding halt by the IAF, is a good example. Also, it is a truism that in-your-face air force and attack helicopter strikes against the enemy in contact with own troops – strikes that can be seen by the troops – provide a major psychological boost to their morale.

The smooth conduct of electronic warfare and "information operations" also benefits from air force and attack helicopter strikes. Writing in 'The First Information War', author Alan D Campen noted that "The targets of the opening shots in Desert Storm were two Iraqi radars located just inside Iraq's border with Saudi Arabia. Hit from army helicopters firing Hellfire missiles, these stations went silent. Moments later, a stealthy F-117 launched a 2,000 pound, laser-guided bomb, on an interceptor control station. Those two attacks opened a door in an electronic wall through which 668 aircraft were to streak into Iraq."

Air Cmde Jasjit Singh has written: "If there is a single lesson of warfare for the past hundred years, it is that land forces cannot achieve their strategic, operational and tactical tasks effectively without deep synchronisation, bordering on synergy, between land and air operations. In effect, air power is the crucial lynchpin without which no military objective can be achieved; and, hence, the key to joint operations."

Another battle winning factor is the possession in abundance of precision-guided munitions (PGMs). Superior precision firepower, delivered from ground-based and aerial platforms, can give ground forces a decisive edge in limited wars. Long-range lethal munitions and precision targeting promise to provide an immense edge to well-equipped ground forces. According to Robert H. Scales Jr, "The lesson from the Gulf War is clear: in a high intensity war, firepower must break the enemy's will to resist before close combat begins. Firepower must so weaken the enemy that close-in killing by infantry and armoured forces becomes a *coup de grace* rather than a bloody battle of attrition."

The Indian army's experience during the Kargil conflict had also brought out a similar lesson. Maximum Indian casualties occurred during initial assaults on the icy mountaintops occupied by regular Pakistani soldiers before the artillery had built itself up to the level of being able to concentrate 100 guns on each target in turn. Sustained, accurate and high volume concentrated artillery firepower eventually won the battle for India by completely decimating enemy *sangars* and enabling the infantry to assault virtually unopposed. Tiger Hill and many other objectives were finally re-captured with minimum casualties. Air-to-ground strikes by the IAF were also instrumental in weakening the enemy's resolve. The battle winning capability of ground-based and aerially-delivered firepower in limited wars was established beyond doubt.

As seen here, attack helicopters can be rapidly transported over large distances between theatres inside large airlifters, such as the IAF's Boeing C-17s (photo: USAF/Capt Raymond Geoffroy)

Forming Joint Air Attack Teams

However, fighter ground attack (FGA) aircraft have several limitations. FGA aircraft are finding it increasingly difficult to penetrate the dense air defence (AD) umbrellas of manoeuvre forces to launch effective air strikes. Secondly, the electronic warfare (EW) measures adopted by the enemy successfully degrade the capability of FGA missions to deliver their lethal payload within acceptable limits of accuracy. Low survivability and reduced effectiveness of FGA missions are bound to cause considerable anxiety. This is applicable with a variation of only one order of magnitude to strikes by attack helicopters. Hence, the suppression of enemy air defence (SEAD) is rapidly becoming a high priority task whenever FGA or attack helicopters missions are planned while operating in a high density AD environment.

During a lo-lo attack mode, flying just above the tree tops at near-supersonic speeds, an FGA mission pilot's time-over-target is not adequate to allow acquisition and engagement to the desired accuracy. Any help that he can get by way of guidance from a heliborne FAC and for unmistakable target acquisition will enhance mission effectiveness. Ideally, FGA missions should be integrated with army aviation assets and the indirect firepower of the artillery. Such a concerted employment of air support resources would be a potent combat force multiplier and would result in the optimum utilisation of valuable and scarce assets.

One method of achieving the levels of integration and close cooperation that are necessary to optimise capabilities is to form joint air attack teams (JAAT) – an idea whose time has come. The JAAT provides the ground formation commander with a highly mobile, lethal force capable of

engaging enemy forces beyond the range of ground-based direct firing weapons, well before the enemy forces establish contact with own troops or mechanised forces. The JAAT can delay, disrupt or destroy enemy manoeuvre elements in any tactical situation, help contain enemy penetrations and provide commanders with useful information about enemy dispositions, locations and activities. The flexibility of JAAT can be employed to maintain continuous pressure on mobile enemy forces beyond the range of ground-based weapons, particularly in situations of dire emergency such as when a heliborne force is counter-attacked by enemy armour before a link-up can take place.

A JAAT is a composite team of army aviation's reconnaissance (light) helicopters, attack helicopters and air force FGA aircraft. The team will usually operate as the aerial punch of the combined arms team. The aviation assets forming a JAAT may be brought together for a pre-planned CAS strike or for immediate CAS requests or during battlefield opportunities. The ground forces commander, normally the brigade commander or the GOC of a division, would normally have overall responsibility for the planning, coordination and employment of a JAAT. However, battalion or combat group commanders may request JAAT strikes at their discretion.

The process of pre-planned JAAT strikes follows the same decision-making process as that of pre-planned CAS missions. However, such strikes are likely to be extremely limited in number because of the rapidly changing tactical situation on modern battlefields, particularly during mechanised operations. During defensive operations, while planning to deny the enemy a successful breakout over a linear obstacle system before first light, it would be prudent to plan JAAT strikes against enemy armour inducted into a bridgehead or armour that is in the process of breaking out. Should a bridgehead have been denied to the enemy, such a pre-planned JAAT mission can be diverted with relish to the enemy's 'A' vehicle waiting areas. Similarly, vehicle-based infantry battalions scurrying to occupy a depth line of defence would be lucrative interdiction targets.

During meeting engagements and tank versus tank battles, spontaneous requests for immediate JAAT strikes would be commonplace. A JAAT can also act as an 'anvil of fire' in the classic 'hammer and anvil' tactics of destroying enemy forces. During defensive operations, enemy actions designed to disrupt the defender's time frame or to pose unmanageable threats would be justified grounds for whistling in JAAT strikes. In situations where attack helicopters are 'on call' to brigades, for example to a leading combat command, immediate JAAT strikes would be easier to plan and execute.

Skilful execution is necessary to implement the JAAT concept successfully. Reconnaissance helicopters must first reconnoitre the target area for firing positions for attack helicopters, also called battle positions. They must findsuitable directions of approach, locations of enemy AD weapons launchers and command and control vehicles, choke-points and

The HAL Rudra (ALH Mk.IV) will be an invaluable combat asset to commanders on the ground once induction is complete with appropriate weaponry (photo: Angad Singh)

bottlenecks through which enemy forces may pass and potential engagement areas. On locating and identifying the enemy elements to be attacked, they must ensure that visual contact is maintained throughout the operation. Subsequently, during the attack, the reconnaissance helicopters provide visual security for attack helicopters. The FGA aircraft will usually enter the target area in a two-aircraft flight as the basic attack configuration. Terrain and weather will influence the number of flights which can operate in a target area at one time. FGA aircraft commence moving for the strike using low-altitude tactical navigation to draw maximum advantage from contour masking. The Forward Air Controllers (FAC) provide updated information as necessary and give the final attack clearance.

Concluding Observations

Indian attack helicopters must be capable of night attack and all-weather flying. These must be able to lay-off in and operate off small helipads in forward hides where the pilots can be briefed in real-time and can return for ammunition replenishment, re-fuelling and maintenance checks for short durations. In other words, attack helicopters need to become a well-knit and finely integrated part of the ground battle environment with the only difference being that they launch their lethal payload while they are airborne.

Attack helicopter pilots must eat, live and train together with their counterparts in the manoeuvre arms. In some Western armies attack helicopters are known as the 'fourth squadron' of a combat group. That is the level of integration that Indian attack helicopter units should aspire to achieve.

Finally, while a beginning has been made, six attack helicopters will be grossly inadequate to support ground operations across the full spectrum of the threats and challenges with which the army will need to cope over the next few decades. The remaining 33 attack helicopters that the army requires must be acquired expeditiously so that the Army Aviation Corps becomes a potent force and an effective force multiplier during the next conventional conflict that the army is required to fight. Ideally, the 22 Apaches being procured for the IAF should be transferred to the army so that a single force holds all of them.

There would be operational synergy in doing so as the army is the primary user of the potent firepower punch that the Apaches pack and their employment during war has to be planned in intimate coordination with the ground forces. Such a move would also facilitate training and logistics. It was a mistake to have initially decided that the IAF should hold and man the attack helicopter fleet. In other modern armies attack helicopters are an integral part of army aviation. The consequences of historical mistakes do not have to be endured in perpetuity.

The writer is Distinguished Fellow, Institute for Defence Studies and Analyses (IDSA), New Delhi.

HAL's Light Combat Helicopter (third prototype pictured here) has entered low-rate production and is optimised for air support at extremely high altitudes (photo: Angad Singh)

Boeing's AH-64 Apache: "Enhancing combat and industrial capability"

The Indian military's force projection capabilities are set to grow with the government approving the acquisition of six AH-64 Apache attack helicopters for the Indian Army. This is a significant milestone as the AH-64 Apache manufactured by Boeing will be the first attack helicopter to be approved for the Army. The AH-64 is the world's most advanced multi-role combat helicopter and is used by the US Army and a growing number of international defence forces. Boeing has delivered more than 2,200 Apaches to customers around the world since the aircraft entered production.


Boeing

India is the 14th nation to select the Apache to strengthen the country's homeland defence significantly and deter regional threats. India will receive the most modern variant–the AH-64E Apache – which is also flown by the US Army, featuring enhanced performance, joint digital operability, improved survivability and cognitive decision aiding.

Boeing India President Pratyush Kumar opined, "Boeing welcomes the opportunity to support the Indian Army on their requirements. The AH-64E Apache is the world's most advanced multi-role combat helicopter. With this development, we look forward to supporting all three Indian defence forces – the Air Force, Navy and now the Army. It is noteworthy that under Prime Minister Modi's Make in India initiative, AH-64 Apache fuselages and other aero structures are being manufactured at the Tata Boeing Aerospace joint venture facility in Hyderabad."

The government's clearance to the Army to get AH-64 Apaches is in addition to the 22 AH-64E helicopters that the Indian Air Force will receive starting in 2019. India finalised an order with Boeing for 22 AH-64E Apache attack helicopters for the Indian Air Force in September 2015. These helicopters will enhance India's attack capabilities across a range of missions.

Tata Boeing Aerospace Limited (TBAL), a joint venture between Boeing and Tata Advanced Systems will manufacture Apache fuselages, secondary structures and vertical spar boxes for the US Army and international customers out of Hyderabad. The state-of-the-art facility became operational in July 2017 ahead of schedule. Deliveries of the AH-64 Apache fuselages will begin in 2019. The Hyderabad production facility will eventually be the sole producer of AH-64 fuselages globally. If the Indian Army or the Indian Air Force decide to exercise their options and purchase additional Apache helicopters, the fuselages for those units will be manufactured at Tata Boeing Aerospace Limited as well.

AH-64E Apache: Always Mission Ready

Since the delivery of the first AH-64A Apache attack helicopter in 1984, the AH-64 Apache has been evolving with technology advancements at regular intervals to ensure that the 'world's most capable multi-role combat helicopter meets the needs of the warfighter well into the future'.

The Apache has the latest technology insertions that make it a lethal attack helicopter and is the only available combat helicopter with a spectrum of capabilities for virtually any mission requirement. It is uniquely suited to meet the commander's needs, including reconnaissance, security, peacekeeping operations, and lethal attack, in both land and littoral environments, all without reconfiguration.

The gunship incorporates new technologies designed to enhance its capabilities. The improved drive system features a new split-torque face gear transmission that increases power capability to 3,400 shaft horsepower. The new composite main rotor blade accommodates the power increase, resulting in improved aircraft performance with increased payload.

The aircraft capabilities features increased digitisation, the joint tactical radio system, enhanced engines and drive systems, capability to control UAVs and new composite rotor blade. The new blades, which successfully completed flight testing in May 2004, helps increase the Apache's cruise speed, climb rate and payload capability. Apache has a strong shell made of composite fibres to protect the pilots from bullets.

Integrating the T700-GE-701D engine with the enhanced digital electronic control unit and other drive system technologies results in an increase in hover ceiling altitude at greater gross weight on a 35°C day. The twin-engine tandem seat Apache is operated by two pilots, and can execute an attack within 30 seconds of an alert.

The Apache can be equipped with air-to-air missiles (Stinger, AIM-9 Sidewinder, and Mistral) and the advanced precision kill weapon system (APKWS) rockets. The Longbow Apache carries the combination of armaments chosen for the particular mission. In the

Boeing

close support role, the helicopter carries 16 Hellfire missiles on four four-rail launchers and four air-to-air missiles. The Longbow Apache's radar dome is unmasked for a single radar scan and then re-masked.

The target acquisition designation sight, TADS (AN/ASQ-170), and the pilot night vision sensor, PNVS (AN/AAQ-11), are some of the other features. The turret-mounted TADS provides direct-view optics, television and three-fields-of-view forward-looking infrared (FLIR) to carry out search, detection and recognition, along with a Litton laser rangefinder / designator. PNVS consists of a FLIR in a rotating turret located on the nose above the TADS. The image from the PNVS is displayed in the monocular eyepiece of the integrated helmet and display sighting system.

Boeing's services and support for the Apache programme provides an array of services that are uniquely tailored to the requirements of each customer. Owing to the long tradition of success of the Apache, Boeing can help provide mission effectiveness, improved readiness, at a reduced total cost of ownership.Today, Apache helicopters have either been inducted or are being considering by a growing number of defence forces worldwide for upgrading to or adding these latest combat machines to their rotorcraft fleets.

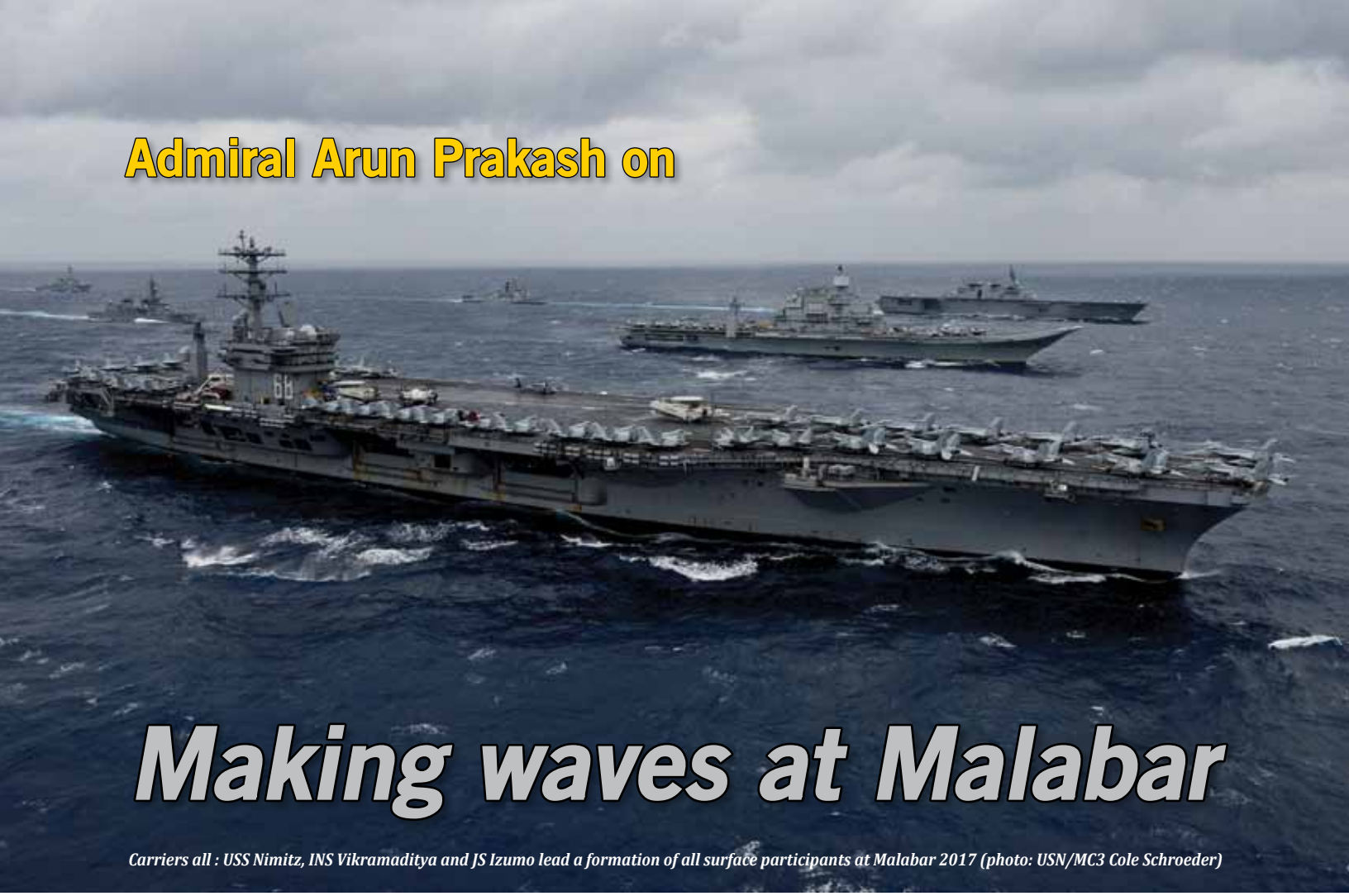
Apache's application range is 'unmatched' and ranges across spectrum of conflict to peacekeeping and nation building. It has been used time and again by the US as well as international customers for military and training operations to peace enforcement, humanitarian relief, disaster relief, national defense and counter special operations forces.

The Apache has completed 3.5 million flight hours and is still the most advanced attack helicopter in the world. It is the only one which has proven itself in combat beginning with the 1991 US-Iraq Gulf war. After its highly successful attacks on Iraqi armour during the war over the liberation of Kuwait, Apache has now been operating and executing successful missions in Afghanistan.

Courtesy: Boeing

Admiral Arun Prakash on

Making waves at Malabar



Carriers all : USS Nimitz, INS Vikramaditya and JS Izumo lead a formation of all surface participants at Malabar 2017 (photo: USN/MC3 Cole Schroeder)

The Malabar series of naval exercises has far-reaching geo-political impact, and the India-Japan-US triad must be elevated to strategic status.

July 2017 saw the waters of the Bay of Bengal roiled by frothy wakes of warships and submarines of three navies as their jets streaked across the skies. The 21st edition of exercise *Malabar* had two aircraft carriers, a helicopter-carrier, nuclear and diesel-electric submarines, cruisers, destroyers and maritime patrol aircraft belonging to the Indian, Japanese and US navies participating. For a week, these units, divided into 'Red' and 'Blue' forces were pitted against each other in mock combat, involving, surface, under-water and aerial warfare. Naval exercises don't get more complex or sophisticated than *Malabar* 2017!

For the Indian Navy (IN) it has been a long journey from professional isolation of the non-aligned era, to being the 'belle of the *Malabar* ball.' Soviet patronage and naval hardware had commenced flowing in the 1960s, but since they never undertook professional interaction or exercises at sea, the IN found itself clinging to outdated NATO doctrines. The disintegration of the USSR saw India losing not only its steadfast political ally and sole purveyor of arms, but also the inhibitions that went with non-alignment. The US, perhaps waiting for this moment, lost no time in despatching

Malabar 2007 was the largest exercise in the series, involving two USN 'supercarriers' in addition to INS Viraat, and caused great consternation in China (photo: USN/MCS Stephen W Rowe)

Pacific Army Commander, General Claude M Kicklighter, with proposals for military-to-military cooperation in 1991.

Keen to shed its insularity, the IN initiated the first ever Indo-US naval drills in May 1992. These became the precursor for bilateral exercises with the navies of a dozen other nations, which have become an annual feature on the IN calendar. Having got off to a good start, the Indo-US exercises named *Malabar* were interrupted by US sanctions imposed after India's 1998 nuclear tests. Resumed in 2001, these naval interactions have not only provided the IN with invaluable insights into the tactics, doctrines, warfare techniques and best practices of the US Navy, but also enabled periodic self-assessment, using the world's most powerful navy as a professional yardstick.

The path of these exercises has neither been smooth nor untroubled. Externally, China has sustained a determined opposition to *Malabar* because of its paranoid suspicion that India is colluding with the US in an attempt at "containment". Consequently, when the 2007 edition of this bilateral exercise, held off Okinawa, was enlarged to accommodate Australia, Singapore and Japan, China issued a shrill demarche, conveying its fear and displeasure. It took another eight years before Japan was formally admitted to make *Malabar* tri-lateral.

Domestic opposition to *Malabar* has come from diverse sources. Notwithstanding the steep decline of Communism as a political force, there is a strong residual streak of leftist ideology in many of India's political parties. At the same time, the right wing has its ultra-nationalists and xenophobes. Thus, an accusation of being "pro-American" can still become a damaging political tool. Another factor that sometimes poses an impediment is the public anger about America's continuing economic and military assistance to Pakistan despite its use of jihad as a strategy and its duplicity vis-a-vis anti-India terrorist groups.

However, it is the far-reaching geo-political impact of these exercises that needs to be kept firmly in sight. Although India's traditional strategy of 'non-alignment,' and its more recent mutation, 'strategic autonomy,' have served to preserve its freedom of action, India's past leadership did not allow it to come in the way of national interest. The aftermath of the 1962 Sino-Indian crisis as well as the impending

An Indian Navy MiG-29K conducts a 'missed approach' over the flight deck of USS Nimitz with its F/A-18 Super Hornets during Malabar 2017 (photo: USN/MC3 Weston A Mohr)

1971 Indo-Pak War saw our leaders suspend their political beliefs in favour of national interest — in the first case, to seek military aid from the West, and in the second, to sign a treaty of friendship with the USSR.

With the 1998 nuclear tests and the 2005 Indo-US nuclear deal having resulted in a fundamental transformation of India's status, PM Modi has also given clear indications that India's foreign policies will be guided by pragmatism and national interest, rather than idealism. As we note the hostility and aggressive posturing by a rising China, both on our land borders and at sea, we need to recall the words of Greek historian, Thucydides. "It was the rise of Athens," he said, "and the fear that this inspired in Sparta, that made war inevitable." Today, realpolitik demands that India take necessary steps to avoid the 'Thucydides Trap' by ensuring a favourable regional balance-of-power, through cooperation and partnerships; striking short-term alliances if necessary.

Apprehensions about the Trump administration's stance on Indo-US naval relations have been set at rest by repeated mentions, in the recent Trump-Modi joint statement, of Indo-Pacific security, of maritime cooperation and of the significance of exercise *Malabar*. Japan, too, is easing its laws vis-a-vis foreign military relations. The stage is, therefore, set for the three navies to expand their linkages beyond exercises at sea. In the realm of maritime warfare, the three navies could derive mutual benefit from their diverse operational expertise. Given China's sinister intent in acquiring bases in the Indian Ocean, and increasingly frequent transit of PLA naval units through our waters, cooperation in strategic anti-submarine warfare as well as maritime domain awareness deserve top priority. Equally, amphibious operations, trade-warfare, maritime interception operations, anti-access concepts and, of course, disaster relief, must receive due importance.

Our navy's indigenous warship-building programme is still heavily reliant on key inputs from foreign sources. We must seek help from the advanced US and Japanese military industrial complexes to acquire the competence for designing and building our own weapons and sensors. Heading our wish list should be electric-drive technology for our amphibious-warfare ships and (hold your breath) nuclear reactors to propel our submarines as well as aircraft carriers.

Indo-US naval cooperation has, for 25 years, formed the sheet-anchor of bilateral relations, stoically weathering political and diplomatic storms. With the invaluable accession of Japan to this partnership, the India-Japan-US triad must, now, be elevated to strategic status. A proposal worthy of contemplation would be the creation of a "maritime-infrastructure and economic initiative" that reaches out to smaller Indian Ocean nations in an endeavour to wean them away from the Dragon's claws.

Enter the F-16 Block 70

Enter the F-16 Block 70, the latest iteration of that continuous improvement process. The Block 70 resets the standard for fighter aircraft, with its weapons systems, sensors, avionics, engine, operational capability upgrades and structural upgrades enabling it to stay ahead of emerging threats. No other 4th generation platform even comes close to matching to F-16's record of real-world combat experience and operational effectiveness.

The F-16's iconic shape remains relatively unchanged from the famous fighter's original design, but internal structures and systems on the F-16 have been continuously modernised to incorporate new, advanced technologies. The F-16's success stems from relentless operational modernisation informed by real-world combat experience, and the Block 70 incorporates decades of combat lessons-learned by the US Air Force (USAF) and the twenty-six other air forces around the world who selected the F-16 as their frontline fighter of choice. Sixteen of those air forces made repeat orders for more F-16s :55 times altogether.The USAF itself operates far more F-16s than any other fighter aircraft owing to the F-16's proven combat capabilities, unparalleled adaptability and affordability.

The USAF and other F-16 operators continue to demonstrate the F-16's proficiency across mission sets, including Defensive Counter Air (DCA), Offensive Counter Air (OCA), Air Interdiction (AI), Close Air Support (CAS), Strike, Suppression/Destruction of Enemy Air Defences (SEAD/DEAD), and Intelligence, Surveillance, Reconnaissance (ISR).

The F-16 flies farther, intercepts faster, accelerates quicker, and turns more tightly than any others extant. The F-16's 9G capability and immense thrust-to-weight ratio enables it to dominate the skies with unmatched agility, lethality and survivability. And unlike any of its competitors, the F-16 has the combat hours to prove it.

The F-16 Block 70 with conformal fuel tanks has a mission radius exceeding 1,700 km in an air-to-air configuration carrying four AMRAAMs, two ASRAAMs and two 370 gallon fuel tanks. This yields a 750 km DCA Combat Air Patrol (CAP) with on-station time of more than two hours.

Even with the addition of targeting systems and two 2,000 lb class Joint Direct Attack Munitions (JDAMs), the F-16 Block 70 has a mission radius exceeding 1,300 km or some 30 percent greater than that of the F-16's closest competitor. With the optional 300 gallon center line tank and two 600 gallon wing tanks, the F-16 Block70's advantages are even greater.

The Active Electronically Scanned Array (AESA) radar

The F-16's APG-83 Active Electronically Scanned Array (AESA) radar delivers significantly enhanced situational awareness, flexibility and quicker all-weather targeting. The APG-83 provides pilots with unprecedented target area detail and digital map displays that can be tailored with slew and zoom features on the new high-resolution 6"x 8" Center Pedestal Display (CPD) screen. The high-resolution display allows pilots to take full advantage of AESA and targeting pod data.

The APG-83 - more accurately defined as a multi-function array (MFA) - builds on three prior iterations of operational AESA radars integrated into Lockheed Martin fighter aircraft. The APG-83 provides F-16s with 5th generation fighter radar capabilities by leveraging hardware and software commonality with F-22 and F-35 AESA radars. With more than 85 percent hardware and software commonality with the F-35 MFA, radar technology upgrades will continue to flow from the F-35 to the F-16 well into the future.

The F-16 Block 70 also delivers with an advanced modular mission computer (MMC), gigabit ethernet capability, and enhanced memory and throughput to enable future growth as technology advances. The Block 70 can also be equipped with advanced Infrared/Electro-Optical (IR/EO) sensor technology and the largest array of certified munitions of any fighter aircraft. The F-16 Block 70 architecture enables India to indigenise the aircraft with unique systems, sensors, and weapons to meet specific sovereign service and national requirements.

With unmatched structural rigidity, the F-16 is poised to fly and fight for decades to come. The F-16 has been tested to beyond 27,000 hours of structural life and is certified to more than 12,000 hours - 50 percent beyond that of the F-16's nearest competitor.

Partnership with the Tata Group

The Lockheed Martin-Tata Group F-16 partnership is without equal, combining Lockheed Martin's global experience and success establishing defence ecosystems in six countries, with the strength and integrity of Tata. This would deliver the advanced defence capabilities and industrial benefits to truly propel India's military and defence industrial base into the future.

Lockheed Martin has partnered with India for more than 25 years and remains committed to fostering technology development, manufacturing and strategic collaboration. That strategic partnership is reflected in our successful joint venture company with Tata Advanced Systems Limited (TASL), which manufactures major airframe components for the C-130J airlifter and the S-92 helicopter.

The F-16 programme proposed for India is unprecedented in scope, including the opportunity for India to become the exclusive home of worldwide F-16 production and exports. F-16 production in India will also establish a comprehensive manufacturing ecosystem in India capable of building, testing, maintaining and upgrading advanced fighter aircraft for decades to come.

Courtesy: Lockheed Martin

F-16 India partnership signing, 19 June 2017

VAYU on-the-spot report

Visit to Thales in France

Thales site at Rouen

Part II

Radars, airport security and new technologies

To continue from *Vayu's* last issue where were covered Thales' UAV activities and Thales in India, in this issue we focus on developments on their radar and airport security front.

As a brief recap from *Issue IV 2017*, after spending time being briefed on UAV developments throughout France especially with respect to Thales, the next module involved radars. At the Thales Rouen site there were presentations on activities with focus on civil radars activity. Talking to us on these topics were Marc Fiolin, Director of Rouen Thales site and Thierry Le Joncour, Director for surface civil radar activities, Thales. More details were given on new generation radars by Gaston Marcantoni, Director for surface multi-functions radar activities at Thales. Later we were introduced to Thales' 'Factory of the Future' and the Company Group vision as well as focus on the Factory 4.0 with the Sea Fire 500 radar at Rouen.

RBE2 AESA on the Rafale

Presentations by Philippe Chamoret, Vice President Industry, Thales, Marc Fiolin, Director of Rouen Thales site and Philippe Eudeline, Innovation Director for surface radar activities for Thales, were informative indeed.

We walked around the site to observe first-hand the operations of the Trac NG radar and its systems as well as three production centres. Philippe Juge, Product line manager for Air Traffic Management radars, Thales took us through the details.

As for military aspects, we were provided information on the RBE2 AESA radar, and also had the opportunity to discover two new RBE2 innovations. A presentation on this radar for the international market was provided by Bruno Gilon, Product line manager for combat

aircraft, Thales. Hands-on activities included simulation of airborne systems and 3D immersive training. The Rouen tour continued with information given by Thibault Trancart, Marketing director for Intelligence, Surveillance and Reconnaissance activities on the Searchmaster radar (and its new developments) and the Coast Watcher 100 (CW100).

After radar briefs, the next module was at Thales' Gennevilliers site, where we were introduced to the company's solutions in the security market. This included airport security solutions from anti-terrorism to new video technology tools.

Now in more detail!

We were informed that Thales and PAL Aerospace had strengthened their global partnership with the announcement of a new operational aircraft platform. The PAL Aerospace 'Force Multiplier' Dash-8 Q 300 aircraft, as it is called, will be equipped with a Searchmaster multirole radar and an Amascos multi-mission system. This aircraft has been specially designed by PAL and Thales to meet both the needs of maritime and ground surveillance. PAL Aerospace and Thales will now be able to propose to government customers an operational service that meets their requirements through the acquisition of flight hours. The platform will also carry out flights demonstration to illustrate the high-performance of the multirole radar and the Amascos multi-mission system in operational conditions.

When the Force Multiplier aircraft goes into service, the flight crew will comprise a PAL operating crew with over '40 years› experience encompassing over 250,000 hours of airborne surveillance experience'. The platform is currently being integrated and will be presented during the Dubai Airshow in November 2017. The Force Multiplier aircraft will be available to perform flight hours for customers in 2018.

The Searchmaster multirole surveillance radar is the first in its category (under 80 kg) developed to meet the needs of both maritime and ground surveillance. It also provides tactical air support in both of these environments, using active antenna (AESA) technology and qualified to fly on all types of platforms. The Searchmaster was selected in 2014 by the French Defence Procurement Agency (DGA) as part of the Atlantique 2 (ATL2) maritime patrol aircraft upgrade programme for the French Navy. Several international customers have also opted for this radar and this multirole radar has been in series production since March 2017.

Scalable and adaptable, the Amascos system offers extended multi-mission capabilities, covering both maritime and ground surveillance missions. Amascos is described as the "ideal solution" in response to all Intelligence, Surveillance and Reconnaissance (ISR) requirements. Designed by Thales and featuring the latest generation sensor suites, it is already in service with several national navies and air forces. The TopEagle helmet-mounted designation system produced by Thales may be offered as an option in order to provide pilots with "eyes-outside" functions enabling an enhanced, coherent vision of the mission data processed by the system.

The partnership signature! From left to right are Jake Trainor, Chief Operating Officer at PAL Aerospace, Mark Halinaty, TC CEO, PEP, Thales and Michael Sangster, Chief Commercial Officer, PAL Aerospace

Concerning airport security, Thales announced that they and SITA would provide the security and operations management systems for Bahrain International Airport. The Airport Modernisation Programme was launched in 2015 with an overall aim to elevate Bahrain International Airport's infrastructure and services and make it one of the most important hubs for tourism and services. This ongoing programme includes the construction of a new passenger terminal as also expansion and refurbishment of the existing terminal. With growing passenger flow, airport authorities face two challenges: enhancing the security and safety of all the passengers, airlines and staff, and making the airport operations more manageable and more efficient. As the master system integrator, Thales will deliver an innovative and trusted security system ensuring continuity of operations, centralising the airport operations management and meeting all safety and security requirements. Thanks to smart data processing, the system will provide the operators with real time security and operations situation awareness. This security system will be embedded with all the cutting edge technologies needed for airport management such as smart video protection, access control and biometrics, IT and telecommunication infrastructures. The airport operators will rely on decision support tools and procedures to enable a better and faster response time in case of emergency. The system will also allow operators to monitor airport performances. As a major player in cybersecurity and a world leader in data protection, Thales will finally ensure end-to-end protection of the global solution, providing real time counter-measures against the most sophisticated of cyber-attacks. "Thales leverages its international expertise to serve airports with best-of breed integrated solutions maximising operational performance whilst securing infrastructures, information and the people," stated officials.

As a 'world leader in airport security' providing smart and integrated airport solutions, Thales has implemented several similar projects in the Middle East such as the expansion of Dubai International Airport and Hamad International Airport in Doha. Thales has also been chosen by Salalah and Muscat airports in Oman which are still under construction. Thales has also provided airport security solutions for Durban (South Africa), Changi (Singapore), Lisbon and Madeira (Portugal), Pisa (Italy) and Lyons (France).

Meanwhile, the John F Kennedy International Airport (JFK) Terminal 4 is planning to modernise their Security Operations Centre (SOC) with Thales. This three-year contract is part of an extensive security modernisation project at JFK Terminal 4 to enhance the situational awareness of its security operations. Thales will deliver an Airport Operation Control Centre

Bahrain International Airport has selected Thales for elevating its systems

(AOCC) platform that provides processes and procedures to make management of security and operations of the airport terminal smoother and more efficient. Thales will also provide a command and control centre to enhance situational awareness of terminal activities while giving the operators complete functionality of all subsystems and enabling the proactive response of security personnel. Thales will lead the system integration in cooperation with key airport stakeholders, and provide airport security engineering services for the next three years. In 2015, JFK Terminal 4, the first and only privately operated air terminal in North America, operated by JFKIAT, LLC., completed a multiyear, multibillion dollar expansion and renovation of its physical terminal to ensure it had the infrastructure in place to match its growth expectations. The terminal is the largest and busiest at JFK, processing more than 20.6 million travelers annually. The contract with Thales ensures that the newly expanded terminal maintains a strong security apparatus by acquiring the latest in state-of-the-art security technologies. These technologies will help the terminal keep up with passenger traffic growth and make Terminal 4 the "desired experience for travelers arriving to or departing from the New York metropolitan area". JFK is consistently one of the top five busiest airports in the United States and ranks among the top 15 airports worldwide.

John F Kennedy International Airport (JFK) Terminal 4 is planning to modernise their security operations

Thales flight simulators to train Kuwaiti Caracal pilots

Thales has been selected by Airbus Helicopters to provide the Kuwait forces with flight and mission training solutions for pilots and crews of its Caracal helicopters. The Kuwait forces has signed a contract for 30 multirole Caracal H225M helicopters (24 for the Kuwait Air Force and 6 for the Kuwait National Guard) in order to carry out combat search and rescue duties, transport and ground support missions. To meet the pilots and crews' hands-on training needs, Thales will supply a Reality H Full Flight Mission Simulator (FFMS) as well as two trainer stations for flight procedures and tactical training. Thanks to the Reality H Full Flight Mission Simulator, pilots will receive training (in a realistic tactical visual environment) in normal navigation procedures, instrument flight, how to handle failures and emergency procedures, which cannot be easily accomplished on real helicopters. The communication systems, weapons and self-protection systems, as well as the in-flight refueling function, are identical to those of an actual helicopter, to ensure pilots are trained as in real-life conditions.

Thales Ground Fire: future ground application of its multifunction radar

Thales has unveiled its Ground Fire family: a range of latest-generation multifunction ground radar. The radar system, which is fully digital, will carry out air defence and surveillance missions simultaneously.

Air Forces are confronted today with major changes in the type of threats they face, as well as in their environment. Targets can be very slow or extremely fast-moving, furtive and manoeuvring. In addition, military personnel often face very challenging interference conditions. Consequently, they require a radar that allows them to perform all the missions they are expected to operate. The Ground Fire family meets this requirement "perfectly", since it offers an "unprecedented" level of performance for air and defence surveillance including anti-ballistic missiles with a capacity to conduct missiles from the Aster family in hostile environment (clutter, rain, jamming, etc.). The Ground Fire versions, which are fully digital, are able to simultaneously detect and track a comprehensive range of targets such as ballistic missiles, with continuous 360° coverage in azimuth, up to 90° coverage in elevation and at a range of 400 km.

The Ground Fire range is identical to the Sea Fire family - the naval version which is set to equip the future intermediate-size frigates of the French Navy. Both families are based on the principle of modular, scalable architecture. Like those of the Sea Fire radar, the transmitter/receiver modules that make up the antenna will all be identical and interchangeable, to facilitate series production and maintenance operations. It will be possible to adapt the number of modules in order to modify the strength of the radar depending on the user's needs.

TRAC NG radar for dual civil/military operators unveiled

Thales has unveiled TRAC NG the 'world's most advanced' dual use civil/military en-route radar. Derived from Thales STAR NG, TRAC NG responds to the need to extend primary surveillance across en-route segments in ever more congested airspaces, and the more effective monitoring of secured military airspaces. The radar has already been ordered by two major customer countries, including Brazil's armed forces who handle both civilian and military air traffic in the country.

Thales TRAC NG is an L-Band primary radar with a range up to 250 nautical miles, "perfectly tailored" to serve as an effective system to guarantee primary surveillance across large tracks of en-route airspace. Just like STAR NG, it is a fully dual civil/military system that offers as options altimetry and the ability to track both fast and slow targets like helicopters, as well as small targets like UAVs. In addition, it can include concrete military features like frequency agility, jammer strobe detection and least jammed frequency selector, making it better hardened against electronic countermeasures than any other civilian radar.

The use of TRAC NG presents some very concrete benefits that reduce lifecycle cost, several unique aspects making it a very attractive proposition for both civilian and military users. Its compact design architecture optimises power consumption and enables easier site installation. It has a "much improved power budget, system stability, dynamic range and instantaneous bandwidth that allows it to increase detection performance, as well as signal-to-clutter ratio and false alarm management functionalities that make it harder to confuse the radar even during complex operations".

If you have it, flaunt it !

National Formation Aerobatic Team displays on special occasions

Red Arrows over Buckingham Palace, London

There are only a few formation aerobatic teams maintained by leading Air Forces of the world, which include the famed *Red Arrows* of the British Royal Air Force, the *Patrouille de France* of the *Armée de l'Air,* the *USAF* has its *Thunderbirds*, while the US Navy has the *Blue Angels*, the PLAAF flies its *August 1*, the Pakistan Air Force has its *Sherdils*, the Russian Air & Space Force have the *Russian Knights* and, of course, we have the *Surya Kirans* of the Indian Air Force.

The months of July-August 2017 had many national formation aerobatic teams mount displays over their respective capital cities, in celebration of special days. The Royal Air Force flew over London to mark Queen Elizabeth II's birthday, the French Air Force Alpha Jets were in spectacular fly past over the Champs-Élysées in Paris and also the French Riviera, while the *Sherdils* of the Pakistan Air Force, were amongst several teams taking part in fly pasts over Islamabad on 14 August 2017, marking 70th anniversary of independence.

Across the Radcliffe Line, even while the Indian Prime Minister spoke to the nation from ramparts of the Red Fort, the *Surya Kirans* were surely missed as they too would have appropriately marked the 70th anniversary of India's independence !

Alpha Jets in Cross of Lorraine formation over Paris

K-8s of the PAF Sherdils Aerobatic Team

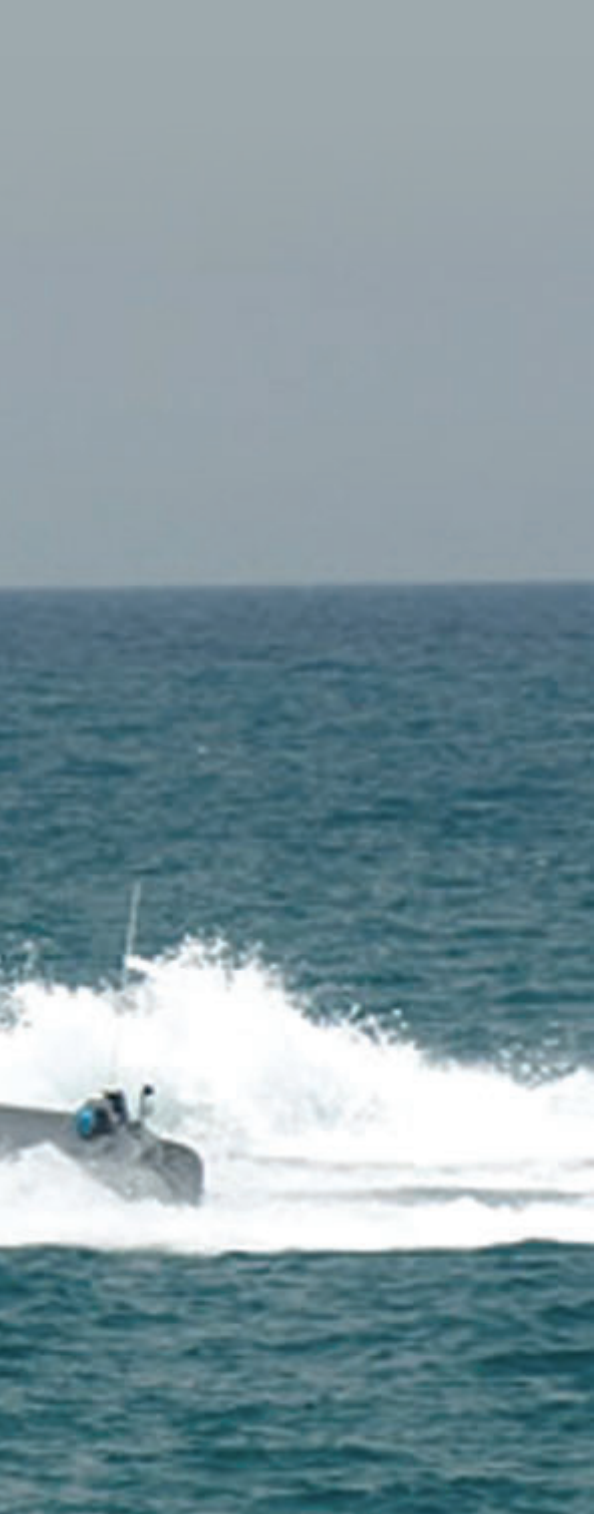
The Startling Growth

Expanding UAV/USV market

Protector USV from Rafael, Israel

A new market study on military UAVs by *Market Forecast* indicates a growth of the military VTOL UAV market from $81 million in 2016-17 to $392.8 million in 2022-23, or an increase of over 400%. UAVs operated in Afghanistan and Iraq have demonstrated their usefulness for Counter-Improvised Explosive Device (C-IED) tasks. Vertical Take-Off and Landing UAVs (VTOL UAVs) are particularly seen as suitable for C-IED with the air vehicle capable of hovering at a distance to find and locate Improvised Explosive Devices (IEDs). VTOL UAVs are additionally seen as useful in urban environments, for maritime ISR tasks from naval vessels and in areas where normal fixed-wing UAV operations might be difficult due to terrain, threats or insufficient support personnel deployed at forward bases to recover the UAV. Major companies offering VTOL UAVs include Northrop Grumman with the MQ-8B/C Fire Scout, Austria's Schiebel with the Camcopter S-100 and UMS Skeldar, a joint venture formed between Sweden's Saab (47 per cent) and Switzerland's UMS Aero Group (53 per cent), with the Skeldar series. Multiple countries have bought or intend to buy VTOL UAVs including the USMC (USA), ONR (USA), Bulgaria, Germany, Greece, United Kingdom, Portugal, Norway, Korea, the Philippines and the UAE.

Another report *Unmanned Surface Vehicle (USV) Market by Application (Defence, Scientific Research, Commercial, Miscellaneous), Size (Small, Medium, Large, Extra Large), Propulsion System, Modes of Operation, Payload and Geography - Global Forecast to 2022*, states that the unmanned surface vehicle market is estimated at



The VTOL UAV VRS 700 is being developed by Airbus Helicopters and Naval Group (DCNS)

$470.1 million in 2017, and is expected to reach $938.5 million by 2022, at a CAGR of 14.83% from 2017 to 2022. This growth can be attributed to rising demand for maritime security, protection of shallow waters and ports, and need for ocean data & mapping, globally.

The defence segment is expected to grow at a highest CAGR due to huge demand from navies across the world for purposes such as surveillance, reconnaissance, anti-submarine warfare, and mine countermeasures. Most of the players have invested into large sized USVs for combat operations, cargo supply, and lethal and non-lethal armament among others.In terms of payload, the unmanned surface vehicle market has been segmented into sonars, sensors, camera, visual systems, INS, X-band radars, and others. The camera segment dominates the market. Cameras are cost-effective and provide ample opportunities for more advanced technological developments in near future. The sensor segment is projected to grow at the highest CAGR during the forecast period.

The unmanned surface vehicle market is dominated by North America, as of now, owing to the technological advancements and the growing terrorist activities being combated. The market is driven by increasing demand for water quality monitoring, ocean data mapping, asymmetric threats, and maritime security. In the European region, USVs are used in mine countermeasures (MCM) and focus is on to build new MCM-dedicated vessels. The major players in this market have been identified to be ASV Unmanned Marine Systems (UK), Teledyne Technologies, Inc. (US), Textron Inc. (US), and Elbit Systems Ltd. (Israel), among others.

LM continues flight demos of Fury UAS

In flight tests, the LM Fury has flown more than 200 hours and reliably demonstrated more than 12-hour endurance, while simultaneously operating 100 pounds of payload, including electro-optical/infrared surveillance systems, voice communications relays, SATCOM links, and multiple signals intelligence payloads.The ramp-up in flight tests and demonstrations has grown significantly. "These flight tests have consistently proven that the Fury is a true 'anytime, anywhere' tactical Group 3 aircraft. Fury can be deployed to execute strategic and tactical Intelligence, Surveillance and Reconnaissance missions with endurance and capability previously found only in Group 4 systems," said Kevin Westfall, Director of Unmanned Systems at Lockheed Martin. "We continue to investment internally in Fury to deliver this proven, critical capability at the best value for our customers."

MQ-4C Triton improves Mission Capability

The US Navy's MQ-4C Triton, built by Northrop Grumman Corporation, completed formal lab testing and successful first flight of an improved software suite that enhances the autonomous unmanned system's operational capabilities and enables Early Operational Capability (EOC) deployment in early 2018. The Navy conducted the first flight test of the software upgrade which is designed to enhance Triton's capabilities including Traffic Alert and Collision Avoidance System (TCAS), multi-aircraft control and additional Multi-Function Active Sensor (MFAS) radar modes. The Navy's MQ-4C Triton is a forward-deployed, land-based, autonomously operated system that provides a persistent maritime ISR capability using a multi-sensor mission payload (radar, electro-optical / infra-red / electronic support measures). The Triton provides real-time intelligence, surveillance and reconnaissance (ISR) including vessel detection, tracking and classification over vast ocean and coastal regions. Its robust mission sensor suite provides "unprecedented persistent 360-degree maritime domain awareness".

Predator B demonstrates Threat Radar Detection

General Atomics Aeronautical Systems, Inc. has also announced the successful airborne demonstration of a Radar Warning Receiver (RWR) on a GA-ASI Predator B/MQ-9 Reaper Block 5 aircraft. The company-owned Predator B operated from GA-ASI's Gray Butte Flight Operations Facility near Palmdale, Calif., against various ground-based radars.The Raytheon ALR-69A RWR, carried within GA-ASI's standard payload pod, provides enhanced situational awareness to aircrew and air element command and control units by identifying potential radar threats in or near "contested airspace" environments.In various flight profiles, the pod was able to validate RWR performance which met or exceeded current thresholds for both air and ground radar threats. Additionally, the RWR information to the flight crew was deemed useful for triggering flight crew action, such as manually cross-cueing to other onboard sensors to validate threat information.

GA-ASI continue Gremlins Phase Two for DARPA

General Atomics Aeronautical Systems, Inc. (GA-ASI), a leading manufacturer of Remotely Piloted Aircraft (RPA) systems, radars, and electro-optic and related mission systems solutions, have announced that the Defence Advanced Research Projects Agency (DARPA) has continued to contract the company for Phase 2 of the Gremlins programme, which seeks to develop innovative technologies and systems enabling aircraft to launch volleys of low-cost, reusable Unmanned Aircraft Systems (UAS) and safely and reliably retrieve them in mid-air. Such systems, or 'gremlins,' would be deployed with a mixture of mission payloads capable of generating a variety of effects in distributed and coordinated manner, providing US forces with improved operational flexibility at a lower cost than is possible with conventional platforms.

GA-ASI was awarded a contract for Phase 1 of the programme in March 2016. While Phase 1 was conceptual in nature, Phase 2 aims to mature the design and perform in-flight risk reduction testing for the C-130-based recovery system. Activities will include Preliminary Design Review (PDR) for the aircraft and recovery system, ground testing to validate key technologies, and flight test to demonstrate safety and recovery system performance. The programme is expected to culminate in an air launch and recovery demonstration in 2019.

The Gremlin aircraft is one in a line of new Small UAS (SUAS) being developed by GA-ASI, the vehicle capable of one-hour time-on-station at a range of 300 nmi while carrying a modular 60-pound payload.

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First Flight of MQ-8C Fire Scout from LCS

Northrop Grumman's autonomous helicopter, MQ-8C Fire Scout, flew for the first time from a US Navy independence-class Littoral Combat ship, USS *Montgomery* (LCS-8). The flight took place off the coast of California during the second phase of Dynamic Interface testing, once again demonstrating Fire Scout's stability and safety while operating around the ship.The two week at-sea event enabled the US Navy to test the MQ-8C Fire Scout's airworthiness and ability to land and take off from a littoral combat ship throughout a broad operational envelope. The MQ-8C Fire Scout conducted its initial at-sea flight test aboard the guided missile destroyer, USS *Jason Dunham* (DDG-108) in December 2015. With completion of Dynamic Interface testing, the MQ-8C Fire Scout is one step closer to Initial Operational Test and Evaluation (IOT&E) and

full operational deployment.The MQ-8C Fire Scout builds on the ongoing accomplishments of the MQ-8B Fire Scout programme. Helicopter Squadron 23 is currently operating onboard the deployed littoral combat ship, USS *Coronado* (LCS 4), with two MQ-8B Fire Scouts in the South China Sea.

Schiebel Camcopter S-100 heading towards MUM-T operations

Schiebel and Patria have been working together to integrate Patria's Compact Airborne Networking Data Link (CANDL) communication network onto the Camcopter S-100 Unmanned Air System (UAS). The two European companies' joint effort is the first step of an ongoing programme of work examining how the Camcopter S-100 can be deployed to directly support manned helicopter operations. Patria's CANDL provides a backbone to explore the benefits of Manned-UnManned Teaming (MUM-T) operations, where the combined strengths of each air asset can be optimised to increase overall situational awareness and enhance decision making.

As Schiebel's Chief Technical Officer Chris Day pointed out, "using

the unmanned element of a MUM-T operation to provide both the forward and higher altitude view will help to keep pilots and the manned assets safe as well as improve overall mission effectiveness."

Elbit presents UAS Capabilities

Elbit Systems of America, LLC, recently highlighted unmanned aircraft systems (UAS) capabilities at the Association for Unmanned Vehicle Systems International's XPONENTIAL.

As a global innovator in the use of unmanned aircraft systems, Elbit Systems of America's parent company, Elbit Systems Ltd., has logged hundreds of thousands of mission flight hours with systems such as the Hermes 450 and Skylark I-LE. Elbit Systems of America has adapted these units to US-unique operational requirements by incorporating new electronics, sensors, command and control, and mission packages. The results are low risk, low cost, unmanned systems that are tailored to meet diverse requirements. "Elbit Systems is a proven global leader in advancing UAS technology and innovative applications," stressed Raanan Horowitz, president and

Hermes with agricultural grid and powerlines

CEO of Elbit Systems of America. "We continue to demonstrate the extensive UAS capabilities our company has to offer across a broad range of applications, including emerging commercial applications such as precision agriculture and storm damage assessment of power lines."

UAS capabilities and solutions highlighted at XPONENTIAL included *Versatility in a Small Package* the Vidar is a small, fixed-wing UAS. It features a universal payload mounting system that supports multiple types of vertically-mounted payloads during any deployment, Advanced Aerial Observation. Designed for commercial and military applications, the THOR and NOX are multi-rotor UAS with vertical take-off and landing capabilities and Commercial UAS. Equipped with advanced sensors and high resolution cameras, the Large Scale UAS are capable of covering large areas at high scan rates, providing timely high resolution crop data from high altitude.

VIDAR

GA-ASI's MQ-9B SkyGuardian Airborne for over 48 hours

General Atomics Aeronautical Systems, Inc. (GA-ASI) has announced that its new MQ-9B SkyGuardian Remotely Piloted Aircraft (RPA) system, a "Certifiable" (STANAG 4671) version of its Predator B product line, has set a company record with the longest endurance flight of any Predator-series aircraft.Configured in an Intelligence, Surveillance, and Reconnaissance (ISR) 'clean wing' mode, the company-owned MQ-9B aircraft took off 16 May from Laguna Airfield at Yuma Proving Grounds, Ariz., with 6,065 pounds of internal fuel. The aircraft flew between 25,000 and 35,000 feet for the duration of the mission and landed 48.2 hours later on 18 May with 280 pounds of reserve fuel. The company's previous endurance record was held by Predator XP, which flew 46.1 hours in February 2015.

Development of the MQ-9B began in 2012 as an internally-funded effort. The endurance flight is continuation of an 'exceptionally efficient test programme' that began with the successful first flight in November 2016. GA-ASI is currently building three company-owned aircraft and plans to deliver the first production aircraft next year.The SkyGuardian version of the "Certifiable" Predator B has been designed to operate under the stringent airworthiness requirements of non-military airspace. The weaponised variant of the system is being acquired by the Royal Air Force under the Protector programme,while a maritime patrol variant, SeaGuardian, is designed to support open-ocean and littoral surface surveillance. All three variants are designed to fly in excess of 35 hours with airspeeds up to 210 knots and reach altitudes of more than 40,000 feet.

First flight of UAV demonstrator SAGITTA

Airbus Defence and Space tested a new type of aircraft that will aid the development of future unmanned aerial vehicles (UAVs) for series production. The unmanned jet-propelled demonstrator with the project name SAGITTA flew completely autonomously for around seven minutes over the test site in Overberg, South Africa, on a pre-programmed course. The innovative flying-wing construction demonstrated 'excellent' flight characteristics during the test. This flight marked the successful completion of the first test phase, which also comprised an extensive series of ground tests.

LM unveils Lightweight Canister Launched UAS

Lockheed Martin has unveiled a new small unmanned aircraft system (UAS) that has been designed and developed in the UK. The Outrider is only four inches wide and weighs only 1.7 kilogrammes, it is designed to be used in environments where conventional, larger unmanned air systems are not practical. Despite its size, Outrider can travel up to 50 knots and boasts the best payload capacity and endurance when compared with similar UAS's. Launched at the press of a button, it can be operated remotely or has the ability to be autonomous. It features a high-definition TV and infrared camera to give the operator enhanced situational awareness. The versatility means it has potential military, civil or commercial use and Lockheed Martin UK plans to offer it to market both in the UK and to interested export customers too.

GA-ASI's test flight from upgraded FTTC

On 30 August, General Atomics Aeronautical Systems, Inc. flew its first test flight out of its new Flight Test and Training Center (FTTC) facility in Grand Forks, North Dakota. The GA-ASI Block 5 Predator B/MQ-9 Remotely Piloted Aircraft (RPA) flew a round-trip of approximately 1,075 nautical miles being the longest transit flown by a Remotely Piloted Aircraft (RPA) in Class A civilian airspace under a Certificate of Waiver or Authorisation (COA) granted by the FAA. The COA authorised the Block 5 MQ-9 to fly in airspace managed by air traffic controllers without the requirement of utilising a "chase" airplane. Additionally, this was the first time an unmanned aircraft operated through multiple spot beams of a High-throughput Satellite (HTS). HTS is a new generation of satellites providing higher data throughput and interference mitigation. As an RPA's mission distance increases, it needs to be able to transition seamlessly from one satellite beam to another. For this flight, the Block 5 MQ-9 communicated with two HTS beams.

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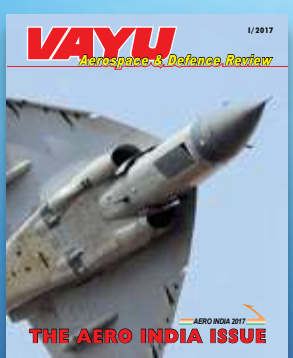

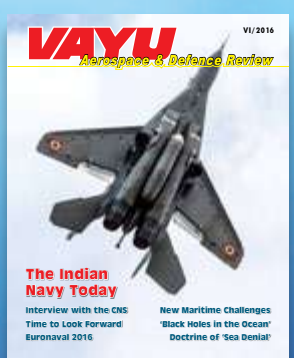

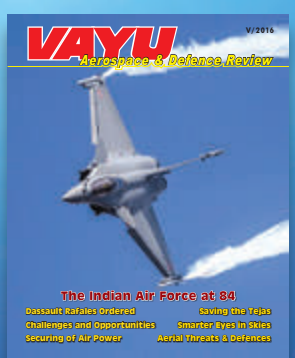

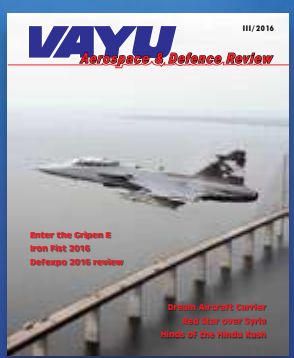

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Surprise order for Typhoons by Qatar

Qatar has signed a letter of intent (LOI) for the procurement of Eurofighter Typhoon combat aircraft, the UK government announced on 17 September. The LOI, which was signed during a meeting in Qatar between defence secretaries Michael Fallon and Khalid bin Mohammed al Attiyah, is for the proposed purchase of 24 Typhoons. No details on delivery timelines were disclosed.

Qatar's LOI comes three months after the Gulf state signed an agreement with the United States for the procurement of 36 Boeing F-15QA (Qatar Advanced)-variant Eagles, which itself came two years after it ordered 24 Dassault Rafales from France. The Qatar Emiri Air Force (QEAF) is known to have a requirement for 72 new combat aircraft to replace its ageing 12 Dassault Mirage 2000-5 fighters. If the Typhoon and Eagle orders are fulfilled in entirety, the QEAF will field an advanced fighter force of 84 platforms across three different types. For some years, Qatar has been building up its combat aviation capabilities with procurement of the latest platforms and technologies. The increase in the QEAF's frontline fighter force from the current 12 aircraft to upwards of 84, in particular, will represent a massive enhancement in its capacity and capability.

While the growth in Qatar's fighter numbers is in-line with the country's increased commitment to international operations over recent years, and with the somewhat perilous position it now finds itself (in a volatile region surrounded by less-than-friendly neighbours), its decision to replace its one current fighter type with three new different types is "extraordinary."

More Dassault Rafales delivered to Egypt

Two additional Rafales have been delivered to the Egyptian Air Force, both single-seaters arriving at Cairo-West Air Base on 26 July. The latest arrivals bring the total delivered to date to 11 with a further three are due to arrive before the end of the year, while the remaining ten on order are all due for delivery during 2018. Egypt is acquiring 16 two-seat Rafale DMs and eight single-seat Rafale

EMs operated by 34 Squadron 'Wild Wolves' as part of the 203rd Tactical Fighter Wing 'Storm' at Cairo-West.

RAAF Super Hornet upgrade plans

The Royal Australian Air Force (RAAF) fleet of F/A-18F Super Hornets will receive new communications and defensive aids systems for enhanced interoperability with the US Navy. The deal covers the new equipment plus testing, training and support. The Australian government has requested the sale of 32 Multifunctional Information Distribution System Joint Tactical Radio systems (MIDS JTRS) with four-channel concurrent multi-network (CMN-4), and 39 AN/ALQ-214(V)4 countermeasures systems. Meanwhile, the RAAF has received its full complement of 12 EA-18Gs, the final aircraft arriving at RAAF Base Amberley on 7 July serving with No 6 Squadron. Australian Growlers have conducted successful weapon firings and integration flights with RAAF F/A-18Fs and US Navy EA-18Gs as part of operational test and evaluation. The RAAF aims to declare initial operating capability with the EA-18G in 2018, followed by full operating capability in 2022.

Two more Su-57 prototypes

Sukhoi is to produce another two Su-57 (the new identity of the PAK-FA or T.50) prototypes this year, even as Russian Deputy Defence Minister Yuriy Sadovenko said that work on the PAK FA

project was "at the final stage." The next two prototypes produced by the Gagarin Aircraft Plant in Komsomolsk-on-Amur will be the tenth and eleventh to join the test programme. The most recent prototype to fly had made a maiden flight at Komsomolsk-on-Amur on 24 April. Russia plans to purchase a first batch of production Su-57Ks as part of its future 2018-25 state armament programme. An initial T-50 fitted with the 'second phase engine' (Izdeliye 30) is due to make a first flight in 2018.

Angola for more ex-IAF Su-30Ks

So where did the Indian Air Force's interim batch of 18 Sukhoi Su-30Ks go? Angola, which is now reported to be looking at purchasing a further six Su-30K fighters in addition to the 12 it has already contracted for. The Director of the 558 Aircraft Repair Plant (ARZ) at Baranovichi in Belarus, where the jets are stored stated that "a search for a buyer was continuing." All 18 of the former IAF Su-30Ks were placed in storage at the 558 ARZ and put up for sale. They were withdrawn from service in 2006 and shipped to Baranovichi five years later. In February 2014, it was confirmed 12 had been sold to the *Força Aérea Nacional de Angola* (FANA, National Air Force of Angola) under a contract signed in October the previous year. These are being refurbished and upgraded to Su-30KN standard, the first having been re-flown at Baranovichi around 31 January 2017.

Croatia to evaluate new fighters

The Croatian Ministry of Defence has issued an official request for proposals for the acquisition of a multi-role fighter to replace its present MiG-21s (pictured above). The RFP has been submitted to the embassies of five countries identified as potential suppliers of the 'new' aircraft. These are Greece (second hand F-16C/Ds), Israel (second-hand F-16A/B Netz), South Korea (FA-50 offered by Korea Aerospace Industries), Sweden (JAS 39C/D Gripen offered by Saab) and the US (used and/or new F-16s). It is understood that the "interested parties" will have till early October to submit their proposals. The special advisory team will then review these, including three of its former Chiefs and two highly experienced MiG-21 pilots. The team is expected to present its decision by the end of this year, after which the government will have the final word. Flight performance, technical characteristics and final price will be scrutinised, along with potential offset arrangements.

RAF Poseidon squadrons identified

The UK Defence Secretary has announced the selection of the RAF's two frontline squadrons as to be equipped with Boeing P-8A Poseidon MR/ASW airrcraft. These will be Nos 120 and 201 Squadrons, both based at RAF Lossiemouth, Scotland, the first being due to stand up in April 2018. The first of nine P-8s will arrive in the UK in 2020 and No 201 Squadron will form in 2021.

Upgraded Hawks for RAAF

The RAAF has begun operating upgraded Hawk Mk127 jet trainers of No 79 Squadron at RAAF Base Pearce, Western Australia, "which introduce new capabilities including simulated

radar, electronic warfare, digital mapping, ground proximity warning system and traffic collision avoidance." Presently, a joint team of BAE Systems and RAAF technicians has upgraded 12 of the 33 aircraft. The entire fleet will have been upgraded by early 2019.

Iraqi Air Force Texan IIs

The Iraqi Air Force (IQAF) will return to service its fleet of 15 T-6A trainers ahead of the first in-country F-16IQ training course in 2019. The Texan IIs were put in storage around 2013 when it was noted that the aircraft had begun to sustain damage to their wings as a result of poor runways at Al Taji Air Base, north of Baghdad. The Iraqi T06A fleet will resume training activities by the second quarter of 2018.

Hawks for Oman

The first two Hawk Mk166 jet trainers for the Royal Air Force of Oman (RAFO) have been delivered to the Service at Masirah Air Base, being ferried to the Sultanate on 29 July, just days after it had received the first Eurofighter Typhoons (see image). The Hawks are part of an eight-aircraft order placed in December 2012. Meanwhile, another pair of Hawk Mk165s for the Royal Saudi Air Force was delivered recently. Saudi Arabia had ordered 22 Hawk Mk165s as part of a £1.6bn contract, officially announced in May 2012. Deliveries began on 1 April 2016. In February 2016, BAE Systems had announced that a further order for 22 more aircraft were signed, bringing the total of Mk165s on contract for the RSAF to 44.

PAC Super Mushshaks to Qatar

The first batch of PAC Super Mushshak primary training aircraft has been delivered to the Qatar Emiri Air Force (QEAF) from Pakistan at a formal ceremony that took place at the Al Zaeem Mohammed Bin Abdullah Al Atiyyah Air College at Al Udeid Air Base on 19 July. The contract for these was signed on 23 June 2016, though it remains unconfirmed as to how many aircraft are involved in the deal.

...and Azerbaijan

The Pakistan Aeronautical Complex (PAC) has secured another order for ten Super Mushshaks, this time from Azerbaijan. The contract was signed on 27 July and the PAC will provide training and technical assistance to the Azerbaijan Air Force.

Nigeria receives Super Mushshaks

The Nigerian Air Force has received five Pakistan Aeronautical Complex (PAC) Super Mushshak basic trainers, delivered from PAF Base Minhas aboard an Il-76 transport, arriving in Nigeria on 14 July. The NAF had signed an agreement with the PAC for acquisition of ten Super Mushshaks in October 2016, the contract also including training and technical support. The aircraft will be based at the 401 Flying Training School at Kaduna for primary flight training.

Malaysia's MRCA programme stalled

Reports suggest that the *Tentera Udara Diraja Malaysia* (TUDM, or Royal Malaysian Air Force) has cancelled its delayed Multirole Combat Aircraft (MRCA) programme. Reports citing sources from the Malaysian Ministry of Defence (MINDEF) have it that funds are instead being allocated for counter-terrorist operations but that the MRCA programme may be re-launched after Malaysia's general elections next year.

All FA-50PHs delivered to Philippines

Korea Aerospace Industries (KAI) has completed delivery of all 12 FA-50PH light attack aircraft ordered by the Philippine Air Force. An event to mark induction into service of the final two aircraft was held at Clark Air Base on 4 July although these had actually arrived at the base some weeks earlier. During the event, Philippine President Rodrigo Duterte announced that his government would consider purchasing a further 12 FA-50PHs at

some point during his six-year term of office. The FA-50PHs were ordered under a contract signed on 28 March 2014, and the first pair was delivered on 25 November 2015.

Indonesia to buy 11 Su-35s

The Indonesian Government has confirmed plans to purchase 11 Su-35 fighters for the *Tentara Nasional Indonesia – Angkatan Udara* (TNI-AU or Indonesian Air Force). Payment for the Su-35s will be partly financed by a barter deal involving palm oil. The aircraft will replace the F-5E/F s of *Skadron Udara* 14 at Madiun/Lanud Iswahjudi. The Indonesian Air Force already operates five Su-27SKs, two Su-30MKs and nine examples of the Su-30Mk2 (see image).

Thailand orders more T-50s

The Government of Thailand is acquiring eight additional Korea Aerospace Industries T-50TH advanced jet trainers, under contract signed on 11 July. Thailand previously ordered four T-50THs to replace L-39s in the Royal Thai Air Force. The first two aircraft from the original order are due to be delivered in December, followed by another two next June.

Meanwhile, an additional second-hand Saab 340B has been delivered to the Royal Thai Air Force, with another being acquired

but not yet delivered. Both will be operated by 702 Squadron at Surat Thani. In addition to its AEW versions of the type, the unit already flies two standard Saab 340Bs, one to act as a crew trainer and the other as a passenger aircraft.

New Austrian fighter plans

The Austrian Ministry of Defence has announced plans to retire its early model Eurofighters from 2020. According to a report, "retaining the 18 Eurofighters over the next 30 years would cost up to €2bn more than replacing them with a similar number of replacement supersonic fighters." In Austria's plans, the Eurofighter and Saab 105OE would both be replaced by 15 single-seat and three two-seat jets of "a single type," yet to be identified but likely to be the Gripen.

Reapers in France

An MQ-9A unmanned aerial vehicle (UAV) of the *Armee de l'Air's Escadron de Drones* (ED) 1/33 'Belfort' operated from BA 709 Cognac Châteaubernard for a 5hr 10 min flight over French territory north of the base, demonstrating the air force's ability to conduct training locally. The test flight also proved calibration of emergency parameters and verified satellite links using two ground control stations. Currently, six aircraft are operational with ED 1/33, five of which are forward deployed at the expeditionary air base in Niamey, Niger. By 2019, the squadron will have 12 aircraft operated by 30 crews.

G550 for Australia

Australia is to acquire Gulfstream G550 aircraft with Airborne Intelligence, Surveillance, Reconnaissance and Electronic Warfare (AISREW) mission systems at an estimated cost of $1.3bn. Beside AISREW mission systems, the package includes GPS capability, secure communications, aircraft defensive systems; spares, including whole life costs of airborne and ground segments; aircraft modification and integration; ground systems for data processing and crew training and ground support equipment.

Ex RAF C-130Js for Bahrain

The British Government will sell two C-130Js to Bahrain, both aircraft refurbished by Marshall Aerospace in Cambridge. The Royal Air Force is retaining its fleet of 14 stretched Hercules C4 (C-130J-30) aircraft until 2030 but 10 standard length Hercules C5 (C-130) aircraft are being withdrawn and will be offered for sale by the DSA. The C-130Js will be the first transports operated by the Royal Bahraini Air Force, which has been supporting the Saudi-led operation against Houthi rebels in Yemen. Acquisition of the Hercules will allow Bahrain to increase its support for expediting operations.

Super Tucanos for Nigeria

The US State Department recently gave its approval for the sale of 12 A-29 light attack aircraft to Nigeria. The Super Tucanos will support operations against terrorist organisations Boko Haram and ISIS (Islamic State of Iraq and Syria) West Africa, with efforts to counter illicit trafficking in Nigeria and the Gulf of Guinea. Nigeria has been seeking permission to buy A-29s since 2015 and the Defence Security Co-operation Agency has notified the US Congress of the sale on 2 August.

Upgrade of RAF Chinook HC4s

The Royal Air Force plans to upgrade its fleet of Boeing Chinook HC4 helicopters to a new HC6A standard. The earlier analogue flight control systems will be replaced with the Boeing Digital Automatic Flight Control System (DAFCS) to improve aircraft handling and stability in more demanding operational environments and increase flight safety in low-light levels and/or degraded visual environments. In addition, a contract has been placed to incorporate an Airborne Collision Avoidance System (ACAS) across the RAF Chinook fleet, and this has already achieved initial operating capability.

More MD 530Fs

The US Department of Defence has plans to purchase up to 120 MD 530F light attack and reconnaissance helicopters to equip "allied armed forces". The helicopters, which have already been delivered to Afghanistan and Saudi Arabia, would be acquired over a five-year period by the US Army's Non-Standard Rotary-Wing Aircraft Project Office. The helicopters are to be procured under indefinite delivery/indefinite quantity (IDIQ) contracts and provided with the Mission Equipment Package (MEP), which includes the EN Herstal Heavy Machine Gun Pod (HMP). The Enhanced-MEP (E-MEP) is also requested, this adding 70mm (2.75in) M151 rockets and M274 smoke rockets to the weapons options. The helicopters would also be fitted with electro-optical/infrared (EO/IR) sensors.

Vipers for Pakistan

The first AH-1Z Viper attack helicopter for the Pakistan Army was recently unveiled by Bell Helicopter at its Amarillo, Texas facility. The US had earlier approved the sale of 15 Vipers to Pakistan in April 2015 and an initial order was subsequently placed for three AH-1Zs in August 2015, with a second deal for nine Vipers which followed in April 2016. According to reports, a batch of three AH-1Zs will be delivered by the end of 2017, with the remaining nine following by 2018.

Potential sales of Predator Avenger Cs

General Atomics Aeronautical Systems are reportedly negotiating the potential sale of upto 90 jet-powered Predator C Avenger remotely piloted aircraft to "an unidentified international customer." Single examples of the air vehicle are operated as a company testbed and by the US Air Force, while the remainder are operated by unnamed US agencies for classified missions. General Atomics is currently testing the Avenger ER, which first flew at the company's Gray Butte flight operations facility in Palmdale, California in late October 2016. Powered by a single Pratt & Whitney Canada PW545B turbofan engine, the Avenger has an internal payload of 3,000lb (1,361kg) and can operate at a maximum altitude of 50,000ft (15,240m).

Mi-38T for Russian MoD

Kazan Helicopters has assembled first prototype of the Mi-38T as per a contract with the Russian Ministry of Defence in July 2017, for two Mi-38Ts. The Mi-38T helicopter is a military version of the Mi-38, developed by JSC Mil Moscow Helicopter Plant. These helicopters will be used for conducting joint flight tests for compliance with requirements of the Armed Forces, following which further purchases of the Mi-38T will be planned within framework of the state armament programme of 2018-2025.

Germany and Norway to pool A330 MRTTs

Germany and Norway have officially joined the European/NATO programme on the Airbus A330 Multi-Role Tanker Transport aircraft along with the Netherlands and Luxembourg. The Multinational Multi-Role Tanker Transport Fleet (MMF) was initiated by the European Defence Agency (EDA) in 2012. European organisation for the management of cooperative armament programmes - OCCAR - manages the MMF acquisition phase as Contract Executing Agent on behalf of the NATO Support and Procurement Agency (NSPA). Following the acquisition phase, NSPA will be responsible for the complete life-cycle management of the fleet.

Maiden flight of A330 MRTT Phénix

Airbus Defence and Space has conducted maiden flight of the A330 MRTT Multi Role Tanker Transport for France, where it will be known as the Phénix, and is the first of nine ordered by the French Defence Procurement Agency DGA, plus another three expected to be confirmed. It is the second new standard A330 MRTT to fly, featuring structural modifications, aerodynamic improvements giving a fuel-burn reduction of up to 1%, upgraded avionics computers and enhanced military systems. The aircraft was converted in Getafe from a standard A330 assembled in Toulouse. The Phénix fleet will be equipped with a combination of the Airbus Aerial Refuelling Boom System (ARBS) and underwing hose-and-drogue refuelling pods, and can also carry 272 passengers or be configured for medical evacuation. First delivery is due in 2018. Fifty-one A330 MRTTs have been ordered by eight nations of which 28 have been delivered.

Rafale competes for Belgian order

Dassault Aviation and its partners are 'fully participating' in the partnership offer made by the French Authorities to the Belgian Government, by presenting the Rafale as replacement for F-16s with

the Belgian Air Force. The Rafale "has clearly demonstrated its total NATO interoperability in combat operations. Its procurement and operational costs are well known and without risks and its design guarantees that Belgium will remain at the cutting edge of technology for the next 40–50 years."

Mi-28UB tested for Russian MoD

The Mi-28UB attack helicopter is being developed at the Rostvertol company of Russian Helicopters Holding, under a contract to deliver 8 Night Hunters with dual control by end 2017. The Mi-28UB, designed for the Russian Aerospace Forces, cleared all tests and can be used for flight instruction and for training flight personnel, the development of dual control helicopters being logical continuation of developing the concept of an attack army helicopter.

The main difference between Mi-28UB from a classical Night Hunter is the dual control system that allows piloting the helicopter from both pilot's cockpit and weapon operator's. There are other special characteristics including enhanced ergonomics and energy-attenuating seats with improved characteristics to absorb shock energy in event of crash landing. Airborne avionics and communication tools have also been changed, significantly improving the helicopter's reliability, safety and performance specifications.

Presidential Helicopter VH-92A in first flight

First flight of a VH-92A configured test aircraft in support of the US Marine Corps' VH-92A Presidential Helicopter Replacement Programme has taken place, commencing the 250 hour flight test programme, which will take place at Lockheed Martin facilities in Owego, New York. The aircraft later flew to Sikorsky Aircraft in Stratford, Connecticut. The VH-92A aircraft is based on Sikorsky's FAA-certified S-92A commercial aircraft, which has recently surpassed one million flight hours. The S-92A

aircraft, assembled in Coatesville, Pennsylvania, is being modified to include integration of government-defined missions systems and an executive interior.

Russian Helicopters to develop high-speed combat helicopter

Russian Helicopters holding (part of Rostec State Corporation) and Russian MoD have signed an agreement to work on the concept of a high-speed combat helicopter within framework of the international military-technical forum 'Army-2017'. The contract will determine the technical appearance of the "perspective high-speed combat helicopter."

100,000th Paveway II Plus laser guided bomb

Lockheed Martin delivered its 100,000th Paveway II Plus Laser Guided Bomb (LGB) thus "enhancing US and allies' munitions worldwide." A qualified supplier of Paveway II LGB kits since 2001, Lockheed Martin continues to "expand its production capabilities to improve efficiency, and, as a result, has driven down average unit prices by 45 percent." In the last eight annual competitions,

the US Air Force and its foreign military sale partners have selected Lockheed Martin to provide the majority of their LGB kits. Paveway II Plus includes an enhanced guidance package that improves accuracy over legacy LGBs. Qualified for full and unrestricted operational employment in GBU-10, -12 and -16 (2,000-lb./500-lb./1,000-lb.) configurations, Paveway II Plus is cleared for use on US Air Force, US Navy and international aircraft authorised to carry and release LGBs.

USS *Gerald R Ford* is commissioned

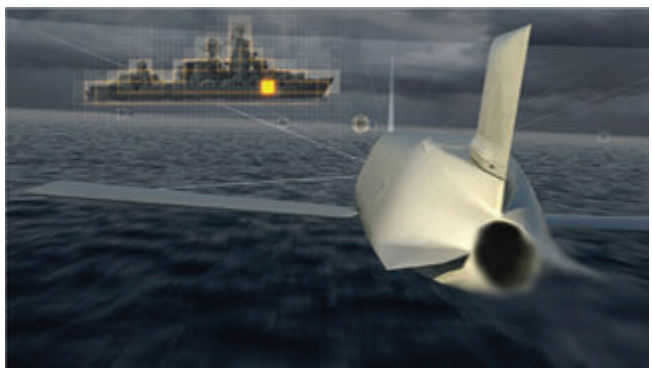
First of the *Ford*-class aircraft carriers, USS *Gerald R Ford* (CVN 78), went into active US Navy service at a ceremony in Newport News, Virginia on 22 July. Completed by Huntington Ingalls Industries (HII), the *Ford* features a relocated island, which is higher and further aft than on previous *Nimitz*-class vessels. It also incorporates General Atomics' Electromagnetic Aircraft Launch System (EMALS) and Advanced Arresting Gear (AAG) as well as an enhanced flight deck with more space than *Nimitz*-class aircraft carriers. An F/A-18F of VX-23 'Salty Dogs' at NAS Patuxent River, Maryland made the first arrested landing with the new AAG and subsequent take-off with EMALS on 28 July.

Tomahawk cruise missiles tested

The US Navy has test fired two Raytheon Tomahawk cruise missiles from new submarine payload tubes on the *Virginia*-class USS *North Dakota* (SSN-784). The tests, in the Gulf of Mexico near Florida, proved the submarine's ability to load, carry and vertically launch Tomahawk missiles from the new Block III *Virginia* Payload Tube, "which feature fewer parts and will be even more reliable." In addition, the US Navy is also developing a new Virginia Payload Module. The new modules will triple the number of Tomahawk missiles that *Virginia*-class submarines can carry, dramatically increasing each submarine's firepower.

LM's LRASM test launched

Lockheed Martin launched its Long Range Anti-Ship Missile (LRASM) surface-launch variant from a topside canister on 1 June 2017. The flight test, at White Sands Missile Range, New Mexico, proved the missile's ability to conduct an angled launch from the newly designed topside canister, replicating a ship-launched environment. During the test, the LRASM, with its Mk-114 booster and booster adapter ejected cleanly from the topside launcher using the same launch control and launch sequencer software currently employed by the Mk-41 Vertical Launch System (VLS).



LRASM is a precision-guided anti-ship missile that leverages the successful JASSM-ER heritage, and is designed to meet the needs of the US Navy and Air Force in "a robust contested environment". The air-launched variant provides an early operational capability for the Navy's offensive anti-surface warfare Increment I requirement to be integrated onto the US Air Force's B-1B in 2018 and on the US Navy's F/A-18E/F Super Hornet in 2019.

4,000th Tomahawk Block IV cruise missile for US Navy

Raytheon has delivered the 4,000th Tomahawk Block IV cruise missile to the US Navy, which highly advanced missile can cruise for hours, shift course instantly on command and strike with pinpoint accuracy. Launched from ships or submarines, the Tomahawk missile can penetrate heavily defended airspace 1,000 miles away to conduct precise strikes on high-value targets with minimal collateral damage.

Upgrades to the Tomahawk missile include enhancements to the weapon's communications and navigation capabilities, while adding a multi-mode seeker so hitting moving targets at sea. Some of these enhancements will be implemented beginning in 2019. Other upgrades will be phased in over time. Modernised Tomahawk cruise missiles will be in the US Navy's inventory beyond 2040.

Sea Ceptor air defence system tested

HMS *Argyll* has conducted first firings of the Sea Ceptor system, a major milestone for the Royal Navy as it brings its upgraded Type 23 frigates back into service. The Sea Ceptor system, which utilises MBDA's next-generation Common Anti-air Modular Missile (CAMM), is being fitted to replace the Sea Wolf weapon system on Type 23 frigates as part of their life-extension programme

and will provide improved protection for the Royal Navy against anti-ship cruise missiles, aircraft and other sophisticated threats.

HMS *Argyll* is the first Type 23 to undergo the life-extension programme, and will conduct further firing trials of the Sea Ceptor system before returning to frontline service. Sea Ceptor not only provides "a robust self-defence capability for the host vessel but importantly also a local area air defence competency to defend consort vessels within a maritime task group." Designed and manufactured by MBDA in the UK, Sea Ceptor will also protect the Royal Navy's future Type 26 frigates, even as Land Ceptor will replace Rapier in British Army service. The missile uses innovative technologies that provide significant improvements in performance compared with previous generations of missiles.

Elbit's C4ISR System for an "Asia-Pacific Navy"

Elbit has received contracts worth some $11 million to supply an integrated maritime C4ISR system to an "Asia-Pacific navy". The contract, to be performed over a two-year period, will include interconnected coastal sensor towers, naval command centres and maritime C4I capabilities, as well as ongoing maintenance. The project will support commanders and other users (headquarters, command centres, coastal observation posts and vessels) throughout routine and special operations and will also be used for training and simulation.

Bangladesh Navy to receive Leonardo's AESA for Dornier 228s

The Leonardo Seaspray 5000E Active Electronically Scanned Array (AESA) radars will equip the two Dornier 228s recently ordered by the Bangladesh Navy. The new aircraft will be used to monitor and protect Bangladesh's 120,000 square kilometres of maritime territorial area and exclusive economic zone (EEZ), the radars to be delivered in 2018. Seaspray, which can detect small targets in rough seas, will be also be used by the Bangladesh Navy to conduct anti-smuggling and anti-pollution missions and for the prevention of illegal fishing and migration.

MEWP for the Royal Navy

Elbit Systems UK and Lockheed Martin UK are in a strategic teaming agreement to partner on the Maritime Electronic Warfare Programme (MEWP) for the Royal Navy. The MEWP is a significant procurement to upgrade the Royal Navy's Electronic Warfare capabilities. Delivered in increments, the upgraded system will be fielded on the Royal Navy's frigates, destroyers and amphibious assault ships, with the programme expanding to the wider fleet including submarines in due course.

Hong King Airlines acquires Airbus A350-900

Hong Kong Airlines has taken delivery of its first A350-900, on lease from AerCap, making the carrier the 15th airline to operate the airliner. Altogether, Hong Kong Airlines will acquire 21 Airbus A350 XWB, including 15 purchased directly from Airbus and six on lease from third party lessors. The aircraft features the airline's latest cabin products, including an all-new entertainment system and full in-flight connectivity. After an initial period flying on regional routes, Hong Kong Airlines' A350-900 will begin long haul operations in December this year, flying on the carrier's non-stop service to Los Angeles.

A350 XWB for Delta Air Lines

Delta Air Lines has taken delivery of its first A350-900, and will be the first US airline to operate the newest member of Airbus' leading widebody family. This delivery is the first of five A350-900s scheduled for delivery to Delta in 2017. The aircraft features 32 seats in the Delta One cabin, 48 seats in Delta Premium Select and 226 seats in the main cabin. The A350 XWB was the first aircraft to incorporate the innovative passenger experience elements collectively known as *Airspace by Airbus*. "Delta's customers will enjoy the quietest twin-aisle cabin, with more personal space and the largest overhead bins, besides LED ambient lighting, and optimisation of cabin pressure, temperature and humidity."

United Airlines opts for A350-900s

United Airlines has switched its order for Airbus A350-1000 to the smaller A350-900, a move that had been in the offing for some time after chief financial officer Andrew Levy had stated in 2016 that the airline wanted "smaller jets for its long-haul

fleet". The A350-900 typically seats 300, while the A350-1000 in United's Polaris / premium economy / economy configuration would have featured between 330-350 seats. Fewer seats and lower fuel consumption compared to the larger A350-1000 would mean more profit for United on the same routes.

The 35 A350-1000s ordered in 2013 were changed to 45 A350-900s, on 6 September, worth $14 billion. The new airliners will begin arriving in 2022 and deliveries will end in 2027. The decision to go with the -900 means that United sees the A350 as a like-for-like replacement for the 777-200 rather than for the 747s it is retiring this year. The larger 747s will be replaced by 777-300ERs, which have about the same number of seats, while the Airbuses will gradually take the place of 777-200s.

SAS plan external bases

The SAS Group plans to station nine Airbus A320neos at external bases and has applied for a new air operator's certificate in Ireland as preparation for the transition. Reportedly, first flights will be conducted from bases located in London and Malaga at the beginning of its new financial year in November 2016. These are "external" to SAS's core Scandinavian operations but the airline wants to "secure its profitability and take advantage of the same pre-conditions as its rivals otherwise it will be forced to reduce its production and discontinue routes." SAS has turned increasingly to leisure traffic to expand its network and expects leisure production to be double the level it was, five years ago. Over the summer, the SAS Group has opened nine new routes including services to Ibiza, Lisbon, Malaga, Malta and Olbia.

25 E-Jets for SkyWest

Sky West will acquire 25 Embraer E-Jets for some US$ 1.1 billion based on current list prices. All 25 aircraft are scheduled to be delivered in 2018, of which, SkyWest will receive 15 E175 SC (Special Configuration) aircraft, in a 70-seat configuration. The E175 SC aircraft features an E175 airframe, which can be retrofitted to 76 seats in the future. SkyWest will also receive 10 E175s, in a 76-seat configuration, similar to aircraft SkyWest has previously ordered.

Airbus delivers 100th A350 XWB

Airbus has delivered the 100th A350 XWB, just some 30 months after first delivery of this widebody aircraft in December 2014, which is an A350-900 for China Airlines. "The 100th A350 XWB

milestone comes as we reach our fastest widebody production ramp-up, on track to meet the target of 10 A350 deliveries per month by the end of 2018," said Fabrice Bregier, Airbus COO and President Commercial Aircraft. "We are especially proud to deliver this aircraft to our long-standing customer China Airlines. The A350 is setting new standards for long haul air travel in terms of efficiency and comfort, thus being the perfect aircraft for China Airlines to expand its long-haul network."

Airbus delivers first A320 to Spirit Airlines

First delivery of an A320 aircraft from Airbus' US Manufacturing Facility has taken place in Mobile, Alabama, USA, the aircraft being delivered to Spirit Airlines. The previous 36 aircraft were A321s, making this delivery another important milestone for Airbus. Airbus had announced its commitment to build a single-aisle assembly line in Mobile, Alabama in July 2012, and broke ground for the $600 million facility in April 2013, the ceremonial inauguration of the plant taking place in September 2015. Airbus anticipates delivering four aircraft per month from the Mobile plant by the end of 2017.

Altair and Rolls-Royce collaborate

Altair Engineering Ltd will collaborate with Rolls-Royce to support design of the company's next generation engine architecture, UltraFan which forms part of Rolls-Royce's future vision for aircraft engines with a focus on weight reduction and fuel efficiency, together with reduced noise. Altair Engineering will develop and deploy virtual simulation tools and methods to assist with UltraFan weight reduction, to enable the development of an innovative product. Proposed for service from 2025, UltraFan is designed for use across the civil aviation sector, spanning a 25k-110k thrust range. For a typical large engine application, UltraFan will have the largest fan diameter making it the world›s largest geared turbofan engine, delivering an estimated 25% improvement in efficiency over the first generation of Rolls-Royce Trent engines.

Comac C919 flight trials

The first C919 prototype, launched by Chinese company Comac on 5 May, resumed high-speed taxi tests at the Shanghai Pudong International Airport on 6 September, including brake system testing: performing normal brake, emergency brake and anti-skid tests as well as evaluations of its back-up brake systems. According to reports, the C919 is likely to return to flight testing later in September 2017 and is scheduled to perform a ferry flight to Xian along with a number of flights around Shanghai. Certificate and service entry of the C919 are scheduled for 2020-21. Meanwhile, a second prototype, aircraft 102 is in final assembly and first flight is being planned for later this year.

PC-12 for Australia's Royal Flying Doctor Service

Pilatus has handed over a PC-12 to the Royal Flying Doctor Service of Australia (RFDS), the aeromedical provider taking delivery of its first unit in 1994 and presently operating 33 PC-12s,

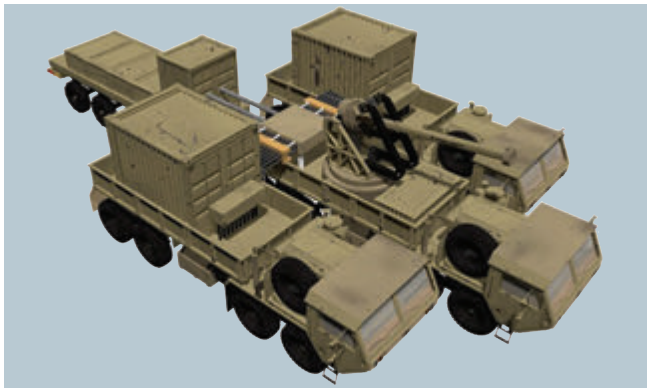
which along with its fleet of 34 Beechcraft King Airs, two Cessna 208 Caravans and a single Hawker 800XP transports around 18,000 patients annually across the remotest regions of Australia.

H145M with HForce weapon system

In end August 2017, the H145M performed its first flight with a complete HForce weapon system in Donauwörth. Owing to this modular weapon system designed by Airbus, the H145M can be equipped with all kind of guided and ballistic armaments such as missiles and laser guided rockets, guns, machine guns and rockets. The qualification of HForce for use on the H145M is planned for 2018. HForce is a comprehensive, modular and weapon system that can be used on any military version of Airbus' civil helicopter range (H125M, H145M and H225M).

Saab NLAW for Swiss Army

Saab has received an order from the Swiss Federal Office for Defence Procurement, Armasuisse, for deliveries of the Next generation Light Anti-Tank Weapon system (NLAW) to the Swiss Army, the order value amounting to BSEK 1,035. The order



includes the supply of NLAW weapon systems, associated training equipment, such as drill rounds, indoor training simulators, and support and maintenance of the training equipment. Under a framework contract between Saab and Armasuisse, repeat orders can be placed for NLAW weapon systems and equipment during the period 2017-2030.

Saab training systems for Estonia

Saab has contracted with the Estonian Armed Forces for BT46 training systems with deliveries to be made in 2018. These comprise laser simulators for gunnery and combat training in 2008, to be used by the country's mechanised brigade and at the infantry school. The contract includes BT46 systems for the CV9035, Carl-Gustaf as well as several infantry simulators up to the Company level. Additionally, a five-year support contract is included.

EUROSAM, ASELSAN and ROKETSAN in cooperation

The heads of Eurosam, Aselsan and Roketsan, Michel Vigneras, Faik Eken and Selçuk Yaşar respectively, have signed a Heads of Agreement (HoA) in Ankara under the aegis of the Turkish Undersecretariat for Defence Industries (SSM) to launch in-depth co-operation in the field of air and missile defence. The HoA sets work sharing agreements for a definition study with the SSM on a long-range air and missile defence system to be launched in the coming months. The future Turkish air and missile system will be based on the technologies and experience that Eurosam has built in ground and naval systems using the Aster missile over 25 years and some Euro 11 billion of collective investment.

GE 10 MJ Railgun System testing

General Atomics Electromagnetic Systems' new 10 Mega Joule (MJ) medium range multi-mission railgun system has completed final assembly and factory acceptance test in preparation for transport to Dugway Proving Ground in Utah for testing. The GA-EMS multi-mission medium range railgun weapon system integrates the High Energy Pulsed Power Container (HEPPC), 10 MJ launcher, hypersonic hybrid missile, and fire control technologies. The HEPPC utilises GA-EMS next generation railgun capacitors and a new approach to packaging and distribution of the energy in a smaller footprint than existing pulsed power solutions, which reduces the number of pulsed power containers required to launch the guided projectiles or hybrid missiles. The HEPPC provides additional capabilities to test GA-EMS hypersonic projectiles, which contain a Guidance Control Unit with guidance, navigation, and control software and a complex control actuation system.

Oshkosh JLTVs for US Army

The US Army has placed an order for the Joint Light Tactical Vehicle (JLTV) programme including procurement of 748 vehicles and 2,359 installed and packaged kits from Oshkosh Defence, valued at more than $195 million. The JLTV programme is currently in Low Rate Initial Production (LRIP) and remains on-schedule, on-budget and is completing reliability and performance test activities as well as logistics supportability evaluations around the country. The programme anticipates a Full Rate Production decision in 2019, with the first Army unit equipped by mid-2019 and both Army and Marine Corps Initial Operating Capability (IOC) in early 2020.

ATACMS missile for US Army

Lockheed Martin has delivered the first Army Tactical Missile System (ATACMS) missile to the US Army from its new production facility in Camden, Arkansas. Lockheed Martin is under contract to deliver 124 new ATACMS missiles to the US Army and "an international customer". ATACMS is the US Army's only tactical long-range, deep precision-strike surface-to-surface weapon system. ATACMS missiles can be fired from the entire family of

Multiple Launch Rocket System (MLRS) launchers, enabling battlefield commanders the capability to operate in contested environment. Lockheed Martin has produced more than 3,800 ATACMS missiles, with more than 20 years of on-time deliveries. More than 600 ATACMS missiles have been fired in combat, and the system has demonstrated extremely high rates of accuracy and reliability while in theatre.

Raytheon's air & missile defence radar tested

On 15 August 2017, Raytheon's AN/SPY-6(V) Air and Missile Defence Radar successfully searched for, acquired and tracked a ballistic missile test target during its second live-target flight test at the US Navy's Pacific Missile Range Facility at Kauai in Hawaii. This test event featured a more complex, threat-representative ballistic missile target than prior tests, intended to challenge the detection and tracking capabilities of the new radar. AN/SPY-6 acquired and maintained the long-range missile target track, from launch through flight. This result is the most recent in a series of successes for AN/SPY-6, following the tracking of the first ballistic missile target in March 2017.

IAI's new HF Direction Finding (HF) COMINT

Israel Aerospace Industries (IAI) has unveiled a new, highly compact version of its Ground and Naval HF COMINT Direction Finder (DF) - ELK-7065, which can be used for tactical ground HF COMINT missions as well as for naval missions. The ELK-7065 3D HF COMINT provides quick interception and identification of HF signals, creating a reliable Electronic Order of Battle (EOB) picture and accurate geolocation. The HF antenna configuration, measuring only 1.2 metres in diameter (substituting the full sized system that requires a very large area), is optimally suited for fixed or mobile tactical ground and naval forces applications. The patented compact HF system expands the current product line which includes airborne systems already installed on several aircrafts and RPV.

IAI SIGINT Centre's operational capability Phase I

The Israel Aerospace Industries (IAI) advanced, highly automated SIGINT Centre has achieved phase I operational capability with an "undisclosed customer". Developed by ELTA Systems Ltd., a Group and Subsidiary of IAI (IAI/ELTA), this is the first time that a SIGINT centre has been developed to handle such large amounts of sensors and data, creating national level Electronic Order of Battle (EOB) from ground, airborne and other sensors, and integrating all sources into a unified national SIGINT Database. The Centre provides unparalleled operational benefits such as increased SIGINT mission availability using ad-hoc sensors on various platforms, as well as a dramatic increase of SIGINT 'Probability Of Intercept' (POI) and accuracy. The system supports net-centric mode and offers enhanced mission support including mission planning tools, reporting tools, extensive analysis and real time simulator and trainer.

Irkut at MAKS 2017

UAC subsidiary Irkut Corporation was a leading participant at the International Aviation and Space Salon 'MAKS-2017' held at Zhukovsky near Moscow in July 2017. Aircraft manufactured by the Corporation participated in the flight programme and were also on static display at the show.

The 'Russian Knights' aerobatics team of the Russian Air Force made its MAKS debut, with six new Su-30SM aircraft, having previously flown earlier model Su-27 and Su-27UBs. The team's new multirole super-manoeuvrable fighters were delivered by Irkut in 2016, and the new display profile was finalised earlier in 2017.

In addition, two Su-30SM fighters of the Russian Navy carried out mock combat engagement over Zhukovsky to demonstrate employment of super-manoeuvrability in achieving air dominance, the aircraft piloted by mixed crews of Navy pilots and Irkut test pilots.

Advanced combat trainers from Irkut trainers were also at the show: two Yak-130 combat trainers took part in the flight programme, one painted in the traditional

red-and-white colours of the Yakovlev Design Bureau and the second in combat configuration with external fuel tanks, guided and unguided weapons, as well as an on-board self-defence system. The new Yak-152 basic training aircraft was displayed for the first time at MAKS-2017, while another was parked in the static area along with a third Yak-130, modified as a light attack platform with a laser rangefinder installation in the nose.

On the civil aviation front, a flight simulator of the MC-21 airliner and a model of the new VIP variant of the aircraft were exhibited at the UAC stand in Pavilion F-1. While the first MC-21-300 test aircraft, which made its maiden flight on 28 May 2017 was unable to make it to the show as it was being tested at the Irkutsk Aviation Plant, the type did secure business over the week, receiving some 34 lease commitments and an agreement from Angara Airlines to purchase three MC-21-300s.

The MC-21 also attracted high profile attention as Russian President Vladimir Putin familiarised himself with the programme during his visit to the air show on 18 July, being briefed by Irkut President Oleg Demchenko, and interacting with MC-21 test pilots, Heroes of Russia Oleg Kononenko and Roman Taskaev, who shared their impressions of the new airliner, describing the first flights as "most favourable." The President also watched videos of recent test flights over Lake Baikal, this footage being released at the air show.

MC-21 programme update

As of 18 July, the sole flying MC-21-300 test aircraft had completed 9 test flights and preparations for strain-gauge testing have also begun, with more than 500 sensors glued onto the aircraft to record the loads acting on all elements of the airframe. Thereafter ground-based strain-gauge calibration will be carried out, during which the sensors will record the effect on the aircraft of various combinations of reference loads. This calibration will ensure the required accuracy of the sensor readings in subsequent flights. Designers will thus be able to compare the actual loads acting on the airframe in flight with the loads predicted during the design phase of the aircraft.

The MC-21-300 aircraft is to conduct more than 30 flights from Irkutsk during the factory testing campaign, before heading to Zhukovsky to commence rigorous certification tests. In 2018, three more MC-21-300s will join the flight test programme, these currently being built at Irkutsk.

Saab reveals the Gripen Aggressor

Saab has unveiled a new variant of Gripen, the *Gripen Aggressor* based on the Gripen C-series and is "the ultimate platform for the adversary air combat training market." Gripen Aggressor brings a 'unique' mix of high performance, mission flexibility and availability combined with a low life cycle cost. There is a growing segment within the adversary air combat training market for highly advanced aggressor capabilities to be able to perform realistic combat training. Gripen Aggressor provides an 'exceptional, dissimilar opponent aircraft system against which pilots will sharpen and refine their combat skills so as to fight and win against an advanced enemy threat'.

"There is a major difference in the capabilities provided by the aggressors on the market today and what the need is for the coming years. In order to train as you fight, you need to fly advanced combat tactics against peer and near peer opponents like the Gripen Aggressor. Essentially world class pilots need to train against world class opponents and that is the Gripen Aggressor", stated Richard Smith, head of Gripen marketing and sales at Saab.

Gripen Aggressor is based on the proven Gripen C-series fighter weapon system, but has been customised for the aggressor role. It has all the 'renowned' handling and flight characteristics associated with the Gripen C and its advanced sensor and datalink capabilities, but will not carry live armament. The Gripen C-series is in-service across the world including NATO members and has a firm development plan with on-going enhancements in hand.

An aggressor, or adversary, aircraft, is used to act as an opposing force in advanced military combat training. Aggressor squadrons use enemy tactics, techniques, and procedures to provide a realistic environment for the fighter pilots to train against. Saab sees potential for the platform as a high-level aggressor option within both the United States Air Force's Adversary Air (ADAIR) and UK MOD's Air Support to Defence Operational Training (ASDOT) requirements, and wherever users look to prepare pilots for the challenges of sophisticated modern air combat.

Saab plans US based Production Capability for the T-X

Saab together with Boeing are competing to win the tender process to supply the United States Air Force with an advanced trainer aircraft. Saab will establish manufacturing and production capability in the United States for the T-X advanced trainer aircraft, should the Boeing and Saab solution be selected. Developed in partnership with Boeing, the T-X advanced trainer can provide a new highly capable training solution for the United States Air Force,

USAF. Saab has started the process to evaluate and identify potential locations for production.

"The Boeing and Saab T-X is designed and purpose built for the USAF training mission, so we believe that the entire aircraft, including our part, should also be manufactured in the US," stated Håkan Buskhe, President and CEO of Saab AB. "Saab has already invested in the development of the T-X Advanced Trainer aircraft and if Saab and Boeing win, Saab will carry that commitment a step forward into manufacturing and production in the US. The United States is a strategic market for Saab and the company plans for continued growth in the country. The establishment of this type of production capability in the US would be another step forward in Saab's objective to grow its national presence and to create strong organic capabilities for the development, manufacturing and sales of its products", continues Håkan Buskhe.

Boeing T-X is a training system designed specifically for the US Air Force training mission. If Boeing and Saab win the competition, T-X will replace the service's fleet of aging T-38 aircraft. An award is expected at the end of this year.

Saab explores the market for Gripen Aggressor to meet the US ADAIR requirement

Saab is exploring the potential for the recently announced Gripen Aggressor, to meet the needs of the United States Air Force (USAF) for Adversary Air (ADAIR) combat training. The new Gripen Aggressor with its unique mix of high performance, and advanced sensor and datalink capabilities, combined with a low life cycle cost, provide a perfect solution for this unique requirement.

There is a growing segment within the adversary air combat training market for highly advanced aggressor capabilities to be able to perform more realistic combat training. Gripen Aggressor, recently unveiled at the DSEI exhibition in London, UK, provides an 'exceptionally capable, dissimilar opponent aircraft system'. It is able to perform the advanced combat maneuvering and networking tactics needed to represent a realistic peer or near-peer adversary threat for current and future pilots.

The USAF solicitation for ADAIR indicates the need for a high performance, highly capable dissimilar aircraft platform to meet the Level C requirements as outlined in the solicitation document. Fighter pilots need to train advanced combat tactics against peer and near-peer opponents, which is exactly what Gripen Aggressor can provide. Unlike the legacy platforms or current fighter platforms in use by the USAF, Gripen Aggressor, brings a distinctly different appearance and set of capabilities to the training scenario that will further enhance the proficiency of USAF pilots.

Gripen Aggressor, with significant US content, shares many components and systems, including the engine, in common with existing US platforms. There is therefore a high level of logistic synergies that can act to reduce cost and maximise efficiency. Saab is currently exploring the market potential and business case for this unique capability and is in discussion with several potential partners to provide a solution.

Joint Strike Fighter Milestones

The F-35 programme crossed the 100,000 flight hours mark in July, and completed a range of weapons tests

F-35B elevated-G centerline 25mm gun pod test firing, piloted by NAS Patuxent River Integrated Test Force Test Pilot Peter "Whizzer" Wilson, on 4 May 4 (photo: Lockheed Martin/Andy "Bones" Wolfe)

Lockheed Martin F-35 Lightning II fighter aircraft fleet recently exceeded 100,000 flight hours while the F-35 Integrated Test Force teams continue work on completing the remaining requirements in the programme's System Development and Demonstration (SDD) phase. "This 100K milestone marks a significant level of maturity for the programme and the F-35 weapons system," said Lockheed Martin Executive Vice President and F-35 Programme General Manager Jeff Babione. "We are well positioned to complete air vehicle full 3F and mission systems software development by the end of 2017."

Major testing milestones in recent months included validation of the F-35A's final envelope involving high risk 'edge

An inverted F-35C launches an AIM-9X missile during a live fire test on 8 June, piloted by Maj Eric Northam (photo: Lockheed Martin/Dane Wiedmann)

F-35B fires the last Flight Sciences separation test of an AIM-132 ASRAAM, piloted by Lt Col Tom Fields, on 17 May (photo: Lockheed Martin/Andy "Bones" Wolfe)

of the envelope' manoeuvres, stressing the aircraft to its limits in structural strength, vehicle systems performance, and aerodynamics while proving excellent handling qualities, completion of all UK Weapon Delivery Accuracy tests for the AIM-132 ASRAAM and Paveway IV weapons, and completion of 45 out of 50 SDD Weapon Delivery Accuracy tests including multiple target and multiple shot engagements as well as internal gun and centreline external gun pod accuracy tests, as well as multi-ship mission effectiveness tests, such as Offensive Counter-Air and Maritime Interdiction, demonstrating the performance of the F-35 System.

Three distinct variants of the F-35 Lightning II will replace the F-16 Fighting Falcon and A-10 Thunderbolt II for the US Air Force, the F/A-18 Hornet for the US Navy, the F/A-18 and AV-8B Harrier for the US Marine Corps, and a variety of fighters for 11 other countries, to date. Following the US Marine Corps' July 2015 combat-ready Initial Operational Capability (IOC) declaration, the US Air Force attained service IOC in August 2016 and the US Navy aims to declare IOC in 2019.

The remaining development flight-testing includes validating the final release of 3F software, F-35B ski jump testing, F-35B austere site operations, high-mach loads testing for both the F-35B and F-35C and completion of the remaining weapons delivery accuracy tests.

An F-35C, piloted by Col Scott "Nova" Cain, drops a GBU-12 at the test range in China Lake, California on 29 March (photo: Lockheed Martin/Darin Russell)

Developments at BAE Systems

The Advanced Hawk demonstrator

The concept of a future variant of BAE Systems' Hawk advanced jet trainer has flown at the Company's military aircraft facility in Warton, Lancashire. Equipped with a new cockpit display, a redesigned wing and defensive aids, the Advanced Hawk "will meet market requirements for the next generation of fast jet training aircraft."

Whilst the existing Hawk continues to be the "world's most successful jet trainer", the Advanced Hawk concept demonstrator builds on these proven successes. The concept demonstrator features an upgraded cockpit equipped with BAE Systems' LiteHUD (a low-profile head-up display) and a new, large area display that introduces a new student/pilot training experience. It also features a redesigned wing that increases performance in areas such as turn rates, angles of attack and both take-off and landing. Other technology advances include increased stores capability, a new set of defensive aids and a range of new flight systems, all aimed at ensuring Hawk continues to provide the edge in fast jet pilot training, as well as offering increased operational utility.

Upgraded Australian Hawks

Royal Australian Air Force's pilots of the future are now flying the latest, digital standard of Hawk advanced jet trainer having accepted the first upgraded aircraft from BAE Systems. The first cohort from 79 Squadron at RAAF Base Pearce has commenced training, taking advantage of enhanced training capabilities which make the RAAF's fleet amongst the most advanced in the world. Each upgraded Hawk provides new training capabilities including simulated radar, electronic warfare, digital mapping, ground proximity warning system and traffic collision avoidance. The upgrade also includes the replacement of two legacy synthetic training devices with three full mission simulators provided by CAE.

Upgrade of the Australian Hawk fleet is delivering an enhanced training capability to prepare pilots for life in the cockpit of fast jet aircraft including F/A-18 A/B Classic Hornets, F/A-18F Super Hornets, EA-18G Growlers and, when introduced into service in late 2018, the F-35A Lightning II Joint Strike Fighters. The Hawk aircraft fleet embodiment upgrade started in 2014 at BAE Systems Australia at its Fast Jet facility at Williamtown, NSW and the fleet upgrade will be completed by early 2019.

Order for laser-guided rockets

The US Navy has awarded BAE Systems a $180.5 million contract for more Advanced Precision Kill Weapon System (APKWS) laser-guided rockets to meet the growing US and international demand for the systems. APKWS rockets are seeing increasing use in theatre because they deliver cost-effective precision strikes with reduced potential for collateral damage. The latest order, is funded under the recently announce indefinite delivery/indefinite quantity contract.

APKWS laser-guided rockets leverage existing munitions and weapons systems investments with minimal effort and training. The APKWS mid-body guidance kit transforms standard unguided Hydra 70 (2.75-inch) rockets into highly accurate precision munitions by easily screwing into place between the warhead and motor. The 'exceptional accuracy' of the APKWS laser-guided rocket makes it extremely versatile to address various missions, and its modular design enables streamlined deployment on fixed- and rotary-wing platforms. The technology is available to international customers through the US Foreign Military Sales (FMS) programme.

BAE Systems and Leonardo to collaborate

BAE Systems and Leonardo have announced an initiative to pursue collaborations on new precision-guided solutions that will offer US and allied military forces a range of low-risk, cost effective, advanced munitions for advanced, large caliber weapon systems. The two companies anticipate offering new adaptations of Leonardo's Vulcano, a family of gun-launched munitions that exceed the performance of currently available precision-guided projectiles, in a variety of gun systems, including the BAE Systems-built Advanced Gun System (AGS) and the Mk 45 naval gun. The AGS is currently on board the US Navy's *Zumwalt*-class of destroyers, and the Mk 45 is widely used by the Navy and allied nations.

The new adaptations of Vulcano will also focus on providing solutions for land-based 155-mm artillery systems, including variants of the M777 and M109 howitzers

for the US military and its allies around the world. In testing, the 155-mm Vulcano achieved launch accelerations that support maximum engagement ranges similar to distances required for the former Long Range Land Attack Projectile (LRLAP) programme. The Mk 45 naval gun offers the potential to fire the 5-inch Vulcano at 20 rounds per minute to a maximum range over three times greater than existing munitions.

First Hawk for Oman

The Royal Air Force of Oman has taken delivery of its first Hawk advanced jet trainer aircraft, the two Mark 166 aircraft arriving at Masirah Air Base in July 2017. The Onam air arm fleet includes the Eurofighter Typhoon. The aircraft were the first batch of Hawks which will be delivered to the Sultanate over the coming months as part of an order placed in December 2012.

Earlier in May, the first Hawk and Typhoon aircraft were formally presented to the customer at a ceremony held at BAE Systems' Military Air & Information business in the UK, in front of an audience including His Excellency Sayyid Badr bin Saud al Busaidi, the Sultanate of Oman's Minister Responsible For Defence Affairs (MRDA) and the Commander of the Royal Air Force of Oman, Air Vice-Marshal Mattar bin Ali bin Mattar Al Obaidani.

Unveiling of iMOTR

BAE Systems has introduced its iMOTR, an innovative, mobile multiple-object tracking radar (MOTR), which uses commercial-off-the-shelf (COTS) solutions to provide military test and evaluation ranges a higher degree of accuracy in tracking time, space, and position information (TSPI) for objects in flight. The company developed the iMOTR solution over the past two years using the its internal research and development funding. The project focuses

on leveraging existing in-house radar designs matched with COTS components — including those improving gallium nitrate, radio frequency and analog-to-digital technologies — to design a highly capable, yet affordable multiple-object tracking radar.

The iMOTR features a C-band or X-band active electronically scanned array antenna and enhanced clutter suppression for improved accuracy assessments of object launch data, which provides more precise flight-path tracking for objects travelling close to the ground. Tracking information can be shared with other radars or data collection sensors in real-time. The radar is also equipped to provide higher precision TSPI data on a greater number of multiple objects in flight above today's test range radars. These added capabilities will allow the test and evaluation of larger, more complex scenarios critical to developing the next generation of solutions to enhance national security.

Production of first RN Type 26 Global Combat Ship

Sir Michael Fallon MP, Secretary of State for Defence, visited the BAE Systems Glasgow shipyard to start production of first of the new Type 26 Global Combat Ships for the Royal Navy. During his speech, the Defence Secretary revealed the name of the first ship as HMS *Glasgow*. This ceremonial event follows the UK Government's recent award of a contract worth £3.7bn for the first three ships to be built at BAE Systems' sites in Glasgow, following work already underway to construct five River Class Offshore Patrol Vessels and provides a strong foundation for the next two decades of shipbuilding in Scotland, securing more than 4,000 jobs across BAE Systems and its UK maritime supply chain.

The Type 26 Global Combat Ship will be a 'world-class' anti-submarine warfare ship, replacing the Type 23 anti submarine variant frigates, with the first ship due to be delivered to the Royal Navy in the mid 2020s. Having a flexible mission bay, aviation facilities and combat systems "ensure it will be capable of undertaking a wide range of roles from high intensity warfare to humanitarian assistance, either operating independently or as part of a task group." BAE Systems are exploring potential export opportunities and there is "strong interest from international customers."

Inputs from BAE Systems

Big Stick over

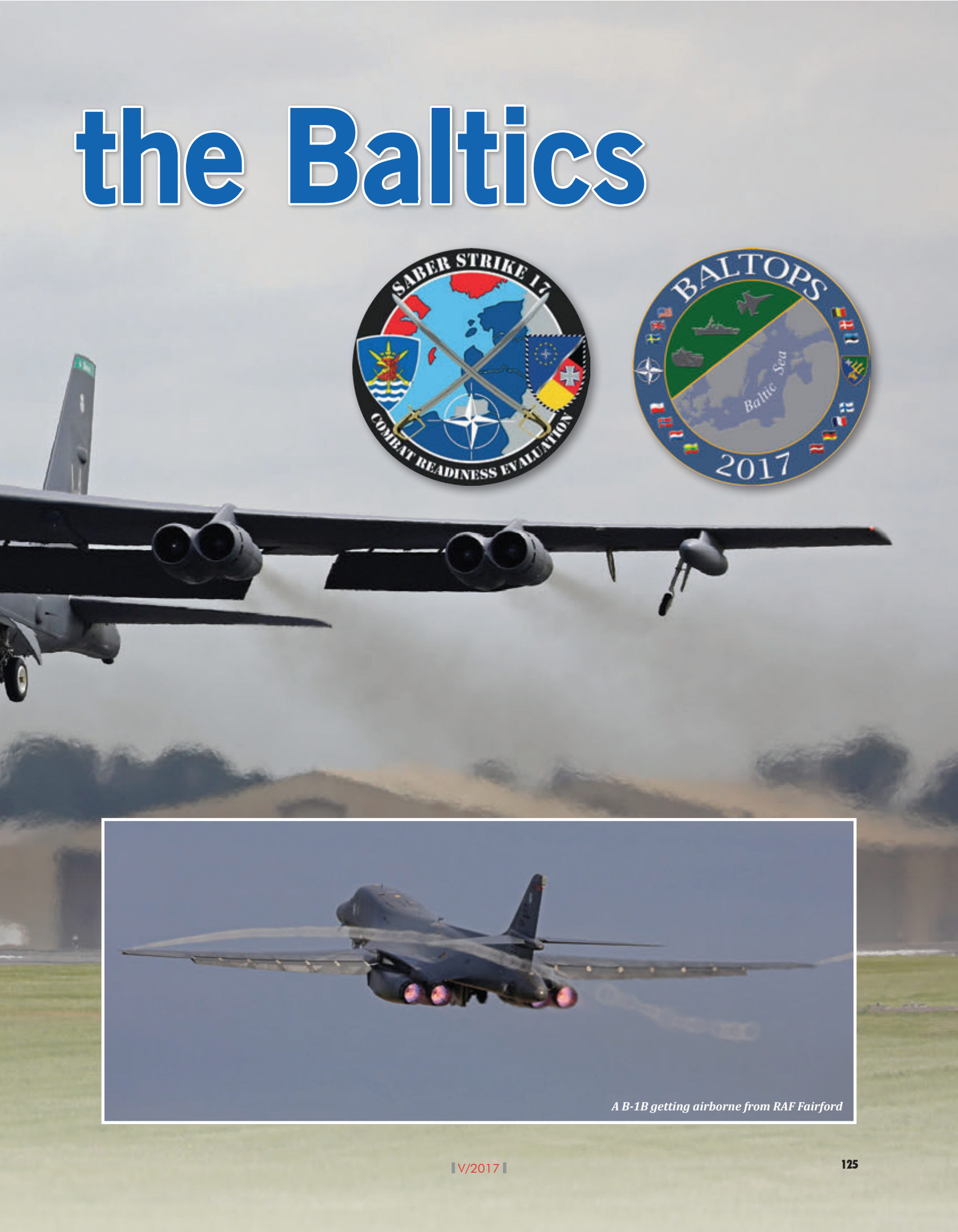
USAF bombers in the UK–BALTOPS and Saber Strike 2017

Between 28 May and 24 June, two large exercises, BALTOPS and *Saber Strike*, took place above the Baltic Region.

BALTOPS is an annual maritime-focused exercise in the Baltic Region and was held between 1-15 June, taking place for the 45th time. During these two weeks about 4,000 personnel, more than 50 ships and submarines and about 55 aircraft from 14 countries (including NATO Enhanced Opportunities Partners like Finland and Sweden) took part in an intensive and complex training in the Baltics. The goal of this exercise was to enhance flexibility and interoperability among the participants.

On the other hand *Saber Strike* is a long-standing US European Command cooperative training exercise, and this year took place in various regions in the Baltics and Poland from 28 May to 24 June, with about 11,000 US and NATO service members from 20 countries taking part. The goal of *Saber Strike* was to exercise with

the Baltics



A B-1B getting airborne from RAF Fairford

The Lancer's flight deck, with some upgrades

NATO's enhanced forward presence battle groups as part of a multinational division, while conducting an integrated, deterrence-oriented field training exercise designed to improve the interoperability and readiness of participating nations' armed forces.

Bomber Participation

During these two exercises, all three types of USAF bombers (B-1B Lancer, B-2 Spirit and the B-52H Stratofortress) deployed to RAF Fairford in the United Kingdom. It was the first time that all three bombers were deployed simultaneously at RAF Fairford, involving a total of three B-1Bs from Ellsworth Air Force Base, South Dakota and three Boeing B-52H Stratofortresses from Barksdale Air Force Base, Louisiana for duration of the exercises. Two B-2 Spirits from Whiteman Air Force Base, Missouri flew in to RAF Fairford for the media day on 12 June.

About 800 US Air Force Global Strike Command personnel were deployed to RAF Fairford for the third year running to support the exercises. The deployment of strategic bombers to the US Air Forces in Europe-Air Forces Africa's forward operating location for the USAF's strategic bombers is intended to provide important integration and interaction with the United States' NATO allies and partner nations.

Captain 'Jackal' from the 34th Bomb Squadron, Ellsworth AFB, South Dakota spoke about his experiences on the B-1B and the deployment to Fairford. He has flown for five years on the B-1B and has about 1,600 flight hours on the type. He got his wings in 2012 after successfully completing the Undergraduate Combat System Officer Training at Pensacola.

'Jackal' spoke about the difference in scenarios between the both exercises. "Both BALTOPS and *Saber Strike* are different from the war we were fighting in the past 15 years." The scenarios during BALTOPS were based around assaults and landings with troops. The scenarios during *Saber Strike* had large troop movements, infantry and vehicles such as tanks in contested environment with potential danger from surface-to-air weapons.

The Captain continued: "The main task during *Saber Strike* is Close Air Support (CAS), which B-1B pilots have executed earlier in Afghanistan, Iraq and Syria. The main task during BALTOPS is just surveillance, using the radar to find boats and portray an adversary trying to penetrate defences and destroy the carriers." The B-1Bs were playing 'Red Air' to give the ships a general overview of what to expect, but they also sometimes played 'Blue Air,' fulfilling both roles.

The captain emphasised the significance of the deployment of the amount of bombers: "It was very important to have so many different bombers at RAF Fairford for these two exercises because it was to show the allied partners nations and show NATO that, no matter what will happen, we will support them with strategic bombers of the United States military.

It is also to show to any kind of aggressive state that we can move on a very short notice to a forward deploying location and execute a global strike wherever we want, at any time."

During the exercises the B-1B crews worked in cooperation with JTACs (Joint Terminal Attack Controllers) on the ground. These forward controllers were from the USA, Poland, Latvia, Estonia and Lithuania. 'Jackal' talked about communication with JTACs on the ground: "For us it was really awesome to work with these ground troops, despite the language barrier between the controllers and us. Because we are very experienced at working together with coalition JTACs in the Middle East, it is no problem to work with these guys!" B-1B crews are very used to working with foreign ground personnel, but sometimes there were small language or knowledge gaps, because the JTACs did not know what the B-1B Lancer was capable of. For many of the controllers it was their first time working together with B-1Bs.

Russian Interceptions

During BALTOPS and *Saber Strike* the bombers were sometimes intercepted by Russian Su-27s. "The Russian Su-27s were flying around us, but for the most part they were complete safe intercepts," said 'Jackal.' During these flights the Lancer crews had no issues with the Russian fighters. "As crews it was important to keep flying our own missions, but the Su-27s didn't really bother us."

Reservists and the Lancer

Another unique thing about the participating B-1B bombers was that they were flown and maintained by USAF reservists. Reserves integrate with active duty personnel, and share aircraft to better utilise expensive assets.

Capt 'Jackal' spoke about the reservists flying the B-1B : "One of our guys retired and is now a police officer, but he is still a Reserve Weapon System Officer (WSO)." The US Air Force maintains this practice particularly with older aircraft within the Reserve Component and the Guard Component. Some people in the squadron fly full time and they maintain currencies on type, but then there are others who show up maybe once or twice a month and fly for a week.

Maintenance of the B-1B Lancer

Lt McKerman was responsible for maintenance of the B-1B Lancers during this deployment and he detailed the learning experience : "The parts for the new Block 16 are different then for the older models. It was a learning experience to decide which

A B-1B on the apron at dusk

parts were not necessarily needed. It is also important to learn which parts did not come with the unit, but are necessary for a deployment like this."

Depending on the part in question, it normally takes between a few days to a week to receive parts at RAF Fairford. Because the B-1B is a unique and older aircraft, a lot of parts are no longer manufactured, and refurbished parts from the 309th Aerospace Maintenance and Regeneration Group (AMARG) at Davis-Monthan Air Force Base in Tucson, Arizona are used instead. Not many people are needed to keep a B-1B airworthy, only about 10 personnel, including a few crew chiefs and some specialists. "But when you have to stay for a longer period you have to bring more with you for the bigger issues and the manufacturing parts."

If there are technical problems with the B-1B Lancers and they have to land at an alternate air base in Poland instead of RAF Fairford, for example, they can call the maintainers at RAF Fairford. "When we haven't got the manpower or the capability to fly to that location, we will call our people at our home base Ellsworth AFB to repair the aircraft. These guys are on the right location within a couple of days."

The B-1B Lancer

Nicknamed 'The Bone', the B-1B Lancer is a long-range, multi-mission conventional bomber, which has served with the United States Air Force since 1985. Originally designed for nuclear capabilities, the B-1 switched to an exclusively conventional combat role in the mid 1990s. The B-1B carries the largest payload in the USAF long-range bomber fleet. In 1999, during *Operation Allied Force*, six B-1Bs flew 2 per cent of the strike missions, yet dropped 20 per cent of the ordnance. During *Operation Iraqi Freedom* in 2003, B-1Bs dropped 40 per cent of all weapons while flying only 5 per cent of the sorties. The B-1B has been nearly continuously deployed in combat operations over Afghanistan and Iraq since 2001.

Today's Lancer can carry a mixed load of weapons in each of its three bays. Its

A B-52H with a Sniper targeting pod mounted between the engines

The B-1B's swing wings, bomb bays and targeting pod are all clearly visible as it approaches RAF Fairford to land

range allows it to be deployed far from the conflict zone and fly un-refueled for long periods. Its swept wings allow it to fly fast, slow, low or high as the situation demands. With only four crew members, missions can rapidly be adjusted in flight to keep up with adversaries. The radar and targeting pod can be used for positive target identification and the aircraft can employ a variety of other weapons, including laser-guided Joint Direct Attack Munitions (JDAMs), Joint Air-to-Surface Standoff Missiles with an extended range, and high explosive BLU-129 bombs.

Upgrades

In April 2012, Boeing received a US $55.3 million production contract from the US Air Force to upgrade the B-1 Lancer navigation system, replacing the original navigation hardware with a new ring laser gyro system. The new inertial navigation system uses a ring laser gyro with no moving parts to wear out, dramatically increasing reliability.

Later in 2012 Boeing received a follow-on contract for nine bomber Integrated Battle Station (IBS) modification kits, spares, training, support equipment and engineering support. IBS integrates three major aircraft modifications: an updated front and cockpit, a new diagnostic system and a new Link 16 data link, all of which enhance situational awareness and communication for the crew.

While the B-1B continues to receive updates to keep it relevant, 'Jackal' believes nothing particularly revolutionary is on the cards. "I don't see big changes. I think that the B-1 is getting some engine part replacements. Not the whole engine, but pieces and parts of it that improve fuel efficiency."

Conclusion

For the B-1B crews the biggest difference between the exercises in Europe and operations in the USA were that they had the chance to cooperate with coalition partners. As 'Jackal' explained : "We can't do this at home. It costs tons of money. During *Red Flag* and *Green Flag* we have worked together with Emirati Mirages before. But we were able to integrate and train together with the coalition and with the navies of multiple different countries. Because we are situated in the middle of the United States, we don't fly to the coast very often to train and integrate with the navy."

"It is good to see this part of the world and it is good to see how we can pick up all our necessities and move to a location, fly out from there, work with coalition partners or other US units – like F-16s from Aviano – and execute missions successfully with JTACS from Lithuania and Latvia."

Text and photos : Roelof-Jan Gort & Ralph Blok (DutchAviationPhoto.com)

"Home is the Aviator..."

LOAD DIFFUSER 2017

F-16s meet Gripens in Hungary

The partnership of the US state of Ohio with Hungary was established on 14 July 1993 with the signing of a bilateral agreement. The Ohio-Hungary pairing was chosen in part due to the large population of ethnic Hungarians throughout Ohio as well as shared geographic features. Confirming this relationship, the 180th Fighter Wing out of Toledo Express Airport deployed six F-16s to Hungary for the *Load Diffuser* 2017 joint exercise.

Change of wind

The first *Load Diffuser* (LD) had been held in 2008 and was set up as a Dissimilar Air Combat Training (DACT) exercise to hone the skills of pilots after the introduction of the Saab JAS-39 Gripen into Hungarian service just two years earlier. Hungary joined NATO in 1999 and at that time was flying MiG-29 Fulcrums that it had acquired from Russia in the early 1990s as part of re-payment of Russian debts to Hungary. In a major move toward modernisation, Hungary decided on a 'lease-to-buy' arrangement for 14 Saab Gripen fighters in 2001. The first group of these Swedish-built aircraft arrived at the resident 59th Tactical Fighter Wing in Kecskemét on 21 March 2006. The introduction of the Gripen was a major change for the squadron, with a senior squadron pilot, who had flown the MiG-29 and now flies the Gripen, remarking that the transition "from the MiG-29 to the Gripen was just unbelievable! Except for the MiG's amazing WVR (close combat) capabilities, like the R-73 missile that can be cued by a helmet-mounted sight (HMS) and the power of its two engines, the Gripen is superior in all aspects. The glass cockpit with all the available information helps us to get better knowledge of our surroundings and build better situational awareness. In the MiG you were lost compared to the Gripen!"

Line up of Hungarian Gripens at Kecskemét

Expanding to multirole

After mastering the air-to-air combat capabilities of the Gripen, the Hungarian Air Force wanted to expand the employability of both man and machine by shifting focus to air-to-ground roles. Major Gróf, chief of air operations and project officer for LD, explained what the exercise meant for the Kecskemét wing: "Apart from improving our air-to-air skills during LD, the international scene also calls for air-to- ground capabilities. In 2010 we slowly started to integrate Close Air Support (CAS) missions in our training syllabus and during this LD we can use the expertise of both the American and Slovenian aircrews to broaden our capabilities on CAS."

With establishment of the Air Ground Operations School (AGOS) in August 2016, the Slovenian Air Force would like it to be a centre of excellence on CAS as elaborated by 1st Lt Gomboc, pilot of the Slovenian 152 *Letalska Eskadrilja* (152nd Fixed Wing Squadron): "AGOS is our international Joint Terminal Air Controller (JTAC) school and our squadron is highly involved in the courses given by AGOS. Our squadron is specialised in CAS and apart from flying renegade QRA profiles it is the primary task of our squadron and our Pilatus PC-9Ms. Contrary to other Air Forces, we fly and train for CAS operations daily so I can say we have quite a bit of experience, which we are happy to share with Hungary and other partners."

Slovenian PC-9Ms were keen participants at 'Load Diffuser 2017'

Stingers

For the men and women of the 180th Fighter Wing / 112th Fighter Squadron nicknamed 'Stingers' from the Ohio Air National Guard (ANG) and their six Lockheed Martin F-16s, it was the first time in Hungary. Their sister fighter unit from Springfield Ohio, the 178th Fighter Wing, which has converted to the General Atomics MQ-1 Predator, was the last Ohio unit to visit Hungary during LD in 2010. The delay in return had different reasons but one in particular, explained Lt Col Greg Barasch, 112th FS commander and Detachment Commander (DETCO) for LD, "The primary reason for not getting back sooner was the operations tempo and busy schedule including an operational deployment in 2013 (*Operation Enduring Freedom*) and a Theatre Security Package (TSP) to Guam in 2016. But it is great to be here."

"This type of deployment gets us out of our comfort zone where the repetition of our daily grind back home can at times

Specially-painted 'flagship' F-16 from the 180th Fighter Wing

stunt our growth as a fighter wing. We had some problems with one of our jets, which got stuck at Iceland and in the end did not make it at all to Hungary. So instead of eight F-16s we only had six here in Kecskemét, but maintenance did a great job in making sure we could deliver and we were still able to fly six jets in the morning and afternoon as planned. Building relationships is the basis of this exercise, but these multi-national training engagements not only strengthen relationships, they also help maintain joint readiness and reassure European allies and partners."

New mission

While the previous LD aimed primarily at DACT this edition had some new goals and missions scheduled to benefit all involved. The exercise started during the first out of three weeks involving Basic Fighter Manoeuvres (BFM) and Air Combat Manoeuvring (ACM) to get to know each other, the airspace and European weather conditions. Almost daily the Czech Air Force participated with two Aero L-159 ALCA and two Gripens, which would land at Kecskemét during lunch time for face-to-face debriefing. During the second and third week CAS and SCAR (Strike Coordination and Reconnaissance) were increasingly scheduled for the morning missions while in the afternoon Large Force Employment (LFE) exercises were flown building up to 30 aircraft (in the third week) including Slovakian MiG-29s.

"The Hungarians requested to be trained in the planning and execution of an LFE." Lt Col Barasch elaborated. "At first our pilots were mission commanders for those LFEs and later on in the exercise the Hungarians took over. They did very well considering the steep learning curve involved."

These kind of exchanges are very important for the Hungarian Air Force as explained by Maj Gróf: "The way we execute BFM/ACM missions can be different. The same goes for CAS, but SCAR in particular is [rather] new to us. What we have learned in this exercise we can share among our colleagues and build it into our training syllabus. Leading an LFE as mission commander was also high on our priority list. With the experience we gained from the Americans we can send two pilots to the Tactical Leadership Programme (TLP) in Spain next September in order to further develop experience and become well trained mission commanders."

The biggest ever

With around 200 international participants on base, LD 2017 was the biggest edition to date. Originally a Hungarian-American exercise, this year was different with Czech, Slovakian, Croatian and Slovenian aircrew participating with helicopters and jets. During the last week Royal Air Force (RAF) Eurofighters of 3 (Fighter) Squadron, currently based in Romania for Southern Air Policing duties, joined the exercise, but operated from Pápa air base acting as Red forces while fighter control for the LFE was provided by a NATO E-3 AWACS.

Czech Gripen on the apron

"The current size of the exercise was just enough to handle from one airfield if you look at available aprons and buildings although it was considered to use Pápa air base more extensively for Red forces during the exercise not only for two days for the RAF Eurofighters," stated Maj Gróf. "Also, other units not based at Kecskemét were involved in the exercise like Hungarian Ground Based Air Defence (GBAD) with SA-6 'Gainful' mobile surface-to-air missile systems at the Hejmasker weapons range near Lake Balaton and JTACs from four different countries including Germany. Unfortunately the Serbian Mil Mi-17s cancelled and the invited Romanian MiG-21 unit had no interest in the exercise. Maybe next time!"

A bright future

Considering the growth and interest in the exercise it is more than likely that a future edition will occur. With the experience of the Americans and other forces involved, the Hungarian Air Force hopes to organise a LD sooner than the seven years gap between the last two. "From a Hungarian point of view this exercise has been very valuable for us," said Maj Gróf. "We have been able to bring [younger] guys to a higher standard on different kinds of aspects of combat aviation. With 370 missions flown, totalling 460 flight hours in three weeks for all assets involved we can say it has been a great success. Between the seven years since the last exercise people have moved from their position and therefore we lost valuable experience in organising an exercise of this magnitude so we hope to realise a LD within the next two to three years to maintain a high organisational level."

Lt Col Barasch was also impressed by the exercise: "After our spring deployment to Florida and ahead of the upcoming TSP this winter, LD was a great work-up for us in an international training environment. Hungarian support has been outstanding. For example, we had a myriad of logistical issues moving equipment around the world and had some delays in delivering some of the equipment we needed for our operations. The Hungarians were quick to offer assistance and fill these voids so we could move on with our missions. We would love to come back soon!"

Text and photos: Remco Stalenhoef

Poland's 'Unique

The Polish Air Force has in its combat inventory a unique trio of types. Owing to decades of influence from the former Soviet Union, Poland initially procured the entirety of its fighter force from the communist bloc. Latterly, however, Poland finally had the chance to source its equipment from a broader market, allowing for inclusion of F-16C/Ds in its inventory. These are accompanied by Cold War era MiG-29s and a type used only by a handful of other countries, the Sukhoi Su-22 (NATO reporting name: *Fitter*).

The Polish Air Force recently provided outsiders an opportunity to observe all three fighter types flying side by side in the air, with photos taken from a C-295M transport aircraft stationed at 8 Airlift Base in Kraków.

From the oldest to the newest in the inventory, the Su-22 is shown with a new, more modern grey camouflage instead of the old green paint that was better suited for ground attack roles – the primary role of those aircraft. They are the only aircraft in Polish inventory with variable-sweep wings, and capable of carrying nuclear weapons (which Poland does not have). They also have the abilities to perform electronic intelligence and are considered by some as a great asset to sustain the skills of highly trained Polish pilots and prevent them from leaving the military before new aircraft arrive. A recent decision has been made to retain 12 single-seat Su-22M4s and six twin-seat Su-22M3Ks, while rest of the 32 aircraft will be withdrawn from service. One of the biggest advantages of these aircraft in Polish service is the massive amount of ordnance available to be used for live firing training. Besides the new camouflage, the 18 modernised Su-22s have new radios and are modified to meet NATO specifications : for instance pilots now see altitude on their flying instruments in feet rather than metres. This modernisation package will

Trio’

allow for a further 10 years or 800 hours of operation.

The second aircraft from the Polish trio is the MiG-29 ‘Fulcrum,’ often nicknamed “smoker” owing to the thick smoke emitted by its engines. These were extensively used by the Polish air arm, first inducted in 1989 when twelve of them landed in Mińsk Mazowiecki, one of two MiG bases in Poland (the other is Malbork).

The second batch of nine MiG-29s was acquired from the Czech Republic through a barter transaction for W-3A helicopters. A decade after the re-unification of Germany, 23 MiG-29s were purchased from the

Luftwaffe for the symbolic price of one Euro, with 14 of these entering service and the rest used for parts. Poland's "smokers" fly missions relating to guarding Polish airspace and meeting Poland's NATO commitments to protect the Baltic States as part of NATO's Baltic Air Policing mission. A modernisation programme initiated in 2011 saw part of the Polish MiG-29 fleet receive significant updates. 13 single-seat and three two-seat aircraft received new avionics and paint schemes. One of the most recognisable features of the Polish MiGs are the portraits painted on the insides of their vertical tails, commemorating Polish pilots who flew in the Battle of Britain.

The last of the Polish fighters is the well known F-16C/D Block 52+. This is a special variant tailored for Polish needs, with 32 stationed at 31 Tactical Air Base in Krzesiny near Poznań, and 16 at 32 Tactical Air Base in Łask, near Łódź. Altogether Poland has bought 32 F-16Cs and 12 F-16Ds with conformal fuel tanks, Goodrich DB-110 recce pods, AN/AAQ-33 Sniper XR pods, JHMCS helmet sights, and a diverse arms package. The Polish MOD also recently begun talks with the United States about buying JASSM-ER stand-off strike missiles.

Each of these aircraft is often displayed at air shows in Poland and Europe – the F-16 flying solo as the 'Tiger Demo,' the MiG-29 as a *very popular* solo display, and Su-22s conducting demonstrations in pairs.

Text: Dr Krzysztof Kuska
Photos: Piotr Łysakowski/ piotrlysakowski.pl

Tactical Weapons Meet 2017

No.1 Squadron based at Florennes and operating the F-16 Fighting Falcon is the oldest squadron of the Belgian Air Force. The history of the unit began during the First World War, when the squadron was established as an air defence squadron of the Belgian Army. The unit, with the Latin motto *Nemo me impune lacessit* ('No one provokes me with impunity') and the prickly thistle as its emblem, celebrated its 100th anniversary this year. An F-16 was specially painted in

The French joined the Belgians with a specially painted fighter, this one a Mirage 2000C

an eye-catching black-and-yellow scheme to commemorate the Squadron's milestone. French designer Didier Wolff, responsible for designing a number of beautiful Mirage and Rafale paint schemes for the French Air Force, was asked to design the special colour scheme for No.1 Squadron, and aircraft number FA-132 was made available for the project. The aircraft went to Charleroi for painting and was eventually presented on 11 May 2017. The aircraft is painted in the

A 1.elt MiG-29 from Poland taking off for a TWM2017 mission

Hellenic Air Force F-4E Phantom II over Florennes

RAF Hawk T1 XX285 wore commemorative No.100 Squadron anniversary markings in addition to the distinctive skull and crossbones on the tail

An Italian Air Force Eurofighter with Polish MiG-29s on the tarmac at Florennes

black and yellow colours of the Squadron, and bears the Scottish thistle in grey tones on its tail.

During the next month, between 5 and 16 June 2017, Florennes and No.1 Squadron hosted the Tactical Weapons Meet 2017 (TWM2017), a European joint training exercise. A media day at Florennes was organised around the exercise to celebrate the 100th anniversary of No.1 Squadron and coincide with the culmination of the Tactical Weapons Meet. In addition to the exercise participants, a number of other foreign aircraft were also flown to Florennes.

The Tactical Weapons Meet

The Tactical Weapons Meet 2017 is a very serious exercise for the participating pilots. The Belgian hosts participated with four F-16s, two from 2 Wing at Florennes and two from 10 Wing at Kleine-Brogel. The Royal Air Force took part with two glossy-black Hawk T1s from RAF Leeming, where they fly as aggressors with No.100 Squadron. The Italians sent two EF2000 Eurofighters from 4° Stormo, based at Grosseto. The Spaniards also participated with Eurofighters sending three from Seville/Morón where they are assigned to Ala 11. Poland brought three MiG-29s from 1 *Eskadra Lotnictwa Taktycznego* (1.elt) at Minsk-Mazowiecki. The final participant, Greece flew with two F-4E Phantom IIs from Andravída, where they are assigned to 117 Combat Wing. The Phantom was the oldest participant at the TWM2017 exercise. At the beginning and end of the exercise, several transport aircraft arrived to support the participants on their journeys to and from Florennes.

The Tactical Weapons Meet is a relatively small scale exercise, aimed at the training of young pilots at section leader level (Level II/III, see the *Pilot ratings* below). For the latest fighter pilots of the Belgian Air Force and its partners, the TWM is an ideal way to qualify these pilots to Level III. The training focuses on two-ship leadership in which the pilot will act as flight leader of the formation. During the training, the pilots will also learn in an international context what the capabilities and limitations of each other's aircraft are. In addition to the qualifications, many young pilots will also train for the first time in NATO cooperation. For most pilots, the TWM is the first training where they fly against dissimilar aircraft types, the participating aircraft therefore always leaving in pairs during their missions. The different two-ship formations then meet each other in air-to-air engagements.

Apart from air combat training, the formations are also used to simulate attacks on ground targets. Building leadership skills during these scenarios is the main objective here. In the past, this kind of training for young pilots was mostly completed within their own squadrons. However, training opportunities such as the TWM2017 are intended to be continued in the future, because training in this environment of multinational collaboration is very effective for young NATO pilots. While No.1 Squadron organised and hosted the exercise this year, the intention is for other NATO squadrons and bases to host the exercise next year and beyond.

The Belgian organisers hope that this dedicated exercise for the younger pilots will get a follow-up for next year, "as there is a need for these kinds of exercises, to prepare the younger pilots for the larger exercises as *Frisian Flag* or *Red Flag*."

Pilot ratings

When pilots participate in exercises like the TWM2017, it is important to ascertain how far the participants are with their skill levels. There are a total of five qualification levels for operational pilots, which indicate their skills.

A pilot starts operational flying after his basic training as a Level I pilot. This means he or she can fly the fighter and knows the basic procedures, but has not yet undergone any tactical training. At Level II, the pilot is combat ready and can fly as wingman on a mission, having completed the full Mission Qualification Training Syllabus. A Level III qualified pilot is able to take leadership in a scenario for the first time, acting as a Flight Lead for a two-ship flight. Training for Level III focuses primarily on leadership, involving pilots in briefings and de-briefings.

The next step is Level IV, where a qualified pilot is able to lead a four-ship formation. Level IV is more extensive than Level III, but the pilot is still not yet a Mission Commander. An intermediate level is Level IVi, which is closest to a flight instructor on an aircraft type. A Level IVi pilot can also train other pilots in addition to leading a four-ship. The highest level is Level V, which is a highly experienced and fully qualified fighter pilot. In the United States, a Level V in the Navy would be referred to as a 'Top Gun' graduate, and in Europe, could be referred to as a Fighter Weapon Instructor Course qualified pilot.

Text and photos: Alex van Noije & Joris van Boven

A Spanish Eurofighter taking off from Florennes

The Tiger Meet 2017

NATO's 'Tiger' units at Landivisiau

The annual *NATO Tiger Meet* (NTM) is among the exercises in Europe that is most widely visited by air enthusiasts from all over the world, eager to record the various kinds of aircraft adorned with ever more elaborate tiger-themed paint schemes. The 2017 Tiger Meet from 5 to 16 June was organised by the French Navy, specifically by 11 Flottille based at Naval Air Base Landivisiau in Brittany.

Tiger Meet is an exercise that also includes a social character in addition to joint training, and therefore there has always been a traditional 'spotter day' organised during the exercise. However, the French Navy decided this year to facilitate *two* different spotter days, the first taking place on 8 June and the second on 14 June. Both days saw over 500 enthusiasts allowed to enter the airbase to photograph participants of the exercise. Every participating unit sent at least one aircraft painted in a tiger-related scheme, with the theme this year being the 'Atlantic Tiger,' a symbol of host 11 Flottille, which also celebrated its 50th anniversary during NTM 2017. The unit flew six Rafale M carrier fighters during the exercises, with one example painted in with striking black-and-white tiger stripes (*lead photograph*).

In addition to the bonhomie and *esprit de corps* fostered among NATO's 'tiger units' by the annual NTM, the meet also involves serious COMAO (COmbined Military Air Operations) training. The meet this year was attended by eleven NATO and partner member states, with 53 aircraft, 15 helicopters, along with 800 pilots and technicians participating. During the two-week exercise more than 800 missions were flown, involving a total of over 1,200 flying hours. Large-scale exercises of this format are not common in Europe despite the fact that they are very important in an environment that almost always has fighters operating in a multi-national context (for example, the air campaign against ISIS over Syria and Iraq). In order to perform these types of operations, realistic training with partner air forces remains necessary. For fighter pilots, it is important to plan, execute and evaluate complex flight assignments. The assignments distributed to the individual groups are eventually brought together in a complex scenario in which everyone has a specified role. The fighters participating in the Tiger Meet essentially practiced aspects such as air defence, escort and strike, while the similarly-painted helicopters mainly trained for Special Forces operations and personnel recovery.

The field of participants of the NATO Tiger Meet was very varied, with eight countries participating in the COMAO exercise. In addition to the French Navy, the French participation also included seven Air Force Rafales from Mont-de-Marsan along with four Army Aviation Gazelles from Etain-Rouvres. The Swiss Air Force sent

five F/A-18 Hornets from Meiringen, the Austrians deputed three Saab 105Ö trainers from Linz-Horsching, the Italians were represented by four Eurofighters from Gioia del Colle and two AB-212ICO helicopters from Grazzanise, the Belgians participated with five F-16s from 31 Squadron at Kleine-Brogel, and the Royal Netherlands Air Force sent eight F-16s from 313 Squadron at Volkel. The final fast jet participant was the Czech Air Force, with four JAS-39 Gripens from Cáslav. The British sent a RAF Puma HC2 from RAF Benson, and a Navy Sea King ASaC Mk.7 AEW from the Navy. A French Navy E-2C Hawkeye and two Army EC665 HAP Tigre helicopters also flew along during some scenarios. Poland and Greece sent only observers to this edition, while the entire exercise was coordinated by a NATO E-3 Sentry out of Geilenkirchen in Germany.

The Czech 'Tiger' Gripen

Traditionally, the annual Tiger Meet is also a social event. During the Tiger Meet, a number of prizes are awarded in different categories.

As is now standard, NTM 2017 concluded with a NATO Tiger Association award ceremony for various achievements during the meet. The first trophy, awarded to the unit with the best results during the COMAO, was won by the Belgian Air Force's 31 Squadron. The award for "the most beautifully painted aircraft" was won by the hosts, 11 Flottille of the French Navy, while award for the best uniform was claimed once again by the Belgians. The sports trophy for the 'Tiger Games' this year was awarded to EC01.030 of the French Air Force, while prize for the best skit went to the RAF's No.230 Squadron. The Silver Tiger Trophy, for best all-round performance at NTM 2017 went to No.31 Squadron of Belgium.

Specially marked French Air Force Rafales

Italian AB212 in special tiger-themed colours

Belgian F-16AM with NTM paint scheme

Text: Alex van Noije & Joris van Boven
Photos: Alex van Noije

Air Marshal Philip Rajkumar recollects

Four Unforgettable Events

In a flying career which lasted a little over forty years, there were a great many close shaves, near misses and 'There but for the grace of God go I' moments. Four events stand out in my memory as they happened during various stages of my career. The first was when I was inexperienced, the second was my very first operational sortie in a war, the third was during test flying and the last was at the fag end of my career when I had my neck well and truly inside a noose !

Abandoning take off in a Toofani

In October 1963, I was a Pilot Officer flying Toofanis with No 47 Squadron at Bagdogra. I had about 50 hours on type and 300 hours in my log book. The 18/36 runway was only 1800 yards long leaving little room for error during take off and landing. One morning I was doing a formation take off on R/W 36 and concentrating a lot on station keeping. As the speed built up I felt the stick move forward on its own. When the leader raised his nose wheel I tried to do the same but the stick was frozen solid. I could not move it back even a millimetere. I immediately abandoned take off by throttling back and braking hard to bring the aircraft to a stop just before the black top ended. As I cleared the runway I moved the stick and it moved freely. I was nonplussed! After switch off I got out and went to look at the elevator. The elevator trim tab which was electrically operated by a trim wheel in the cockpit was in the fully nose down trim position. The cockpit indicator which was also electrically operated showed neutral. The Court of Inquiry found the screw jack which moved the tab had failed in the fully nose down trim position. The C-of-I also found the trim position indicator did not show the actual position of the trimmer, something which we did not know. Eastern Air Command recommended me for a CAS Commendation for displaying good airmanship. A slightly delayed decision to abandon take off would have been catastrophic due to the short runway and a very, short, uneven overshoot area.

Daylight raid over Sargodha

When the Indo-Pak war started in September 1965, I was a Flying Officer in No 1 'Tiger' Squadron at Adampur, flying the Mystere IVA ground attack aircraft. On 7 September I was in a four aircraft formation ordered to attack the heavily defended PAF air base, Sargodha which was 100 miles inside enemy territory. The aircraft were armed with 2x1000 lbs bombs and front guns. We took off at 0945 hours, flew at extreme low level and were over the target at 1015 hours. As we pulled up for the bombing dive, heavy flak greeted us. Three Sabres and one F-104 were attacked on the ORP and the ATC building was destroyed. All aircraft returned safely to base. The formation members were, No 1 Sqn. Ldr. Sudarshan Handa, No 2 Flt. Lt. Darshan Singh Brar, No 3 Flt. Lt. Dilmohan Singh Kahai, No 4 Fg. Offr. Philip Rajkumar. This raid was the most successful counter air mission of the entire war. It was acknowledged for its audacity even in the official PAF history of the war. Handa and Kahai were awarded the Vir Chakra while Brar and I were awarded a Mention-in-Despatch.

Hairy Moment in a Gnat

In August 1975, I was a SqnLdr at the Aircraft and Sysytems Testing Establishment at Bangalore. On 2 August I was to air test a Gnat Mk. 1 before ferrying it to Hindon for a trial. I had about 12 hours on the Gnat. As I taxied out for take off the sky was overcast with a cloud base of 1000 feet above ground level. I kept moving the ailerons all the time while taxying, as was the practice in Gnat squadrons, to ensure the ailerons were in hydraulic power. When I moved the stick to the left and released it, it would not self centre. To the right it would. This made me suspect that the left aileron was in manual. After line up I did the check again and the stick stayed stubbornly stuck to the left stop. I abandoned the sortie, returned to dispersal and reported the snag to the Chief Test Pilot, Wg Cdr 'Babi' Dey who was a very experienced Gnat pilot. He started up, checked the ailerons and said they were fine. He told me to go ahead with the air test. I started up again and after ensuring the ailerons were in power I took off, did an instrument climb through a thick overcast to 30,000 feet, broke cloud and levelled out. Seconds later the stick snatched violently to the left

Mystere IVA of No.1 Squadron, IAF

Sketch by Timothy O'Brien

and I had 90 degrees of bank in an instant. The nose dropped and I was in imminent danger of diving back into the clouds. I booted in full right rudder and managed to level the aircraft, selected hydraulic power off, descended through the overcast and landed in manual for the first time. Investigations revealed that the hydraulic filter had burst and sent a lot of debris into the hydro boosters and almost fully clogged the filters resulting in intermittent operation of the ailerons in power. Air Commodore Johnny Greene who was the Director Flight Safety at Air Hq said that at long last the cause for a number of Gnat crashes over the years after encountering roll control problems was established. Had the aileron reverted to manual during take off I would have crashed. Had it happened during the instrument climb I would have been disoriented and probably ejected. Dame Fortune smiled on me that day!

First flight of the LCA TD-1

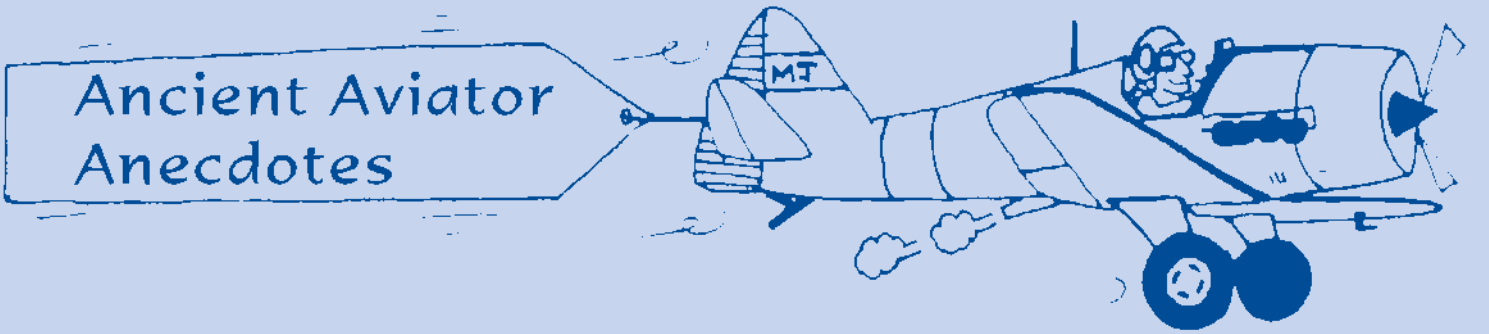
In September 1994 when I was posted at Air HQ as Addl. ACAS(Ops), I was deputed to the Aeronautical Development Agency to take charge of the flight test programme of the two technology demonstrator aircraft of the high profile Light Combat Aircraft programme. This was India's widely publicised effort to catch up with the advanced countries in contemporary aeronautical technologies. A fly-by-wire flight control system, glass cockpit and microprocessor based monitoring of utility systems were being introduced in the technology demonstrator aircraft. The airframe had composite materials.

So many complex technologies in a single aircraft for the first time in the country made the effort risk prone. My main responsibility was to manage the risk and plan the flight test programme accordingly. I participated fully in the development of all the new technologies. I flew in-flight simulation sorties in the USA, worked extensively on the development of the engineering simulator in Bangalore and set up the National Flight Test Centre with advanced telemetry monitoring facilities. After the Pokharan nuclear tests in May 1998 the Western powers implemented a technology denial regime against India and the programme was badly hit. The crucial hardware in loop tests on the Iron Bird rig had to be done entirely by the Indian team. At the Flight Readiness Review Board meeting on 24 December 2001 to clear the Technology Demonstrator (TD-1) for first flight I flashed the green light. The CAS, SA to RM and offg Chairman HAL attended the meeting. No one questioned my decision.

On the day of the first flight, 4 January 2001, the Directorate of Aeronautical Quality Assurance inspector who had to sign the release for flight Form 1090 wanted my signature as well! Never before has a serving Air Marshal been made to take responsibility for the first flight of a prototype. I happily signed the document as I was sure the flight test preparations had been done with utmost professionalism. After the first flight the test pilot, WgCdr Rajiv Kothiyal wrote 'Nil snags' in the Form 700. There could have been no finer tribute to the dedication of Team LCA.

Some months after the first block of flights had been completed safely the Raksha Mantri, George Fernandes, told the team he had received a letter from the US company which was helping us develop the flight control system asking him not to allow the first flight as it was too dangerous. The technology sanctions were in place for 31 months before first flight! Had something untoward happened on that day guess who would have been hanged?

LCA Technology Demonstrator 1 (KH 2001)



Air Vice Marshal Cecil Parker recollects...


An IAF Canberra B.66

Tribute To A Pathfinder

Our friendship goes back to 1949 when we were both students at the same college in Calcutta, he a 'bong' from Shantiniketan and this writer a 'half-bong' from elsewhere. A year my senior, he was even then very mature, disciplined but somewhat reserved by nature. Yet, he had a quiet sense of humour and was not above joining his more boisterous fellow students in our occasional cutting of classes to watch football matches or pooling our (very restricted) financial resources to enjoy *puchkas*/*jhaal muri* on the *maidaan* or (during *Durga Puja*) choosing to visit only those *pandals* where the prettiest girls were queued up!

We both appeared for the FPSC entrance exam for the IAF, attended the Air Force Selection Board in Dehra Dun and the Central Medical Establishment in Delhi in the same group and were selected for the same pilot training course at No.1 AFA up north in Ambala.

On a cold winter morning in March 1951 we reported together to the academy and joined 48 other young lads from all over India to form No.58 Pilots Course. Soon after our training commenced, the academy was relocated to Begumpet and we were sent home for a month after which we again travelled together, this time down south to Secunderabad. Our togetherness continued when we found ourselves pupils of the same instructor. Navroze Lalkaka was a gem of a teacher and gentleman who not only taught us how to fly but instilled many soft skills both during and after working hours. My co-pupil's leadership potential led to his being a very popular and successful appointment cadet. He was near the top of our course of 30, which finally graduated on 30 August 1952. Post-commissioning we separated, he to TTW for twin-engine conversion and me to FTW for fighter conversion. Our meetings thereafter were infrequent but we kept in touch and got news of each other as coursemates do. After marriage we met at course reunions and get-togethers with families.

After tenures in Dakota squadrons, he was selected to convert on to the Canberra twin-engined light jet bomber aircraft. We both commanded squadrons at the same time but at different air bases. Once, during an inter-command exercise, we 'crossed swords in the air' (so to speak) and only discovered in debrief that he was flying the Canberra and I was flying the Hunter – pupils of the same instructor now on opposite sides! With his admirable personal and professional attributes he was posted abroad as our Defence Attache. Post our respective (premature) retirements, he became Secretary of the Tolly Club in Kolkata which I visited frequently on business trips for my company in Mumbai. When his son relocated to Hyderabad, he and his wife were frequent visitors and we enjoyed many family get-togethers in our home and in restaurants.

Five years ago he was diagnosed with cancer and flew here for treatment at the Indo American Cancer Hospital. Throughout, he maintained his calm, cheerful demeanour and rarely missed the annual meetings of the Canberra Club in Pune. Our last personal visit to him was in April when he was bedridden. He overcame his last operation and flew back to Kolkata. On 7 May we received the sad news that he had passed away. A deluge of e-mails and messages poured in from coursemates and many friends for a caring husband, father, officer and gentleman. True to one of the primary roles of the Canberra, my friend Jaypee is now a pathfinder for his coursemates. (It should be the ultimate high spirited Reunion!)

Yesterday's Air Force

The Indian Air Force shares a year of birth (1932) with this ancient aviator. For its first 15 years our air force was a limb of the RAF but, particularly during World War II (1939-1945), our pioneer Indian pilots and technicians acquired skills, knowledge and experience that would equip them later to build an independent IAF post-1947. During the war years this writer was in a Raj-era boarding school, which had a military airfield in close proximity. The daily sight and sound of aircraft made all of us young boys dream of becoming pilots! Post partition our fledgling air force was left with a truncated inventory of aircraft: transports (Dakota), fighters (Spitfire and Tempest), bombers (Liberator) and trainers (Tiger Moth, Harvard, Prentice). Nonetheless it performed admirably in 1948, airlifting our troops into Srinagar and providing offensive air support to our land forces, thus saving Kashmir. As we grew, the first jet aircraft, the British Vampire, was inducted in 1948, the year I completed school and joined college.

By the time we became a Republic (1950) it was clear that, to build up India's primary instrument of military air power, a large-scale induction and training of personnel of all branches and trades, had to be undertaken immediately. Thus it was that in early 1951 I found myself in a pilot's course of over 50 flight cadets at No.1 Air Force Academy in Ambala. Standards were strict and 18 months later only 30 of us received our wings and commission just before the IAF and I marked our 20th birthday(s). In the next 34 years, I moved 19 times on various postings, while acquiring skills and knowledge, making mistakes and learning from them, surviving accidents, raising a family, gaining valuable experience in the air and on the ground, but above all, thoroughly enjoying my flying as 80 per cent of my assignments were at airfields.

In the same period, the IAF developed into a balanced tactical air force with the induction of aircraft and equipment from various sources/countries *viz*: HAL (HT-2, Marut, Kiran, HPT-32, Krishak, Ajeet), France (Ouragan/Toofani, Mystere, Alouette/Chetak, Mirage), UK (Hunter, Canberra, Viscount, Devon, Gnat, Avro, Jaguar), USA (Packet, Sikorsky S-55, Super Constellation, Boeing 737), Canada (Otter, Caribou), Poland (Iskra), and USSR (Il-14, Mi-4/8/17/25/35/26, An-12, MiG-21/23/27, Tu-124, Su-7, An-32, Il-76). It is a great tribute to our veteran air warriors of every single branch and trade that they coped effectively with this staggering diversity of airborne platforms and support equipment. '*Jugaad*' was developed into a fine science that demonstrated air power successfully in peacetime commitments, and the 1965 and 1971 Indo-Pak wars.

The 'vintage' MiG-21 was state-of-the-art when the author was in service! (photo: Angad Singh)

For three and a half decades I had served as a squadron pilot in three different squadrons, a flying instructor, a squadron commander, a commanding officer (twice), a staff officer (twice), a station commander, an AOC (twice), a chief instructor, a commandant, raised two new units and attended flying/staff courses in India and abroad. In 1986 the air force opened up an opportunity for me to exit. After a most fulfilling career and in my 54th year, I was happy to avail of this opening and move into the corporate world. Today, 31 years later, the sight and sound of aircraft from a nearby air base, does generate nostalgia for the service I grew up in, yesterday's air force.

25 Years Back

From Vayu Aerospace Review Issue V/1992

ALH First Flight

The Advanced Light Helicopter (ALH) prototype (Z 3182) made its first official flight at Bangalore on 30 August 1992, in the presence of India's Vice President KR Narayanan, Defence Minister Sharad Pawar and other dignitaries. The ALH is being designed and developed by HAL in technical collaboration with MBB of Germany (now Eurocopter), the formal contract having been concluded in July 1984. The genesis of the ALH goes back to the mid-seventies when HAL received what amounted to a joint air staff requirement (ASR) for a multi-role helicopter to meet the needs of the Indian Air Force, Army and Navy. The original design was based on a single-engine and HAL's Design Bureau was assisted by SNIAS of France but following the new ASR, which specified twin-engines, enhanced crash survivability and other characteristics, HAL re-negotiated with alternate European companies and selected MBB as its technical collaborator.

More MiG-29s for IAF ?

The Miroyan Design Bureau has reported that the visiting Indian Defence Minister Sharad Pawar was looking to buy additional MiG-29s from Russia. Adding that India already had 64 MiG-29s in service, reports had it that another 26 MiG-29s were to be ordered and added that India's fighter pilots were amongst the best in the world and had "no problems" with the MiGs. Also reporting from Moscow, a Western Defence Analyst who was given a briefing by CIS Defence Industry officials has stated that India was receiving quantities of the SA-11 *Gadfly* SAM and 2S6 self-propelled air defence cannon missile system.

ISRO Plan Mission to Mercury

India's first planetary destination is most likely to be Mercury which is the smallest but closest planet to the Sun. An Indian Space Research Organisation (ISRO) study has recently revealed such a mission to Mercury by the turn of this century, first as a fly-by and then as an orbiter. In ISRO's planetary mission, the GSLV will launch the spacecraft first into a 300-km, orbit, then be boosted into orbit around the Sun which will then propel it to Mercury. The planet Mercury could be used for several swingbys before entry of the spacecraft into an orbit around the planet. Instrumentation abroad the Mercury orbiter would include devices to determine the composition of gases in the planet, Mercury being selected by the ISRO because of its seismicity, magnetism, volcanism and geological features.

INAS 310 re-equips with Dornier 228s

Indian Naval Air Squadron 310 ('Cobras') has recently been re-equipped with the Dornier 228 Maritime Patrol Aircraft. INAS 310 was formed on the Breguet Alize carrier-borne ASW aircraft which was operated for some 30 years, and is now supplanted by the HAL-built Dornier 228 maritime patrol aircraft.

Pakistan receives more F-7s, looks at "new options"

The Pakistan Air Force has re-equipped two additional squadrons with the Chinese Xian F-7P fighter, raising to six the total number of such formations including Nos. 17, 18, 19 and 20 Squadrons. The PAF is inducting additional F-7Ps to supplant the obsolescent F.6s which have remained in service with Nos. 15, 23 and 25 Squadrons. The initial quantity of 95 F.Ps, including 15 FT-7 operational conversion trainers, have been followed by 40 more F-7Ps and it is likely that further deliveries will be made, the PAF reportedly fairly satisfied with this fighter unlike the Nanchang Q-5 III "which has been disappointing".

Meanwhile, Air Chief Marshal Farooq Feroze Khan, CAS of the Pakistan Air Force, visiting the Farnborough Air Show in mid-September 1992 was to look at the "other options" on display, including the Russian Sukhoi Su-27 and MiG-29, French Mirage 2000 and Rafale and the Tornado ADV.

First JAS 39 Gripen for Swedish AF

The first production JAS-39 Gripen made its maiden flight from the Saab airfield at Linkoping on 16 September 1992. The flight lasted for 44 minutes and was the 594th flight in the test flight programme to date. This Gripen (No. 101) is first production aircraft of batch One, consisting of 30 aircraft, equipped with a limited recording system and will be used in the test flight programme, with No.101 concentrating on verification of aircraft equipment and the systems status. There are now five test aircraft in the test flight programme. To date, there are orders for 140 JAS 39 Gripens for the Swedish Air Force with deliveries to start in 1993 and will continue until 2001. The total requirement for the Swedish Air Force is approximately 300 Gripens for 16 squadrons, according to the defense decision taken by the Swedish Parliament in June 1992.

Russian aircraft carrier for China

The Chinese Navy's interest in the Russian aircraft carrier *Varyag* (still incomplete) is being reconfirmed with a reported price offer of US$2.4 billion for the ship. The money, in hard currency, is to be paid in equal installments over three years but does not include the procurement and installation of western radar, sensors and weapons which have yet to be selected. The *Varyag*, under building at the 61 Kommunar yard on the Black Sea, is considerably different in design to the earlier sister ships *Admiral Kuznetsov* and *Admiral Gorshkov.* The type and number of aircraft to be embarked on the *Varyag* are also not identified but could include the carrier-borne version of either the Sukhoi Su-27 or MiG-29 both types which have been evaluated by China, some 72 of the former already on order for the PLA Air Force.

Tale Spin

Leading from the Front

From the Times of India

A senior Air Force veteran has sent *Vayu* the following as tribute not only to Marshal of the Air Force Arjan Singh, the magnificent and imposing figure personifying India's air arm for over half a century, but to the many Sikh members of the IAF who have always led from the front. He recollects that after the 1965 war, not only was Arjan Singh the first Chief to be elevated to four stars, but the AOC-in-C Western Air Command was a Sikh officer, as were many other senior officers including those commanding frontline Air Force Stations and operational squadrons, creating a semi-serious appellation of this being a 'Sikh Air Force' !

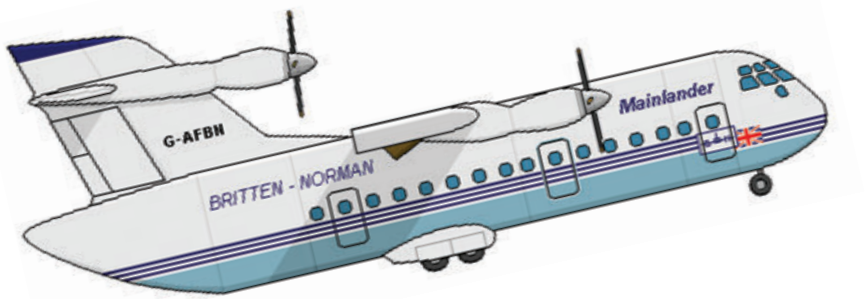
Without necessarily any community bias, it is certainly a fact that the first Indian fighter pilot (albeit with the RFC) was Hardit Singh Malik in 1917, while four of the seven IAF fighter squadrons in the Burma Campaign of 1944 were commanded by Sikhs. A quarter century later, the IAF's first (and only) Param Vir Chakra was awarded to a young Sikh pilot in the 1971 war. The present IAF Chief is also a Sikh.

The inspiration is eternal !

How short can a short flight be ?

Amidst the excitement of UDAN and the Government's brave attempt to revive regional air connectivity in India, one is sobered by geographical constraints where airlines would receive subsidies for flights connecting city-pairs, but not for those less than 150 km apart. This airline in the UK would not qualify : Logan Air, operating Britten-Norman Trilanders, flies in the Orkney archipelago, north of Britain's mainland where flights are between 53 seconds to just under two minutes. There are other examples such as in the Okinawa area of Japan, the Mediterranean and in the Congo.

Surely, the Barapani-Tura sector in Meghalaya cries out for air connectivity too ?



Cattle battle for Army

The Indian Army is in the middle of a "socially sensitive issue". With its military farms slated to be closed within the next few months, it does not know what to do with more than 25,000 head of cattle at these farms, which have existed for over a century. Most cantonments in the country have been milk-fed by military farms but now have options such as Verka and Mother Diary, etc. The Cabinet Secretary chaired a meeting to deal with the issue of allocating the cattle to the Agriculture Ministry for further use by the Animal Husbandry Department.

The White Revolution re-dux !

Red Faces

Our indefatigable aviation genius and writer Prodyut Das has commented on *Vayu*'s article on the PLAAF 'Dragon's Claws' (*Issue IV/2017*), sending a stern message : "How could you show a Chinese DH Mosquito but call it a Tu-2? Not acceptable from Vayu Aerospace !"

Knuckles ! The real aircraft type is as shown above !

Afterburner

Publications by The Society for Aerospace Studies on

Naval Aviation

On The Wings of Gold

Golden Jubilee of INS Hansa

by Pushpindar Singh

This book explores in comprehensive detail the history of the Indian Navy's largest and most active Naval Air Station, INS Hansa, at Dabolim in Goa. From the Station's beginnings as the Naval Contingent, Coimbatore in September 1961, to the move to its present day home in Goa in 1964, and right up to contemporary times, this richly illustrated book details the growth and evolution of the Station as well as all Naval Air Squadrons associated with it.

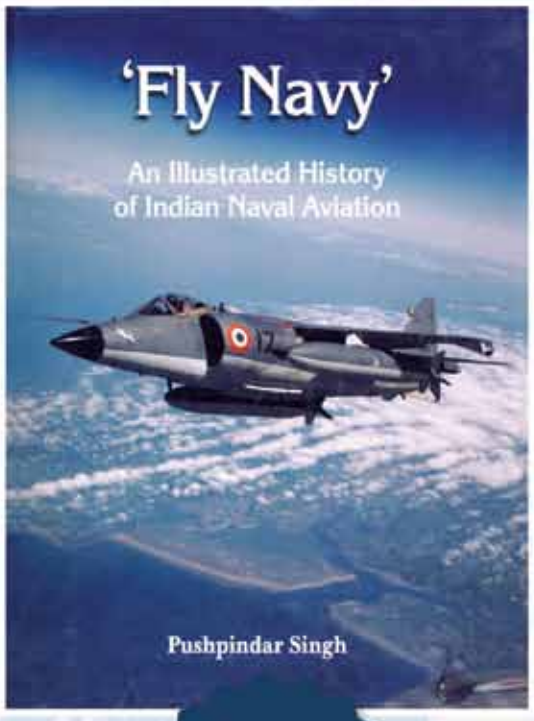
'Fly Navy'

An Illustrated History of Indian Naval Aviation

by Pushpindar Singh

The first dedicated history of Indian Naval Aviation, this book contains hundreds of rare photographs a treasure trove of painstakingly collected information on India's Naval Air Arm, making it a tremendous resource for enthusiasts and analysts alike.

In his Foreword, Admiral Arun Prakash, then Chief of the Naval Staff observed that "over half a century after the first Short Sealand amphibian flew into Cochin, marking the foundation of our Fleet Air Arm, India's naval aviation has grown to the size of a respectable air force. Even as the navy's growth as a maritime force is seen to be inextricably linked to India's renaissance as a major Indian Ocean power, aviation has progressively assumed centrality in our operational planning"



Limited Stocks !

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