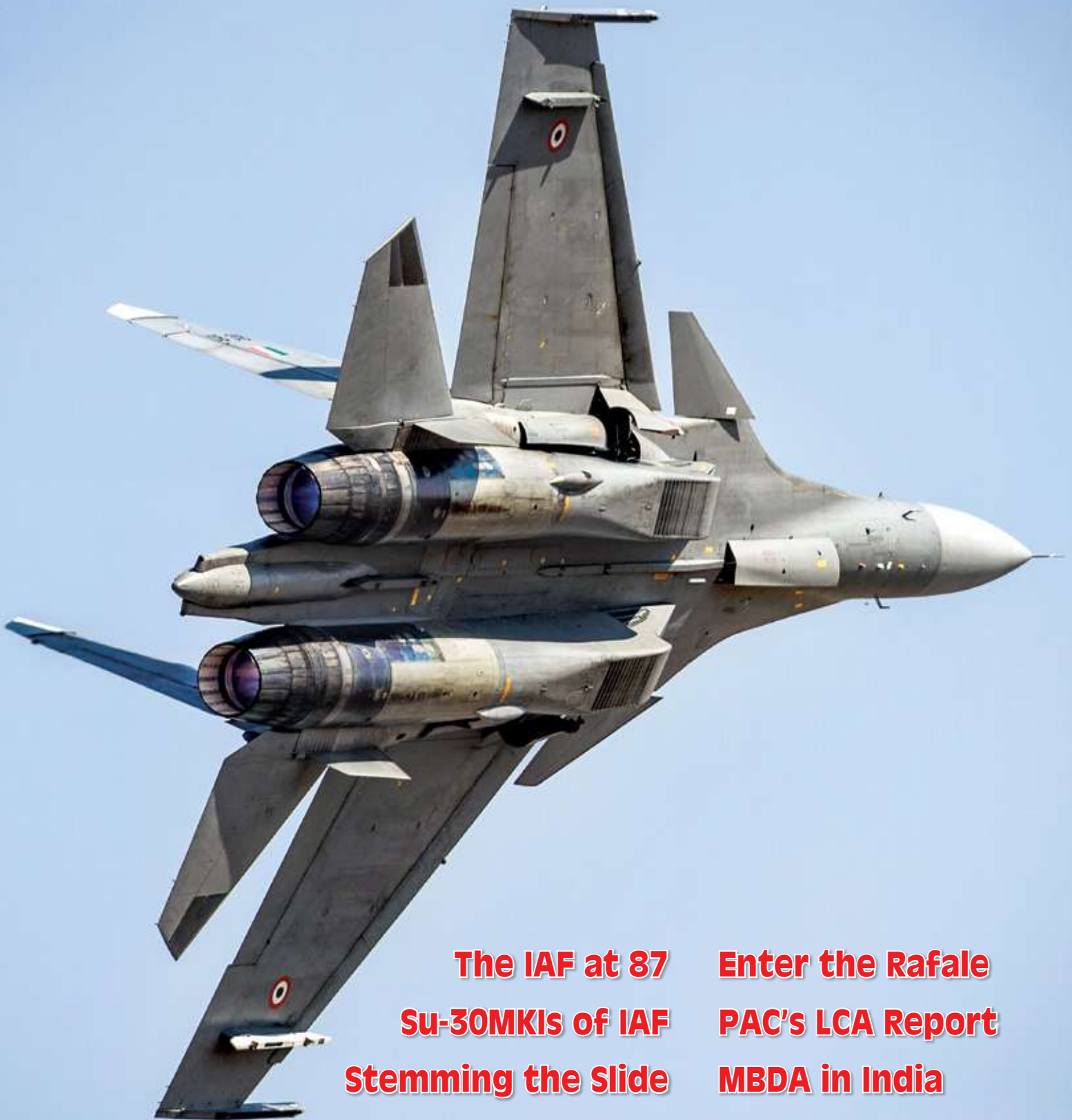


VAYU

V/2019

Aerospace & Defence Review



**The IAF at 87
Su-30MKIs of IAF
Stemming the Slide**

**Enter the Rafale
PAC's LCA Report
MBDA in India**

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Cover : Sukhoi Su-30MKI air dominance fighter of the Indian Air Force (photo by Angad Singh)

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Aerospace & Defence Review

V/2019

The IAF at 87

36 Evolving Facets of Aerospace Power

Excerpts of address by Air Chief Marshal BS Dhanoa at the *Jumbo Majumdar International Conference*, organised by the Centre for the Air Power Studies at New Delhi. The CAS reviews the various responsibilities and commitments of the IAF.

44 Stemming the Slide



Air Marshal Harish Masand on the IAF's depleted strength, "causes and remedies". In his candid article, he recalls the IAF's 'salad days' when the Force got close to achieving its sanctioned 42 combat squadron strength and then looks at subsequent knee jerk acquisitions with resulting difficulties in maintenance and availability, and the possible way forward.

57 Dominating Indian Skies



The Sukhoi Su-30MKI is arguably the most significant combat aircraft in service with the Indian Air Force extant, the Service having received near 250 of these heavy fighters over the past two decades, with more to come. Genesis and progression of this programme has been studiously recorded in Issues of this journal for two decades.

61 The IAF's diversified AAM range



As Atul Kumar writes, access to modern WVR and BVR air to air missiles are essential for any Air Force for gaining air supremacy over its adversaries during aerial engagement. He reviews current and future AAMs in IAF service.

66 The PAC's LCA Report



Professor Prodyut Das reads "in-between the lines" analysing key points brought out in the PAC's 114th Report on 'Design, Development, Manufacture and Induction of the Light Combat Aircraft (LCA)', which programme has the somewhat doubtful distinction of being the most lengthy development of any such programme in aviation history.

75 MBDA in India's Defence partnership



This on-the-spot-report by Vayu's Managing Editor takes readers through a tour of MBDA's facilities in three countries, with an overview of its

various programmes in India and partnership with both public and private enterprises. Companion articles are on MBDA's 'strong partnership' with the IAF and also on its unique AIM-132 ASRAAM as part of the Jaguar's self defence system.

85 Enter the Rafale : The IAF's next generation begins !



As this Issue goes to press, the first Rafale for the IAF (tail number RB 001) is being handed over in France on Air Force Day. The Dassault Rafale F3 variant marks further development of this multi-role combat aircraft, with priorities shifting towards both nuclear strike and conventional attack yet retaining formidable air superiority attributes, leading to classification by its manufacturer Dassault as this being an 'omni-role' aircraft.

Also: The Saab GripenE: 'an intelligent fighter system'; The F-21 "For India, From India"; Boeing's Super Hornet; R-R India and the IAF; Irkut's Aircraft; Rosoboronexport at IMDS-2019, ARMY-2019, MAKS-2019; IAI's Heron TP; GA-ASI's SeaGuardian; AI combined with Optronic Solutions; F-35: "Transformation Capabilities"; Safran: partnering Indian Aviation; Flypast on Bastille Day; Dromaders from Athens; Book Review: Idris & Bilkees Latif "The Fragrance Lingers on"; The Chief for all Reasons.

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The Russian bond

Moscow has remained New Delhi's all-weather friend before as well as after the collapse of the Soviet Union. From the enduring Indo-Soviet Treaty of Peace, Friendship and Cooperation of August 1971 to endorsing the abrogation of Article 370, Russia has thrown its weight behind India during critical situations. But the abiding relationship does not imply that India can take its old ally for granted. Russia's strategic ties with China have gone from strength to strength in recent years. The former has also not been averse to boosting defence cooperation with India's bugbear Pakistan. Considering the current geopolitical dynamics, External Affairs Minister S Jaishankar has admirably done the groundwork ahead of the upcoming Eastern Economic Forum in Vladivostok, to be attended by PM Narendra Modi.

Jaishankar, a career diplomat who served in Russia four decades ago, has observed that the two countries' ties have enjoyed stability all these years even though the world has changed considerably. Last year, India sealed a deal to acquire Russian-made S-400 surface-to-air missile systems worth about Rs 40,000 crore despite America's warning that such pacts could invite sanctions under the Countering America's Adversaries Through Sanctions Act restricting defence purchases from Russia, Iran and North Korea. In June this year, Jaishankar categorically told US Secretary of State Mike Pompeo that India would go by its national interest while dealing with other countries, including Russia. Standing up to the superpower and respecting the 'history of relationships' have undoubtedly endeared New Delhi to Moscow all over again.

India has been a major beneficiary of Russia's eagerness to share high-end defence technology, be it the leasing of nuclear-powered submarine INS Chakra or the AK-203 assault rifles set to be manufactured at a joint production facility in Amethi. Even as the military-technical collaboration is going great guns, prudence and pragmatism should be India's mantra on the diplomatic front. Expecting Russia to go out of its way to denounce Pakistan and China over the Kashmir issue is merely wishful thinking. It all boils down to striking a balance between national and bilateral interest.

From The Tribune

Fighting unfit

In another big indictment of the quality of the fighter squadrons with the air force, Air Chief Marshal BS Dhanoa has said that his MiG-21s are so old that no one even drives cars of that vintage. The air force chief's assessment reflects a suboptimal level of war preparedness. There is a severe shortage of fighter squadrons that needs to be remedied immediately if India is to meet its varied security challenges. The IAF is down to just 30 fighter squadrons which in a few years will be whittled further to 26. In comparison much smaller Pakistan will have 25 fighter squadrons by 2021.

This hardware deficit was brought home during the post Balakot air skirmishes with Pakistan earlier this year when ageing MiG-21 Bisons were deployed against Pakistani F-16s. It was in those skirmishes that Wing Commander Abhinandan's MiG was shot down by Pakistani forces after he himself downed a Pakistani F-16. If these conditions persist, victory in war will only come at huge costs. The IAF's hardware woes are due to a combination of

ageing aircraft, tardy pace of indigenisation and slow induction of foreign imports. Even the 36 Rafale jets being bought from France are yet to see delivery.

So acute is the situation that IAF earlier this year was looking to acquire 21 MiG-29 jets lying in a mothballed condition in Russia since the 1980s. And all this 'jugaad' is at a time when other forces are looking to fifth- and sixth-generation fighters. Understandably, the budget for weapons modernisation is tight. But funds can be freed up by pursuing greater integration within the forces and creating joint theatre commands. And to move along this tri-service architecture it is imperative that the post of chief of defence staff is inaugurated forthwith.

From The Times of India

Old can be gold

The government must take seriously Indian Air Force (IAF) chief BS Dhanoa's recent lament that the IAF was still flying 44-year-old MiG-21 fighter jets, a vintage far older than the cars people currently drive. With Defence Minister Rajnath Singh listening on, this was an unmissable indictment of the defence ministry's tardy procurement system, which compels the IAF to make do with just 29 squadrons of fighter aircraft, against the 42 that defence planners say the country needs. The IAF will have to manage with even fewer squadrons, because the MiG-21 fleet will retire soon, and only a handful of Rafale, Sukhoi-30MKI and Tejas Mark 1 fighters would be inducted in their place. Further, as this newspaper has reported, the IAF has decided against extending the service life of four Jaguar squadrons, which means even more fighters will become due for retirement. The defence ministry has commenced the purchase of six fighter squadrons but, going by past experience, they could take a decade and a half to come. All of this was foreseeable, but has still come to pass.

Notwithstanding the real crisis in fighter numbers, the IAF chief's complaint does not reveal the full picture, which is that combat aircraft routinely remain in service for many decades. The US Air Force, unarguably the world's most cutting edge, continues to fly several aircraft that are over half a century old. The B-52 bomber has been in service for more than 60 years, and the KC-135 Stratotanker has been refuelling American fighters for over half a century. The T-38 Talon super-sonic trainer has trained close to 60,000 US pilots over the last 50 years.

The IAF should know this, because it is procuring American combat aircraft that have crossed the half-century landmark. The CH-47 Chinook, which began entering IAF service earlier this year, has already flown in combat for 57 years. The US Air Force plans for the Chinook to remain till 2050, by when it will be 90 years old. The C-130 Hercules, which the IAF happily bought, has completed 50 years of service and will continue for another 30 years. The AH-64 Apache, which will enter IAF service next month, is not far from its golden jubilee.

There is a lesson for the IAF in how these "vintage" American aircraft remain at the cutting edge even today, even as Indian MiGs become flying jalopies much earlier. The US military works with the American defence industry in developing its own aircraft, and then incrementally upgrades them, and progressively introduces new technologies that improve combat capability, without obsessing

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about flying performance. The F-16, which is also close to its half-century age landmark, flies today much like it did in the early 1970s.

However, its current airborne radar, data links, communications and weaponry make it far superior to its initial variant. The IAF too has upgraded its MiG-21s, MiG-27s and MiG-29s, largely with Israeli avionics. However, there are limits to the extent of upgrading a foreign aircraft, whose design parameters and software source codes are not known. The answer is to introduce indigenous aircraft into service early, and continually upgrade them, keeping them combat-worthy for decades. This is the most economical way of structuring an arsenal. The Tejas light combat aircraft would be a good place for the IAF to start.

From Business Standard

A new playbook

It is not surprising that Defence Minister Rajnath Singh's comments last week that India's commitment to "no first use" of nuclear weapons is not cast in stone have elicited widespread reaction in the Subcontinent and beyond. A number of factors make the minister's statement a major departure in the evolution of India's nuclear strategy. One is the choice of place and occasion. For his statement, the minister chose the site of India's nuclear weapon tests on the death anniversary of former prime minister, Atal Bihari Vajpayee, who had declared India as a nuclear weapon power after the 1998 tests. That it comes in the middle of an unfolding political crisis with Pakistan lends greater salience to the statement.

A similar statement was made in 2016, by one of Singh's predecessors in the defence ministry — Manohar Parrikar. But the government quickly intervened to insist that there was no change in policy. This time, there has been no denial or correction. Domestic and international critics have underlined the dangers of creating a credible first use policy. They suggest that abandoning no-first-use increases the danger of using nuclear weapons, especially in military crises of the kind that have become frequent on India's borders with Pakistan and China. Others point to the demanding requirements of a first-use policy — a large inventory of nuclear weapons and missiles to deliver them, strong intelligence and reconnaissance capabilities, and a sophisticated command and control system. If no-first-use offers a simple, robust and relatively inexpensive basis for deterring atomic adversaries, the structure to support a first-use doctrine is costly and inherently unstable. Some have argued that the steady accretion of India's nuclear and related capabilities in recent years may be giving the NDA government the confidence to abandon the no-first-use policy.

The immediate motivation appears to be less technical, and more political. It is about managing India's ties with Pakistan and China following Delhi's decision to revoke the special constitutional status of J&K and the bifurcation of the state into Union Territories. Delhi is warning Pakistan and China — both of whom have nuclear weapons — that India will not be intimidated by Rawalpindi's threats to trigger violence in Kashmir and then limit India's responses with the threat of a nuclear escalation. Delhi is signalling its readiness to go to any extent, including the first use of nuclear weapons, in defending the changes it has initiated in Kashmir. This tough message is of a piece with Prime Minister Narendra Modi's decision to launch air strikes on Pakistan's territory last

February, for the first time since the 1971 war, following the terror attack in Pulwama. In reorganising the political structures of Kashmir, demonstrating that it will use conventional force against terror camps in Pakistan, and affirming that it will not accept nuclear blackmail, Modi is declaring that the old rules that constrained India in Kashmir are no longer valid. We may be in uncharted waters until there are new rules to regulate the triangular nuclear dynamic between the three nations and their contestation in Kashmir.

From The Indian Express

Chandrayaan 2

The Chandrayaan 2 mission will be classified as a partial success. The most ambitious component — a soft landing in an unknown, un-surveyed spot followed by exploration via a rover vehicle — has failed, for reasons unknown at time of writing. But the orbiter is functioning fine, and it will continue to carry out its scientific experiments.

In many respects, a soft landing on the moon is a very challenging task. Any soft landing requires the lander to gradually lose speed with respect to the moon as it comes closer to the surface. This requires tricky calculation since the moon has much lower gravity and no atmosphere to speak of.

That's only part of the challenge. Much of the moon is covered with a thick layer of dust and it's not easy to figure out how deep that dust is. A lander could sink metres under the surface. Picking a spot where there is firm ground is, in itself, quite hard.

It's even harder to do this on the uncharted "far side". The ISRO mission deliberately chose a spot not studied by earlier missions. Think of the moon as a ball, which orbits the Earth once every 27.3 days. That ball also rotates, turning around in almost exactly the same period of 27 days. This tidal locking means that it always presents the same side to an Earth-bound observer and just about 59 per cent of the moon can be observed from the Earth.

The Chandrayaan 2 mission aimed to land at the Lunar South Pole on the far side. That's an area we know very little about. This is precisely why it was chosen. The plan was for the Vikram Lander-Pragyan Rover combination to survey local rocks, study their chemical composition, and above all, look for water.

The last news before the communication link broke showed that Vikram was moving at around 50 metres/ second at 2.1 km above the surface. A successful landing as planned, would have required speed reduction to about 2 metres/ second in the final touchdown.

The first phase — "rough braking" — to reduce speed from 1680 m/s seemed to go well. But the next fine braking phase to take it down to near ground-level and cut speed to 2 m/sec is when communication broke down. The breakdown suggests that this phase didn't complete as scheduled and the lander crashed.

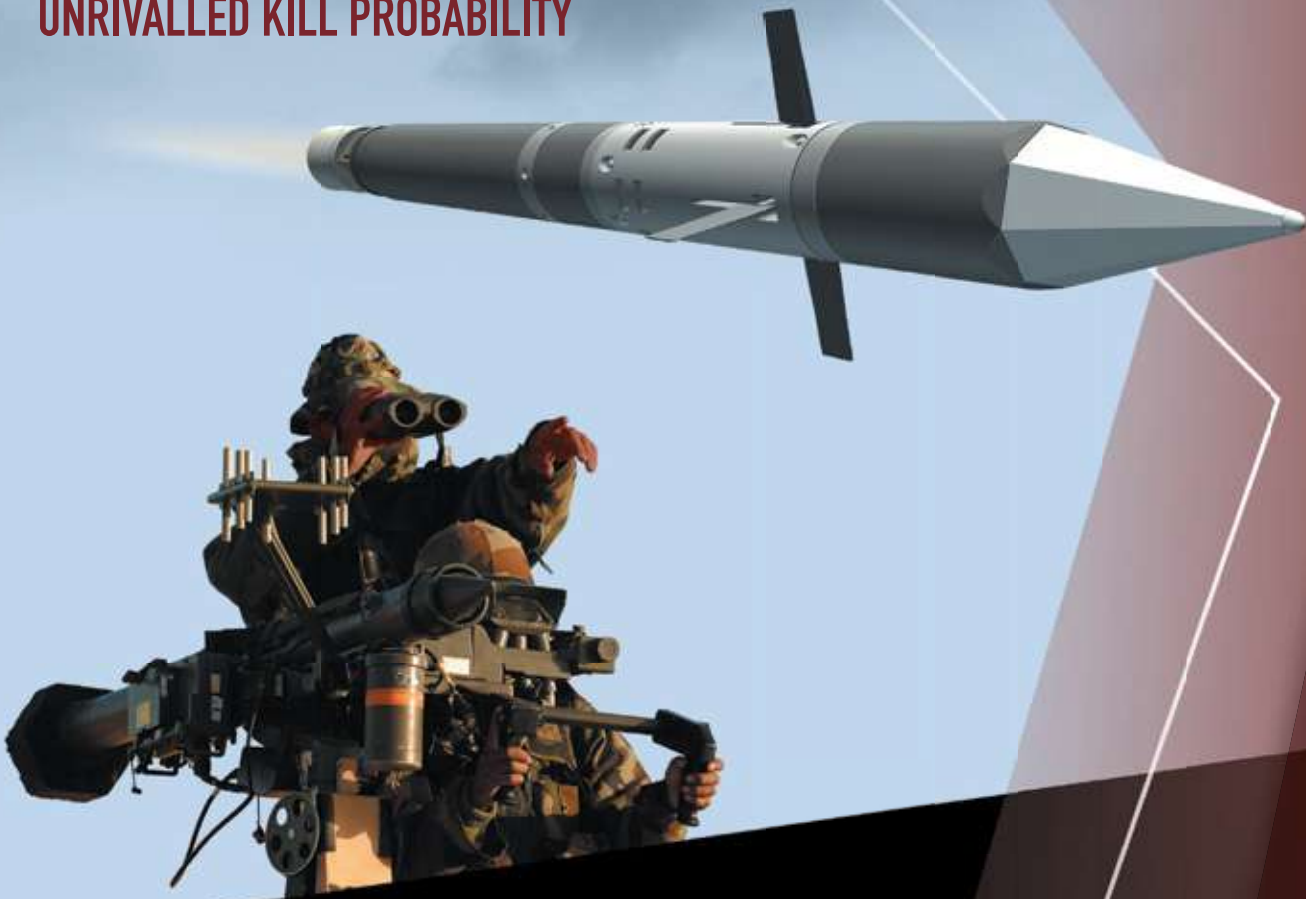
There will be a next attempt at some stage for sure, though we can't say when. Meanwhile, the orbiter continues to orbit the moon in a near-circular orbit about 100 kms above the surface. Over the next year, the orbiter will carry out the surveys and experiments it was designed for.

It's important to note that the odds were against anybody pulling off a soft landing at the first attempt. Just three nations have managed soft lunar landings and an Israeli mission failed earlier this year. ISRO should be proud of what it has achieved and this will surely aid the next mission.

From The Business Standard

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Dr Manoj Joshi on the CDS

“Huge step forward, but only the beginning”



Among the many announcements made by Prime Minister Narendra Modi in his Independence Day address on ramparts of the Red Fort in Delhi was that of the decision to appoint a Chief of Defence Staff. The PM said that the debate on reform in the defence sector, had been an ongoing one in the country involving successive governments. Many commissions have looked into the issues and their reports are more or less in agreement of the fact that while there was commendable coordination among the services, in today's technology-driven world, the nature of war is changing and we cannot afford to think in separate compartments. For greater integration and to ensure that all three Services move lock-step, he said that he was announcing the creation of the post of CDS to give the three Services “effective leadership at the top level”.

What Modi has done, in his typical style, is to cut through thirty years

of procrastination, often induced by vested interests in the armed forces, the civilian bureaucracy and the political class itself. Throughout the world, such moves have been resisted and have required the political authorities to ram them down the throat of the existing military bureaucracies, which tend to be conservative and status quo-like.

So far all we have is an announcement. In the coming period we will get a better idea of how the government plans to implement it. Hopefully, they understand that the appointment of the CDS is only the beginning of a process, not its end. It signals the government's decision to integrate the functioning of the armed forces as the PM has said clearly. But there are other issues involved as well such as the integration of the armed forces and the ministry of defence, the overhaul of the acquisition process, the creation of theatre commands and so on.

Making an appointment of a CDS is the easy part, the more difficult one is on shaping his mission and supporting him by making the necessary changes in the government's rules and regulations. All this can be well understood by going back into the history of the CDS issue.

Though there had been talks about the need for a tri-service commander earlier, the first formal move came through the 2001 Group of Ministers Report on Reforming the National Security System (GOM) which is the most extensive set of reforms in the country's history. New procedures were adopted, institutions modified and strengthened and new structures created. Indeed, all the recommendations of the GOM were accepted, yet when the report was approved by the Cabinet Committee on Security on May 11, 2001 it was decided that the recommendation with regard to the appointment of a Chief of Defence



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Staff would be considered later “after the Government is able to consult various political parties.”

The GOM envisaged that the CDS would provide “single point military advice to the government,” have administrative control over India’s Strategic Forces Command, be responsible for intra and inter-Service prioritization of acquisitions and projects and finally, ensure the required “cohesion” in the armed forces.

He would be the permanent chairman of the Chiefs of Staff Committee (COSC) with the Vice-Chief of Defence Staff (VCDS) as a Member-Secretary. For the purpose of facilitating the CDS, an Integrated Defence Staff headed by a Chief of Integrated Defence Staff (CIDS) was also created. This post was to be held by rotation among the three services.

The GOM did not seek to make him senior to the service chiefs, but they were clear that he would be “*primus inter pares*” in the COSC and function as the “Principal Military Adviser” to the Defence Minister.”

A key goal of the GOM reforms was to enhance the “uniformity” of the armed forces. The CDS/VCDS system along with the creation of a defence staff and the cross-posting of officers in the operations, intelligence and plans directorate in the service headquarters were to be the first major steps in this direction. Another step in that direction was the creation of a joint Defence Intelligence Agency, as well as the tri-Service Andaman & Nicobar Command, both of which were to come under the proposed CDS.

From the outset it became clear that the position of CDS would not get approval immediately because the NDA government wanted political consultations before making a decision. However, it later transpired that the United Progressive Alliance government was also not in favour of appointing such a person and the result was that the UPA tenure saw the position unfilled and the integration of the armed forces and planning process was severely constrained.

When it became clear that the CDS and VCDS appointments were not happening, the government created the Integrated Defence Staff in 2001 with a three star officer appointed as its chief. In the absence of a CDS, the IDS became the secretariat of the existing Chairman, COSC, a position held by the senior-most serving chief which

rotates among the three Services. As of now, it is the COSC who advises the defence minister and, through him, the Cabinet Committee on Political Affairs on all matters relating to military affairs.

The real weakness of this system is that the tenure of the Chairman COSC is limited and, furthermore, since he is also the chief of his branch of the armed forces, not only is he not seen as an impartial arbiter on inter-Services matters, but he simply lacks the time to devote himself to the significant responsibilities that came with the creation of the IDS.

In the absence of the CDS, some of proposed functions of the CDS were taken over by the Chairman COSC who, through the IDS, assumed the supervision of the tri-service Andaman & Nicobar Command, the integrated planning and the supervision of the DIA. In recognition of the importance of the IDS, its chief, though a three star officer, was given the status of a non-voting member of the COSC.

In 2012, the Task Force on National Security headed by Naresh Chandra revisited the issue and in view of the resistance towards the CDS, sought to find a way by re-labeling the position as the Permanent Chairman of the Chiefs of Staff Committee (COSC). This would provide a fourth four-star officer to the COSC, but who would be *primus inter pares* among the chiefs of staff of the three services. He would be assisted by a 3-star chief of staff heading the Integrated Defence Staff (IDS) which already existed.


The permanent chairman COSC would: a) coordinate and prioritise the 15 year Long Term Integrated Perspective Plan (LTIPP), the Annual Acquisition Plan, b) administer the tri-service institutions and agencies c) exercise command over the Andaman & Nicobar Command, the Special Operations Forces and forces involved in out of area contingencies d) have administrative control over the Strategic Forces Command e) plan and conduct joint service exercises which could be used to prove a future theatre command concept f) encourage the creation of integrated logistics, training and administrative mechanisms involving all three services g) be the source of coordinated advice on matters relating to two or more service h) prepare an annual defence status report which would lay out the readiness posture of the services.

Aware of the pitfalls of the earlier committees, the Naresh Chandra Committee also strongly recommended that the duties and responsibilities of the PCOSC be written into the government of India’s rules relating to the allocation and transaction of business. These rules define the Secretary of the Ministry of Defence as being “responsible for the proper transaction of business” related to the Ministry. They are silent on the role of any uniformed officer.

In beginning of the reform of the higher defence management of the country, there is need for a wider shift of the paradigm. A great deal of resistance to the idea of a CDS had come from the political class who in the words of Steven I Wilkinson, had structured India’s higher command “to minimize the risk of military intervention in the country’s politics.” Indeed, the UPA’s hesitation in appointing a CDS came from Sonia Gandhi herself, who felt that this could endanger democracy.

Actually, when theatre commands are set up, their commanders will be the one with operational forces. Neither the CDS, nor the Service Chiefs will have direct command over them. The former will be involved as a link between the political masters and the theatre commanders, while the latter will merely be in-charge of provisioning their respective forces and training them.

After the disaster of 1962, the political class went to an extreme and left the operational issues to the armed forces and relied on the non-expert bureaucracy to exercise supervision over them. But war today involves an overlap of nuclear, conventional, sub-conventional war with law fare, cyberwar, spywar and info war.

The space between the strategic and operational have been squeezed, as is evident from the fact that an attack on the Golden Temple in 1984 had nation-wide consequences. In short, politicians need to be more, rather than less, involved in military issues and be so at all levels, strategic, operational and tactical. Furthermore, they need more sophisticated advisers, both civilian and uniformed. So far, politicians have tended to rely on non-expert civilians to supervise the military personnel and have excluded military personnel from playing a role at the strategic level. The appointment of a CDS and its attendant reforms should ring in change in this state of affairs. 

Air Marshal Brijesh Jayal urges for “A military power working in unison”

Observing that the scope and nature of warfare were changing, in view of which the military power will have to work in unison, and to address changes that experts have long been advocating, Prime Minister Narendra Modi recently announced his government's decision to create the post of Chief of Defence Staff (CDS). A recall of recent history will, perhaps, indicate why I believe that the PM's call for 'military power working in unison', whilst laudable, is unlikely to be achieved merely by the addition of the CDS post. The Kargil Review Committee (KRC) had highlighted various shortcomings in the security system, recommending a complete review. In pursuance, a GoM (Group of Ministers) formed four task forces, of which the one on Management of Defence was led by Arun Singh, former Union Minister of State for Defence and a keen student of military affairs. Recommendations of these task forces were reviewed by the GoM, whose report was released in 2001.

The core weaknesses in our higher defence management system are in two areas. One, linkage between the Ministry of Defence (MoD) and the services' headquarters and the other, of jointmanship and integration amongst the services. These are central to where in governance the nation wishes to place its armed forces and what authority it is willing to endow upon them, apart from the traditional gun-fodder role for which there are no competitors any way.

In respect of the former, the KRC had noted: "India is perhaps the only major democracy where the armed forces' headquarters are outside the apex governmental structure. The chiefs of staff have assumed the role of operational commanders of their respective forces rather than chiefs of staff to the Prime Minister and Defence Minister."

Both the KRC and the Arun Singh task force had, hence, recommended the integration of services' HQ with the MoD. The GoM, however, did not favour this approach where both civil and uniformed personnel could work side by side, contributing to jointness in

policy formulation. Instead, it suggested a cosmetic change of nomenclature of service headquarters from 'attached offices' to 'integrated headquarters'.

Further, by emphasising that there will be no dilution in the role of the defence secretary as the principal defence adviser to the defence minister on all policy matters, the GoM ensured that genuine integration within the MoD remained a mirage. Ironically, the KRC's caution that "political, bureaucratic, military and intelligence establishments appear to have developed a vested interest in the status quo" had prevailed.

No justification had then been put forth to indicate why physically integrating the services' HQ with the MoD was not considered viable, a model that works perfectly well in Western democracies. One can only guess that the political executive preferred to deal with the uniformed fraternity through a bureaucratic cushion and the civil bureaucracy feared dilution in its authority by working alongside the uniformed. A sad commentary on our governance mindset in an age of 'revolution in military affairs' where, as the PM observed, "both the scope and nature of warfare were changing."

On jointmanship and integration within the services, the CDS, as proposed by the GoM, was to be the principal military adviser to the defence minister, provide single-point military advice to the government and exercise administrative control, as distinct from operational military control, over the strategic forces.


Further, he was expected to promote efficiency in planning, budget and equipment prioritisation and so on without in any way being accountable for the impact of his decisions on the operational potential of the services. This dichotomy stemmed from the fact that operations would have continued to remain the responsibility of the respective service. With one more layer of bureaucracy being added, albeit in uniform, not all were enthusiastic.

There is a recent view that since an integrated HQ now already exists, all that is needed is a CDS to head this. This shows a superficial understanding of jointmanship in

the complex arena of individual service ethos, training and war-fighting.

In the US, where also lack of jointmanship was acutely felt, the concept of joint chief of staff had to be mandated through the Goldwater-Nicholas Act in 1986. Mindful of single-service ethos challenges, the Act also formalised the concept of professional military education (PME) and mandated the strengthening of focus on joint matters in courses of instruction offered by PME schools and the maintenance of rigorous standards for the education of joint specialty officers. It is pertinent that for an officer to be posted in the JCS in the US, he/she must have undergone some of these PME courses.

The concepts of integrating services' headquarters with the MoD and designating a chief of defence staff along with its associated joint staff cannot be considered mutually exclusive. Indeed, together they constitute national military power. In a model generally followed by other democracies and in keeping with the principle of designating authority with associated accountability, the chiefs, as part of the MoD, are expected to concentrate on managing their service with regard to budgeting, future planning, recruitment, training, operational readiness, while shedding the actual operations to the CDS who can then focus on joint fighting and operational prioritisation. By shying away from the concept of integrating the services' headquarters with the MoD and focusing merely on the CDS, we do no justice to the PM's vision of military power working in unison. It is this mindset that has cost the nation a model of higher defence management that best suits our national security needs.

Now that the PM has flagged a vision for military power working in unison, he may consider the setting up of a Blue Ribbon Panel to look at the entire issue of civil-military relations and arrive at an organisational and higher defence management model that can best achieve this vision, in keeping with the national ethos and genius. This can form the basis of a blueprint for a potential National Defence Act for the nation and Parliament to debate and adopt. 

Handover of first IAF Rafale



The first Rafale for the Indian Air Force (RB001) was 'technically accepted' at Dassault's manufacturing facility at Bordeaux-Mérignac in France on 20 September 2019, by Air Marshal VR Chaudhari, Deputy Chief of the Air Staff who thereafter flew in the aircraft for an hour. The formal handover ceremony is slated for 8 October 2019, Air Force Day, reportedly in the presence of Defence Minister Rajnath Singh. The aircraft had made its maiden flight on 17 July 2019 and is earmarked for No.17 Squadron *Golden Arrows* to be based at Air Force Station Ambala (*see following item*).

17 Squadron resurrected



On 10 September 2019, the 'Resurrection' ceremony for 17 Squadron, Indian Air Force took place at Air Force Station Ambala. Air Chief Marshal Birender Singh Dhanoa, CAS was present along with Air Marshal Raghunath Nambiar, AOC-in-C Western Air Command at the ceremony where the CO designate, Group Captain Harkirat Singh SC was presented the plaque, along with Air Commodore D Joshi, AOC Ambala.

No.17 Squadron was formed at Ambala on 1 October 1951, under command of Flt Lt DL Springett and equipped with Harvard IIBs, converting in 1955 to Vampire FB Mk.52s and to Hawker Hunter FGA Mk.9s in 1957, and then MiG-21Ms in 1975, the type with which it remained till number plating. No.17 Squadron is the first IAF formation with the Rafale new generation multi-role combat aircraft.

11th Boeing C-17 Globemaster III for IAF



Boeing delivered the 11th C-17 Globemaster III for the IAF on 26 August, 2019, joining the earlier 10 aircraft serving with No.81 Squadron (*Skylords*). A USAF spokesman said that "it's an increase in strategic airlift for the Indian Air Force, it strengthens the partnership between our two nations and increases the interoperability of our militaries so we can assist each other on humanitarian and defence issues". The IAF had lately deployed several C-17 Globemaster-III strategic airlift aircraft to transport paramilitary forces to J&K from different parts of the country in late July 2019. "The C-17s are ferrying CAPF for counter-terrorism, crowd-control and law and order duties" according to an official statement.

Additional Su-30MKIs for IAF



Russia's Federal Service for Military-Technical Cooperation has confirmed, what was earlier speculated, that the Indian Government plans to acquire another 18 Su-30MKI multi-role fighters. These would add to the 272 aircraft already in service or under production at HAL in Nasik. This batch would be delivered in CKD condition for final assembly and delivery to the Indian Air Force.

IAF C-17 Sustainment Follow-on Support

The US State Department has made a determination approving a possible Foreign Military Sale to India of C-17 sustainment follow-on support for an estimated cost of \$670 million. "The Government of India had requested to buy equipment for C-17 follow-on support, to include spares and repair parts; support equipment; personnel training and training equipment; publications and technical documentation; support and test equipment; US Government and contractor engineering, technical and logistical support services; and other related elements of logistics and programme support."

Upgrade of Su-30MKI



The fleet of IAF Sukhoi Su-30MKIs are to be upgraded to 'Super Sukhoi' standards, a total of 272 aircraft being received or on order for the Indian Air Force. This programme has long been discussed and involves major upgradation of the Type's avionics, self defence systems and weaponry. HAL Nasik Division will be primarily responsible for the upgrade programme and could well offer its expertise to foreign air forces flying the Sukhoi Su-30. "There is a market outside. We are already the only ones doing overhauls for this aircraft and once we conduct the upgrade, we can offer this for export to as well," stated HAL Chairman R Madhavan.

Apaches inducted

On 3 September 2019, the Indian Air Force officially inducted the first 8 AH-64E Apache attack helicopters at Air Force Station Pathankot, with a total of 22 on order (plus six for the Army Aviation Corps). Air Chief Marshal BS Dhanoa was chief



guest at the ceremony accompanied by AOC-in-C Western Air Command Air Marshal R Nambiar. "It is a ceremonial induction of the aircraft into IAF... the Apache brings in lethal firepower with great accuracy." (See article in this Issue).

LCA (Navy) makes successful arrested landing



On 13 September, the first arrested landing of LCA (Navy) at the shore-based test facility at INS Hansa Goa took place which will now pave the way for the platform to undertake aircraft carrier landing demonstration on board INS Vikramaditya. After several years of flight testing and four campaigns of dedicated testing at the Shore Based Test facility, the LCA (Navy) Flight Test Team led by Cmde J A Maolankar (Chief Test Pilot), Capt Shivnath Dahiya (LSO) and Cdr J D Raturi (Test Director) successfully executed this text book arrested landing.

More AEW&C aircraft, BVR missiles from Israel



On the agenda during Israel Prime Minister Benjamin Netanyahu's planned visit to India, was acquisition of two more Airborne Early Warning and Control Systems (AEW&C) and Derby BVR missiles for the Indian Air Force, besides joint projects in agriculture, water and waste management. Earlier, Israel's National Security Adviser Meir Ben-Shabbat had visited India and met his Indian counterpart Ajit Doval. There has been speculation that India is set to conclude a follow-on order for 15 more Harop attack drones for the IAF from Israel Aerospace Industries.

MR-SAMs for IAF

Defence Minister Rajnath Singh presented the first medium range surface-to-air-missile (MRSAM), built by Bharat Dynamics Limited (BDL) in collaboration with Israel, to the Indian Air Force on 3 August 2019. In Hyderabad to attend BDL's golden jubilee celebrations, he handed over the MRSAM on behalf of BDL Chairman and Managing Director, Commodore Siddharth Mishra, to the IAF's VCAS.

Quick Reaction SAMs tested



On 4 August 2019, the Defence Research Development Organisation successfully test-fired an indigenously developed Quick Reaction Surface-to-Air Missile (QRSAM) from the Integrated Test Range (ITR) in Chandipur. Two missiles have been tested against two live targets "meeting complete mission objectives of engaging the targets". The systems have been tested in final configuration with radar mounted on a vehicle and missiles on the launcher. The QRSAM uses solid-fuel propellant and has a range of 25-30 km.

DRDO conducts five trials of AAM Astra

DRDO has successfully flight tested the Astra Beyond Visual Range Air-to-Air Missile (BVRAAM) from a Su-30MKI platform off the coast of Chandipur, Odisha. The trials were held from 16-19 September 2019, conducted by the Indian Air



Force against a Banshee target aircraft simulating various threat scenarios. The five trials conducted during this period tested missiles in different configurations, three missiles launched in combat configuration with warhead and manoeuvring targets to establish the end game capability of the missile. The trial campaign also included a direct hit by the telemetered missile at maximum range. All the subsystems performed accurately meeting all the mission parameters and objectives. The Astra BVRAAM has range of more than 100 kms with modern guidance and navigation techniques, with midcourse guidance and RF seeker based terminal guidance.

Orders for Russian-origin AAMs



According to reports from Russia's Federal Service for Military and Technical Cooperation, the Government of India is to procure over 1,000 new air-to-air missiles for the Indian Air Force fighter fleet comprising MiG-21Bisons, MiG-29UPGs and Su-30MKIs. Numbers given are 300 each of both the R-27 (*AA-10 Alamo*) infrared-guided or semi-active radar-guided, medium-to-long-range missiles and 300 R-73E (*AA-11 Archer*) IR-guided, short-range missiles. The balance of the order valued at some \$700 million, is for 400 R-77 (*AA-12 Adder*) active radar-guided, medium-range missiles.

Additional Akash SAMs for IAF

On 13 September 2019, PSU Bharat Electronics Limited (BEL) formalised a contract with the Ministry of Defence, for supply of seven additional squadrons of Akash Missiles for the Indian Air Force. This is a turnkey contract with specialist infrastructure, the total value being Rs.5,357 crore with delivery to be completed in three years.



Modernisation of systems on Delhi-class warships

The contract for modernisation of “Air Defence Complex Kashmir and Radar Fregat MAE” on P-15 (Delhi-class) warships was signed between the Ministry of Defence, and JSC Rosoboronexport, Russian Federation on 12 September. The modernisation of radar and missile systems would substantially enhance the air defence capability of the P-15 ships and as part of the scope of work under modernisation, major overhaul and refurbishment of sub-systems is to be undertaken in India. “In addition, manufacturing of critical hardware would be undertaken in partnership with the Indian industry.”

“IAF still flying 44-year old MiG-21s”



During his address at a recent Seminar in New Delhi, IAF Chief BS Dhanoa remarked that the Service “is still flying aircraft that are over four decades old when no one even drives cars of that vintage”. Air Chief Marshal Dhanoa was referring to the MiG-21 fighter that was inducted into the force in 1973-74. “Fifth-generation fighters are a reality today and next generation fighters are already on the drawing board. We cannot wait for indigenous technology to replace obsolete war fighting equipment. I still fly the MiG-21MF aircraft which is almost 44 years old. I’m sure none of you are driving a car of that vintage,” he observed.

IAF awards for 26/27 February actions

Included in the Presidential Awards announced on 15 August 2019 were a Vir Chakra for Wg Cdr Abhinandan Varthaman, five Yudh Sewa Medals and seven Vayu Sena Medals (Gallantry). While that for Wg Cdr Abhinandan is linked to the aerial action on 27 February when flying a MiG-21bis of No.51 Squadron, the other awards are reportedly for the Mirage 2000 pilots (and supporting officers) who carried out the PGM strikes on Balakot on 26 February. Sqn Ldr Minty Aggarwal was fighter controller during the 27 February air skirmishes.

Meanwhile, on the other side, Pakistan has awarded the Sitar-e-Jurat to Wg Cdr M Nouman Ali and Tamgha-e-Shujaat to Sqn Ldr Hassan Siddiqui, for their operations on 27 February.

Rajnath Singh flies in Tejas LCA



Defence Minister of India Mr Rajnath Singh was given a demonstration flight in a trainer version of the Tejas light combat aircraft on 19 September 2019. Air Vice Marshal Narmadeshwar Tiwari, Director NFTC was at the controls during the 30-minute flight over Bangalore which the Defence Minister later described as “thrilling and special”. Later that day, the Minister addressed personnel of the DRDO at the Centre for Airborne Systems (CABS). Asked why he chose to fly in the LCA (and not the Su-30MKI as did his predecessor Nirmala Sitharaman), Mr Rajnath Singh said “because it is indigenously developed”.

MoD for ‘Corporatisation’ of Ordnance Factories

The Ministry of Defence plans to get Cabinet Committee on Security (CCS) clearance to set up an Empowered Group of Ministers (EGoM) to convert 41 Ordnance Factories and 16 other associated organisations into Corporates “to make them competitive and self-reliant in the production of arms and ammunition”. Once so, the Indian Ordnance Factories will no longer be “attached offices” under the Department of Defence and instead become Private Limited companies with management control by the government. To address employee concerns, the MoD proposes to safeguard wages and retirement benefits of some 1.45 lakh employees, including 1,752 Group A officers of the Indian Ordnance Factory Services, working in 41 factories, nine training institutes, three regional marketing centres and four regional controllers of safety.

The NDA government is optimistic that with such transformation, dependence on imported arms would come down sharply from the current 75-80% in less than a decade and instead, the new entities would export 24% of their products. The EGoM will be headed by Defence Minister Rajnath Singh and includes Home Minister Amit Shah, Finance Minister Nirmala Sitharaman, Law and Justice Minister Ravi Shankar Prasad, Labour and Employment Minister Santosh Gangwar and the Minister of State for Personnel, Public Grievances and Pensions Jitendra Singh, as its members.

MoD to “simplify acquisitions”



Defence Minister Rajnath Singh has reportedly been examining options to address the Ministry of Defence’s “notoriously lethargic acquisition process and the stalled *Make in India* initiative for the defence sector”. Mr Singh has announced setting up of a Committee headed by Director General (Acquisition) Apurva Chandra to review the DPP 2016 and Defence Procurement Manual (DPM) 2009, the terms of reference for the 11-member high level Committee being “to remove procedural bottlenecks and hasten defence acquisition, align and standardise provisions of the DPP and the DPM and include new concepts like life cycle support for equipment, simplify policy and procedures to facilitate participation of Indian industry and incorporate new concepts like life-cycle support, performance-based logistics, ICT, lease contracting and include provisions to promote Indian start-ups and R&D”.

According to reliable sources, major thrust areas for the Committee will be to enhance private sector participation and level the playing field with the public sector, as also linking the *Armed Forces Long Term Integrated Perspective Plan* with the DPP and DPM.

Defence Minister’s visit to Japan, Korea

With the reported objective of getting Japanese and South Korean companies to invest in India’s defence equipment manufacturing sector, Defence Minister Rajnath Singh was on a five-day visit to these two eastern countries in early September, these countries having deep strategic and economic ties with India and

“are open to investment”. South Korean company Hanwha Techwin has already partnered with L&T to produce Vajra K9 self-propelled artillery guns, now being inducted in the Indian Army. Cooperation in defence technology (co-development and co-production) is one of the targets of the ‘India-Japan Vision 2025’.

An India-Japan Defence Forum was instituted in 2017 and



the two sides agreed upon cooperative research in the area of Unmanned Ground Vehicle (UGV), or Robotics, while there have been continued negotiations concerning the US-2i amphibian aircraft, manufactured by ShinMaywa Industries. From South Korea, Hyundai and Korea Aerospace Industries, among others, have shown interest in offering KT-1 basic training aircraft and utility helicopters to the IAF.

India-UAE “to strengthen strategic ties”



Prime Minister Narendra Modi visited Abu Dhabi on 23 August 2019 and met with Abu Dhabi Crown Prince Sheikh Mohammed bin Zayed Al Nahyan “to strengthen strategic ties”. According to reports, “there is a significant convergence of views on strategic issues including both the political and security dimensions, with shared stance against radicalisation and violent extremism, which has led to exceptional cooperation on the security side”. While the visit was highlighted by Indian Prime Minister receiving the *Order of Zayed*, the highest civilian decoration conferred by the UAE government, there were opportunities to discuss various bilateral and strategic issues.



India and US review defence, security, key policy issues

In August 2019, senior Indian and US officials carried out a comprehensive review of defence, security and key foreign policy issues under the framework of the “2+2 Dialogue”, the meeting taking place in Monterey, California. “The two sides reviewed the progress and development of bilateral relations across defence, security and foreign policy areas since the inaugural 2+2 ministerial meeting of September 2018, and explored further possibilities of cooperation in these fields based on common interest. They also discussed regional developments, and agreed to pursue their quest for a free, open, inclusive, peaceful and prosperous Indo-Pacific. The two sides agreed to carry forward these discussions”. This is to be followed by the ministerial meeting between external affairs minister S Jaishankar and his American counterpart Michael Pompeo later this year.



Meanwhile, the Defence Policy Group (DPG) has been revived after a gap of four years to take up discussions on the *Basic Exchange and Cooperation Agreement* (BECA), being one of the three foundational military agreements. The Government of India is presently engaged in discussions to acquire Predator UAVs made by General Atomics, and has separately signed two other military agreements called the *Communications Compatibility and Security Agreement* (COMCASA) and *Logistics Exchange Memorandum of Agreement* (LEMOA), the latter enabling India to use US facilities for refuelling, increasingly required for Indian warships sailing to the Far East.

PM Modi visits Bhutan

Prime Minister Narendra Modi made a two-day state visit to Bhutan in mid-August 2019, flying to Paro in an IAF B-737, to hold talks with the country’s leaders to further deepen existing bilateral ties. During his visit, the two countries inked 10 MoUs in the fields of space research, aviation, IT, power



and education. Mr Modi also called on Bhutanese King Jigme Khesar Namgyel Wangchuck and exchanged views on taking the “exemplary” India-Bhutan partnership forward”.

India’s “Grave Concern to US over Military Assistance to Pakistan”



On 2 August 2019, the Government of India conveyed its “grave concern” to the United States over its decision to provide military assistance to Pakistan. This follows the Pentagon’s notification to US Congress to approve military sales worth \$125 million for “monitoring of the F-16 fighters of Pakistan”. The notification came days after a meeting between President Donald Trump and Pakistan Prime Minister Imran Khan at the White House. However, according to India’s External Affairs, “the proposed sale does not indicate any change in the US policy of maintaining a freeze in military assistance to Pakistan ... the US has publicly stated that the proposed sale is intended to enable the US to continue technical and logistics support services to assist in the oversight of the operations of F-16 aircraft in Pakistan’s inventory.”

DRDO successfully tests MPATGM

Defence Research and Development Organisation has successfully flight tested the indigenously developed low weight, fire and forget Man Portable Antitank Guided Missile (MPATGM) at the ranges of Kurnool in Andhra Pradesh. The missile was launched from a man portable tripod launcher with the target simulating a functional tank. The missile hit the target in top attack mode and destroyed it “with precision”. All the mission objectives were met. This is the third series of successful testing of MPATGM, the missile incorporated with an Infrared Imaging Seeker along with advanced avionics.

Smiths Detection's new Centre in India

Smiths Detection has announced the opening of its state-of-the-art service, training and experience centre in Gurugram. With an investment of \$1.5million, the facility is first in the region and features a training centre, a rework depot, a customer call centre, a parts warehouse and a customer experience laboratory. The 11,000 square feet facility will “boost Smiths Detection’s support to its customers across airports, ports and borders, hospitality industries, critical infrastructure, logistics providers and e-commerce platforms in countries throughout Asia Pacific and the Middle East”. The facility will provide technical training on Smiths Detection’s Computed Tomography X-ray (CTX) systems, Conventional X-ray Screening systems (CXS), Explosives Trace Detection (ETD), metal detectors and networking solutions.

Cyient and QinetiQ in MoU

Cyient has signed a Memorandum of Understanding with UK-based defence technology firm, QinetiQ’s Target Systems (QTS), to offer avionics products for its unmanned target systems. Cyient will provide advanced manufacturing and electronics engineering solutions for QTS’ range of unmanned air, land, and sea target systems from its facilities in India.

DRAL and ITI Nagpur in agreement

Dassault Aviation has signed an agreement with ITI Nagpur in July 2019 for starting an Aeronautical Structure and Equipment Fitter course at the institute, for assembly of aerostructures, cockpit fitting, wings and body structure at the Dassault Reliance Aerospace Limited (DRAL) facility at Nagpur. The Dassault Reliance Aerospace Limited (DRAL) is joint venture between Dassault Aviation and the Reliance Group with its facility at MIHAN (Multi-modal International Cargo Hub and Airport at Nagpur). Students



of the Industrial Training Institute (ITI) at Nagpur will be trained on aspects of assembling Dassault Rafale and Falcon aircraft parts.

CAG to table Rafale offsets report in Parliament

The Comptroller and Auditor General (CAG) has reportedly completed audit of the ‘offset deal’ part of the Rafale fighter contract with France and is likely to table its report in the winter session of Parliament. The report contains audit of at least 32 offset contracts of the three defence services between 2012-13 and 2017-18. The CAG report on the Rafale deal was tabled in Parliament in February 2019, the auditor having then avoided mixing it with offset deals which include purchases for the Army, IAF and Navy.

MBDA Mistral on ALH Mk.4 Rudra



The purchase of 450 Mistral missiles worth around Rs 3,000 crore for the HAL ALH Mk.4 (Rudra) have so far reportedly been delayed over the price of storage shelters, located at 11 forward bases across the country, now subsequently reduced to five locations. The MoD negotiating team is believed to be close to getting approval from the defence minister to revise the benchmark price and so in the deadlock.

LCH sea level trials with IRSS



Systems performance trials of HAL's Light Combat Helicopter (LCH) integrated with an Infra Red Suppression System (IRSS) began in November 2017, with certain modifications made for improved air flow. To assess the helicopter performance and handling qualities, LCH TD-4, installed with IRSS and improved cowlings was subjected to sea level trials at Puducherry during 9-13 July 2019. "Helicopter performance, loads, handling qualities and engine bay temperatures were found satisfactory". Flight trials with LCH TD-4 were carried out by Gp Capt SHK Nair, DCTP (RW), Air Cmde. SA Kunte, DCTP (RW), Col. RS Chitale, FTE (RW) and Sqn Ldr PN Joshi.

LUH in high altitude trials



The HAL Light Utility Helicopter (LUH) has successfully completed high altitude trials in hot and high conditions in the Himalayas, the trials carried out by test pilots from HAL, the IAF and Army in late August. "A comprehensive test plan was executed at Leh (3300m) in temperatures upto ISA + 32°C which included envelope expansion, performance and flying qualities. The LUH then lifted off from Leh and demonstrated its hot and high hover performance at Daulat Beg Oldie (DBO) at 5000m followed by another forward helipad (5500m at ISA +27°C). While these extreme weather conditions imposed flight restrictions on all other civil and military aircraft, the LUH is actually designed for such extreme operations".

The test flights were conducted by an HAL flight test team led by Wg Cdr Unni Pillai, CTP (RW) and accompanied by Wg Cdr Anil Bhambani, Gp Capt Pupinder Singh, Gp Capt V Panwar, Wg Cdr A Jena, plus representatives from the Air Force and Indian Army. The LUH had earlier completed hot weather trials at Nagpur in 2018, cold weather trials at Leh in 2019, sea level trials at Chennai in 2018 and at Puducherry in 2019.

HAL's IMRH project proceeds



First publically revealed as a full-scale mock-up at Aero India 2017, development of HAL's Multi Role Helicopter (IMRH) has been given formal go ahead. Essentially to be developed for replacement of the large fleet of Mi-8/17 Russian-origin helicopters currently in service with the IAF, the 12-tonne multi-role helicopter will be employed for tactical troop transport (24 seats), carriage of high value stores, off shore operations and as a VVIP transport. The twin-engined helicopter will also have a dedicated Naval variant.

Government to divest from Air India

The government wants to fully exit from Air India as it embarks on another effort aimed at divesting the loss-laden carrier after a plan to sell a 76% stake failed last year.



Aviation Minister Hardeep Singh Puri is clear that, "I believe the government should not be in the business of running airlines... and believe the government should completely exit Air India.... there are many who are very interested in the airline and the one who gets the airline will be very fortunate." According to the Minister "details are being finalised and the committee headed by the cabinet secretary

will look into this first and then the alternative mechanism will clear it the so-called alternative mechanism, a panel headed by home minister Amit Shah, will meet soon to finalise". Air India has debt remaining of about Rs 31,000 crore after the government took over Rs 29,000 crore off its books, thus reducing the airline's interest burden.

Domestic air traffic in double-digit growth

Despite the dismal collapse of Jet Airways earlier in the year, and domestic air traffic slowing down, the domestic aviation industry has steadily revived, with airlines flying more than 70 million passengers between January and June 2019, a 3 per cent growth over last year. Airline executives and analysts are optimistic and expect domestic air traffic to return to double digit growth in the next few months.

Air India's Delhi-San Francisco flight over North Pole



Marking a new aviation milestone, Air India recently inaugurated its scheduled flight from Delhi to San Francisco, flying over the North Pole region on 15 August. This first commercial service was operated by Captains Ranjeesh Sharma and Digvijay Singh, "with another frontier crossed", observed Air India Western Region Director Mukesh Bhatia.

SpiceJet awaits 737MAX operations

SpiceJet has posted its highest profit at Rs 261.7 crore in the April to June 2019 quarter, including a compensation of Rs 114.1 crore from Boeing for grounding of 13 737MAX aircraft. Chief Financial Officer Kiran Koteswar has, however, said that the company is to receive a higher compensation but had accounted only for Rs 140 crore as it was certain about getting that amount as lease rental payment to lessors. "This is a compensation which is a no brainer, is already sitting on my books. As a listed entity, I did not give any guidance to my investors for compensations on the other items which I am still not certain of".



Boeing had earlier disclosed that \$4.9 billion was earmarked as payment including compensation to airlines for the grounding and delayed deliveries of 737MAX aircraft.

Vistara services to Europe, Australia in 2020

Vistara, the joint venture airline between Tata Sons Ltd and Singapore Airlines, plans to launch long-haul international flights to destinations in Europe and Australia in 2020. According to its chief executive, Leslie Thng "we look at our independent network in India as a very big source market. Every destination we fly, we look for a partner. SIA (Singapore Airlines) is a natural partner for South-East Asia and Australia, and have plans to eventually fly to Australia on our own. We are also working on vice-versa codeshare with British Airways (for Europe)".



Vistara began its international operations on the Delhi to Singapore route, followed by Mumbai-Singapore and Mumbai-Dubai operations and Delhi-Bangkok flights from late August.

In July 2018, Vistara had ordered 19 airliners from Airbus and Boeing, earmarking the B787 (Dreamliner) for long-haul international routes, Airbus A321 on medium-haul routes plus Airbus A320s on short-haul international routes. These aircraft will be acquired through a mix of direct orders, leases and options.

IndiGo evaluating wide-bodied airliners



IndiGo is reportedly also evaluating wide-bodied airliners in plans to launch services to international destinations including London, this coming at the time when a void has been created by the grounding of Jet Airways. As IndiGo CEO Ronojoy Dutta stated “clearly, at this point we are range limited. (Airbus 321) XLR is a great plane, we think, but that plane cannot reach London, can take us to Seoul and we would be looking at markets like these with the XLR. A large part of IndiGo’s growth over the next few years will come from international flights, we are very optimistic about going international, would grow by about 30% annually over the next few years and expect that half of that growth will go international, half will go domestic”.

IndiGo flies to Chengdu



IndiGo Airlines have begun daily nonstop flights from Delhi to Chengdu, capital of the Chinese province of Sichuan. A modern city, located in a landscape of sacred mountains and ancient villages, with some Tibetan aspects, Chengdu is also a location of China’s aircraft industry which produces, amongst other types, the Sino-Pakistani JF-17 Thunder multi-role light fighter.

CSTPL adds NEO A320 simulator

CAE Simulation Training Private Limited (CSTPL), a joint venture between Inter Globe Enterprises Pvt. Ltd. and CAE Inc. are expanding its presence at Bengaluru with the addition of its sixth A320neo Full Flight Simulator to support growing aviation market of India. Over the last few years, the aviation sector in India has witnessed strong growth leading to a high demand of talent for the sector including pilots and this expansion at Bangalore will



meet increasing demand for training needs. In its expansion drive, CSTPL is also establishing a new state-of-the-art pilot training centre in Gurugram near Delhi. With the arrival of CAE Series 7000 XR FFS, CSTPL received approval from DGCA for its new addition A320neo simulator to provide improved training experience for pilots in Southern India.

EASA support for HAL 228 certification



While HAL has been licence manufacturing the Dornier 228 series of light transport aircraft since the mid-1980s, these have largely been to military operators with a few for civil use. In 2017, the Directorate General of Civil Aviation (DGCA) had given ‘type certification’ for HAL-built Dornier 228s, and the European Union Aviation Safety Agency (EASA) has now endorsed such certification. DGCA head Arun Kumar commented that “after extensive interaction between DGCA and EASA at Cologne on 26 August 2019, EASA agreed to DGCA for issuance of the TC”.

Nine Precision Approach Radars to be installed

A contract for installation and commissioning of nine Precision Approach Radars (PARs) was concluded on 26 August 2019 between the Ministry of Defence and Data Pattern (India) Pvt. Ltd. at a cost of Rs 380 crores under ‘Buy Indian’ category. These state-of-the-art radars incorporating latest Phased Array technology will be installed at Indian Naval Air Stations and Indian Air Force bases to, “enhance Flight Safety at terminal stages of aircraft landing.” The installation and commissioning of radars at Indian Naval Air Stations is to be completed by April 2022 and that at IAF stations by December 2022.

Boeing and TAL milestone



TAL Manufacturing Solutions and Boeing marked delivery of the 25,000th advanced composite floor beam for all Dreamliner airliner variants (787-8, 787-9 and 787-10) from TAL's aerospace manufacturing facility in Nagpur. Boeing had awarded TAL, the first contract to manufacture floor beams for the Dreamliner family of airplanes in 2011, TAL shipping the first set of floor beams in 2014. "We are very proud of our partnership with TAL. The delivery of the 25,000th floor beam for the Dreamliner, one of the most advanced airplanes in the world, marks a special milestone for the partnership that has stood the test of time," stated Salil Gupte, president, Boeing India.

Indian Army Restructuring



On 20 August 2019, the Ministry of Defence issued formal instructions on restructuring of Indian Army headquarters at New Delhi which will essentially result in the reduction of officers strength besides creation of separate wings to deal with internal vigilance and human rights policies. As per the Government Sanction Letter (GSL), affected officers, will be posted to field formations, in line with the government's resolve to make the 1.3-million strong Army "leaner and fit for a 21st century war".

Further, the GSL requires merger of some Directorates which includes that of weapons and systems procurement agencies and creation of a new Deputy Chief to coordinate the military's

intelligence, operations and logistics wings. The GSL includes creation of a new Deputy Chief to oversee strategy and operations, intelligence collation, conduct of operations and the movement of logistics. DG (Military Operations) and the DG (Military Intelligence) presently report to the VCOAS. Restructuring will reportedly merge the Master General Ordnance (MGO) and the DG (Weapons and Equipment) Directorates under a single vertical with the Deputy Chief (Planning and Strategy), which will be renamed as *Capability Development*. Also expected is the creation of a consolidated Information Warfare wing to subsume two existing wings under the DGMI and the DGMO. The DG (Military Training) will now be merged with the Shimla-based Army Training Command.

Indo-Thailand Joint Military Exercise : MAITREE 2019



The Joint Military Exercise MAITREE-2019 between India and Thailand was conducted at Foreign Training Node, Umroi (Meghalaya) 16-29 September 2019. Indian and Royal Thai Army contingents comprised 50 soldiers each, who participated in various counter terrorism operations. This annual training event is conducted alternatively in Thailand and India and is a significant in terms of the security challenges faced by both the nations in the backdrop of changing facets of global terrorism. The scope of this exercise covered company level joint training on counter terrorism operations in jungle and urban scenario.

Exercise TSENTR 2019

Exercise TSENTR 2019, as part of the annual series of large scale exercises of the Russian Armed Forces, has rotated through four main Russian operational strategic commands, Vostok (East), Zapad (West), TSENTR (Centre) and Kavkas (South). In 2019 the exercise took place 9 September to 23 September at the Donguz training ranges in Orenburg, Russia. Apart from host nation Russia, military contingents from China, India, Kazakhstan, Kyrgyzstan, Tajikistan, Pakistan and Uzbekistan took part in this exercise. TSENTR-2019 focussed on evaluating the level of troop preparedness, the acquisition of required skills and raising level of inter-operability and demonstrate readiness of the participating armies.

Exercise Yudh Abhyas 2019



As part of ongoing Indo-US cooperation in defence, the joint military training *Exercise Yudh Abhyas* 2019 was conducted at Joint Base Lewis McChord, Washington, USA from 5-18 September 2019, being the 15th edition of the joint exercise hosted alternately between the two countries. “*Exercise Yudh Abhyas* provided an opportunity to the armed forces of both countries to train in an integrated manner at Battalion level with joint planning at Brigade level”. The objective is to facilitate interoperability between the armed forces of both countries “to meet any unforeseen contingency across the globe. Both armies jointly trained, planned and executed a series of well developed operations for neutralisation of threats of varied nature”.

The US contingent was represented by a company from the 5-20 Infantry Battalion while the Indian Army had troops from the Assam Regiment. “Both sides jointly trained planned and executed a series of well-developed tactical drills for neutralisation of likely threats that may be encountered in UN peace keeping operations”.

Navy seeks bigger share of defence budget

Vice Admiral G Ashok Kumar, the VCNS, has stated that the Indian Navy needs to have its share in the country’s defence budget increased. “Our endeavor is to ask for a higher share of capital budget within the defence services budget, which has also



dropped in the last six-seven years”. He pointed out that from a share of 18 per cent of the total defence budget in 2012-2013, the Navy’s share has come down to 13.66 per cent. It is the navy’s aim, to “constantly convince” the government “to enhance the Navy’s budget within this budget”.

Indian Naval Ships at Kota Kinabalu



As part of Indian Navy’s overseas deployment to South East Asia and the Western Pacific, INS *Sahyadri* and *Kiltan* made a port call at Kota Kinabalu, Malaysia on 12 September 2019. The ships are part of the Indian Navy’s Eastern Naval Command under the FOC-in-C, Eastern Naval Command, based at Visakhapatnam.



IN Ships *Sahyadri* and *Kiltan*, operating under the Command of Rear Admiral Suraj Berry, Flag Officer Commanding Eastern Fleet, are the latest, indigenously-designed and built multi-role ships of the Indian Navy, equipped with a versatile array of weapons and sensors, multi-role helicopters and represent “coming of age of India’s warship building capabilities.”

Navy adopts modular construction approach

The Indian Navy is looking to adopt modular construction technologies “to achieve parity in ship building pace with the rapidly expanding Chinese Navy”. Such new methodology is being applied to the Navy’s Project 17-A frigate, follow-up of the Project 17 *Shivalik*-class warships. The first ship under the project



is expected to be inducted in three years while the remaining six are to be ready by 2026-27. The Navy expects that the new method for ship-building “will help bring down construction time from the present 7-8 years to 3-4 years”. While Garden Reach Ship Builders (GRSE) Kolkata are working on three of the warships, Mazagon Dock Limited (MDL), Mumbai is involved with the other four, the cost of each warship being given as around Rs 6,300 crore.

Indian Navy on “high alert”



In early August 2019, the Indian Navy reportedly activated its warships and shore-based assets “to prevent any terror attack, with coastal security measures stepped up and forces keeping a tight vigil”. This was as backdrop of the government’s decision to revoke special status to Jammu and Kashmir as, according to reliable sources, Pakistan-based terror groups have been training for underwater sabotage activities.

100th GRSE-built warship commissioned

The sixth ship of eight Landing Craft Utility (LCU) Mark-IV vessels, IN LCU L-56 has been commissioned by Vice Admiral Atul Kumar Jain of Eastern Naval Command in Visakhapatnam, this being the 100th warship of Garden Reach Shipbuilders and Engineers Limited (GRSE), Kolkata. LCU Mk-IV is an amphibious



ship with its primary role being transportation and deployment of main battle tanks, armoured vehicles, troops and equipment from ship to shore, and part of the Andaman and Nicobar Command.

Finnish DA-Group in ASWSWC programme

The recently awarded contract worth Rs 6,311.32 crore for construction of eight Anti-Submarine Warfare Shallow Water Craft (ASWSWCs) to Cochin Shipyard Ltd. (CSL) by Indian Navy will be a joint collaboration effort between CSL, Smart Engineering & Design Solutions Private Ltd. of India (SEDS) and DA-Group subsidiary Surma Ltd., Finland. This is described as “one of the most technologically advanced naval combatant platforms to be commissioned by the Indian Navy”.

INS Tarkash visits Helsinki

INS *Tarkash* visited to Helsinki in Finland during late July for a three day visit. The ship is part of the Indian Navy’s Western Fleet and is under operational Command of FOC-in-C, Western Naval Command, based at Mumbai. Vice Admiral Ajit Kumar P, Flag Officer Commanding-in-Chief, Western Naval Command had also arrived in Helsinki on 30 July 2019, leading the Indian delegation during this visit.



28th Indo-Thai CORPAT



28th Edition of the *India-Thailand Coordinated Patrol* (Indo-Thai CORPAT) between the Indian and the Royal Thai Navies was conducted from 5 to 15 September 2019, which involved participation of INS *Kesari*, an amphibious Landing Ship Tank (Large), and HTMS *Kraburi*, a Guided Missile Frigate along with Dornier 228MPAs from both the navies. Objectives of the Indo-Thai CORPAT are “to ensure effective implementation of United Nations Conventions on Laws of the Sea (UNCLOS) which specify regulations regarding protection and conservation of natural resources, conservation of marine environment, prevention and suppression of illegal, unregulated fishing activity/ drug trafficking/ piracy, exchange of information in prevention of smuggling, illegal immigration and conduct of Search and Rescue operations at sea.”



Interestingly, both Navies deployed their Dornier 228s for the exercise; while that of INAS 318 at Port Blair flew to Thailand for the ‘Single Planning Conference,’ that of Royal Thai Navy’s 101 Squadron flew from U-Tapao to Port Blair (*photo above*).

60th L&T vessel delivered

Continuing with its “exemplary track record” in construction of warships ahead of schedule, L&T launched the fifth Offshore Patrol Vessel (OPV) for the Indian Coast Guard at its Kattupalli Defence Shipyard on 5 September, this being the 60th Defence Vessel built by L&T for the Government. Larsen & Toubro is executing a MoD contract for design and construction of seven



OPVs with deliveries mandated for between 2018 and 2021, the shipyard having delivered three OPVs, ICGS *Vikram*, ICGS *Vijaya* and ICGS *Veera* during the financial year 2018-19, all ahead of schedule. The Fourth OPV ICGS *Varaha* is currently undergoing sea trials.

BNS Somudra Avijan at Visakhapatnam



Bangladesh Naval Ship (BNS) *Somudra Avijan* visited Visakhapatnam Naval Base on a four-day visit to the Eastern Naval Command in mid-September 2019. During the ship’s stay at Visakhapatnam, a series of activities were carried out between the two navies.

Singapore, Thai and Indian Navy Trilateral Exercise

A trilateral exercise involving the Republic of Singapore Navy (RSN), Royal Thailand Navy (RTN) and the Indian Navy (IN) commenced at Port Blair on 16 September 2019, this five-day exercise aimed at “bolstering maritime



inter-relationships amongst Singapore, Thailand and India". Participating were RSN *Tenacious*, a *Formidable*-class guided missile stealth frigate, HTMS *Kraburi*, a guided missile frigate along with the guided missile destroyer INS *Ranvir*, missile corvette INS *Kora*, and OPV INS *Sukanya*, along with P-8I long range maritime reconnaissance aircraft.

Indian Navy tracks Chinese warships



Indian Naval Boeing P-8I long range maritime reconnaissance aircraft have tracked a number of Chinese Naval warships sailing in the IOR, including the amphibious warship *Xian 32*. Images of the Chinese warships have been shared in public forum and as reported "the three vessels of Chinese counter-piracy escort taskforce 32 were coming back from Gulf of Aden and three vessels of counter-piracy escort taskforce 33 were moving to take their place. They are being constantly monitored during their presence in the Indian Ocean when they pass closer to Indian exclusive economic zone and territorial waters".

Major Naval projects

Defence Minister Mr Rajnath Singh was Chief Guest at the commissioning of a number of major naval projects including commissioning of INS *Khanderi*, the second Project



75 Submarine, launch of INS *Nilgiri*, first ship of Project 17A and inauguration of the Aircraft Carrier Dry dock at Mumbai on 28 September 2019. (Details in the next issue)

MoU between Indian Navy and IMD



On 28 August 2019, the India Meteorological Department (IMD) signed a MoU with the Indian Navy for handing over its Cyclone Detection Radar (CDR) centre to the Navy for meteorological purposes. Rear Admiral RJ Nadkarni, Chief of Staff, Southern Naval Command (SNC) and Dr D Pradhan, Scientist 'G', Additional Director General of Meteorology (Instruments), signed the MoU. The CDR building has a S-band Cyclone Detection Radar to provide weather support for civil aviation at the old Kochi Airport, now the Naval Air Station INS *Garuda*.

Maritime Mobile Coastal Batteries



The Defence Acquisition Council (DAC) has approved procurement of next generation maritime mobile coastal batteries (long range) for the Indian Navy as also the SDR state of art communication system, indigenously-designed and developed by DRDO, BEL and Weapons Electronics System Engineering Establishment (WESEE). The next generation maritime mobile coastal batteries (NGMMCB, long range) comprise the indigenously-built supersonic BrahMos surface-to-surface cruise missiles, to be deployed along the Indian coast line.

India and France plan low-earth orbit satellites



India and France have formalised the development and launch of a constellation of some 10 low-earth orbit satellites to continuously provide maritime surveillance and security of facilities. These will cover a wide belt around the globe and specifically focus on the Indian Ocean region where France, with its Reunion Islands and also has strategic interest. When in place, the satellite-based Automatic Identification System or AIS will detect, identify and track a range of vessels moving in the ocean region and guard against aggression, terrorism, piracy, smuggling, source of oil slicks and also for fishery protection and rescue.

Russia to select, train Indian Cosmonauts

From the 12 Indians shortlisted for the planned manned space mission, Russian Space Agency Roscosmos will select and train four Indian cosmonauts for intensive training to prepare them for India's planned *Gaganyaan* mission, scheduled for early 2022. Under the Rs 10,000 crore manned space mission, there are to be three Indians in space for 5-7 days, conducting various micro-gravity tests amongst others. During NSA Ajit Doval's recent visit to Moscow, the two countries had also discussed Indian-crewed flight carrier rocket tests, piloted vehicles and rescue systems.

HAL HTT-40 clears "six-turn spin test"



On 7 September 2019, HAL test pilots successfully carried out the crucial "six-turn spin test" in the indigenously developed Hindustan Turbo Trainer-40 (HTT-40), regarded as perhaps the ultimate and most difficult test for such an aircraft. The HTT-40 had already met, and in many aspects of flight performance, surpassed the IAF's ASQRs thus proving its capability in the face of some reluctance to order this basic trainer. The MoD/IAF had some years back ordered 75 Pilatus PC-7 Mk.II basic trainers from Switzerland with the case made out for a follow on batch of 38 more of the same time type. This is now in suspense.

VACS on Hawk-i

Hindustan Aeronautics Ltd. has tested the indigenously-developed Voice Activated Command Systems (VACS) integrating this on the Hawk-i, the first indigenous Artificial Intelligence based system to be integrated on a military aircraft



in India. The flight tests were conducted by HAL Test Pilot Wg Cdr (R) P Awasthi and Flight Test Engineer Wg Cdr (R) M Patel.

The VACS has been designed and developed by SLRDC, being a Speech Recognition system which recognises pilot voice commands and sends appropriate commands to the Mission Computer.

Vietnamese delegation visits HAL Nasik

A team from the Vietnam People's Air Force and Air Defence visited HAL at Nasik in early August 2019, the Vietnamese team being given detailed presentations on the Su-30MKI manufacturing programme, ROH Facilities as also the aircraft design and upgrade capabilities of HAL Nasik Division. Discussions were reportedly held on repair and overhaul as also an outline of planned upgradation of Sukhoi Su-30MKIs.

Trials of GTEG-60



An indigenously designed and developed Gas Turbine Electrical Generator (GTEG), the 60 APU for the An-32, has been tested at AFS Jamnagar, the trials conducted at sea level in hot weather conditions. The tests were carried out by ASTE pilots and flight test engineers in coordination with the AERDC, the APU being subjected to tests including continuous operations of one hour, five consecutive starts and three group starts including 18 main engine starts.

Latecoere inaugurates new site in India

Latécoère, which is a tier 1 partner to major international aircraft manufacturers, inaugurated its new plant at Belagavi on 10 September. The new site is dedicated to manufacturing of the Radio Navigation harnesses for Dassault Falcon 2000s and in the future, its main harness as well as avionics harnesses for Thales in



aircraft including the Boeing 777, 737 and Airbus A320. "Latécoère continues to evolve in line with its *Transformation Plan 2020*, and is actively pursuing its strategy to optimise its industrial infrastructure and ensure operational excellence and quality for all customers".

MKU in MoU with UP Government and Thales



Seeking opportunities in the defence and homeland security domain, MKU has signed an MoU with the UP Government for an investment of Rs. 1,000 crore in the newly inaugurated *Uttar Pradesh Defence Corridor*. In addition to protection for personnel and platforms, MKU also offers IDDM range of electro optic systems, which include various thermal imaging devices, night vision devices, laser range finder and day EO devices. MKU Limited and Thales have signed two MoUs for strategic co-operation in the development and production of optronic devices and F90 close quarter battle (CQB) rifle for soldiers. The optronic devices will be co-developed by Thales and MKU and both the optronic devices and F90 rifles will be manufactured in India at MKU's facilities in Kanpur, Uttar Pradesh.

Rafael expands in India

Astra Rafael Communication System (ARC), a Joint Venture between Astra Microwave Pvt Ltd. and Rafael Advanced Defense Systems Ltd. of Israel, inaugurated their state-of-the-art facility at Hardware Technology Park, Hyderabad on 27 August 2019. "The 51:49 Joint venture established with all regulatory approvals, follows the Government's *Make in India* initiative and will invest in high-end technology and advanced production techniques to design, develop and manufacture state-of-the-art Tactical Communication systems (BNET) for the Indian Armed Forces."



APPOINTMENTS

Air Marshal RKS Bhadauria is new CAS

The Government of India has announced appointment of Air Marshal Rakesh Kumar Singh Bhadauria as next Chief of the Air Staff, taking over on 30 September 2019 on retirement of the incumbent CAS Air Chief Marshal Birender Singh Dhanoa.



An alumnus of the National Defence Academy, the institution he went on to later head, Air Marshal Bhadauria was commissioned in the fighter stream of the Air Force in June 1980 and had won the Sword of Honour as he stood at the top in the overall order of merit. With more than 4,250 hours of flying experience on 26 types of fighter and transport aircraft, he commanded the famed No.5 Squadron (*Tuskers*) flying Jaguars. He was chief test pilot for the Tejas LCA, and has also headed the NFTC as part of the LCA development programme. He was one of the first pilots of the Indian Air Force to fly the Rafale.

Air Marshal Bhadauria has been Commandant of NDA, Deputy Chief of Air Staff at Air headquarters, Air Officer Commanding-in-Chief of Southern Air Command, and later Training Command before taking over as Vice Chief of Air Staff. He has been awarded the Param Vishist Seva Medal, the Ati Vishist Seva Medal, and the Vayu Sena Medal.

Dr Ajay Kumar appointed Defence Secretary, Subhash Chandra is Secretary (DP)

Dr Ajay Kumar, a 1985-batch IAS officer of Kerala cadre, has been appointed as Defence Secretary in the Ministry of Defence, succeeding Sanjay Mitra, a 1982-batch IAS officer of



West Bengal cadre, upon the completion of latter's term. The ACC has also cleared the appointment of Subhash Chandra, Special Secretary (Defence) as Secretary (Defence Production) in place of Dr Kumar. Mr Chandra is a 1986-batch IAS officer of the Karnataka cadre.

MS Velpari takes over as Director Operations, HAL

Mr Velpari has been appointed as Director (Operations) at HAL, having previously been Chief of Project (LCA-Tejas) at the LCA-Tejas Division. Mr Velpari is a Mechanical Engineer from College of Engineering, Guindy, Chennai and did his Masters from IIT Madras in Aircraft Production Engineering. He joined HAL in 1985 as Management



Trainee (20th batch), and has experience in the areas of manufacturing, assembly, design, product support, customer support, indigenisation and other management functions while serving at LCA-Tejas, Aircraft, Foundry & Forge Divisions in Bengaluru and Aircraft Division at Nasik. He was responsible for sustained increase in LCA production from an initial two in 2015-16 to eight aircraft in 2018-19.

'Airpower 2020: Threats and Counters'



Joint USI - SAS Symposium

A t a largely attended Symposium held at the United Service Institution auditorium in New Delhi, the keynote address was by Air Marshal D Choudhury SASO Western Air Command, excerpts of which are reproduced for *Vayu* readers.

The subject of this morning's symposium "Air Power 2020- Threats and Counters" initially implied a somewhat near term view of the immediate future. The objective however, as amplified by the Director, was to discuss the IAF's future combat strength in affordable numbers to provide India with credible air power over the coming decades.

Given that the IAF's combat strength has come down to 30 squadrons, the topic for today could not be more apt and in the wake of the post Balakot flurry, more timely. The picky topic for the three sessions encapsulates the subject rather more comprehensively and the three speakers, if I may say so, are hardcore erstwhile air power practitioners and scholar warriors, thus we have ideal ingredients for what I confidently believe will be a master class session.

In keeping with the subject, I would like to keep my talks around as three themes ;

Future threats and challenges; IAF counter in the near term and wider long term overview from the strategic perspective.

I would like to begin with an old JFK quote that "we live in an interesting times" to which I might ironically add, is believed to be an old Chinese curse and the fact is that we indeed do ! Seen in the geopolitical

context of India today, the unipolar moment of US domination needs an urgent review also with China's overt and aggressive rise towards becoming global power. This ascent coupled with gradual shift at the centre of gravity of global economic power from the west to the east has changed the regional dynamics of Asia – especially the Indian Ocean Region.

With respect to India's growing economic rise and power stature, I would simply quote the iconic Stan Lee in his famous Spiderman comic when he wrote "with great power comes great responsibility". We are living today in an era of a variety of evolving and coexisting threats which range from the classic conventional to the contentious nonconventional or the nuclear threat and most worrisome a new kid on the block who brings the sub conventional threat. Call it by any name-hybrid war, irregular war, no-peace-no-war, the grey zone - it is worrisome since it does not conform to the norms and boundaries of warfare as we know it.

Warfare is no longer the preserve of state-based militaries, given the ever increasing involvement of non-state players, proxies and violent extremists or terrorist organisations which are rapidly morphing and aligning with each other opportunistically. Add to this, the equally intricate tapestry of the current global power realignments, international competition and conflicts and now the increasing challenges of climate change, diminishing resources, access to global commons and the widening variety of humanitarian disasters, we end up

with a wide array of threats and challenges to deal with both the near and the long term future. In the Indian context one cannot wish away the threat of conventional war but its probabilities get somewhat diminished owing to the prohibitive cost of war when weighed against the national goal of economic progress.

Despite the current economic slowdown, the Indian government has set a target of becoming a five trillion dollar economy in GDP terms by 2024 and a three trillion dollar economy in the current financial year. Whether or not we achieve these targets within these timelines, there is little doubt of the preponderance of economic growth as a national priority. Pakistan has India in a bear hug of sorts and much as we want to disengage and pull away from, it only serves to perpetrate the Indian threat which enables the Pak military to remain the power centre, with regular Kashmir baiting, cross-border terrorism, periodical India bashing sustaining the Pak military's anti-Indian hegemonic agenda narrative to its people. Given the history of sub-continental wars, all initiated by Pakistan, this does not leave India with much choice but to continue to look at its western neighbour as an immediate threat. The western border has also seen the spectre of nuclear conflict but the 1999 Kargil War proved that conventional conflict is still possible under the nuclear umbrella. In keeping with the recent Indian hardpower responses by way of surface and air strikes, the Pakistan threat remains alive. Although it is a strong and modernised air force, despite the reduced numbers, the IAF still retains superiority by way of some modern platforms, smart weapons, force multipliers and net centric operations.

China on the other hand is India's actual long term adversary – if not the direct threat. Till recently, India did not feature much in the Chinese strategic calculus as its own real world challenges are on the eastern flank. US support and power position in the South East and East Asian regions is China's biggest challenge. However having successfully given clear indications of its rising power trajectory, the Chinese approach on India has recently undergone ups and downs. While it stood its ground in the stonewalling of India's NSG entry, UN Security Council seat and has actively as well as openly supported Pakistan on the Masood Azhar issue, its response in supporting

Pakistan on the recent abrogation of Article 370 (in Kashmir) has been relatively mellow in the face of international opinion. China however remains keen to get boots on the ground along the CPC corridor which passes through northern Kashmir, giving it an alternate route for its trade and energy requirements which otherwise are totally dependent on the vulnerable (from a Chinese perspective) Malacca Straits route. The Tibet Autonomous Region and the Chinese-occupied Aksai Chin links Tibet with Shenyang province which shares borders with Mongolia, Russia, Tajikistan, Afghanistan, Pakistan – and India. This is China's gateway to the resource-rich Central Asian region and geographically vital for all its economic initiatives whether it is a SEO, BRI and the CPEC. This is therefore also a key vulnerability since China has committed and invested so much in these initiatives and is very unlikely that it will resolve its territorial claims with India in a hurry.

Thus the simmering threat of conflict with China, albeit a localised one remains very real. And finally there is that collusive threat from both these nations. Pakistan most certainly may want to have a collusive go against India, but China may be reluctant to do so in the immediate future as it would lose face internationally. May I suggest that any major military aggression would be contrary to the carefully predicted, albeit not wholly successful perception, shaping efforts of being a peaceful nation regaining its long lost glory. This could force the world to take sides in a situation it would not want to risk – as yet. Despite its military modernisation and changes in the National Security policies, China has not really fought a fully fledged war in a long time. While it has started exposing its forces for training opportunities externally, its modern military warfighting model is still largely rooted in concepts of the Soviet era.

However, active training and exercises between the PLAAF and PAF are clear efforts at closing this gap. Over the last two decades, the PLA has embarked on a series of transformations from being a massive but low tech force to a leaner and a modern high tech one, capable of power projection and influence adapted on western precepts, primarily the US. Being a long way off from achieving its desired capabilities and capacities, the Chinese military is still crossing the river carefully. Overall, any major military confrontation with India

would force it to open another front. Since thinning of its vital eastern coast is not an likely option, any additional 'Front' would most certainly tie down the PLAAF, forcing it to spread its thin high-tech resources.

Still a collusive threat most certainly remains a reality for India in the long run but this also provides India with some strategic space in the interim to bolster the IAF's capabilities and capacities. While such unconventional threats, on in our borders has been a clear and present danger for years owing to cross-border terrorism the Balakot strike was arguably a crossing of the Rubicon moment for Indian air power. It is a compelling indicator of the country's recognition of the capabilities of kinetic air power and the willingness to prosecute it across our borders in the national interest. The mind set of our services till now has been unconventional war and so it is been for the IAF. Today, therefore we also have to plan equip and train for this grey zone. In the near-term, restoring the BVR missile advantage in our favour at the earliest is the most important necessity. The IAF also needs to expand its current basket of specialist weapons with speed, including new PGMs and expand its employment with integration on our mainstay fleet of Su-30s.

Combat survivability remains an imperative in all future scenarios for which software-defined radios, airborne self-protection systems and standard jammers, coupled with adversary and operational data links are mandatory and vital for greater combat situational awareness. Reduction of the sensor-to-shooter cycle and achievement of total net centric operations is of importance. Force multipliers and enablers are both tactical and a strategic necessities and we need to enhance this vital capability both in the near and the long term.

The IAF already has a well-established ISR capability and structure in place, however given its fundamental necessity for all types of future standalone and joint operations, this has equally important peacetime applications ranging from surveillance to search and rescue.


Upgradation programmes for the Jaguar, MiG-29 and Mirage fleets along with additional weapon integration are well underway but will only see us through the near future. Speedy induction of the FOC version of the Tejas Mk.I will help offset

the declining numbers. Interestingly while we are on the subject of reduced numbers, the recent Exercise *Gaganshakti* in 2018 conclusively showcased two aspects. First was the IAF's combat capacity to generate a higher sortie rate despite its reduced squadron bench strength. Over a two week period, more than 11000 sorties were flown which included approximately 9000 sorties by fighters. Compare this with 11,500 sorties flown by 38 combat squadrons in a similar period in the 1971 war.

Second was the IAF's ability to offset reduced numbers with a higher serviceability. We were able to achieve 80 percent serviceability of aircraft while radars and SAMs maintained 97 percent of serviceability including some legacy systems which are over 40 years old. Such a focused effort enabled the dispatch rate of more than 95 percent of combat assets, a hundred percent availability of combat support systems and almost a hundred percent dispatch rate of combat enablers. Enhancement of our air defence capability is another encouraging story.

The IAF has amply, and consistently, demonstrated its ability to adapt to new roles, missions and tasks. It has today an undeniable strategic transport ability. I may add a word borrowed from the founder Director General of CAPS which is that the IAF must be employed independently or jointly as per the requirements. Whether it is another 'Balakot', or stand off at Demchok or long range maritime missions in support of the Navy or in strategic manner, the IAF's regional response in the IOR or India's area of interest or simply a swift and efficient HDR, these missions and tasks will continue to increase in the near future.

In the words of our Air Chief "We have the second largest strategic transport fleet in the world, therefore India will pull its heft in helping out friendly nations in times of humanitarian distress and relief". In addition India is very much alive to the threats that could arise in Indo-Pacific region.

To conclude, an integrated approach towards right sizing the IAF combat strength, investing in cutting edge technologies, human resources, leadership and training while maintaining a clear strategic vision are the key means to achieve this. It is imperative to build up the IAF to 42 combat squadrons, both by augmenting the (limited number of) Rafales and co-producing a selected MMRCA. 

More on Garuda VI



An illustrated account on ‘Exercise Garuda VI appeared in Vayu Issue IV/2019. This follow on article with equally superb images augments the record of that important exercise

The sixth edition of Exercise Garuda was held in July 2019 at Base Aérienne 118 Colonel Rozanoff, Mont-de-Marsan in southern France, with the objective of “improving the level of interoperability of French and Indian air

crew in air defence missions and ground attack”.

The scenarios had been jointly prepared by the two air forces, so as to bring the French and Indian crews “on the same page” to prepare for missions and operating

their respective aircraft in realistic complex tactical situations.

Garuda VI witnessed participation of a large mix of the French Air Force aircraft such as the Dassault Rafale, Alphajet, Mirage 2000 C/D, Boeing C-135F tanker, Boeing E-3F AWACS, Lockheed C130 Hercules and CASA-235 tactical transport aircraft. This French armada of aircraft was joined four Indian Air Force Sukhoi Su-30MKIs, one Ilyushin-II-78 and two Boeing C-17 heavy transport aircraft, the latter transporting personnel and supplies from India and then returned to home base.

The IAF Sukhoi Su-30MKIs were from No.24 Squadron ‘Hunting Hawks’, normally based at Air Force Station Bareilly, and the Il-78 tanker was from No.78 Squadron ‘Battle-Cry’ at AFS Agra. There were 110 IAF personnel involved, departing India on 26 June with intermediate stops at the UAE and Egypt; arriving in France on 28 June, with Base Commander Mont-de-Marsan Colonel Gaudillere formally receiving the Indian Air Force contingent on their arrival.



Dassault Rafale at Mont-de-Marsan (Alex van Noye)



Su-30MKI at Mont-de-Marsan (Alex van Noye)

Garuda VI was hosted by 2nd Squadron of the 30th Fighter Wing (*Escadron de Chasse EC2/30*) 'Normandie-Niemen', operating Dassault Rafales at their homebase BA Mont-de-Marsan.

With the imminent induction of Dassault Rafales in the IAF's inventory, *Garuda VI* was all the more important as it gave IAF pilots the chance for a closer look at their new fighter. The first IAF Rafales are expected to be handed over to the Service in September 2019, which will be then employed for conversion training, testing and evaluation for the next six months before they are ferried to India and formal induction in the Indian Air Force.



Rafale before take off (Alex van Noye)



Sukhoi Su-30MKI takes off at Mont-de-Marsan (Alex van Noye)

The Exercise itself

Two missions were planned for every day, whereby the Indian and French Air Force would alternate roles as mission leaders. The workup phase was to get the pilots acquainted to fly in large packages of dissimilar aircraft in compact air space, particularly important for the younger pilots. Also air-to-air refueling was included in these preparatory sessions.

After launch of aircraft, select media were taken to the Detection and Control Centre (*Centre de Détection et de Contrôle (CDC)*) with call sign 'Marina' to monitor morning wave of the exercise, the 'Marina' CDC being responsible for all flying activities in southwest France, monitoring air traffic, controlling exercises and Air Defense QRA missions (*Permanence Operationnelle, PO*) in



Mirage 2000D returns from sortie (Joris van Boven)

that region. The control centre cooperates closely with other regional CDCs and the centralised French CDC at the Lyon-Mont Verdun airbase, with call sign 'Rambert'.

Lt.Colonel Courty, commanding officer of EC 2/30 'Normandie-Niemen', briefed the media about the exercise and its goals, the main focus being co-operation by building up the exercise from familiarisation missions in the first week to large package in the second week.

After morning missions, debriefings took place in the afternoon, a key objective of the exercise being to protect a slow moving transport aircraft delivering paratroopers to a DropZone (DZ). The IAF Sukhoi, as *Blue Air*, were tasked to protect the transport aircraft.

From the Indian Air Force, interviews were held with Group Captain Rodrigues

'Rods', who has 3000 flying hours including 1000 on the Su-30. He too flew operational missions during *Garuda VI* as did Group Captain Arvind, CO of No. 78

Squadron with the Il-78 MKI, having 8000 flying hours himself, including 3500 hours on the Ilyushin-78.

As Gp Capt Rodrigues summed it up, "this was a great experience and more than challenging, it was much more learning value for us, primary because the French Air Force is at NATO standards, so in terms of understanding each other, it was not difficult. But going through various phases, starting from the basic fighting manoeuvres until large force engagements, and at each stage, integrating with them, the learning value was quite a bit. And we have much to take away, continue to progress to move ahead in years to come". 🦋

Text and photos : Joris van Boven and Alex van Noye



Su-30MKI returns to flight line at Mont-de-Marsan (Alex van Noye)



IAF Ilyushin Il-78 (Joris van Boven)

Increasing Boeing footprint in India



Here come the Apaches

United States aerospace giant Boeing had handed over to India the first of 22 AH-64E (I) Apache Guardian attack helicopters at a ceremony in Boeing's production facility in Mesa, Arizona on 10 May 2019. The Indian Air Force (IAF) took delivery of the initial batch in July of 22 Boeing AH-64E (I) ordered in September 2015 for \$ 2.02 billion. The twin-engine

helicopters were subsequently transported to Pathankot Air Force Station in northern India, where they were assembled ahead of their formal induction into IAF service. On 3 September 2019, the Indian Air Force officially inducted the first 8 AH-64E Apache attack helicopters at Pathankot Air Force Station (AFS), with a total of 22 on order (plus six for the Army Aviation

Corps). Air Chief Marshal B.S.Dhanoa was chief guest at the ceremony accompanied by AOC-in-C Western Air Command Air Marshal R Nambiar. Delivery of the remaining platforms is expected to be completed by the end of 2020.

In anticipation of the impending deal, the United States Defence Security Cooperation Agency (DSCA) notified

Congress on 22 December 2010 of a possible Foreign Military Sale (FMS) to the Government of India of various engines, equipment, weapons, training, parts and logistical support for a possible Direct Commercial Sale of 22 (then referred to as) AH-64D Block III Apache helicopters which was the only contender ultimately short listed. The notification was made in advance so that, in the event that the AH-64D proposal was selected, the United States might move as quickly as possible to implement the sale. The proposed sale was projected to 'contribute to the foreign policy and national security of the United States by helping to strengthen the US-India strategic relationship and to improve the security of an important partner (India) which continued to be an important force for political stability, peace, and economic progress in South Asia'. The AH-64D Block III emerged victorious after extensive flying tests conducted by the Indian Air Force of both United States Boeing AH-64D 'Apache Longbow' and the Russian Mil Mi-28NE "Nighthunter" next-generation attack helicopters (to counter ground-armoured threats).



The contract was signed in September 2015 and the attack helicopters have entered IAF Service under the designation AH-64E (I) Apache Guardian featuring improved digital (Link-16) connectivity, the joint tactical radio system, more powerful

T700-GE-701D engines with upgraded transmission to accommodate more power, capability to control Unmanned Aerial Vehicles (UAVs), new composite rotor blades, full Air-to-Air Refuelling (AAR) capability and improved landing gear. The redesigned rotor blades increase cruise speed, climb rate, and payload capacity, while the updated Longbow radar has an over sea capacity.

As per the notification, the sale included 50 T700-GE-701D engines, 12 AN/APG-78 Fire Control Radars (FCR), 12 AN/APR-48A Radar Frequency Interferometers, 812 AGM-114L-3 Hellfire Longbow missiles, 542 AGM-114R-3 Hellfire II missiles, 245 STINGER Block I-92H missiles, 23 Modernised Target Acquisition Designation Sight/Pilot Night Vision Sensors, rockets, training and dummy missiles, 30 mm ammunition, transponders, simulators, global positioning system/inertial navigation systems (GPS/INS), communication equipment, spare and repair parts, tools and test equipment, support equipment, repair and return support, personnel training and training equipment, publications and technical documentation, US Government and contractor engineering and logistics support services as well as other related elements of logistics support to be provided in conjunction with a direct commercial sale of 22 AH-64D Block III Apache Helicopters.

Sensor technology remains a key advantage of the twin-engined AH-64D



Air Marshal AS Butola of the IAF accepting the first AH-64E (I) Apache Guardian helicopter during a ceremony held at Boeing production facility in Mesa, Arizona, USA on 10 May 2019.

(maximum take-off weight is 10,433-kg) which is also successfully battle proven having been deployed by the United States Army in Afghanistan as part of *Operation Anaconda* and in support of *Operation Iraqi Freedom* to fulfil the Close Air Support role. The AH-64D 'Longbow Apache' is equipped with the Northrop Grumman AN/APG-78 millimetre-wave FCR capable of performing under poor-visibility conditions, less sensitive to ground clutter, while the short wavelength allows a very narrow beam width, which is resistant to Electronic Counter Measures (ECM). AN/APG-78 additionally incorporates an integrated AN/APR-48A Radar Frequency Interferometer for passive location and identification of radar-emitting threats. Block III includes increasing digitisation, the joint tactical radio system, enhanced T700-GE-701D turbo shaft engines (each providing 1,265-kW) and drive systems, capability to control Unmanned Aerial Vehicles (UAV) and new composite rotor blades to increase the Apache's cruise speed (284 km/h), climb rate (889 m/min) and payload capability. The ferry range is 1,900 km and service ceiling 6,400 m, with endurance being 3 hours 9 minutes. Lockheed Martin incidentally has developed a new targeting and night vision system for the Apache, using second-generation long-wave Infra-Red (IR) sensors with improved range and resolution. The new system is called 'Arrowhead' and has a targeting Forward Looking Infra-Red (FLIR) with three fields of view, a dual field-of-view FLIR, a Charged Coupled Device (CCD) TV camera, electronic zoom, target tracker and auto-boresight.

The 30-mm automatic Boeing M230 chain gun is located under fuselage with 1,200 rounds of ammunition and can provide a rate of fire of 625 rounds a minute. AGM-114L-3 Hellfire Longbow air-to-surface missiles with millimetre wave seeker perform in full fire and forget mode up to a range of 12 km against armoured formations and fortified installations. Stinger Block I-92H Air-to-Air Missiles (AAM) are carried for armed escort and self-protection. In the close support role, the helicopter carries 16 Hellfire missiles on four four-rail launchers plus 4 Stinger AAMs. If integrated with proposed AIM-9X close combat missiles (CCM), the helicopters will pose reasonable threat to even hostile unsuspecting fixed wing aircraft. The radar

dome atop the rotor blades is unmasked for a single radar scan and then remasked, enabling the processors to determine the location, speed and direction of travel of upto 256 targets.

To neutralise hostile armoured formations and enemy bunkers and fortifications, the sales package for the IAF includes 812 Lockheed Martin AGM-114L-3 Longbow Hellfire Anti-Tank Guided Weapon (ATGW) plus 542 AGM-

system, which provide home-in on active jammers that try to degrade or disable the missile. The missile will also receive advanced countermeasures to defeat and cancel jammers.

For effective fire control and optimum utilisation of AGM-114L-3 Longbow Hellfire the AH-64D 'Longbow Apache' is equipped with the Northrop Grumman AN/APG-78 millimetre-wave Fire Control Radar (FCR) capable of performing under

The Inspiration

Many US-origin helicopters and aircraft have been bestowed tribal names of the traditional American Indians who are from the south western United States, including the Apache. Distant cousins of the Apache are the Navajo, and there are Apache communities in Oklahoma, Texas, and reservations in Arizona and New Mexico. The Apache Nations are politically autonomous, speak several different languages and have distinct cultures.



114R-3 Hellfire II ATGW. The name *Hellfire* comes from its original role as a helicopter-launched fire & forget weapon. The AGM-114L-3, or Longbow Hellfire, is a fire & forget weapon equipped with a Millimetre Wave (MMW) radar seeker coupled with inertial guidance, enabling Lock on after Launch (LOAL) capability and very effective against hostile multiple rolling armour. The MMW radar also rectifies inherent limitations of the Semi-Active Laser Homing (SALH) guidance system by providing capability in adverse weather and battlefield obscurants such as dust, smoke and fog which mask position of the target or prevent the designating laser from producing a detectable reflection. Besides autonomous homing on targets designated by the Longbow Fire Control system, the missile can also use advanced modes, currently being upgraded to the

poor-visibility conditions, being less sensitive to ground clutter, while the short wavelength allows a very narrow beam width, which is resistant to Electronic Counter Measures (ECM).

Complementing the AGM-114L-3 Longbow Hellfire will be the multipurpose 8 km. range AGM-114R or *Romeo* that uses a Semi-Active Laser Homing (SALH) guidance system and an integrated blast fragmentation sleeve (IBFS) warhead likely built around tandem shaped charge HEAT to engage targets that previously needed multiple Hellfire variants. Hellfire II locks on before or after launch and can engage multiple targets simultaneously. The missile uses trajectory shaping to enable optimal performance in degraded weather along with automatic target reacquisition after loss of track in low clouds. 🦋

Sayan Majumdar

Evolving Facets of Aerospace Power

This conference is fitting tribute to one of the finest officers of the Indian Air Force, Wg Cdr KK Majumdar DFC & Bar. He has the achievement of being the first and only Indian pilot to have been awarded the DFC twice for his courage and daring leadership during World War II.

In the 20th century, air power matured to the extent that it started playing a decisive role in conventional conflict. The 38-day air campaign in the Gulf War, followed by only four days ground campaign was perhaps the best demonstration of air power's war winning capability. The present debate on procurement of aircraft or equipment displays a limited understanding on aerospace matters.

In our subcontinent, air power initially played a very nascent role post-independence during the Kashmir operations (1947-48) wherein the IAF, under strict rules of engagement, was permitted to carry out offensive actions, but first air-landed the 1 Sikh Regiment into the war zone. This timely action saved the Kashmir valley and thousands of innocent citizens from the brutality of the Pakistan-sponsored invaders.

In the following three wars against Pakistan, the IAF played a stellar role in defeating the enemy. In 1971, complete air superiority was achieved by the IAF over East Pakistan, permitting a free run to our ground forces (the Tangail paratroop and Meghna helilift are examples). Thus, the liberation of Bangladesh was achieved within only 14 days.

In 1999, during the Kargil War, our Effects-Based Operations (EBO) targeting of key headquarters (HQ) and logistics dumps evicted the enemy from his well-entrenched defensive positions on our side of the Line of Control (LoC). This war was fought not just on the ground but also in the media wherein embedded journalists tilted the perceptions in our favour. This was the first televised war in the Indian subcontinent. The social media meanwhile is already a tool of propaganda and widely used by terrorists and non-state actors to plan attacks and spread discontent within the forces.

In future conflicts, our adversaries will pose challenges not just in conventional but



Address by Air Chief Marshal BS Dhanoa at the 'Jumbo Majumdar International Conference' organised by the Centre for Air Power Studies at New Delhi



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IAF Mirage 2000 over the high Himalaya

A lot is being suggested by many armchair warriors on what our nation should do about this. Some people suggest that we need to reduce our manpower and put the money in the capital budget. For your reference, the entire salary bill of the IAF is Rs 16,621 crore, while our capital expenditure is Rs 35,407 crore. We need Rs 8,870 crore in revenue for fuel and maintenance as flying is a perishable skill. Hence, there is no way we can cut down on our manpower to pay for our capital acquisitions. The total cost of ownership of a platform needs to be considered. The Su-30MKI was purchased as a replacement for the MiG-21 aircraft. The present manning of a Su-30 squadron is nearly twice that of a MiG-21 squadron and the cost of per hour operation is 3.5 times higher. In fact, the per hour cost of operating a Su-30MKI

also hybrid war which will have components of cyber, space and information warfare. However, air power will remain a major player in future conflicts.

Investment in air power is an expensive proposition: each Sukhoi Su-30 costs Rs 417 crore, even the Light Combat Aircraft (LCA) Mk I costs Rs 191 crore.

So the question is: “Can we do away with it?” The answer is “NO” ! Not only is superior air power needed for winning a conflict, it is required for deterrence: as the well-known Latin adage goes, “If you want peace, prepare for war”

Si vis pacem, para bellum



The Sukhoi Su-30MKI now equips nearly half of the IAF's combat air squadrons



The Tejas LCA has entered IAF service, albeit in IOC standard (Photo: Deb Rana)



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Meet the leader.



The Jaguar equips six squadrons, including that for maritime strike

is 1.4 times that of 4th Generation aircraft such as the Mirage 2000. In the other example, we are raising two Medium Range Surface-to-Air Missile (MRSAM) units on the establishment of a single Pechora unit, which we will phase out.

Many suggest that we buy more inexpensive fighters, often quoting Stalin who had said, “Quantity has a quality of its own.” Firstly, Stalin’s son was captured and died in World War II and none of these so-called advocates of this theory have

their children serving in the armed forces. Secondly, in air power terms this doesn’t hold true. As was seen in the 1982 Bekaa Valley operations, the Syrians lost over 76 third generation fighters against Israel’s fourth generation F-16s that suffered no losses. Is such an exchange ratio acceptable to us? It’s not that the country can afford an air force made up of only high-end fighters: there has to be a high/medium and low tech mix. It’s the high-end fighters and other equipment that help you shape the air battle for the others to be able to carry out their tasks. The government’s decision to acquire the Rafale and the S-400 would do this for us.

Indigenisation

I am not suggesting that we give indigenisation the go-by. In fact, the Indian Air Force has a clear roadmap for indigenisation. Our policy envisages a progressive improvement in the



The Antonov An-32 remains backbone of the IAF’s large tactical transport fleet



Pair of LCA trainers in formation take off

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Airbus C295 tactical transport aircraft, mooted as the "Avro replacement"



scale of indigenisation. We have procured and operationalised the indigenous Akash Surface-to-Air Guided Weapon (SAGW); are in the process of developing the MRSAM in collaboration with Israel and will finally progress towards the Long Range Surface-to-Air Missile (LRSAM). In radars we started with the Indra a long time ago and now make the Rohini and will progress to the Arudhra to ultimately make the long range surveillance radar in the future. Similarly, with the fighters: LCA Mk.I Mk.IA, Mk.II and, finally, the Advanced Medium Combat Aircraft (AMCA).

As an Indian, it was a matter of immense pride and delight for me to fly the indigenously manufactured LCA during the Aero India Show at Bangalore. I would also like to share with you that I commenced my flying career in the IAF 40 years ago, learning to fly on the HAL HT-2 and HAL Kiran aircraft. Years later, as an instructor, I taught young budding pilots to fly the Kiran aircraft and flew close to 1,000 hours on this aircraft, accident free. All these types were designed, developed and manufactured in India. Prior to the LCA, in the 1970s, the Indian Air Force operated the indigenously designed, developed and manufactured HF-24 Marut fighter bomber.

A crucial contribution to all the successes of indigenisation has also been the supreme sacrifice of IAF's pilots in testing these aircraft to battle worthy standards. We have lost 17 pilots and engineers in air



HAL HTT-40 basic trainer which is under development

accidents during testing and evaluation of the indigenous Marut, Kiran, Ajeet, Saras and AWACS prototype aircraft.

While indigenisation is important, it comes with a price. Out of the 19 Category-I accidents on the HF-24, twelve were due to technical defects, of which five were fatal accidents. But that did not stop us from encouraging indigenisation. It goes to the credit of the Aeronautical Development Agency (ADA) that designed and conceptualised the LCA, and the National Flight Test Centre (NFTC) which flight tested and further refined the aircraft, without any major mishaps (touch wood!).

But to achieve competent levels of indigenisation, we need to also encourage manufacturing in India. Under 'Make in India' we are progressing a case of manufacturing 114 fighter aircraft through a strategic partnership model and 40 Airbus C.295 by an Indian production agency.

In indigenous manufacturing, we have contracted for 40 LCA Mk I; the Request for Proposal (RFP) has been issued for 83 LCA Mk IA and we will be procuring 12 squadrons of the LCA Mk. II and, then, finally, the AMCA. The IAF has not shifted any goal posts, as is alleged, but developments have taken such an



Two squadrons of the Dassault Rafale will augment the IAF strength by 2020-21

incredibly long time that initial armament and technology have become obsolete. To encourage Hindustan Aeronautics Limited (HAL) in manufacturing the LCA, we have maintained the Air Staff Qualitative Requirements (ASQRs) of the first 20 LCA MkI at the standards issued back in 1985!

Even though the first squadron was formed in June 2016, it is equipped with only 12 aircraft. As of today, the backlog with HAL, due to the long overhaul cycle and delays in upgradation, is approximately one squadron of the Jaguar, nearly two squadrons of the Su-30 which are delayed

by over two years, and the LCA production commitment by over six years. To make up for losses, HAL must play a key role to step up manufacture and overhaul.

We desperately need the HTT-40 basic trainer to do our Stage II training, along with basic training as the Intermediate Jet Trainer (IJT) project has not yet succeeded after 15 years. To overcome our production delays and the falling number of fighter squadrons, we, thus have had to make emergency purchases as we needed equipment for winning the high end fight, for which the government has sanctioned the purchase of Rafales and the S-400.

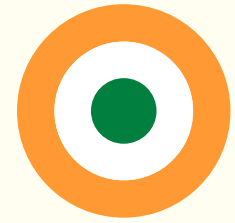
We are also mindful of our commitment towards conserving natural resources. The IAF, in collaboration with the Bureau of Standards, has realised international grade bio-fuel standards and this will not only reduce the carbon footprint by military and civil aviation but also bring an additional source of income for our farmers. 🦋



The futuristic AMCA, being developed by ADA

Air Marshal Harish Masand on

STEMMING THE SLIDE



The IAFs depleted strength: causes and remedies



Sukhoi Su-30MKIs at an IAF base

Despite its creditable performance in recent exercises like *Gagan Shakti* and the Air Power Display at Pokhran followed swiftly by actual operations over Balakot and its aftermath on 26 and 27 February respectively (see *Vayu Issues II and III/2019*) the Indian Air Force is undoubtedly facing a severe crisis in terms of its depleted combat numbers. Against its sanctioned strength of 42 combat squadrons, it is progressively and effectively down to about 30 squadrons while the security challenges facing the nation and its first responder, the IAF, have only continued to grow. Modernisation of the Chinese military including its air force (PLAAF) and the navy (PLAN) along with growing strength and modernisation of the Pakistan Air Force (PAF) albeit with Chinese support, have made the threat of a two front confrontation, even if not a full-scale war, a realistic possibility for India. As a matter of fact, with rapid growth and unprecedented modernisation of the PLAN, there is distinct possibility that a hostile situation could easily confront the IAF with concurrent threats on three fronts, the third being in the maritime domain with increasing presence of PLAN in the Indian Ocean.



Jaguars over the Rajpath



MiG-21s at a forward base

Salad Days

The IAF last saw major expansion and modernisation during the two decades following the 1971 war, with induction of the Jaguar, MiG-21M/Bis, MiG-23BN & MFs, MiG-27, Mirage 2000 and MiG-29s during the 1980s bringing it close to its sanctioned strength of 42 combat squadrons. Because of this, since the 1970-80s, the IAF enjoyed at least a modicum of

technological superiority over its potential adversaries, including China, which could deter them, thus maintaining an overall semblance of peace and stability in the region, minor skirmishes and stand-offs on the ground notwithstanding.

This edge has now been lost with modernisation of the PLAAF, PAF and PLAN. Importantly, India has not been able to keep pace with the large numbers

of 4th and 5th generation fighters along with supporting elements presently being inducted by China. Such lost deterrence, both in quantity as well as technology, would certainly embolden its two adversaries to, at the least, launch limited operations, perhaps concurrently, to test the IAF as well as gain their limited objectives.

Rude Awakening

The incursion by PAF fighters on 27 February 2019 following the Balakot attacks the previous day may be taken as an example of such attempts on a chosen front. That the IAF reportedly responded with just some 8 to 10 aircraft against a force of 24 PAF fighters may be indicative of the way it is thinly spread on all fronts.

Exercise *Gagan Shakti* of April 2018 reportedly had the IAF producing 11,000 sorties over a short period over all fronts by rapidly switching west-to-north-to-east despite its depleted strength. However, such pre-planned exercises cannot be taken as the benchmark for likely responses in real-time and concurrently on all fronts. There is no escaping the fact that a certain minimal numerical strength is essential to respond to contingencies on different fronts which revolves around the actual force deployed



The Mirage 2000 has an outstanding record in IAF service



MiG-29s over the Gulf of Kutch



The Indian Air Force is the last air arm in the world to operate the Anglo-French Jaguar which type will continue in service till the 2030s



MiG-27ML comes in to land, wings swept forward

in that theatre. While some have argued that with increased multi-role capabilities of modern combat aircraft, one does not need the same larger numbers anymore, this argument is largely fallacious since it does not take into account the concurrent increased technological capabilities as well as numerical strength of the adversaries while also ignoring the impossibility of being physically available in reckonable numbers on all fronts at the same time, if the situation so warrants.

In aftermath of the humiliating reverses at hands of the Chinese in 1962, which none of us can forget, the Tata Committee had recommended a force level of 64 combat squadrons for the IAF. That level was never sanctioned or achieved largely due to budgetary constraints and the IAF was instead directed to build up to a level of 45 squadrons. Some recent studies and papers have logically argued and projected a requirement of 50-60 combat squadrons for the IAF to meet foreseen challenges from both China and Pakistan. However, with the current budgetary levels for defence declining over the last decade and more, it would be difficult to reach the sanctioned strength of 42 combat squadrons in the near future, much less an aspirational figure of 50 to 60 squadrons.

Knee jerk acquisitions

Much has already been written on budgetary constraints and our dysfunctional procurement system. While these factors are perhaps largely responsible for this state of affairs, the IAF also needs to review some of the decisions it took or was, perhaps, forced into, over the years. Unless that is done, it cannot hope to draw the right lessons for the future. After all, as a professional service, it is the IAF alone who could advise and convince the political masters as well as the bureaucrats in the ministry on the kind of forces it needs and



The Sukhoi Su-30MKI serves in larger number with the IAF today, and more are expected to join the inventory



The MiG-23U operational conversion trainer



Two-seat Mirage 2000TH operational trainer

then try and stitch the coat within the cloth available, so to speak.

As some examples, when the PAF inducted the F-16 in 1981, the IAF did not really have to rush or be politically pushed into the knee-jerk purchase of two squadrons of MiG-23MFs, which in any case were really no match for the F-16s. There were no immediate prospects of a shooting war at that particular time and a rushed purchase of an entirely new type only squandered the budget available, apart from the problems of maintenance and logistics of a small fleet. Soon thereafter, the IAF

identified the Mirage 2000 from France as the best available aircraft to counter the F-16s and signed a contract for two squadrons of these aircraft in 1982-83 with deliveries from 1985. The Mirage contract had an option clause for license manufacture of more aircraft, to be exercised within about three years of delivery. Considering that everyone in the IAF swears by the Mirage 2000 even today and many wanted to buy more of these, even as the MMRCA in 2001, it was curious, though later understandable, when this option clause was not exercised.

Soon after India signed the deal for the Mirage 2000, the Soviets offered us the yet unveiled MiG-29 *Fulcrum*, which was till then seen only in satellite pictures and given the code Ram-M. The MiG-29 was certainly a better air superiority fighter and we soon opted for two squadrons of these as well which were inducted in the IAF from 1987 followed by a third squadron in 1989. Though the MiG-29 was initially configured mainly for the air superiority role, considering the potential it had for upgrade to multi-role capability – and also because it was far cheaper in acquisition costs – it was understandable that the IAF opted for this aircraft, though it meant yet another type was received in small numbers with consequential difficulties in maintenance and logistics. The MiG-29 contract, once again, had the option clause for license manufacture of 150 aircraft. However, the IAF failed to capitalise on this option and the MiG-29 was much maligned later, I feel incorrectly, for its maintainability.

Maintaining the Force

While this would be the subject for another detailed analysis, it needs to be briefly stated here that, for some strange reason, the IAF did not look at the logistics and 3rd/4th line maintenance of this aircraft even as late as 1991 when it was being offered to us for a pittance compared to what we had spent for maintenance facilities for the two squadrons of Mirage 2000s. It took us another three years and close to twice the costs to procure the 3rd/4th line servicing facilities for the MiG-29 from Russia. By then, owing to rampant cannibalisation, we had literally ruined the existing aircraft and systems. Even as early as in mid-1988, as Commanding Officer of No.28 Squadron, I had brought to notice of the inspecting C-in-C that while the



Squadron was maintaining a serviceability of about 90% with 100% radar availability during the warranty period, I expected this to drop to 50% by end of the year. On being questioned, I had mentioned the state of spares citing the example of Block-02 of the radar of which we had procured just one for the two operating squadrons even without establishing 3rd line or I-level servicing facilities.

Considering the supply chain from the Soviet Union and the prevalent indenting system, that meant that we expected an MTBF of over 12,000 to 16,000 hours for the Block-02 since this one spare would have to last for 3-4 years operations of the two squadrons before we got another spare. The spares state was similar for other systems and avionics too. In 1989-90, as the COO in Adampur, where we inducted the third squadron of MiG-29s, I had conducted a study on the MTBF of various systems with the active support of the STO of the Squadron, then Sqn Ldr SK Gupta, and found very good figures for the MTBF of all systems. The problem essentially was that the IAF those days did not look at MTBFs closely and did not base its logistics on the expected MTBF till we got to the MiG-21Bis upgrade in 1993-96.

For the MiG-21bis upgrade, every contract for the new systems had an MTBF-linked warranty and the initial spares package was based on MTBF figures multiplied by operational deployment requirements even with provision of I-level facilities for all planned bases. Unfortunately, even after introduction of such contractual provisions and operating methodology in the IAF through the Bis upgrade programme, we did not include this in many other procurement contracts till the draft DPP prepared in 2001 included MTBF-linked warranty as a mandatory requirement.

Options not considered

In December 1993, as a Group Captain, I was put in charge of the MiG-21bis upgrade programme, later known as the Bison, and was on the first visit to Russia to evaluate the Mikoyan proposal for the upgrade with then Air Commodore Phillip Rajkumar, the DASR, as team leader. During this visit, we were taken from Moscow to Nizhny Novgorod at the MiG factory for the day. While driving through the very long tarmac, we noticed a large number of cocooned aircraft which looked like the MiG-29s. So, I asked our escort through the interpreter what these were doing, all wrapped up. We were told that there were over a hundred undelivered MiG-29s after break-up of the Soviet Union. Since the Russians with us knew I was a MiG-29 pilot, having been so introduced to them by the Mikoyan Chief Designer Mr RA Belyakov, we were immediately offered all those aircraft at an unbelievable throwaway price of US\$ 1 billion which amounted to less than \$ 10 million per piece! I am certain that if we had followed up on this and negotiated this deal, we could have got those for even less and perhaps even upgraded them to multi-role capability along with the MiG-21bis, all around the one billion dollars. Also, if we had pursued this option, we may not have had to desperately look for MMRCAs in 2001.

It may be recalled that, at that time, the Russians needed funding badly and were selling leftover stocks at throwaway prices just to keep their own establishments running. It is perhaps the last 21 of these aircraft that we have heard about in the media as being purchased by us for around Rs 600 crore.

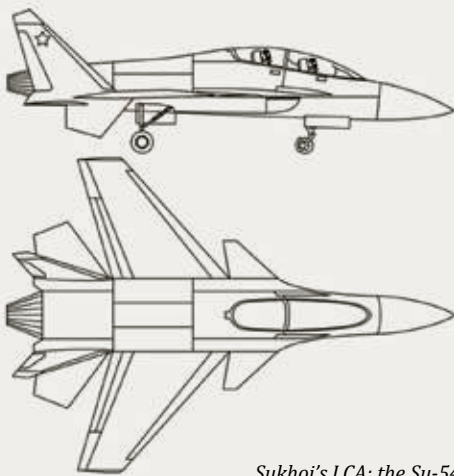
But back to that time in the 1990s, it was also reported that the Israelis and Chinese had picked up not only a large number of defence-related spares—some

reports said full factory inventories – but the Chinese also employed a large number of Russian scientists and designers to work with their own defense industry, all at minimal prices at that time. However, we did not do any thing of that sort, leading to shortage of spares and maintenance issues later with our large Russian inventory even while we were forced to purchase Russian spares piece-meal from other firms through intermediaries at much higher costs. As I conveyed to some friends in late 1991 when the Su-27 was being displayed in Hindan for the first time in India, one buys stocks when the market has collapsed and everyone else is selling, especially when you have faith in long-term prospects and need to invest for the long-term.

The back ground to the MiG-29 offer was a visit by Mr Belyakov with his team to Poona in January 1988 where we had just inducted the MiG-29s. Mr Belyakov had asked us for our experience on the aircraft and what could be done to improve it. I had personally given a list of systems needed to be changed/upgraded including the need for a multimode radar, a more accurate inertial navigation system which is, in any case, essential for the multimode radar, EW systems and some changes in the airframe and engines to make the MiG-29 a “super fighter”. In Moscow, Mr Belyakov recalled all this while introducing us to his team and had told me of the work in this direction. Much of what we were trying to put in the MiG-21Bis could have easily been accommodated on the MiG-29 and given it a true multi-role capability. It would also have been more economical had we initiated the MiG-29 upgrade along with or soon after the MiG-21Bis, more so considering the larger numbers now involved and available even cheaper than we could have built them at. Unfortunately, we opted for yet another new type, the earlier rejected Su-27 (or its Su-30 variant) in mid-1994 and picked up just 10 MiG-29s as reserves in 1995 at about US\$ 25 million a piece.

Russia's LCA

Interestingly, during the same visit, while in Moscow, Air Commodore Philip Rajkumar and I were invited by the Chief Designer of Sukhoi. During this meeting, he showed us the design of a single-engine light-weight fighter in class of the LCA (the Su-54), programme that we were pursuing indigenously, built around the R-25 engine



Sukhoi's LCA: the Su-54

already license produced by us for the MiG-21, and offered to build or help to build this type for us within a cost of US\$ 5 million per aircraft. While we certainly did not want to abandon the indigenous LCA programme, the offer clearly indicated the opportunities around the LCA as well as other indigenous development programmes with Russian design help while containing costs. Unfortunately, we did not consider this option with any seriousness.

As for containing costs as professionals in the IAF, owing to obvious budgetary constraints, example of the Sukhoi Su-30 comes readily to mind. In this context, the previous Defence Minister, Ms Nirmala

Sitharaman, had stated on the news channel *Times Now* on 13 December 2018 that the Su-30 built by HAL costs 45% more than that directly imported from Russia. As Director Projects, at Air HQ, I happened to be the Air Force representative in the negotiating committee for license production of 140 Su-30MKIs by HAL in November/December 2000, headed by then Additional Secretary in the MoD, Mr Dharendra Singh. The bottom line taken by HAL in these negotiations was that the Su-30 produced by HAL should cost \$ 1 million less than the Russian one, otherwise it did not make economic sense to licence-produce the aircraft. The costing of raw materials, other components, NRCs and even the larger initial man-hours of HAL were accordingly worked out and agreed to. All this should have been part of the license production contract signed by HAL. Despite this, it was surprising to see the above statement by no less than the Defence Minister. It also indicates that somehow HAL costs have run amuck over the years and the IAF has not been able to counter the reasons for these and contain the costs, thus adversely affecting the budget for other acquisitions. Some

other examples of HAL costing have also been included in my earlier article *What Really Ails HAL*.

Such unchecked costs and overruns, from all suppliers, public or private, obviously impact on the availability of funds for other urgently required systems in our capital acquisition programme.

The MMRCA Imbroglio

In late December 2000, I was appointed as the Director ASR for just about a year. Along with this assignment came chairmanship of the ASR committee, which, at that time, amongst other things, was formulating ASRs (or QRs) for the 126 MMRCA to meet urgent requirements for about six squadrons of combat aircraft owing to delays in the LCA programme. Considering the likely budget as also the operational requirements, we were working on a 20-ton class of aircraft, which would have shortlisted the Mirage 2000-5, the F-16, Saab Gripen and the upgraded MiG-29 to compete. All these aircraft were expected to cost within \$ 50 million a piece as per available information. Therefore, the budgetary requirement was calculated to be \$10 billion for the programme considering



Various types initially considered for meeting the IAF's MMRCA requirement. Clockwise from top left: the Saab Gripen; LM F-16; Dassault Mirage 2000; MiG-35

about \$ 6.3 billion for the aircraft and the remaining for ground/test equipment, weapons, initial spares and maintenance facilities.

In about September/October 2001, the Ops Branch decided that instead of going through a global tender, they wanted more Mirage 2000s that had done so well in the Kargil operations of 1999. This proposal was however rejected by then Defence Minister, Jaswant Singh, who did not agree with a single-vendor situation for such a large purchase, as against a smaller number to cater for wastage and reserves, although he accepted the necessity for procurement of 126 aircraft. He directed that we formulate ASRs for the required aircraft and then start the acquisition process. Fortunately, we had almost finalised the ASRs by then and were ready to commence the process. For some reasons thereafter, the process got derailed and the RFP for the 126 MMRCA was issued many years later, in 2007 with new ASRs now also permitting 30-ton class aircraft to compete. The cost implications were obviously not revised and, as per information in public domain, the L-1's bid for initial acquisition of 126 Rafale aircraft was around \$ 28 billion in 2011. It was, perhaps, due to such high costs that the Rafale deal did not go through, amongst other reasons which have been reported from time to time. The

essential point being made here is that, to fill the deficiency in combat squadrons, we, perhaps, did not consider if large numbers of such high cost aircraft would fit in our likely budgets and now find ourselves with a depleted combat force.

Cost effective approach

Having given some examples of the decisions which may have contributed to the current situation, essentially to draw some lessons for the future, let me suggest some of the steps that could now be taken to redress the deficiencies and make the IAF more potent, particularly with the force that is available. I intend to focus more on the in-house steps since the allocation of required funds and the entire procurement system are not in our control. Quite obviously, acquisition of the numbers required to bring the strength up to 42 combat squadrons, even while more types phase out, would not be possible even in more than a decade, considering the current budget as well as our dysfunctional procurement system. Therefore, while continuing to work towards larger budget allocations and expediting the procurement process, the IAF must find more cost-effective measures in-house to better utilise its available force in the intervening period.

The first obvious measure is to make efforts to improve availability of the existing

force. A lot of reports in the public domain indicate poor serviceability and availability of some of our combat fleets, particularly the Su-30. While I am not privy to any inside information and the reasons for this state, I can only conjecture that, perhaps, the major reason for this state in front-line squadrons is that we have not captured the field MTBF of systems on the Su-30 despite years of operation of this type, the lack of an MTBF-linked warranty in acquisition of this aircraft already having been pointed out. Based on accurate capture of the field MTBF figures for all systems, the logistics of acquiring requisite number of spares to sustain the desired serviceability and availability could be put in place. While this may add to the revenue expenditure, it would still be more economical than outright acquisition of new aircraft and is possible within the available budgets. At the same time, measures should be initiated to harden the systems and improve the field MTBF of the systems.

Also, in systems where the MTBF-linked warranty is contracted for, we need to keep an accurate record of all servicing, failures and repairs as required in contractual clauses to be able to enforce the contractual terms on vendors for both repairs and maintenance of the systems as also further hardening and improvement of their field MTBF. Non-maintenance of such records for tabulation and verification generally results in the vendor finding an escape route from the contractual obligations.

Perhaps in this area, we may also look at the maintenance philosophy being followed to cut down the time taken for pre-flight inspections and to prevent burning the systems on ground. My experience with the initial daily servicing of the MiG-29s indicates that we may be over-testing the systems and burning them on the ground. As an example, the first squadron equipped with this aircraft in June 1987, followed the 8-trade system then prevailing in the IAF and each tradesman tested the individual systems in the pre-flight testing thus prolonging the system testing on the ground, that too without air-conditioning. In my squadron, I implemented the Built-In Test (BIT) procedure based on the IRAN (Inspect And Repair as Necessary) concept right from the first day in October 1987 when we received our aircraft. This method required just 15 minutes for pre-flight inspection by the single L-tradesman while



More Sukhoi Su-30MKIs have been ordered from time to time to make up continued depletion of IAF fighter strength



The two-seat Sukhoi Su-30MKI

another story for another time. Due to this, not only did we cut down on the testing time thus ensuring faster availability and better utilisation, our systems including radar did not easily fail and we had 100% serviceability of all systems till the aircraft went in for 2nd line servicing. Unfortunately, there I could not stop cannibalisation from our aircraft to service the other squadron's aircraft lying unserviceable due to non-availability of spares as mentioned earlier. Later, the AOC-in-C himself approved adoption of the FLM (Flight Line Mechanic) or crew chief system for the fleet cutting down on the manpower. Unfortunately, by then we had already burned a lot of systems with ad-hoc repairs adversely affecting the future reliability of the systems.

two M-tradesmen did the physical checks and replenishment.

We implemented this system through then Flt Lt Shera and my STO Sqn Ldr Bharadwaj, with the AOC Air Cmde JP Singh's permission. As a matter of fact, the technical publications even had an operational pre-flight system wherein only replenishment and arming was required with the BIT system indicating if there were any failures after starting engines. These procedures permitted faster turn-around and better availability of aircraft with maintenance only on an as required basis. On operational detachments, we even followed the latter system thus cutting down on the time and effort required to keep the aircraft flying. The problems of implementing such a system in the prevalent environment then make for



The Mirage 2000 remains the IAF's front line multi-role combat aircraft



MiG-21 variants of the IAF: at their peak, over 20 squadrons of the IAF were equipped with this type, or near fifty percent of the Force



'Air Warriors' with the MiG-29UPG

Force Multipliers

The other step that we could take is to focus more on combat support systems including EW, ISR, AWACS and AAR aircraft, while pursuing acquisition of combat aircraft. These would act as force multipliers and increase potency of the available force. As just one example, with a much larger number of AWACS, we could significantly cut down on standing patrols by combat aircraft thus conserving their life as well improving the availability and utilisation in times of actual need. Quite obviously, this would help us bring a larger and more potent force to bear at the right time, and the chosen place, as if we had a couple of squadrons more on our strength. In any

event, in the modern battlefield, to send an aircraft without AWACS cover, and an EW system, is like sending a blind lamb to the slaughterhouse. The cost of acquiring the requisite number of combat support systems would also be far less than the cost of required number of additional combat aircraft and could be accommodated in the budget, admittedly at the cost of delaying the last combat squadron or two. Thus, while the IAF works towards building up the number of combat squadrons to the desired level within the allocated budgets over a decade or more, such force multipliers could be used to minimise the ill effects of the depleted strength through more effective utilisation.

To be more conservative ?

Another measure that the IAF may consider is to pitch its operational requirements a shade more conservatively instead of looking for weapon systems which are known beforehand to be too expensive. The intent should be to acquire larger numbers initially at affordable costs on the lines of cutting the coat based on the available cloth. The recent experience of the aerial engagement post-Balakot may be taken as a pointer in this direction. One just needs to imagine the scenario if we had been able to launch 20 or even 10 of the low-cost MiG-21Bisons with a few more high-end Su-30s, MiG-29s, and/or Mirage 2000s in a potent mix for the engagement on 27 February instead of just 4 or 6 MiG-21s (as reported by the media). My views on this engagement and the results are available in the article *F-16 vs MiG-21bison Imbrolio: More Questions than Answers* which appeared in *Vayu Issue III/2019*. Even the US is now working towards a mixed force with a large number of inexpensive expendable drones along with high-end fighters.

In this regard as well as some of the other remedial measures suggested here, the example of China might also be studied. While China is trying to compete with the US to assert its position, particularly in the western Pacific (and Space in the initial stage), it is a well-known fact that Chinese military technology would take some time to come up to levels of the US in most fields. Despite this limitation, the Chinese



Force multiplication: IL-78MKI air-refueling Jaguars

are relentlessly pursuing larger numbers of affordable modern indigenous systems to try and swamp the forces and systems that the US could bring to bear in its area of interest in an effort to deter the US from interfering while the Chinese continue with creeping attainment of their objectives in what has been called the *salami slicing* strategy.

Considering that the MiG-21Bison is still an effective weapon system in numbers for at least some of our needs, based on our experience post-Balakot, is highly affordable and was license-manufactured by HAL, we may also consider finding ways and means to extend their life and product support somewhat longer to alleviate further progressive depletion of our combat strength. Product support for all the new avionics and systems, incorporated during the upgrade, should in any case be available since these have barely done 20 years of service so far. This may also help in progressively reducing the number of types that we have to maintain in our combat fleet thus reducing future cost of logistics and maintenance. Reducing the number of aircraft types we operate to the extent possible should also be our endeavour to cut down on the problems of logistics, maintenance and costs.

Further, once the operational requirements are set, they should be frozen catering for the likely procurement and development time. Changes in operational requirements once the procurement process is initiated not only delays the process unnecessarily but could also result in eventual cancellation of the programme, with much

funding and time wasted. I would quote just two examples to highlight the point.

In 2001, soon after I took over as DASR, I found a case for procurement of some LOROP (Long Range Oblique Photography) systems stuck in the ministry for over two years, even though acceptance of necessity had earlier been granted. Getting into details, I found that the case was stuck with MoD Finance, which was objecting to this acquisition on grounds of satellite imagery being made available in the near future. Through the DCAS, then Air Marshal TM Asthana, I pushed a long reasoned note to the Defence Secretary, then Mr Ajay Prasad, who called for a meeting with the FA(DS), as the post was then called. In this meeting, we technically convinced the FA(DS) on the need for a multitude of complementary reconnaissance systems instead of reliance on just one or two systems. As a matter of fact, in a diplomatic manner, I even made a point that if the Defence Secretary had accepted the necessity as the executive branch of MoD, the finance branch ought not to be questioning the necessity but confine itself to the budgetary and financial aspects. The file was cleared within two weeks as promised by the Defence Secretary. Unfortunately, thereafter, the Ops Branch changed its mind and now wanted a completely different system with different QRs resulting in a fresh case being initiated.

The second example is of the MiG-21bis Upgrade programme. This was a comparatively shoestring budget programme

having been cut down from the estimated \$ 850 million to \$ 626 million. Because of this, we had to look for “the best bang for the buck” while meeting the operational requirements as laid down by the Ops Branch. In this process, we had identified a Video Recording System (VRS) with a four-channel recording facility. At that time, we had the requirement only to record the HUD with outside view and the HDD with the airborne radar picture with the other two channels as spare for perhaps the EW system when carried and an electro-optical pod if integrated to the aircraft in its remaining life of about 20 years.

The contracted VRS had a capability of recording 16 frames per second, which could be divided between the channels through a simple mechanical selection giving us 64 combinations. The system was also accordingly contracted for at very economical costs. Once the D&D work started in Russia in 1996, and I was still in Air HQ as the Director Aircraft Upgrade, our project team in Russia forwarded a requirement to modify the system with an electronic selection mechanism providing many thousand combinations. The vendor was obviously willing to provide a new electronic control system with additional costs and time. I strongly opposed the proposal since such large number of combinations was unnecessary and not truly usable. Fortunately, my immediate superior, the ACAS(Plans), AVM Sisodia, agreed with me and turned down the proposal. Nevertheless, time and effort were wasted and contributed to the confusion



Upgraded MiG-21bison

and, possibly, to overall delay in the D&D phase. The essential point being made here is that we need to have a firm and clear requirement and once the procurement has commenced or contracts signed, the requirements stipulated in the contracts cannot generally be changed without serious impact on costs and time.

Complexities in contracts

Even after setting the firm operational requirements, it is important to have well trained people, with innovative mind-sets and approaches, to assess, benchmark and negotiate fair costs while expediting the planned acquisitions. Defense Acquisition, *per se*, is a complex process, covered as it is in layers of national security with resultant lack of authentic published material, limited number of manufacturers dealing with defence products in a narrow

and the ministry itself, personnel placed in the procurement field are generally without any formal training, previous exposure or even an assessed flair for such assignments.

My own induction in the MiG-21Bis upgrade programme in late 1993 was without any background in this complex area. Personally, having been in the operational field assignments till then, I was not even keen on getting into that job and was certainly not *au fait* with working of the Ministry. It was my own pupil, then Wing Commander N Motilal, who spared me a lot of time during the 15 days that we were together before he left Air HQ, and gave me some good essential grounding. It was thanks to this and later my good fortune, that I did not fall on my face and was able to complete this programme, initially budgeted at US\$ 850 million and later approved at

to drop them home in my small Maruti, that we could finish the programme in the time and manner that we did, charting out unprecedented contracts along the way. The point being made is that procurement results can be achieved despite the hurdles of processes and the bureaucracy, if one knows the objective and has a clear vision of the manner to get there. Formal training in this area is however a definite necessity.

At the end of my tenure as Director Aircraft Upgrade in the latter half of 1996, I had suggested a capsule course for all the IAF personnel being inducted into procurement, including those from Maintenance and Logistics branches, so that they could start with a fair knowledge of the processes as well as nuances of defense acquisition to economise as well as expedite the process. Over time, I felt, the contents and utility of such initial training would progressively improve with the experience and inputs of future generations. However, as far as I know, apart from a few seminars at the IDSA and some visits to the Defense Acquisition University in the USA and such establishments in other countries in this intervening period, the system of such in-house training has not been implemented. If it has been, the IAF could relook at the contents of such training to further improve its own procurement system and processes. Such training would certainly help in expediting decision making at various levels, particularly if there are no personal interests in the procurement.

Towards this effort, one may also wish to see the paper on *Challenges of Commercial Evaluation* at an international seminar on defense acquisition organised by IDSA in July 2011 wherein I had presented my views on benchmarking of costs, negotiations and contracting issues. Many other international speakers also shared their experiences at this seminar, these having been compiled and published in a book by IDSA. I am also aware that since then, IDSA has visited defense acquisition organisations and universities in other countries and submitted reports in this area. All these need to be looked at and adapted to suit our requirements, organisational ethos and 'culture' to make them work for us. The importance of trained personnel with expertise and a flair for negotiations in this domain cannot be over-emphasised since such people produce results regardless of hurdles and actually help mould a workable structure.



limited market and various national and international controls on sale of arms. It is certainly not an open or transparent market and the products themselves have become increasingly sophisticated and technologically complex of an increasingly proprietary nature. In such an environment, it is difficult to assess fair and reasonable costs as also to be able to negotiate the costs along with implementable contractual terms. In the IAF, in fact the armed forces

\$ 626 million, within the \$600 million with unprecedented contractual terms included like the MTBF-linked warranty, which have now become a standard part of the DPP. All this was achieved with a small team of just two other officers, Wg Cdr Rajesh Sethi and Sqn Ldr Mokashi, and two clerks, Corporals HK Sharma and Satyakumar Yedla. It is through their dedication and tireless work, on many occasions till 2 in the morning when I used

The indigenous defence industry

The IAF should also consider doing more to help develop the indigenous defence industry. While there is no denying that our Defense PSUs and the DRDO have not performed to the desired levels, it is a concurrent reality that we cannot hope to acquire cutting-edge technology from foreign vendors, owing to a host of reasons. Even when some limited 'advanced technology' is given to us, this would be at huge costs both because of lack of competition and the natural desire of foreign vendors to not just recover their R&D costs but also reap profits. Much has already been written and published on this issue, that of developing a mature indigenous defense industry and I do not wish to repeat those arguments in this article. All that needs to be re-emphasised is that it should be obvious from our experience so far that, in the long-term, there is just no alternative to a high degree of self-sufficiency in this area. Towards this effort, in order to boost

'Make in India' as a partner and not as a mere customer, the IAF should depute and/or permanently place adequate number of selected qualified engineers and operators in DRDO and defense PSUs, as project teams, for sufficient duration to guide and steer the R&D efforts towards systems needed by the IAF.

We should also encourage our engineers to apply for advanced courses at IITs to generate a pool of experts for such efforts. Without adequate and meaningful participation, we cannot ever hope to make the defence industry focus on our current and future operational requirements with sustained development or even replication efforts. Surely, if we can develop world-class space systems and ASAT missiles at very affordable costs, our indigenous defence R&D is capable of developing worthwhile avionics and other systems for the armed forces. In my opinion, all it requires is the will and the right leadership and team to get it done.

The LCA programme

An example of our 'benign neglect' is arguably the LCA programme where after sanction of the programme in the mid-1980s, the IAF did not place a project team at ADA for a long time with a mutually agreed and well-defined role, responsibility and due authority to help steer the programme. In the late 1990s till about 2001, we had the National Flight Test Centre (NFTC) shouldering this role, with Air Marshal Phillip Rajkumar heading it and providing advice to ADA/HAL. Later in 2005, as an Air Marshal, I was deputed to ADA as an advisor on an ad-hoc basis, but without even a staff that and only for 8 months. Still, the IAF did not really have a say on how the programme was being run and the priorities in development and testing.

The fact that eighteen years after the LCA's first flight in 2001, we are still to achieve full operational clearance in 2019, even with concessions, reveals the manner in which the programme has run. After 2006, the IAF did position a regular project team at ADA, led by an Air Vice Marshal, which was perhaps too little, too late to get the programme going in the right direction, with defined timelines and costs. We needed to have had a team, large or small depending on how the IAF regarded significance of the programme, from concept to operationalisation to get optimum results from the indigenous defense industry.

The Private Sector

At the same time, India's private industry needs to be encouraged to invest and build systems for the armed forces while incubating a robust supply chain for components both for the domestic, and even international markets to meet our aim of 'Make in India'. Even while the Government takes suitable steps to encourage involvement of private enterprises in defence, once again the IAF should also encourage and help private industry in absorbing suitable personnel from the IAF, particularly those who are nearing the end of their term of engagement or have completed their terms. With the help of such specialists with their invaluable domain knowledge, and experience as well as loyalty to and respect for their old organisation, private industry would not only progress substantially to develop and produce required quality systems in time for



National hope for the future: the Tejas Light combat aircraft (LCA)



LCA performs at an Aero India show



Tata's aero structure factory in Hyderabad

the IAF but progressively contribute more to indigenous efforts. Through such specialists embedded in private industry, we would also 'educate the industry' in concurrently realising that business expertise and profits in defense related items come with time and patience over the long-term instead of focusing on just short-term gains.

Initially, during the learning phase and till they acquire the requisite expertise and skills in the military aviation sector, private industry could be given work on components and systems instead of big-ticket items, which they would be tempted to bid for through mere screwdriver technology transfers from foreign partners, as has been the case with our PSUs. Certainly, the DRDO could also help by letting the private industry produce systems developed by DRDO at minimal R&D or licensing costs.

Costing of such systems also needs to be carefully evaluated and monitored through various measures like benchmarking, competitive bidding etc to ensure that we do not end up paying exorbitant costs in the name of indigenous development and the 'Make in India' effort. I have already given an example of HAL's costing practices. As a start, while rightly pursuing the LCA programme, perhaps its also time to revisit the costs, particularly of imported systems in this programme, and, if required, consider integrating our own indigenous systems in future versions/upgrades to bring down costs of the LCA, as also making it a more potent weapon system. This approach would be practical even as we progress our Advanced Medium Combat Aircraft (AMCA) programme. Since India's private industry is still nascent in the defense sector,

we would do well to ensure that it does not go 'the HAL way' as also of some other PSUs owing to lack of a suitable guidance, monitoring and evaluating mechanism.

Training, training, training!

The last in-house measure I would like to suggest is for the IAF to review its training and flight-safety measures to ensure that we do not lose precious resources in avoidable accidents or incidents. Every asset saved is an asset we do not have to procure which comes at the cost of other pressing requirements. The same applies to our human resources. With developments in technology over the years, systems have much better reliability and redundancy and with quality training, it should be possible to reduce the accident rate to a bare unavoidable minimum, if not a complete zero.

It is a well-known fact that most accidents in modern IAF aircraft like the Jaguar, Mirage 2000, MiG-29 and now even the Su-30 and C-130 have been due to human error. This was also established in a flight safety study carried out in the early 1990s of which I was a part. This is a vast subject and cannot be dealt with here owing to constraints of space. However, in brief, many suggestions have been made over the years on the selection, quality of training as well the leadership and supervision issues in operational squadrons. The measures suggested were not just for fighter squadrons but also all transport and helicopter units since these also face similar challenges in meeting military tasks while operating in difficult terrain and conditions.

In my experience, every accident or incident gives a forewarning and there are

tell tale signs of an impending disaster, whether it is in flying, maintenance, support services or administrative areas. A good leader and supervisor gets to notice such trends early enough permitting timely preventive action through close and regular interaction with his team at all levels by winning their trust. I had also propounded that it is better to have empty cockpits on the ground than to have no cockpits or pilots through losing aircraft and pilots in the air considering that the lives of people are infinitely more precious than any other consideration. Based on that, I am of the opinion that it is better to remove the identified weak links and use them elsewhere than to continue with them owing to other extraneous reasons. Also, almost all weak links realise it within themselves but are unable to admit it on their own till identified and counseled by a supervisor. This can be done in a humane and cordial manner without hurting the ego of the individuals or shattering their professional lives.

Personally, I remember cases where the individual, so eased out of his situation, later thanked me for saving his life. An odd individual may turn revengeful then or later but that is a price one has to pay for the sake of the organisation. We may revisit these areas and implement some of the suggested steps, with any refinements that may now be available with developments over the years.



The author, Air Marshal Harish Masand was the first CO of No. 28 Squadron ('First Supersonics') when they were re-equipped with the MiG-29

Dominating Indian Skies



Sukhoi Su-30MKIs with the IAF

The Sukhoi Su-30MKI is arguably the most significant combat aircraft with the Indian Air Force extant, the Service having received near 250 of these heavy fighters over the past two decades, with more to come.

Genesis and progression of the programme has been studiously recorded in issues of the *Vayu Aerospace Review* since the first tranche of aircraft (Su-30Ks) were received at Pune to equip No.24 Squadron in March 1997. Thereafter, in a complex development programme, involving both the OEM in Irkut and the Indian licensee HAL, the Su-30K evolved over several stages into becoming the Su-30MKI Mk.3, incorporating systems from Russia, France, Israel and India.

In 2019, the Indian Air Force operates twelve squadrons of the Su-30MKI and is to receive a last batch of some 21 aircraft to make it some 14 squadrons flying the Type including those with the TACDE. Following the first 50 aircraft received from Russia, HAL were contracted to build 222 aircraft at their Nasik Division and there

have been reports that another 18 aircraft would be ordered on HAL to make up for attrition and add to the TACDE. According to other sources, the figure could well be higher as the IAF faces serious depletion of its combat aircraft strength.

Contemporary Systems

As per public domain, cockpit of the IAF's Su-30MKI incorporates a customised version of the Israeli Elbit Su 967 head-up display (HUD) consisting of bi-cubic phase conjugated holographic displays and seven



Su-30MKI at Yelahanka during Aero India Show



On public display IAF Su-30MKI at Yelahanka

multifunction liquid-crystal displays, six 127mm×127mm and one 152 mm×152mm. Flight information is displayed on four LCD displays which include one for piloting and navigation, a tactical situation indicator and two for display systems information including operating modes and overall status. From 2010, indigenously designed and built HUDs and Multi-Function Displays (MFD) were produced by the Delhi-based Samtel Group Display Systems. Since the IAF has opted for all its Su-30s to be twin-seaters, the rear cockpit has a larger monochrome display for air-to-surface missile guidance.

The primary sensor is a NIIP N011M *Bars* (Panther) passive electronically scanned array digital multimode dual frequency band radar, for both air-to-air and air-to-land/sea mode simultaneously while being tied into a high-precision laser-inertial or GPS navigation system. The N011M can track 15 air targets and engage 4 simultaneously. In the *Super Sukhoi* programme, the *Bars* radar is likely to be supplanted by the Zhuk-AESA (more on this later).

The OLS-30 laser-optical Infra-red search and track includes a day and night FLIR capability and is used in conjunction with the helmet mounted sighting system. Targets are displayed on the same LCD display as the radar while

the Israeli Litening targeting pod is used to target laser guided munitions.

The Su-30MKI is fitted with a satellite navigation system (A-737 GPS compatible), allowing for operations in all weather, day and night. The navigation complex includes the high accuracy SAGEM Sigma-95 integrated global positioning system and ring laser gyroscope inertial navigation system. The *Super Sukhoi* is reportedly to integrate avionic systems being developed for the Russian Sukhoi Su-57 fifth generation fighter aircraft.

Attracting some debate has been the Sukhoi Su-30MKI's electronic counter-measure systems. The RWR system is of indigenous design, developed by India's DRDO, called *Tarang*, which has direction finding capability with a programmable threat library. The RWR is derived from work done on an earlier system for India's MiG-23BNs known as the *Tranquil*, which is now superseded by the more advanced *Tarang* series. The Elta EL/M-8222 self-protection jammer developed by Israel Aircraft Industries is



Tail end of the Su-30MKI's massive Lyulka-Saturn AL-31FP turbofans



Su-30MKIs in formation with Netra AEW&C aircraft of the IAF

the MKI's standard EW pod. The ELTA El/M-8222 Self Protection Pod is a power-managed jammer, air-cooled system with an ESM receiver integrated into the pod, which contains an antenna on the forward and aft ends, which receive the hostile RF signal and after processing, deliver the appropriate response.

The 'Super Sukhoi'

The Indian Air Force has long desired upgradation of the essential Sukhoi Su-30MKI Mk.3 and several proposals have been worked upon involving the Service, the OEM and HAL since 2012. Some years on there were unconfirmed reports that, initially, 80 Su-30MKIs would be upgraded with new airborne radars, onboard computers, electronic warfare systems even as the BrahMos supersonic cruise missile would be carried by select numbers of the aircraft, slated to be some 40. In fact, the first test flight of a Sukhoi Su-30MKI with the BrahMos-A took place at Nasik on 25 June 2016 and first air launch carried out on 22 November 2017.

Recently during the visit to Russia of Air Chief Marshal BS Dhanoa in July 2019, he was quoted by the Russian Ministry newspaper *Krasnaya Zvezda* as stating that the IAF was planning to upgrade the avionics and weapon systems of the Su-30MKI with Russian help to make them "more" lethal. He said, "We are very pleased with the programme to upgrade the MiG-21, MiG-27 and MiG-29. Now they have more modern weapons systems and avionics. In recent exercises, we used them and were very pleased with the results. We are now considering the possibility of upgrading the Su-30, which

we have been operating for about 20 years. Accordingly, their avionics and weapons systems also require modernisation. We have requested proposals from the Russian side for modernisation in accordance with current needs."

It was also reported that the Government of India has ordered more R-27 air-to-air missiles for its Su-30MKIs which are being acquired under '10-1 projects' which mandate the three Services to maintain critical weapon systems and spares for a specified minimum period, which is known as War Wastage Reserve (WWR).

Sparring in air exercises

The IAF's Sukhoi Su-30MKI has had the distinction of sparring with several of the world's leading air arms, including those of the United States, Britain and France during bilateral and multilateral air exercises. In 2004, the IAF first sent Su-30MKs, an earlier variant of the Su-30MKI, to take part in exercises with the United States Air Force (USAF) during *Cope India 04*. The

results were then widely publicised, with the IAF winning "90% of the mock combat missions" against the USAF's F-15C. The parameters of the exercise heavily favoured the IAF, as none of the 3rd Wing F-15Cs were equipped with the newer long-range, active electronically scanned array (AESA) radars and, at India's request, the US had agreed to mock combat at 3-to-1 odds and without the use of simulated long-range, radar-guided AIM-120 AMRAAMs for beyond-visual-range combat. Later, in *Cope India 05*, the Su-30MKIs reportedly exercised with the USAF's F-16s.

Thereafter, the IAF exercised its Su-30MKIs against the Royal Air Force's Tornado ADVs in October 2006, the very first large-scale bilateral aerial exercise with any foreign air force during which the IAF used its Su-30MKIs extensively. During the exercise, then RAF Air Chief Marshal Glenn Torpy flew in the Su-30MKI and later praised the MKI's dogfight ability, calling it "absolutely masterful in dogfights."



Su-30MKI: dominant shape in Indian skies



IAF Su-30MKI together with RAF Typhoon

In July 2007, the Indian Air Force fielded the MKI during *Indra-Dhanush* exercise with RAF Eurofighter Typhoons. but reportedly the IAF pilots did not operate their radar so as to “protect” their highly classified attributes.

In July 2008, the IAF sent 6 Su-30MKIs and 2 IL-78MKI aerial-refueling tankers to participate in the *Red Flag* exercise and again the IAF did not use the radar. In October 2008, a video surfaced on the internet which featured USAF Colonel Terrence Fornof criticising Su-30MKI’s performance against the F-15C, engine serviceability issues, and high friendly kill rate during the *Red Flag* exercise. Several of his claims were later rebutted by



Early variant Su-30MKs of the IAF with F-15Cs of the USAF

the Indian side and the USAF also distanced itself from his remarks.

In June 2010, India and France carried out the fourth round of their joint air exercises *Garuda* at Istres Air Base in France, when the IAF and the French engaged in various missions ranging from close combat engagement of large forces, slow mover protection, protecting and engaging high value aerial assets. The IAF again fielded its MKIs in the *Garuda V* exercise with France in June 2014, where they manoeuvred in mixed groups with other IAF aircraft and French Rafales.

On 21 July 2015, India and UK began the bilateral exercise *Indradhanush* with aircraft operating from three Royal Air Force bases. The exercises included both Beyond Visual Range (BVR) and Within Visual Range (WVR) exercises between the Su-30MKI and Eurofighter Typhoon. Indian media reported the results in favour of the IAF with a score of 12:0 at WVR engagements! However, an RAF spokesman simply stated that the results reported by Indian media “did not reflect the results of the exercise”. According to some reports, in close combat, thrust vector control on the Flankers had more than compensated for the greater thrust-to-weight ratio of the Typhoon.

Exercise Garuda VI took place in the first two weeks of July 2019 when four Su-30MKIs of No.24 Squadron exercised with their French counterparts from Mont de Marsan air base in southern France. (Detailed report in *Vayu Issue IV/2019*). 🦋



At Exercise Garuda VI: French Air Force Rafale at Mont-de-Marsan

Team Vayu

(Images by Angad Singh, Simon Watson, USAF, RAF, FAF)

The IAF's diversified AAM range



MBDA's Meteor will equip IAF Rafales while the ASRAAM has already been integrated on IAF Jaguars and is soon to be mated with the Su-30MKI and LCA

Getting a modern inventory

Access to modern WVR and BVR air to air missiles are essential for any Air Force for gaining air supremacy over its adversaries during an aerial engagement. The development of modern WVR or BVR air-to-air missiles has come about thanks to dramatic technological advancements in propulsion, guidance (navigation) and sensor (seeker) technology, these being the most critical technologies which help the missile not only to detect targets but also to engage them. While heat-seeking close combat missiles have become more accurate because of new superior dual-mode high-resolution IR seeker technology, the radar technology has also revolutionised long-range BVRs. At start of this century even more capable radar-guided beyond-visual-range air to air munitions with active-seeker have been developed to increase the aerial engagement ranges of fighter aircraft, even up to over hundred kilometers ranges such as the MBDA Meteor, Vympel's R-37M and the Chinese PL-15 or PL-21: of these missiles, the "game changing" Meteor is set to enter the IAF's missile inventory this year, being the first time the IAF is getting this class of long-range air to air missiles.

Besides this, there is some talk on the IAF ordering the I-Derby ER which also has very long range but its details are confidential.

After the Balakot airstrike and dogfight with the Pakistan Air Force in February 2019, the Indian Air Force is in the process of enhancing its operational capability in the short and long term by boosting its woefully outdated missile arsenal. Currently, the IAF already has many foreign missile systems of Russian, Israeli and French-origin, with its frontline fighters such as Su-30MKI, Mirage2000 and Mig-29UPG but most

of them are obsolescent and need to be supplanted as soon as possible. The world's 4th largest Air Force is now set to induct more new-generation indigenous and foreign air to air missiles in this year.

Current AAMs in IAF service

The current existing AAM inventory of the Indian Air Force are mostly short-range and medium-range air-to-air missiles, with ranges between 20km to 100km. Apart from this, the IAF is also rumoured to possess the long-range 'AWACS killer' called Novator



Russian missile with French fighter Vypel R-73 fitted on a Mirage-2000 (picture released by NDTV)



The MiG-21bison with its two types of Russian AAMs

KS-172, a Russian designed long-range AAM which can hit targets at 300-400 km range.

For close combat, IAF presently uses the Vypel R-73, Israeli Rafael's Python-4 and Python-5, MBDA's short-range ASRAAM and the older R550 Magic 2. Of the close combat munitions, the R-60K and R 550 Magic 2 are obsolete while Vypel's R-73 is still a capable CCM in dogfights. There was some surprise in late February 2019, when this aging close combat missile was fired from a

mounted sight as confined when an IAF Mirage 2000 was seen with the Russian R-73 air to air missiles for the first time in June this year. NDTV Editor Vishnu Som reported on this new mating of the Russian CCM to an IAF pilot's helmet mounted display DASH, manufactured by Israel's Elbit Systems.

The Israeli Python 4 and 5 have been in service with the IAF for some years. While the Python-4 AAM is a fourth-generation missile with limited 'fire and forget' capability, the Python-5 is superior

its design, the missile can perform excellent manoeuvres comparable to a thrust vectoring nozzle powered air to air missile-like Diehl's IRIS-T, but is 15-20kg lighter than its predecessor and can hit aerial targets at over 20km range with speeds of Mach 4. The IAF was in the process of integrating the missile on its indigenous Tejas fighter but in 2017 they selected MBDA to integrate the ASRAAM on the LCA as the same missile has already been integrated on the Jaguar.

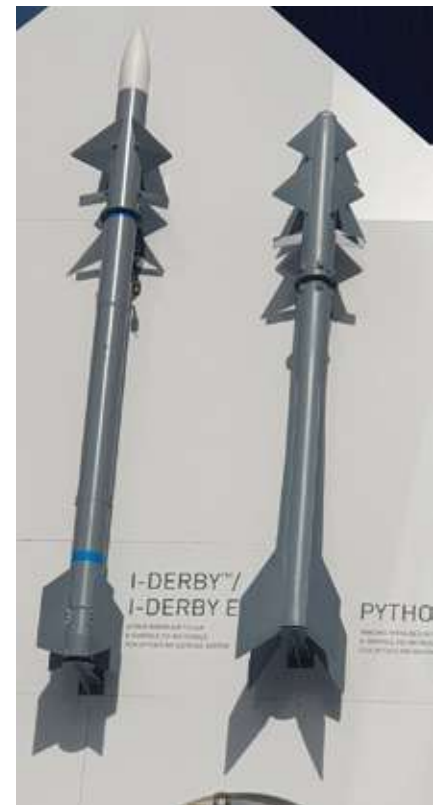
The most advanced short-range air to air missile in IAF inventory is the MBDA heat-seeking ASRAAM which has high speed (over Mach 3), is extremely maneuverable and is a fire-and-forget missile. The ASRAAM has a long acquisition range of up to 50km because of its large rocket motor which gives more thrust and range, has high countermeasures resistance. Its most modern feature is its seeker's 90 degrees off-boresight ability which provides the missile outstanding 'lock-on-after-launch' capability. The missile entered in IAF service in 2014 when the IAF signed a contract worth \$428 million with MBDA to arm its upgraded Jaguars: the contract reportedly comprised over 380 ASRAAMs. It has also been reported for some time that the IAF is also looking to equip its frontline



The R-73 seen here on the Tejas

Mig-21bison to down a Pakistan Air Force F-16. IAF uses this CCM with its LCA Tejas and MiG-21bisons, Mig-27UPG, MiG-29UPG and Su-30MKI. It has an engagement range of 30 km with speed of Mach 2.5, the infrared homing missile fitted with a sensitive, cryogenic-cooled seeker. This can also be directed by helmet

because of its full sphere attack ability, the missile also comes with lock-on-after-launch and features an advanced electro-optical-infrared-homing seeker for scanning and lock-on, the seeker having the ability to acquire targets up to 100 degrees of the missile's centreline. With the help of eighteen control surfaces as per



Rafael's I-Derby ER is planned for induction in the IAF while the Python 5 is currently in service



MBDA's ASRAAM

forget guidance system and an Active RF seeker, the missile having ability to engage targets at a range of up to 50 km with a top speed of Mach 4. It has been selected to be the primary AAM weapon for the Tejas LCA and was successfully test-fired in July 2018.

The IAF will use both versions of MICA air to air missile: MICA RF consists of an active-radar-homing seeker and has a range of 80km and the MICA IR fulfills its dual role as a medium as well as a capable close combat missile because of its advanced imaging infra-red homing seeker; the

Su-30MKI and LCAs with the ASRAAM and that early in 2019, two Su-30MKIs went for the requisite software modification for ASRAAM integration. The ASRAAM is to replace the now obsolescent R-60K, R550 Magic 2 and R-73s.

The IAF's medium-range AAM inventory is dominated by the Russian RVV-AE, R-27R1, R-27T1, R-27ER1, and R-27ET1 missiles. Apart from them, there are also the Israeli I-Derby and French MICA RF, MICA IR. I-Derby and MICA are the only two modern AAMs that will remain operational with the IAF's present and near future fleet while all other medium range weapons are fast being phased out.

The I-Derby AAM has been in active service with the IAF since 2012, which was part of contract for the Rs. 1800cr Spyder AD missile system. It is an active-radar-homing BVR missile fitted with a fire-and-



French Air Force Mirage 2000 with both variants of the MBDA MICA AAMs



The MICA IR and RF on display

missile's propulsion rocket motor is fitted with a thrust vector control unit which gives excellent agility during aerial engagements. As of now, only the upgraded Mirage 2000s are equipped with the MICA but the soon to be inducted Dassault Rafale will also be equipped with these AAMs.

New-generation AAMs

In pursuit of strengthening of its combat fleet, IAF has started the process of acquiring 21 Russian MiG-29s and 18 Su-30MKIs, while HAL is also ramping up the production of the Tejas Light Combat Aircraft; along side, the IAF is also putting in a great effort to equip these types with the latest new-generation AAMs.

On 13 June 2019, *The Print* reported that the Indian Air Force had ordered missiles worth \$700 million from Russia, the order comprising new generation short-



DRDO Astra test fired from an IAF Su-30MKI



The RVV-AE (R-77)

edge over older RVV-AE (R-77) because of its longer range and better guidance system.

Apart from these Russian orders, the IAF has also decided to procure Rafael's newly developed radar-guided I-Derby ER, having a range of well over 100km and a top speed of over Mach 4. The missile features a software-defined radar seeker and a powerful dual pulse rocket motor for long-range; the IAF plans to integrate these with its Su-30MKI and LCAs by 2022-23.

The medium-range inventory of IAF will also include the indigenously designed beyond-visual-range air to air missile Astra. The Astra features a dual pulse ramjet rocket motor and a Ku-band active-seeker (RF) making it highly maneuverable and accurate during endgame engagement, endowing the missile with a high single-shot kill probability. It can engage a target at max range of upto 110km when launched at a

range RVV-MD and mid-range RVV-SD. The RVV-MD is export version of Vypel's R-74, the missile having an improved range of 40km and a more effective two-band IR seeker while the RVV-SD missile has an



The RVV-SD AAM



Astra displayed at Aero India 2019



The MBDA Meteor on the Rafale



MBDA Meteor BVRAAMs will also equip IAF Rafales

height of 15,000 meters. In recent trials, the IAF test-fired the missile five times from a Su-30MKI in different scenarios including three tests in full combat configuration with warheads. The missile performed excellently against the Banshee target aircraft, and successfully neutralised it beyond 100 km with pinpoint accuracy in one of the

tests. DRDO has started work on a new longer-range BVR the Astra Mk.2 with a more powerful dual pulse motor and a new RF seeker, most likely a software-defined-radar one.

Besides all these, the most significant development will be induction of MBDA's Meteor BVR air-to-air missile which is

considered to be the most advanced and modern BVR in the world extant.

On 19 September 2019, the first batch of 36 Rafales contracted for was handed over to IAF in France, along with the Meteor BVRAAM and will be inducted in the newly revived 'Golden Arrows' No. 17 Squadron. The missile can hit the targets beyond 150kms and has the world largest NEZ (*No Escape Zone*). Thanks to this, the IAF will assume a major edge over both its adversaries Pakistan and China. The Meteor has an active-seeker and throttled solid fuel ramjet rocket motor which propels the missile to attain high supersonic speed of Mach 4.5. The Meteor can throttle its engine during different phases of flight instead of burning off all fuel after the launch, which is why Meteor has more energy to manoeuvre during endgame engagement this capability of the missile drastically increases the size of missile's NEZ.

In order to develop its own 'indigenous' Meteor, India's DRDO also has tested a complete Solid Fuel Ducted Ramjet (SFDR) propulsion system from a ground-based launcher, this project worth \$70 million which began in 2013 jointly with Russia. Since then, two successful test firing of the SFDR system have been completed, the last trial of the system taking place in February 2019 in which missile successfully achieved a top speed of Mach 3.

Thus, in the mid-to-near-future, one can see rapid induction and modernisation of the AAM inventory of the Indian Air Force. One hopes that better planning will ensure constant cutting edge weapons are available in the IAF's arsenal. 🦅

Atul Kumar



DRDO SFDR in launch test



Reading In–Between The Lines

Commentary by Prof. Prodyut Das on

The PAC's LCA Report

With a copy of the 114th Report on 'Design, Development, Manufacture and Induction of the Light Combat Aircraft (LCA)' from the Public Accounts Committee in hand, these are my candid reactions. The report is based on the CAG report of 2015 and seeks to establish the status of this programme which has the somewhat doubtful distinction of being the most lengthy development of any such programme in aviation history. It is unlikely this record will ever be broken.

A group of Lok and Rajya Sabha members reviewed the LCA situation in late 2018 with some very senior officials of the MoD, DRDO and HAL

arraigned in their midst. The responses of the officials had the quality, in part reminiscent of a group of schoolboys up before the Rector in his study, with erstwhile rivals providing

lame alibis for each other and in part pure "Yes Minister"! The Parliamentarians also sensed this and observed that some of the replies were "baseless".

'Precis' is a forgotten skill. In keeping with Government reports, this one too is also lengthy and rather loosely worded. It took the report some several paragraphs to marshal five facts about the situation of simulators and trainers. It is also difficult to comment when one has to struggle with babudom profundities of Biblical sonority,

and radar and other related developments. Trained manpower, the great input for aircraft design, was never in short supply. The hiatus between the HF-24 and the LCA ensured that this manpower was ready and waiting. In fact by 1983, that is at start of the project, the senior most people in HAL were those who had been trained by the

Germans and some even had independent and successful project experience with goods delivered. Indeed the first Chief Designer – to use the expressive old term – who was selected to lead this project, was one of such trained personalities. He was soon enough “removed” along with the then ADA Chairman for what appears to be “tribal” reasons : DRDO vs HAL?



Prototype vehicle (PV) of the LCA in flight near Bangalore

and I quote, “LCA programme has taken ab initio development and LSP is blessing in disguise” which is as pure gobbledegook as is “two concessions are linked with weapons accuracies above Tactical Mach No. which has no impact on combat potential”. I defy you to work that one out ! I have restricted myself to a summary of the 130 paragraphs followed by remarks as I felt appropriate and some suggestions at the end. Any “progress report” on the LCA makes for grim reading and this one is no exception.

On Funding

In October 1983, the GOI sanctioned development of the LCA over a period of 8 to 10 years, or by 1991-1993 with a funding of Rs.560 crores including the development of six prototypes. The sum, dates and deliverables may be compared with the equivalent of Rs. 410 crores that the Americans had spent in the period 1973 to 1979 to put the F-117 Stealth Fighter into squadron service, the Americans being handicapped by the high cost of manpower. There was never a situation where the LCA development was held up because the funds ran out.

To date, an arithmetic sum of Rs. 10,397 crore in various tranches have been given out whose present day value, adjusting for inflation, is Rs 80,000 crore not including money spent on the *Kaveri*



LCA Prototype Vehicles (PVs) were joined by Technology Demonstrators (TDs) in the flight test programme

Audit Reviews

Every ten years, the delays in execution of the LCA programme with respect to project definition and deficiencies in planning and financial management, have been adversely commented on, including in 1989 (Report No.3) and 1998 (Report No.8) by the CAG.

The question that arises is why were we violating a fundamental rule of management in reinforcing a failure? The correct decision would have been to restart the project under new management or at least to bring in competing alternate project studies as an insurance to a project which was not meeting specifications.

Project “progress”

The word “progress” is of course hyperbole. It has been a sorry tale of mismanagement and delay. The then CMD of HAL giving reasons for the delay, deposed in 2018, “Yes Sir, there was delay ... so initially you would appreciate when the engineers of DRDO and HAL started producing the aircraft first the belief was not there... so this programme ... might look a *little* (sic!) longer the kind of achievement...”

The above statement would indicate that either senior officials do not seem to appreciate the scale of the non performance as a mindset that thinks a thirty year delay with continuing uncertainty being described as “a little delay”, is certainly to be noted and acted on, or was there at all times a considerable degree of scepticism about the very programme? Subsequent events have unfortunately proved that this scepticism was well grounded in realities.

Scepticism, specially by “outsiders” may be discouraging but it is no explanation why the work should have suffered.

Inadequate expertise

A consultancy fee of Rs. 127.65 crores was paid to the European firm EADS to cover aspects of the IOC and FOC. This contract expired before the scheduled tests could not be carried out because of the lack of aircraft. Subsequently a third contract had to be signed to re-cover the remaining tests which still remained to be completed!

Shortfalls of the ASR

It was clear by **1989** (*emphasis*), this itself at end of the Project Definition phase (PDP), when the project was reviewed by Air HQ that the aircraft was deficient in terms of weight control, “real estate” (internal volume) and aerodynamic configuration. Reminiscent of the Indian Army’s 1959 warning of how the PLA would run through NEFA, this competent analysis was ignored. Instead of revising and refining the proposal, it was proposed to go ahead and build two technology demonstrators where new technology was to be tested on a new “yet to be built” platform which is a reckless violation of standard practice.

This usage of bureaucratic and “net working” clout to bypass the informed ‘opposition’ has led to the situation as of, *at least 2015 if not more recent*, that the aircraft has fallen short precisely on the parameters which had been pointed out 30 years earlier. The LCA does not meet the ASR in terms of range, speed, energy performance parameters, airframe volumes for growth and all weather operations.

Even simple requirements like single point defueling, protection of the fuel systems and the pilot from combat damage or a 725 litre drop tank have not been met and unlikely to be met any time soon. Fifty three concessions, possibly including the nine above affecting operational capabilities have been “conceded”. I think it is, excuse me, blatant cheek of the Ministry, after failing



The R.73E air-to-air missile now arms the LCA

repeatedly to meet the ASR, to hold that shortfalls in weapon accuracies and tactical mach number do not affect combat potential! One expects that they would at least have the grace to blush. Going by the text it is a wonder how an aircraft that has not fired its guns and cannot (legally!) drop a 4 lb. practice bomb (the practice bomb carrier jettison test had not been cleared then) or has not opened out the full envelope, can be declared fit even for peace-time training.

Delays in development of trainers and simulators

The LCA trainer version cannot be built to IOC or FOC standards because development to those standards is not complete. The Full Mission Simulator (FMS) is not ready for the same, and the Real Time Simulator (RTS) upgraded to FMS standard by ADE is being used in the interim. Again the MoD maintained that this was “not an issue”.

Change of specifications

Change of the CCM from the R. 60 to R. 73E and the introduction of the M.62 (the runway buster bomb) has been cited as a cause for delays, there being as many as ten changes in all. Given the time span of thirty years, one is surprised to actually see how *few* the changes have been. The Japanese in the 1940s used to have as many changes in the course of half a year and Mitsubishi or Nakajima would well handle that. The delay has been cited as 12 to 14 months. The R60/R73 change requires further detailing because it is typical of the evasive explanations offered.



IAF test pilots and test engineers have been seconded to the Naval Flight Test Centre (NFTC), being part of the Aeronautical Development Agency (ADA) at Bangalore

The R.60, an excellent CCM in its day, became obsolescent in due course and needed to be replaced with the R.73E whose seeker was “cueable” by the Helmet Mounted Display System (HMDS.) The R.73E weighs 110 kilos as against the 45 kilos of the R.60. Space and power had to be found for some additional “black boxes” required to read the helmet movements and in addition, the wiring harness has to carry the *signal* from the HMDS to the missile via the wing and the pylon. Wing pylons in this class of aircraft are usually stressed to standard weights of 500 kilos for the inboard ones and 500/250 kilos as one goes out towards the tip. The point I am making

EW warfare

The aircraft cannot accommodate a self protection jammer (SPG) for lack of internal volume and at present only has a RWR and the Chaff and Flare dispenser. A passive jammer is fitted but unlikely to be effective. An active jammer was always on the list. Given the present impasse the IAF may wish to consider the adoption of ‘Wild Weasel’ tactics despite its handicap : a half loaf being better than none.

Work Packages

A hundred and fifty two work packages, of which one hundred and ten were to the state sector and the remainder to the

Industry as pariahs in a “socialist pattern of society” justification was that they would “be irresponsible” with the money. Does not that attitude need review?

Lack of User involvement

Given that the user’s (IAF’s) remarkably accurate analysis and forecast *in 1989* about the shortcomings of the proposal were disdained and bypassed without a fair debate, it is surprising this issue has been listed. It is immature to ignore or bypass or disrespect a team member’s expertise and then complain of the lack of full cooperation. Expectedly there now are maintenance issues.



Tejas Limited Series Production (LSP) aircraft at HAL

is that the pylon and the wing structure did not require any major redesign because the new missile was within the standard weight limits. The wing was not “plumbed” to take the slightly bulkier wiring harness nor had space been provided for the R.60/R.73 electronics upgrades *the anticipation* of which was *the job* of the armaments group.

The same goes for the cannon armament. In aluminum structures one simply drills and positions the new bracketery. In composites one cannot simply locate a new clamp; composites can’t easily take point loads, so a new wing had to be made. Hence the 14 months delay and this must have happened for every change. Lucky there wasn’t a war on!

(We were pretty close to one in February 2019-Ed.)

private sector, has suffered delays ranging from two to eleven years. The explanation given by ADA is that since they did not have control over the subcontractors, management of the delays could not be controlled actually speaks ill of ADA’s expectations. Vendor development is an integral part of any project and speaking from experience, the Indian sub contractor will deliver miracles without having to have control over their management. One really needs to take off one’s jacket and put the shoulder to the wheel.

No records of the financial transactions worth Rs.1164 crores between the vendors and ADA during the period 1992 and 2006 were kept. “These are being retraced.” One reason hinted for treating the private

Absence of an Indigenisation plan

The following items continue to be on the imports list : raw materials including composites and metallic, the engine, the radar, ejection seat, cannon, multi mode radar , general systems, accessories. At the same time a 70% indigenisation is claimed, which goes against common sense. It appears that the labour and tooling costs have been included to pad up the figures. Indigenisation should be reckoned in terms of BOC and RM only and is likely to be around low ten percent as of now. The only bright spot is that the Private sector, Godrej & Boyce and MTAR seem to have delivered.



Series Production LCAs are now with No.45 Squadron, the first unit to so equip

Radome

A new more radio transparent radome is under development, so is a smart multifunction display. Regarding SMFDs, HAL Korwa did not find the project “cost effective” and so the SMFD was given to the private sector.

Multi Mode Radar

Multi mode radar, based on Elta modules is now being considered as acceptable, the local efforts being declared closed as there is no market.

This decision needs review because there will be a market for an Indian AESA in the next decade.

Other Hardware

The actuators situation seems to be satisfactory but the Jet Fuel Starter (JFS) whilst performing satisfactorily both for ground start and for air start, needs some more tweaking. I was somewhat puzzled at the inclusion of “lube consumption (in gms./start!) of the JFS in this report.

Whilst fascinating, it did seem out of place in a report like this or was this ‘bumpf’ some kind of ‘pschyops’ by the technical people to baffle the Parliamentarians?

Manufacture

8 aircraft per annum had been planned and in 2018-2019 a delivery of eleven was indicated with FOC aircraft to follow. From past experience, any figure given really does not matter until we see the aircraft at the air bases which appears unlikely. The current

statistics show one delivery every four months which is a considerable improvement since 2015 when the delivery was one every 10 months and a “standard deviation” i.e. one sigma on that figure of 6 months indicating a process badly out of control. We may be out of the woods but we will know for sure by end 2019. Deliveries will remain erratic.

Alternative Measures

Since the ‘90s, delays in the programme required upgrading of aircraft such as the MiG-21, Jaguar, MiG-29 and the Mirage 2000 at various times. This has cost an arithmetic sum of Rs 19,000 crores or a PDV of Rs. 80,000 crores. The current move to acquire some 21 mothballed

MiG-29s is an indication of the urgency of maintaining squadron strength as well as affording some interim relief.

Delay in formation of LCA squadrons

Two contracts for 40 (series production) aircraft were placed in 2006 and 2010 but a *total* of 12 had *been delivered* at the time of writing. What we may get in 2019-2020 will become clearer by December 2019.

The rest of the report castigates the MoD, the ADA and HAL but of course that is water off the duck’s back as many such reports past have shown. Nevertheless those are being summarised below.

- Project is still “in progress”
- ADA took decisions that lacked scientific basis. Coming from “bumptious” Parliamentarians it is a compliment to their common sense and an indication of the trouble. This is strong stuff (but is unfortunately true).
- Testing towards full opening of the flight envelope for FOC remains incomplete. Testing is risky rather than difficult. One got the impression that perhaps the EADS collaboration was as much to have someone to take the responsibility should something go wrong during the tests “He (only!) told us to do it, Sir” - rather than lack of actual know how.
- Agencies monitoring the project were casual leading, to a 30 year delay. Formation of a core monitoring team was suggested and it seems to have had some effect.



No. 45 Squadron at Salur has IOC- standard LCAs

- ADA has failed, after 3 decades, to produce an aircraft which fulfils the IAF's requirements.
- The Committee is appalled at the casualness of some of the replies by Ministry officials.
- The Committee desires that the Ministry identify and fix responsibility upon MoD/DRDO/ADA officials who failed to ensure involvement of IAF personnel in the initial years of the development. *The scope of this has to be expanded.*
- The committee feels that 35% indigenisation has been achieved but the MoD officials maintain that 70% has been achieved *because the rest cannot be achieved anyway! It is an indication of a "different" mindset. This needs review.*
- HAL, ADA and the MoD have failed miserably and are to be rebuked for functioning so.

Unfortunately we can do little about the then Political Leadership and the Establishment for its failure to take timely action, despite ample warnings.

The theories of failure

It is as difficult to spin out a development programme over the 36 years as it is to complete it in five. Indeed it would need more organisation to achieve a spin on such a prolonged development. The following are some possible hypotheses:

The conspiracy theory: is it that there never was any serious intention that the project was to succeed. The project was sanctioned because, given India's capability, the country could not but have such a fighter project, so it was ensured by various means that it did not progress at any useful rate. For supporters of this theory the circumstantial evidence is firstly that it does not take more than ten years to develop and IOC a new fighter and despite early evidence of non performance, the project was not foreclosed and a new start made. There is also the fact that several practical proposals based on the HF-24 e.g. ASA/HSS/HF-73/ HF-25 /GAF etc requiring about 60-65 crores at that time, were not sanctioned and yet an organisation that was yet to be founded, was sanctioned Rs.565 crores to develop an urgently wanted replacement for the MiG-21.

Here is the catch : *that an embryonic organisation (ADA) had to rely on the "ignored" organisation (HAL) to deliver the*

goods. This arrangement has failed wherever it has been used e.g. the UK's aero industry in the 1960s on the English Electric /Vickers for the TSR2 and Fairey /Westland for the Rotodyne. Oversight or deliberate?

The project delays are nothing unusual because that is the way the Government does things. The second Howrah Bridge, which affected the daily lives of sixteen million people, was sanctioned in 1971 and completed only in 1989. Amongst the reasons for the delay was that the stayed cable bridge technology had to be imported because it was a requirement that ships of a certain size had to pass beneath it. It was possibly quite clear at that time that after building the Farakkah Barrage, the river Hooghly would be unfit for any shipping. Certainly no ship of the stated size (10,000 tons), has come upriver in the past thirty years and it would be a brave river port pilot who would even try. The Hooghly needed dredging even for barge traffic ! I mention this because I feel any number of justifications can be found once there is a will to import.

It is also possible that having ignored the "lack of belief" (as in the report) and gone ahead with building of the two Technology Demonstrators, the ADA and Ministry leadership soon realised that they had blundered and the platform would have to be significantly redesigned. Such things sometime happen e.g the Supermarine Type 224/ Specn. F7/30, predecessor of the iconic Spitfire. The leadership lacked the knowledge and courage to grasp the nettle firmly possibly because of loss of face and prestige involved. The changes were understood but repeatedly postponed for the "next watch".

There were genuine technical problems which the top men of ADA completely

failed to see owing to lack of sufficient experience in the necessary area.

One can only conjecture as what actually went on in the labyrinths of Lutyens in the 1980s and 1990s though there has been mention in the memoirs by the then VCAS, of various wildcat schemes by the Scientist-Bureaucrats of that time but if there were technical causes of delay, then the following notes may help in forming an idea.

First it is to be realised that the LCA's configuration is the most difficult such to develop because changes are inevitable during development and the configuration does not allow for easy Plan Bs ? Indeed if a group of experienced aircraft engineers had been hired to recommend a configuration package that would be the most difficult to develop for the Indian Industry of the 1980s, they would recommend a plain delta with FBW and a high proportion of composites ! Unfortunately by the end of the 1980s, ADA had unerringly zeroed onto precisely this configuration. As a footnote I would add that in 1983 India had four proven airframes with manufacturing information and considerable service experience but it is possible ADA chose not to be beholden to HAL for anything and therefore did not seek access to the information. Such organisational behaviour happens and needs intervention from higher direction.

Contemporary Programmes

It would be instructive to look at what other, experienced fourth generation fighter designers were doing around that time. The repeated pattern was of limiting risks to the minimum whilst venturing forth.

General Dynamics was using the conventional tailed layout with blended



Mirage 2000-5



MiG-29

body and LERX strakes and FBW first ensured they had good Plan Bs in case the FBW did not work. They also used less than 3% composites and indeed their structure was decidedly conservative-machined rather than chemically milled skins for the wings and traditional sheet and strip for the rest of the structure. Result : the world-beating F-16.

Mikoyan was even more conservative, used no composites on the prime structure, discarding even that (for the engine cowl) at the first sign of trouble and of course there was no FBW. They just stuck to refining the configuration which was both original and brilliant. Digressing, the MiG-29 is a very “flexible” configuration permitting considerable “change and chop” and reminds me of the Me-262 in the way it reduces the nacelle–body interference drag though with some additional wetted area drag. *In a way they showed what could be done just by sticking to conventional engineering.* We received the MiG-29 in India in the 1980s and if only someone had the wit to “see”.... !

The Dassault team based the Mirage 2000 on the Mirage III, used more composites but only for the wing skins. The fuselage which requires more sculpting, was aluminum. They had of course previous composite experience having tried it out on the Mirage III’s fin.

The Saab Gripen team had based configuration on the Viggen so they mainly focused on the FBW aspect and composites were kept again only for the wing skins. They too had previous composite experience, having used it on the Saab 105 rudder.

It is no coincidence that NONE of these four teams used composites on the fuselage. ADA went in for 65% composites without or perhaps *because of not* having sufficient experience on the material.

The reasons I have focused on the composite percentage is because if we analyse the delays, we see a continuous pattern of *uncertainty* about these. In 2015 the delivery period was about ten months and a sigma of 6 months meant a process badly out of control. It cannot be that senior officers are habitual liars. Indeed some of

those who made the promises were respected men. Nor can it be that the production rate is 4 per annum per tool set. Boeing would need a plant the size of Texas to meet the 787’s demand. Even at the rate of three months per set, we should have produced some thirty two LCAs and not nine ever since the IOC. The construct therefore is as follows:

Once the prototypes are built, the development of an aircraft into a serviceable combat type shifts from engineering and science to art and intuitions and sometimes, almost “black magic”. Not every engineer has the required skills. An aircraft between its first flight and the IOC may need perhaps three hundred ‘mods’. It is here that composites play up. Their great strength – rigidity – is also their great handicap as far as our industry is concerned. Our industry is used to a “suit on assembly” culture. Aluminum is quite amenable to that though it does nothing for build quality. Unfortunately one cannot do that with composites. The tolerance required, 50 microns is *half* the general tolerance of *machined* parts. One cannot just mallet, say the forward fuselage joint line with the centre section to blend. It is possible that the production rate of four every year mentioned is *the probability of having acceptable parts* per annum ! The “out of



F-16s



The Gripen



LCA deploys brake parachute on landing after sortie

control"-ness would affect both performance and aircraft to aircraft variations.

So we have a situation where a particularly ill informed choice of material used in a scale not heard of anywhere else made the prototyping difficult. The changes inevitable in aircraft development could not be made and tested nor was it possible to firmly commit that X number would be ready by Y date! Thus IOC and FOC dates would keep on sliding. Boeing's trouble in productionising composites will long be remembered.

Technical corrections

I have carefully studied the CAG report and as they say, "read the tea leaves". Having said that I reiterate that what I am saying is very probably very true. The CAG report confirms my long held "empirical" beliefs.

Judging by the items of shortfall in the report, the first conclusion is that all nomenclature issued by ADA and DRDO/Ministry (TD, PV, LSP, SP, IOC1, IOC2 etc) are just labels not worth the proverbial Tinker's damn. What we have is a motley collection of prototypes of varying build standards. This is normal in aircraft development. What is not normal is that there is no certainty of when the next will be flown. This factor needs improvement because that is holding up development flying. The recently granted FOC has to be viewed against this background.

The LCA Mk.1 is unfit for service. The aircraft will not meet up on its payload range required for FOC. The superiority of the aircraft over the Combat Hawk regarding the MFDs, BVRs, FBW etc are all LTP (Lost Total Pointed) as in the childhood game of Bagatelle, because of the payload range shortcoming and the energy performance, as reflected in the report.

Thus, the LCA will continue to be *kutcha* (unripe, half baked) unless drastic corrective administrative action is taken. The modifications required by the LCA Mk.1 include increasing length of the fuselage and re-contouring the fuselage as well as cranking the wing along with a careful weight improvement programme. About 40% of the airframe requires redesign. It is the delay incorporating the necessary changes which is the crisis.

New readers may find the earlier discussion on the LCA in *Vayu (V/2010 Wisdom and Courage)*, *Vayu I/2015 The LCA – Beloved Aircraft or Lemon?*, *Vayu I/2017 Falcon, Griffen, Tejas and V/2018 The Riddle of the RFI*, of some interest. Still, the situation is not irrecoverable. It has been the experience in product development that what is seen as a vast and insurmountable problem is in reality a bundle of simple problems all entangled with each other. What is needed is that the composite situation be impartially reviewed

outside of the nexus of HAL/ADA/DRDO/Ministry/IITs and instead of relying on "It is just around the corner" promises made by stressed "retiring in six months" officials in some office in North Block, the people should walk the shop floor and talk to the poor devils who are trying to meet schedules on an unproven technology and also to see the trends of the rejection rates and rework rates.

Significant re-design

Such investigations will indicate the need for significant redesign and a temporary retreat from composites (as the Russians quickly did with the MiG-29) should be considered. New tooling will be required as the fuselage which any way needs lengthening and re-contouring be redesigned in metal to get all the development 'mods' done quickly before reverting to composites thereafter. This will delay the programme by about twenty months but the programme will now be on



The LCA two-seat trainer version is still under development

firmer grounds from the start. The main problem to this solution is the reluctance of the organisations to admit they have been wrong all along for 30+years !

The administrative corrections

Are these various committees such as the PAC or the CAGs merely ceremonial and part of the “rites and rituals of a Republic”? Still, they seem to have put the finger on the problem even at the start – in this case in 1989 – and yet like Cassandra, their warnings were ignored causing loss and harm to the nation and its Armed Forces.

Such committees must be given the counsel of super technical team so that some cross questioning could take place. It would certainly improve the quality of the answers !

The focus of the audits by these Committees should move from the financial and procedural irregularities to the Failure of Programme and Time Management. They could have contributed positively if they had been empowered for “armed reccee” rather than “reccee” mode. The Committee should, like the Election Commission under TN Sheshan, use its power to veto or to recommend the stopping of or changing the management of projects that have significantly overshot their schedules. It is true that at the starting line, *Genius* and *Folly* look similar but the difference comes out quickly. Let the Babus and the Politicians restart them but at least the red flagging would be on record and it would reduce complacency about what the Chinese call “an iron rice bowl”. It is worth recalling that the Americans and the Soviets succeeded because the winner emerged from a Gladiatorial contest. Our ‘winners’ are long anointed. The consequences are very plain to see.

The Committee rightly wants the officials who failed to ensure involvement of IAF personnel during the initial design stage, to now be identified. Indeed the scope of this activity needs to be enlarged. Rather than a superficial identification of this SA or that PD, we have to identify what was the submerged mechanism which selected, sustained and protected such officials despite the lack of progress. What were the forces and the mechanisms which sanctioned FSED on a project that clearly was unsatisfactory to the customer? Why were new pioneering technologies left to be developed on platforms that were yet to fly? Overlooking this common sense decision is a big cause of all the delay.

Our counter espionage in the Weapons and Strategic Industries sector – *Abwehr* to use the convenient German word – needs to be strengthened because there is circumstantial evidence that the delay in the Tejas programme may have been *largely* due to covert action. Serial blunders cannot account for thirty six years. In this connection the need to protect performers cannot be overstated. We have had several key leaders in our strategic programmes mysteriously dying. The case of the ISRO scientist Nambi Narayanan is a warning. It is not enough he was exonerated, his potential contribution over the years has been irretrievably lost.

LCA(s) of the Future

There can be no abandoning of the LCA programme. Fighter specifications are as fickle as feminine fashion. Weapons marketing being what it is, the Light Combat Aircraft – which had become passé after the 1980s, being replaced by 1:1 T/W ratio, AOA, the BVRs and then Stealth as the “to die for” USP features – will again be making a comeback once the order rate of the F-35 falls below a certain rate per annum and the world’s inventory of BVRs reaches saturation! Thanks to the prolonged delay, the LCA will be right on the recycled starting line its possible competitors being the LM T.50 and the Boeing BTX1. Further project studies of the LCA programme should be initiated using the Eurojet 200/ M.88/ RD 93 engines and accessories, Europeans/Russian/French systems just to avoid being “Viggened” as Saab experienced when they tried to offer that for our then DPSA. I am not being skittish. Fighter specs. go through fashion cycles. It has happened before with the T-38/F-5/F-20. Indeed the entire package

of Kaveri, MMR etc should be put as the phrase goes “under new Management” because there is going to be money for the LCAs of the future.

Maintenance of pretensions is often an obstacle to making progress. The LCA Mk.1 is unlikely to have any worthwhile operational use. Like the Hunter F.Mk.1, it should be used for the development of systems.

The Mk.1A and the Mk.II must be given the status of *new* projects because that is what they are, particularly given the difficulties of configuration. As a matter of ample precaution there should be several second strings projects *studies* that should run until the LCA Mk.1A/Mk.II are stabilised. The IAF has excellent experience in upgrades and they should be given the task of exploring a “structural surgery” on a F.414/MiG-23/27 non-VG hybrid. The fuselage size is just about right and many of the 53 concessions (armouring of the cockpit for example) would be easily rectified. At the present, the study should be no more than just a “what if we do this” study and should be completed within 8 to 10 months and perhaps costing Rs one or two crores if that. There can be another 3 or 4 such explorations and the systems developed for the LCA should be repackaged in these ‘new’ airframes much as Dassault and Saab used existing airframes as proven basis for their new designs. The private sector must be asked for proposals even if it is to get the balance right.

Surprisingly the project most to benefit from the ills of the LCA programme will be the AMCA. All this should be read into management of the AMCA programme which is at present going exactly the way the LCA went, so unfruitful and for so long. ✈



Tejas LCA at Leh for high altitude, cold weather trials



MBDA Mistral ATAM on the HAL Light Combat Helicopter (LCH)

VAYU on-the-spot report

MBDA in India's Defence Partnership

Another year and another exciting MBDA media tour! Straight from the recently concluded DSEi show in London, when on 15 September, select media and PR agency persons from India met up with MBDA executives at Manchester, the start of an amazing 5-day multi-country tour of MBDA facilities.

In quick summary, on 16 September, *Vayu* visited the MBDA facilities at Bolton, UK to be briefed on the company's missile programmes such as the Sea Ceptor, Meteor, ASRAAM and Brimstone, followed by a factory tour of the site. Later in the evening, departed for Paris for next part of the programme at Selles-Saint-Denis. On

17 September, at MBDA's facilities, the media team was again given detailed – and most informative – briefs on missile systems such as the Mistral ATAM, Scalp, NCM, MMP, MICA NG and Exocet, followed by another extensive factory tour!

Back in Paris for the night, next part of the tour was to the La Spezia site (via Florence) in Italy, for briefing on MBDA's anti-ship missile range and solutions which included the Marte Mk2, Marte ER with a detailed overview of the Teseo MK2/A plus Otomat MK2 Block IV, followed by an extensive factory tour.

At all times, we were updated on what MBDA had already offered or is currently

offering to the Indian Armed Forces via JVs/MoUs or simply presentations to the concerned authorities on new products for defence of the Nation, ofcourse, always following the *mantra* of 'Make in India'!

We were briefed on the company's achievements in India over the past many decades and plans including recent JVs with Larson & Toubro as well as with BDL – more on this shortly. MBDA's relationship with the Indian Air Force (*see separate item in this issue*) was highlighted and ofcourse that with HAL.

First, on MBDA itself. The Company is the only European group capable of designing and producing missiles and

missile systems that correspond to the full range of current and future operational needs of the three armed forces (land, sea and air). With their significant presence in five European countries and within the USA, MBDA achieved revenues of 3.2 billion euros in 2018 with an order book of 17.4 billion euros. Arming more than 90 armed forces globally, operating MBDA missiles and missile systems, they are a true world leader! The group offers a staggering range of 45 missile systems and countermeasures products, which already are in operational service, and there are more than 15 others currently in development. MBDA is jointly owned by Airbus (37.5 %), BAE Systems (37.5 %), and Leonardo (25 %).

MoU between MBDA and BDL

On 12 September 2019, MBDA signed an Memorandum of Understanding (MoU) with Bharat Dynamics Limited (BDL)



At the MBDA/BDL signing ceremony. Front (left to right): Mr Ravi (BDL), Mr George Kyriakides, Commodore Siddharth Mishra (Retd) CMD, Mr Loïc Piedevache (MBDA). Back (left to right): Mr Tom Fell, Mr Pierre-Emmanuel Jan (MBDA), M. Chandrasekhara Rao (BDL)



ASRAAM

manufactured in India. The ASRAAM is India's New Generation Close Combat Missile (see article in this Issue). With its large rocket motor and clean aerodynamic design, ASRAAM has "unrivalled speed, aerodynamic manoeuvrability and range". The IAF's Jaguars are the first of Indian platforms to integrate this cutting-edge air-combat missile.

The Mistral, with its "unmatched success rate of over 96% during all firings" has been selected by many forces around the world and has been offered to the Indian armed forces to meet their VSHORAD requirement. Working with HAL, integration of the Mistral ATAM system on the Dhruv helicopter and the Light Combat Helicopter (LCH) has been successfully completed.

for the final assembly, integration and test (FAIT) of the Mistral and ASRAAM missiles in India, this being signed at DSEI in London, by George Kyriakides, Director of International Industrial Co-operation at MBDA and Commodore Siddharth Mishra (Retd.), Chairman & Managing Director of BDL.

BDL is a major weapon systems integrator in India and has supplied more than 130,000 weapon systems to domestic as also foreign customers. MBDA has a long, and highly successful track record of working with BDL over the past 50 years, which has already recorded over 50,000 MBDA-designed missiles



Mistral ATAM

The Larsen & Toubro and MBDA JV

Larsen & Toubro (L&T), India's multinational engineering conglomerate and private sector defence major and MBDA have a joint venture (JV) to develop and supply missiles and missile systems to meet the growing potential requirements of the Indian armed forces. The Joint Venture Company, named 'L&T

have collaborated and partnered on co-development and production of major subsystems involving complex technologies and sophisticated weapon systems such as MICA missile launchers and airframe segments including control actuation units for the Indian MoD.

To start with, the JV Company will plan to develop and supply fifth generation Anti-Tank Guided Missiles (ATGMs),

within a year of operations, this joint venture has responded to various RFIs, offering missile systems to meet Indian operational requirements. These include the 5th Generation Anti-Tank Guided Missile (ATGM 5), which has substantially advanced features as compared with other 3rd and 4th generation ATGM missiles. The missile is offered under the *Buy (Indian-IDDMM)* procurement category for



MBDA Missile Systems Ltd', is operating from a dedicated work centre, which include pyrotechnical integration and final checkout facilities. L&T owns 51% of the Company and MBDA 49%, complying with India's Foreign Direct Investment (FDI) policy norms. The JV focusses on business opportunities in the Missiles and Missile Systems domain and target prospects under the *Buy (Indian-IDDMM)*, *Buy (Indian)* and *Buy & Make (Indian)* categories of the Defence Procurement Procedure. Formalising this partnership is a key milestone for both L&T and MBDA in their long term relationship, which was made after 'extensive evaluation and identifying the strong synergy between the two organisations'. L&T and MBDA

missiles for Coastal Batteries and high speed target drones. L&T have been delivering a range of launch systems, fire control systems and airframes/sub-systems for various indigenous weapons including (missile, rockets, torpedo) programmes as development partners and production agency to DRDO and DPSUs. "By combining our manufacturing and system integration capabilities and track record with MBDA's technological excellence, we now look forward to delivering complete missile systems, hitherto imported, to meet the requirements of the Indian armed forces as required under DPP 2016," stated L&T officials.

The L&T MBDA JV was publically exhibited at Defexpo 2018 and just

the Indian Armed Forces. ATGM5 made its public debut at Defexpo 2018, where a model of the missile was displayed on the L&T-MBDA stand and its operational advantages demonstrated using a fully functional simulator.

Also on offer is the Short Range Surface to Air Missile (SRSAM), the JV offering the latest in surface-to-air-missile technologies under the *Buy and Make (Indian)* category for Naval Surface Platforms requirements of the Indian Navy. As for the Medium Range Anti-Ship Missile System, the JV has offered the latest generation anti-ship missile system under the *Buy and Make (Indian)* category for Naval Surface Platforms. The JV is also preparing to participate in various 'Make' category projects.

The new SPEAR-EW weapon



MBDA has been awarded a contract to demonstrate SPEAR-EW, a new electronic warfare version of the SPEAR weapon system family on order for the Royal Air Force. The weapon is being developed by MBDA in partnership with Leonardo to complete a wide range of Suppression of Enemy Air Defence (SEAD) missions, under a Technical Demonstration Programme (TDP) contract awarded by Defence Equipment & Support (DE&S). The SPEAR-EW will integrate a miniaturised EW payload from Leonardo, which will act as a stand-in jammer to greatly increase survivability of RAF aircraft and suppress enemy air defences, in effect being a significant force multiplier.

The core technology of SPEAR-EW's payload is the Leonardo's miniaturised Digital Radio Frequency Memory (DRFM), which offers the most "advanced and future-proof electronic jamming and deception available on the market today". The new SPEAR-EW will complement the SPEAR network enabled miniature cruise missile, which is designed to precisely engage long range, mobile, fleeting and re-locatable targets in all weather, day or night, in the presence of countermeasures, obscurants and camouflage, while ensuring a safe stand-off range between the aircraft and enemy air defences. Powered by a turbojet engine the SPEAR missile offers over twice the range and a far more flexible operating envelope, when compared to a conventional glide weapon. SPEAR-EW utilises this long endurance through its capacity to be launched at enhanced stand-off ranges and loiter while carrying out its jamming mission



As Loïc Piedevache, India Country Head, MBDA, stated, "For over 50 successful years our strategy has been one of true partnership with the Indian Armed Forces and Indian industry. The JV with L&T offers the Indian Armed Forces the flexibility of choice regarding the timely acquisition of key operational capabilities, coupled with the optimised means of acquiring and mastering the very latest and most advanced guided weapon systems technology currently available anywhere in the world."

And so ended this tour of MBDA's facilities. Thank you once again and great going, MBDA! 🇮🇳

VSC



The Media Tour group along with MBDA Executives

MBDA: a strong partner of the Indian Air Force



French Air Force Rafale (in this photo) but soon to be in Indian skies with the IAF as an operator of the type, is seen here with two MBDA Meteor's and four MICA AAMs. (photo: Dassault)

With a strong reputation as a reliable partner that has supported the Indian Air Force for over 50 years, European missile firm MBDA understands the importance of operational capability and sovereignty to the IAF. For these reasons, the company has so strongly committed to Make in India to deliver both industrial sovereignty and the best of military equipment to India. Local firms now supply key components for key new missiles that are enhancing the combat power of the IAF. MBDA continues to deepen its relationship with Indian industry, as seen by the recent formation of a joint venture with long-standing partner Larsen & Toubro to deliver a series of important missile programmes under the Make in India category.

With exciting times ahead as the highly capable Rafale joins the IAF's inventory, these new aircraft come armed with a potent suite of weapons from MBDA. Unquestionably the most famous is the

Meteor, the ramjet powered and network-enabled beyond visual range air-to-air missile that is widely recognised as a game changer for air combat. Meteor's throttleable ramjet engine provides sustained high-supersonic power, making it the only missile able to chase down manoeuvring enemies at even the longest of ranges.

No less game-changing for the IAF is the Scalp stealthy air-launched cruise missile that also forms part of the Rafale weapons package. This potent weapon will give the IAF an unrivalled and flexible tool to conduct deep strike missions at long ranges against even the most protected of hostile targets. MBDA also manufactures the



Meteor BVRAAM

Brimstone and Spear strike missiles. Both lightweight missiles (Brimstone weighs 50 kg and Spear 100 kg), they feature advanced dual-mode guidance that allow them to engage moving, manoeuvring targets in all weather conditions, either autonomously or with operator in the loop control.

Brimstone is well-known as the best anti-armour missile in the world, being able to be salvo fired against multiple targets and excelling at defeating even the best protected armoured vehicles with the latest defensive aid systems. It's also unique for being truly multiplatform, being able to arm fast jets, helicopters, UAVs, land platforms and naval vessels.



The MICA on Rafale



Scalp on Rafale



Mistral ATAM for the ALH/LCH



The ASRAAM

Spear builds on the capabilities of Brimstone, but this mini-cruise missile is able to strike targets over 140km away. With an enhanced seeker and two-way datalink, this truly intelligent and networked enabled weapon is able to defeat even the most sophisticated of air defence systems be they on land or sea.

Another MBDA weapon, MICA provides both the Rafale and the newly upgraded IAF Mirage 2000 aircraft with a

uniquely flexible approach to air combat. MICA is the only missile in the world featuring two interoperable seekers (active radar and imaging infrared) makes MICA highly countermeasure resistant and therefore highly effective.

The IAF is also getting a major boost with the addition of the ASRAAM as its Next Generation Close Combat Missile. With its large rocket motor and clean aerodynamic design, ASRAAM has unrivalled speed and resultant aerodynamic manoeuvrability and range. ASRAAM gives it a high kinematic capability that delivers superior end-game performance for within visual range air combat. MBDA's ASRAAM missiles are significantly enhancing the battle capability India's Jaguar bombers, giving them unrivalled self-protection ability and enhanced ability to penetrate hostile airspace.

Working with HAL, integration of the Mistral ATAM system on the Dhruv helicopter and the Light Combat Helicopter (LCH) has been very successfully completed. Key to many of MBDA's offerings are their ability to be fitted to multiple platforms. By utilising the same weapon across different platforms, not only do extra aircraft benefit from these capabilities, but there are also major cost savings and operational benefits to be found in maintaining common equipment stockpiles, not to mention the training and logistics benefits. For example, utilisation of the Mistral missile on India's helicopter platforms provides a bridge to their use in a ground based VSHORAD role, where the missile is fully compliant with India's requirements and outperforms the capabilities of its rivals. 🦋

Courtesy: MBDA

“Punching above.....”



MBDA's AIM-132 ASRAAM

MBDA's AIM-132 ASRAAM (Advanced Short Range Air-to-Air Missile) entered service with the Indian Air Force (IAF) as a 'fire-and-forget' Close Combat Missile (CCM) for self defence of IAF-operated Jaguar strike fighters, in the process progressively replacing the earlier R.550 Magic. As the Jaguar is essentially a low-flying aircraft, the threat is projected to come from higher altitudes, so two missiles are carried on the Jaguar's over wing stations. Over wing pylons require quick missile separation and ASRAAM being the fastest, lowest drag CCM weapon extant, inherently provides safe separation, unmatched "snap-up" capability, plus guaranteeing "first shot first kill" to avoid getting involved in an unnecessary dogfight.

MBDA's ASRAAM is presently also in service with the RAF and RAAF, which is an optimum solution given its ability to passively provide short to medium range

protection. Reportedly, much impressed by its performance, the IAF have initiated proceedings to integrate the missile with its Sukhoi Su-30MKI and Tejas LCA fleet as well. It should be noted that although labelled as a CCM, the AIM-132 ASRAAM actually qualifies as a *Near Beyond Visual Range Air-to-Air Missile* (NBVRAAM) with its range exceeding 25 km.

The 2.9 metre-long, 88 kg missile is optimised for best possible pre-merge performance, following the dictum that whoever gets the first shot off is likely to win the encounter. Therefore the missile is built from the outset to acquire an opponent and successfully engage it at maximum range. Still, should the first shot not succeed, the missile will then provide





close-in performance to destroy the target aircraft at close quarters.


Key to the missile's acquisition range performance and high 90 degrees off-boresight lock-on capability is its 128x128 element Focal Plane Array (FPA) Indium Antimonite Imaging Infra-Red (IIR) seeker mounted on a two axis gimbal. The device is manufactured as a single Indium-Antimonite die and in effect is a single chip low resolution thermal imager sensitive in the 0.5 to 5.4 micron band. FPA dramatically increases sensitivity because it continuously "stares" at the target, thus exposing a much larger detector area for much longer to the target's emissions. Moreover, because it uses a television style scan, rather than conical reticule scan, it is

for all practical purposes immune to flares as well as blinking Infra-Red (IR) jammers.

The only robust countermeasure is a laser with sufficient power to blind or burn it out. Because in effect the FPA produces a TV picture of the target scene, it is virtually impossible to break lock by violent manoeuvres at any range, also since the gimbal mechanism will adjust line of sight of the FPA. The target airframe is tracked using contrast lock techniques similar in concept to those used by the AGM-65 Maverick ASM, and therefore escape from seeker coverage is geometrically impossible – providing the airframe can sustain this.

The ASRAAM warhead is a compact DASA-built blast fragmentation design, fired by a Thorn-EMI laser proximity fuse,

with a backup impact fuse. This highly accurate ASRAAM is in effect a "hittile" as the warhead serves the purpose of guaranteeing the otherwise almost certain kill produced by a direct hit with a high velocity missile airframe.

The selection of AIM-132 ASRAAM for a considerable proportion of IAF platforms is indicative of the fact that enhanced situational awareness in modern air warfare has resulted in the probability of majority of aerial duels taking place in near beyond visual range, where a combination of Active Radar Homing (ARH) Beyond Visual Range Air-to-Air Missile (BVRAAM) and IIR homing NBVRAAM is likely to dominate the proceedings. 

Sayan Majumdar

Indian Jaguars: into the 5th Decade



At very start of the Jaguar contract and subsequent planning for implementation, the Indian Air Force had specified major upgradation of the aircraft, its engines, and avionics and weapon systems. The Rolls Royce licence agreement signed in 1979 was for the uprated Adour Mk.811 (4205 kg thrust with reheat), to give the Jaguar more power in the prevailing high ambient conditions.

As for the avionics and nav-attack systems, while majority of HAL-built Jaguars would have the standard Ferranti laser ranger and marked target seeker (LRMTS) fitted in the nose, eight aircraft would be fitted with the Thomson-CSF Agave multi-mode I/J band radar for maritime role.

The IAF Jaguars were to be integrated with a new nav-attack system, and the IAF selected the then new-generation Sagem ULISS-82 inertial navigation system. Also selected were the Ferranti COMED 2045 (Combined Map and Electronic Display), already in production for the U.S Navy's F/A-18, Smiths Type 1301 HUD displaying raster and stroke symbology, and Smiths multi-purpose processor interfaced with a MIL STD 1553 dual redundant digital databus charged with weapon aiming and air data computation. Responsibility for installation development and interface was given to the INAS Integration Organisation (popularly known as the I.I.O), established at Bangalore to coordinate the programme with HAL's Design & Development Bureau and the ASTE.

AAMs on overwing pylons

The integration and firing trials of Matra R.550 Magic air-to-air missiles on the Jaguar's over-wing pylons was also successfully carried out and completed by the ASTE in the closing months of 1982. The high technical and operational expertise displayed by the Indian organisations received extremely laudatory praise from the numerous European aerospace firms involved. The Indian Jaguar was, with the new equipment and systems, known as the DARIN version.

Over the past decades, HAL-built Jaguars have been equipped with the indigenously-developed DARIN (Display Attack and Ranging Inertial Navigation) system which incorporated second generation gyros and computers in conjunction with sensor, electronic and nav-attack processors. In this configuration the Jaguar-DARIN served with confidence for over two decades will the relentless march of new technologies and systems inspired HAL's ARDC to work on the DARIN II system, augmenting even further the Jaguar's operational capabilities, followed by the DARIN III at which standard the Jaguar will remain in frontline service till the 2030s.

**Extracted from
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Team Tempest

MBDA offers insight into ongoing work



(Photo: Vayu)

During the recent DSEI 2019, MBDA offered an insight into some of its ongoing work as the coordinator of effects within *Team Tempest*, further highlighting the benefits of this new approach to designing a future combat air system. Being a Team Tempest partner, involved from the inception of a future combat air system, MBDA is ensuring that innovative weapons systems complement the cutting-edge design and novel technologies of the platform around them. This collaborative arrangement is already showing the potential to deliver capability enhancements across a range of missions that led to the concepts on display at DSEI 2019.

In the domain of *Survivability in Attack and Control of the Air*, working closely with Leonardo and BAES has led to MBDA developing concepts for a Hard Kill Defensive Aid System (HK-DAS) capable of tracking, targeting and intercepting incoming missiles in high threat environments. Leveraging commonality,

modularity and reuse of the HK-DAS concept, MBDA are exploring a small form factor, scalable, ground attack micromissile capability to enhance the Tempest system in the close air support (CAS) role for Persistence in Attack.

Drawing upon the prior weapons integration experience of both MBDA and BAES, innovative payload bay and launcher concepts facilitate an improved weapon load such as the twin WVRAAM (Within Visual Range Air-to-Air Missile) concept, or increased weapon release envelopes and the flexibility to introduce enhanced weapons capability.



(Graphics: MBDA)

Outside of concepts on display, MBDA's contribution to the PYRAMID Open Mission System is for exploiting technologies developed in the Ground Based Air Defence (GBAD) command and control (C2) domain to enhance operational effectiveness of the Tempest in air-to-air engagements for control of the air. There is also work on intelligence, surveillance and reconnaissance (ISR) with Leonardo and BAES where MBDA is working to exploit effectors such

as a node on the sensor network, enhancing the situational awareness picture available to pilots.

Whilst next generation missiles previously displayed alongside Tempest - Meteor and the SPEAR family of weapons – will be optimised for use on the future combat air system, being at the heart of the system design stage is creating a synergistic architecting of effectors and platform, to achieve significant force multiplication. Underpinning all this work is the challenge to processes and technologies, which is to deliver a step change in the cost, length and complexity of weapon integration. ✈

ENTER THE RAFALE



The IAF's Next Generation begins !

The Dassault Rafale F3 variant marks further development of this multi-role combat aircraft, with priorities shifting towards both nuclear strike and conventional attack yet retaining formidable air superiority attributes, leading to classification by its manufacturer Dassault as being an 'omni-role' aircraft.

To execute successful attack missions, the Rafale with its superb manoeuvrability and high degree of cockpit automation, is designed to make use of terrain following and masking, particularly at night and in adverse weather conditions, to fly a terrain/obstacle-avoidance profile at 5.5g down at 100 feet in altitude, using to the Automatic Flight Control System (AFCS) that can operate in either digital terrain-following or radar terrain following mode. With digital terrain-following, the AFCS manoeuvres the Rafale over terrain based on a three dimensional map database which is pre-programmed into the AFCS software. The radar terrain following mode of the RBE-2 AESA radar can scan the terrain ahead and safely fly the jet over all obstructions before resuming nap-of-the-earth operations.

In these missions, its digital Fly-By-Wire (FBW) controls and canard-type fore-planes allows the Rafale to secure all advantages of delta wing platform including high fuel storage, low drag, increased manoeuvrability with considerably more authority in pitch, fewer control surfaces and reduced Radar Cross-Section (RCS) while minimising most instabilities that arise when an aircraft carries significant external stores during low-altitude missions. The digital FBW controls in particular empower the Rafale with remarkable manoeuvrability at low altitudes as well as high resistance to *g-bumps* enabling it to fly fast and low, deliver ordnances on targets with



high degree of accuracy and capable of destroying alerted opposing fighters with their formidable defensive weaponry and electronic warfare suite on their flight back.

To further complicate tasks of the adversary, the Rafale has significantly lower Radar Cross Section (RCS), with priorities attached to stealth characteristics from the conceptual phase. The two 'kidney shaped' side-mounted intakes were meant to lower Rafale's 'frontal RCS' by shielding moving parts of the Snecma M88-2 engines compressors while the vertical fin was made of electromagnetic transparent composites. High acceleration Snecma M88-2 engines with 72.9-kN of thrust each in turn enables Rafale to fly in 'super cruise' mode while in supersonic flight without the use of afterburners during part of the ingress and egress route without imposing serious penalty on range. Consequently, exposure to enemy air defence systems and networks are reduced, enhancing its survival capability. This statement is partially true especially in the egress route when at least a part of enemy air defence systems and networks are on full alert after being struck.



The FADEC (Full Authority Digital Engine Control) engine incorporates advanced technologies such as integrally bladed compressor disks ('blisks'), low-pollution combustor, single-crystal high-pressure turbine blades, ceramic coatings, revolutionary powder metallurgy disks and composite materials. The compressor utilises a three stage low pressure fan, and a six stage high pressure compressor. Possible updated versions of the M88 under testing/conceptual stage are bound to push the performance to even greater heights.

Rafale's RCS

Specifically, Dassault designers did not compromise with aerodynamic agility of the Rafale to reduce RCS and preferred to further enhance the low RCS attribute of the Rafale by Thales integrated *Système de Protection et d'Évitement des Conduites de Tir du Rafale* (Spectra) self-protection suite integrated with three specific computers called the *Gestion de l'Interface et Compatibilité* (GIC), offering high sensitivity detection and capable of tackling multiple threats, and operating smart data fusion between multi-spectral sensors, in the process providing the identification, location, jamming and decoying against an extensive range of electromagnetic, Infra-Red (IR) and laser threats. The Spectra consists of Thales developed Radar Warning Receiver (RWR) integrated with a built-in active phased array Self Protection Jammer (SPJ) with prominent square-section antennas mounted on the lower corners of the engine inlets and in the rear of the fin-top pod, MBDA developed Missile Approach Warning System (MAWS) working in two infrared (IR) bands, Thales

developed Laser-Warning System (LWS) and four chaff/flare dispensers all integrated into a single system.

The RWR and SPJ system were integrated as *Détection et Brouillage Electromagnétique* (DBEM) system reported to be capable of detecting hostile transmitters over the frequency range of 2-40 GHz on the F2 standard with a high accuracy of up to 1-degree in azimuth. The DBEM automatically detects, classifies, and identifies emitters and inputs information about them into the central computer. The Spectra's active jamming subsystem uses phased-array antennas located at the roots of the canards and reportedly capable of producing a pencil beam compatible with the accuracy of the receiver system to concentrate power on the threat while minimising the chances of detection. Highly placed officials also hinted at "active cancellation devices & procedures" which is a low RCS technique in which the aircraft,

when painted by radar, transmits a signal which mimics the echo that the radar will receive in return, yet one half-wavelength out of phase, "blinding" the target radar in the process.

Power requirements are very low, compared with conventional electronic warfare, and provide no clues to the aircraft's presence but require very fast processing and high technological finesse. The low RCS of Rafale fleet was strikingly demonstrated during June 2002 over the Indian Ocean when air exercises were conducted between Rafales of Flottille 12F Squadron deployed aboard the *Marine Nationale* (French Navy) aircraft carrier *Charles de Gaulle* and United States Navy (USN) F-14 Tomcats and F/A-18 Hornets operating from USS *John C Stennis*. Rafale was reported to be hardly detectable by radars of USN aircraft and was always able to conduct 'first-look-first-shoot' procedures with Beyond Visual Range Air-to-Air Missiles besides appearing very agile in the close-combat arena.

The new generation MAWS, termed as *Détecteur de Départ Missile Nouvelle Génération* (DDM NG) incorporates a new infrared array detector which enhances performance with regard to the range at which a missile firing will be detected. With two sensors, each equipped with a fish-eye lens, DDM NG provides a spherical field of view around the aircraft. The DDM-NG also offers improved rejection of false alarms and gives an angular localisation capability which will be compatible with the future use of Directional Infrared Counter Measures (DIRCM). 🦋

Sayan Majumdar
(photos: Dassault)



Saab's Flight Plan for the Future



Gripen E: “an intelligent fighter system”

In the last week of August 2019, maiden flight of the first Brazilian Saab Gripen E fighter took place, less than five years since the formal contract was signed. This aircraft is the first Brazilian production aircraft and will also be used in the joint test programme as a test aircraft: this milestone is testament to the partnership between Sweden and Brazil.

The main differences with the previous test aircraft are that the Brazilian Gripen E has a totally new cockpit layout, with a large Wide Area Display (WAD), two small Head Down Displays (sHDD) and a new Head Up Display (HUD), but also incorporates modifications both in hardware and software.

There are four outstanding aspects to be recorded: first, for an almost completely new aircraft, there are two distinct configurations being developed simultaneously for the Swedish and the Brazilian Air Force.

Second, the speed of development continues unabated with the Brazilian aircraft having a further updated flight control system as compared with the Gripen E test aircraft (39-8) that first flew a little over two years ago.

Third, is the complete development and production of an aircraft built as per Brazilian Air Force specifications in less than

5 years from contract.

Fourth, the Swedish Air Force has decided to incorporate the Wide Area Display produced in Brazil on its own fighters, an inverse process that of transferring technology to Saab. So Brazil first specified this, the WAD was developed and produced in Brazil and the Swedish Air Force followed, incorporating this on its own on Gripens.

But far more has been achieved. By now, Saab have trained numbers of Brazilian pilots, technicians, engineers, designers and assembly line personnel. The technology transfer programme has been divided into more than 60 segments. By end of the programme, 350 Brazilian engineers, technicians and pilots will have worked in Sweden for up to 2 years, taking part in the theoretical and on-the-job training, before they return to Brazil to apply and multiply their new knowledge and skills. Till now more than 200 Brazilians have been trained in Sweden, and are now back in Brazil engaged with development work on the Gripen, particularly the twin-seater variant and specific developments related to the Brazilian configuration.

The Brazilian company Akaer has partnered with Saab since 2009 and has accumulated more than half a million

hours of work dedicated to the Gripen programme, including on development of structural details, the rear fuselage and are now involved in development of the two-seater aircraft.

The Brazilian programme is a contemporary of the Indian MMRCA case, which began in 2007, involving most of the same contending aircraft. The Brazilian order for 36 aircraft was won by Gripen in 2013. Today, there is not only production and flight of the first Brazilian Gripen, but a robust transfer of technology has been underway with co-development of the product, continuous upgrades, with benefits for Saab, the Brazilian industry and of course, the Swedish and Brazilian Air Forces.



The Gripen's smart cockpit



Pair of Gripen Es over typical Swedish terrain

This is the model of partnership that Saab brings to the table and believes that this meets requirements of not only the Indian Air Force but would also enable the creation of a strong, sustainable and modern defence aerospace eco-system that builds on strengths of the Indian industry.

Gripen E for the Indian Air Force

The Gripen E is arguably the most modern multi-role fighter aircraft in the world extant, developed to counter and defeat the most advanced threats in modern battlespace. Its unique architecture makes it an 'intelligent' fighter system that continuously evolves by rapidly embracing new technology and tactics in a way which will always keep IAF 'one step ahead'.

The Gripen E offer for India builds upon the family of aircraft as ordered by Brazil and Sweden with deliveries commencing in the near future. With its range of weaponry, including the Meteor BVR (Beyond Visual Range) missile, the Gripen E will give the IAF a definite edge against all adversaries.

The Gripen E has latest high performance sensors including AESA radar,IRST system, advanced data links and AI-enabled decision

support which gives the pilot superior situational awareness and ability to "see first, act first". Its low visual and electronic signatures and a fully integrated onboard self-defence and ECM suite with 360 degree spherical coverage, together with most advanced weapons extent, ensures mission success. With its combat performance and power projection capability, the Gripen E will certainly provide the IAF with deterrence power in the region.

Saab have provided a comprehensive response to the IAF's Request for Information for new fighter aircraft furthermore supports the country's ambition for stronger indigenous defence capabilities with latest technologies for development and production of future fighters, including the next generation AMCA.

Saab's offer will give Indian companies unique opportunity to take part in the industrial process "of the most advanced fighter, absorbing state-of-the-art technologies having applications in both military and civilian aviation sectors. Through the *Make in India* initiative, a generational shift in full spectrum fighter capabilities will accelerate India's defence and industrial endeavours.

Saab's offer also consists of comprehensive Transfer of Capability packages, focused on building indigenous capabilities to design, develop, produce and maintain then state-of-the-art fighter systems. Creation of those capabilities will require substantial investments from the Indian as well as international partners as needed for facilities, training, plant and equipment and so on. Those investments will serve as a baseline for creation of thousands of jobs for skilled workers, apart from engineers and technicians. The spill-over effect will be substantial and DPSUs will also be able to significantly benefit from Transfer of Technology and Transfer of Capabilities. The Saab India Tech Centre (SITC) in Hyderabad, together with Tech Mahindra, is currently undertaking Gripen development work.

The overall aim is to build an eco-system which will support not only India's requirements but also those of global partners/suppliers. Saab have undertaken surveys for manufacture of aero-structures, sub-assemblies, machined parts and sheet metal parts and are continuing on that process, together with system partners, in order to find the right partners for Saab to active optimum localisation.

Fighter for the Future

With rapid development of core technologies for enhancing computational power and software performance, a product being evaluated and compliant today may well be obsolete, or not fully operational or relevant by the time of delivery – unless of course, there is an ability for continuous upgradation.



Gripen 39-8 takes off on test flight

The Gripen has been designed for continuous upgrades so as to counter and defeat new combat challenges, such a design approach having been already proven many times. The Gripen E's inherent upgrade potential and design philosophy as well as the highly efficient manufacturing processes, ease of maintenance and supportability, provides significantly lower upgrade, maintenance and operating costs. The Gripen E will deliver significant cost savings over the expected 40+ years of operation, in comparison with alternative platforms which enables relevant training for and enhancing operational capabilities of the Indian Air Force.

Such an upgradeable design, together with transfer of design and upgrade capabilities are the pre-requisites and enablers to provide the IAF indigenous upgrades and sustainable capability, thus continuously meeting evolving operational needs. These capabilities for systems integration in performing upgrades, needs to be emphasised. Transfer of design capabilities for system integration includes supporting processes, ICT environment, engineering methods, tools and rigs, which will deliver a systems integration capability, most essential to secure the full system performance potential over time.

The cost and complexity of upgrades can be daunting in aircraft programmes, but that is not 'the Gripen way'. Upgrades are essential, but should be relatively easy to manage, quick to implement and

affordable so as to sustain. As a Gripen operator, the IAF would be able to control the path, pace and progress of such upgrade programmes, and should not be forced into costly upgrades by an external party, instead always having a fighter which is on the front line. The Gripen assuredly sustains maximum operational effectiveness over its entire lifecycle

Saab is conscious that the "money is no object" manner of defence spending is a thing well of the past. Unlike other fighters, all costs must be agreed to at the outset and predictable over the aircraft's entire life-cycle. The Gripen programme typically comes as a full package of aircraft, equipment, training and support.

Additionally, Saab delivers economic benefits as well: the Gripen brings skills, technology and shared intellectual property even as the Company looks to creating industrial partnerships and long-term relationships.

Saab has filed a definite flight plan for the Indian Air Force and India's aeronautical Industry. In aviation parlance, they await take off clearance from the Indian government for a joint journey was over the next half a century! ✈️

Mats Palmberg, Vice President, Industrial Partnerships, Saab, and Head of Gripen India Campaign



Gripen of the Swendish Air Force

Mats Palmberg, Vice President, Industrial Partnerships, Saab, and Head of Gripen India Campaign says that, "Saab's Gripen E is the most modern multirole fighter aircraft in the world, developed to counter and defeat the most advanced threats in this modern battlespace. Its unique architecture makes it the intelligent fighter system that continuously evolves, rapidly embracing new technology and tactics in a way that will always keep its operator one step ahead. The range and depth of the capabilities offered to be transferred is unprecedented. Whereas others offer to set up production lines, the Swedish true partnership offer includes also the underlying know-how and know-why that will bring long-lasting benefits not only to the aerospace domain but also to multiplying effects to the wider economy. We will manufacture 85% of the fighters locally in India covering all aircraft manufacturing phases, provide maintenance capabilities to ensure self-reliant and uncompromised operations by the IAF. In addition, we are also prepared to provide capabilities to further develop and upgrade the product in country".



Mats Palmberg

Dr. Vivek Lall, Vice President, Strategy and Business Development, Lockheed Martin Aeronautics on

The F-21 “For India, From India”

We are very excited about the F-21 for India – a true game-changer for the Indian Air Force, the Indian industry and India-US strategic ties. We are confident that the F-21 is the best solution to meet the Indian Air Force’s capability needs, provide *Make in India* industrial opportunities and accelerate India-US cooperation on advanced technologies, including, but not limited to, fighter aircraft.

On the F-21

Specifically configured for the Indian Air Force, the F-21 addresses the Indian Air Force’s unique requirements. The F-21 is an advanced single-engine, multi-role fighter at the most optimal Life Cycle Cost for the Indian Air Force with the longest service life of any competitor, 12,000 flight hours. Simply put, “the F-21 goes further, faster, and stays longer than the competition”. The F-21 will meet all of India’s performance, capability and advanced technology requirements, and provide unmatched opportunities for Indian companies of all sizes and suppliers throughout India.

Such an F-21 partnership also integrates India into the world’s largest and most successful fighter aircraft ecosystem : a USD \$165 billion market and demonstrates Lockheed Martin’s commitment to India: to deliver an advanced, scalable fighter to the Indian Air Force that also provides unrivaled industrial partnership opportunities.

The F-21 provides unmatched opportunities for Indian companies of all sizes, including Micro, Small & Medium Enterprises (MSMEs) and suppliers throughout India, to establish new business relationships with Lockheed Martin and other industry leaders in the US and around the globe. In addition to creating thousands of new jobs for Indian industry, F-21 production in India also supports thousands of US jobs.

The growing India-US ties

We are very encouraged by the positive trend we are seeing in India-US relations, notably on the defence-industrial partnership front. Defence-industrial partnerships have long been a hallmark of strategic ties and trust between both the nations. For example, in collaboration with Tata Advanced Systems, we have established an industrial base in Hyderabad where we currently produce C-130J empennages – which incidentally are on all Super Hercules aircraft globally –

and a metal-to-metal bonding facility at the same location. This bears testimony to our contribution to the development of Indo-US defence industrial partnership.

We see tremendous strength and opportunity in India’s defence industry – both private and public. We are always looking for strategic Indian industry partners across the country – Indian companies of all sizes, including Micro, Small & Medium Enterprises (MSMEs) and suppliers throughout India – to collaborate and explore security solutions which are unique to India. Many foundational agreements have been made between India and the United States that put bilateral defence ties on a strong trajectory. Dating back to 2009, both countries signed the End-Use Monitoring



Agreement, allowing US inspectors to verify the location of US-supplier material. This was followed by the Logistics Exchange Memorandum of Agreement (LEMOA) in 2016, permitting both country’s militaries to carry out re-supply or repairs on each other’s bases.

In 2016, the US recognised India as a ‘Major Defence Partner’ allowing India to procure more

Lockheed Martin and India



With a presence in India for over 25 years, Lockheed Martin opened its India subsidiary in New Delhi in 2008 and has supported and aligned itself with various initiatives of the Government of India. Lockheed Martin continues to explore opportunities for closer collaboration and partnerships, including supporting the Digital India initiative.

As a part of its larger commitment to enhance the growth and development of India's innovation, Lockheed Martin has sponsored and supported the *India Innovation Growth Programme* (IIGP) since 2007 in partnership with the Indian Department of Science and Technology, Indo-US Science and Technology Forum, Federation of Indian Chambers of Commerce and Industry, Stanford Graduate School of Business, and the IC2 Institute at the University of Texas.

Resonating with Prime Minister Narendra Modi's 'Start-up India' call, the IIGP has pioneered an initiative that has supported more than 400 innovators and start-ups with in-depth technology commercialisation training and handholding support to commercialise and scale their ventures in India and across the world, particularly in the United States. To date, the revenue generated for the Indian entrepreneurs through this programme is approaching \$1 billion, and it is a flagship innovation program in the Department of Science and Technology.

The C-130 programme represents a strong legacy of partnership between the US and India. All C-130Js delivered to customers around the world have major aerostructure components from India included in their build through partnership with Tata Advanced Systems Limited (TASL) in Hyderabad, India. This partnership with TASL also includes an on-the-job training element that supports the broader "Skills India" initiative.

The Indian Air Force operates a fleet of five C-130J-30s and it will receive an additional six C-130J-30s as well. India is one of 16 countries operating the C-130J Super Hercules, which is the world's choice for tactical airlifters. The IAF uses its C-130Js to support a variety of missions, from cargo delivery to providing vital humanitarian aid. The Super Hercules is also part of India's C-130J Roll-On/Roll-Off University Design Challenge. Through this initiative, Lockheed Martin provides research grants for teams from Indian universities to work with local industry partners and mentors from India's Defence Research and Development Organisation to develop design specifications for proposed modules that could be used on a Lockheed Martin C-130J Super Hercules cargo aircraft.

Adding on to our successful history of C-130J empennage, S-92 cabin, and now F-16 wing manufacturing in India, the F-21 will be a step function in furthering technology insertion, indigenous manufacturing and global export opportunities. The F-21 is the optimal platform to meet the Indian Air Force's near and long-term capability and affordability requirements. No other fighter in the competition goes further, stays longer or delivers more ordnance per mission than the F-21. A partnership with Lockheed Martin also positions Indian industry to become a key part of the world's largest fighter and sustainment ecosystem.



advanced and sensitive platforms and technologies. In 2018, the US changed the name of United States Pacific Command (USPACOM), the oldest and largest US unified combatant command, to United States Indo-Pacific Command (INDOPACOM) – a clear signal of India’s critical and growing role in the Indo-Pacific region. Arguably the most significant agreement to date is the Communications Compatibility and Security Agreement (COMCASA). Signed during the historic 2+2 dialogue in September 2018, COMCASA enables both countries to transfer secure communications and data equipment in India.

Most recently, the US Government established the US-India Security Cooperation Task Force, which is comprised of multiple services and agencies across the US Department of Defense (DoD), Department of State, Commerce Department and other federal agencies to collectively identify and address opportunities to further US defence partnerships with India. I am personally very excited about this organisation’s charter and the momentum I have witnessed recently.



Dr Vivek Lall speaking at the 2019 Supplier Conference 2019 in New Delhi.

Committed to Partnering with India

As part of Lockheed Martin’s commitment to ‘Make in India’ and positioning current and future programmes for prolonged success, we have performed significant supplier due diligence during the past three years. Specifically, we have evaluated over 400 Indian suppliers and visited over 200 of those Indian suppliers in person to date. This industry ranged from DPSUs, DRDO, OFB, MSMEs, and others.

Lockheed Martin also held its third annual Supplier conference earlier this year in New Delhi, with twenty-six Lockheed Martin Tier 1 suppliers and 75 Indian suppliers attending the event and conducting more than 540 meetings during the three-day conference. US Commerce Department and Government of India stakeholders were both represented at the conference, highlighting the growing US-India bilateral defence trade relationship.

Ultimately, fostering relationships on a bilateral and industrial scale will further progress the Government of India’s objectives and US-India ties. We firmly believe our F-21 proposal is best suited to not only meet but exceed expectations.

Lockheed Martin is committed to strategic, long-term international defence partnerships with India. India has a pressing need for advanced, scalable defence capabilities. We are proposing game-changing defence partnerships that benefit multiple stakeholders in India, the US and beyond.

Our proposed partnerships with India—for new fighter aircraft, helicopters and other platforms—are ideally suited to not just meet but exceed India’s capability and defence-industrial needs in the near-term and well into the future.

Strong, growing defence cooperation and trade highlights the importance of US-India bilateral ties. Significantly, India holds more single-service exercises with the US than with any other country. In September 2018, joint military cooperation was further strengthened by announcing the first US-India tri-services exercise involving the Army, Navy and Air Force.

Defence trade and investment are central to technology advancement and India’s defence industrial ecosystem development. Lockheed Martin has partnered with India for more than 25 years, working with the Indian armed forces, industry, community and other stakeholders to advance the strategic security and industrial capability of the country. We are a strong advocate and supporter of programmes that seek to empower Indian citizens and industry with tools, capability and knowledge that will advance individual and collective progress, including Government of India initiatives ‘Make in India’, ‘Skills India’ and ‘Start-up India’. We are also a founding member of the India Innovation Growth Programme (IIGP) which was established in 2007.



The Super Hornet seen here at Aero India 2009

The Formidable F/A-18 Super Hornet

According to Boeing, the company sees an opportunity to sell more than 350 aircraft across six major fighter competitions, and is in discussions with other unspecified countries. The key publicly-known opportunities for the type are the fighter requirements in Canada, Switzerland, Germany and Finland, as well as separate competitions for the Indian Air force and Navy. Finland has also been cleared by the US government to possibly obtain the EA-18G Growler electronic warfare variant of the type for its HX fighter procurement, which is aimed at replacing its 62 Boeing F/A-18C/Ds. This is only the second time that the EA-18G has been approved for export, the only

international operator of the EA-18G being the Royal Australian Air Force, which has 11 examples.

There have been important updates for the Block III over the Block II, which include conformal fuel tanks for longer range, better connectivity with other assets, an infrared search and track (IRST), an advanced tactical data link and a new distributed targeting processor. The Block III also has a lower radar cross-section. The airframe life has also been extended to 10,000hr, up from 6,000hr for the Block II. In March 2019, Boeing secured a three-year contract from the US Navy for 78 F/A-18E/F Block III Super Hornets, with a total contract value of about \$ 4 billion and

also has a programme to upgrade the navy's existing Block IIs to the Block III standard.

Apart from the US Navy, the Royal Australian Air Force also places immense trust on the Super Hornet as a multi-role, frontline fighter of choice. All 24 of the Australian Super Hornets were delivered by Boeing to the customer, ahead of schedule in October 2011. Further proof of the continued edge this fighter brings to armed forces globally can be gauged from the order recently placed by Kuwait for 22 F/A-18 Super Hornets.

A robust roadmap has been laid out to ensure that the F/A-18 Super Hornet is capable of dealing with future threats. The US Navy's continued investment is proof

of the fact that this aircraft will continue to have the technologies needed to outpace threats for decades to come. Boeing and the US Navy have laid out and maintained a robust spiral development approach to the Super Hornet that provides updates to the aircraft's subsystems and software every two years.

The Super Hornet is arguably the most advanced aircraft of its kind in operation today, with designed-in stealth, an AESA radar and numerous other advanced technologies. The Super Hornet has not only a low acquisition cost, but it costs less per flight hour to operate than any other tactical aircraft in US forces inventory, part of its affordability being because the Super Hornet is designed to need far less maintenance, which translates into the high mission availability.

Boeing and its industry partners have built more than 700 Super Hornets and Growlers, all on cost and on schedule. Boeing is confident that it will see F/A-18 production well into the mid 2020s, based on the US Navy's need for more aircraft and near-term international opportunities.

One Fighter, Many Benefits

The Super Hornet brings the latest generation of technologies to the warfighter. The AESA radar in particular, is an exponential leap in technology that will be needed for current and future missions. The Advanced Targeting Forward Looking Infrared system, Joint Helmet Mounted Cueing System, Multifunctional Information Distribution System, advanced high capacity computer system, and state-of-the-art cockpit provides the warfighter with intuitive situational awareness and capability now and far into the future.

The fighter is highly capable across the full mission spectrum and is a true multirole aircraft, able to perform virtually every mission in the tactical spectrum, including air superiority, day/night strike with precision guided weapons, fighter escort, close air support, suppression of enemy air defences, maritime strike, reconnaissance, forward air control and tanker missions. It has the right level of stealth, the right sensors and the right number of missiles for the Indian Air Force's spectrum of missions.

Boeing has also completed extensive analysis and testing on the F/A-18 Super Hornet's compatibility with Indian aircraft carriers. Results show that the Super Hornet



is capable of launching off a ski-jump carrier and could be operated from Indian carriers with a meaningful fuel and weapons load.

Boeing has had a presence in India for more than seven decades and is committed to expanding its partnership by producing Super Hornets in India and thereby further developing India's aerospace ecosystem. Boeing is proposing a world-class advanced manufacturing facility in India with the very latest technologies in place.

With designed-in stealth and robust capability growth plan, the Super Hornet is also relevant to India's Advanced Medium Combat Aircraft (AMCA) programme. Boeing will work closely with the Indian industry to ensure they have latest technologies and apply lessons learnt from the current Super Hornet production line. Working towards this goal, in 2018, Boeing announced a partnership with Hindustan Aeronautics Limited (HAL) and Mahindra Defence Systems (MDS) for manufacturing the Super Hornet in India for its armed

forces, and pursuing the joint development of future technologies.

Boeing is confident that its partnership with HAL and Mahindra will enable it to optimise the full potential of India's public and private sector to deliver next-generation fighter capabilities. Boeing envisions that this partnership can deliver an affordable, combat-proven fighter platform for India, while adding growth momentum to the Indian aerospace ecosystem with manufacturing, skill development, innovation and engineering. The partnership will transform India's aerospace and defence ecosystem, further building on its 'Make in India' success.

Future production of the Super Hornet in India, with Indian partners, will involve maximising indigenous content and producing the F/A-18 in India for its armed forces thereby creating a 21st century aerospace ecosystem.

Courtesy: Boeing
(photos: Simon Watson)





IAF Hawk AJT

Co-creating the future of Combat

Rolls-Royce India and the Indian Air Force have a shared history and a common vision. This truism is never more a reality than on the occasion of the 87th Indian Air Force Day in October 2019. In 1933, much before India became an independent nation, Rolls Royce engines powered IAF aircraft. The IAF played its part during World War II and Rolls-Royce was a partner in supplying state-of-the-art engines for its aircraft even then. That tradition of world class engines, technology and training has continued for close to nine decades. The Indian Air Force Day 2019 is a moment to recall and celebrate these years of progress and partnership.

We at Rolls-Royce are proud that IAF is the fourth largest in the world in terms of assets and people. To build on this success, India needs to invest in programmes that help co-develop products and co-create solutions customised to the security needs of this country. This will enable the country to own Intellectual Property (IP) for these

solutions, because we believe the future is about India owning the IP.

This is the space that Rolls-Royce want to build on and we are working closely with India's Ministry of Defence, DRDO, HAL and others to co-create products and solutions for the Indian market because we believe that joint IPs between countries will lead the way in the future.

Even while global and regional geo-strategies are undergoing fundamental changes. India will have to enhance its air power manifold in the coming years to meet its changing defence needs, in particular, speed and technology becoming defining factors in future warfare.

The government can invest in programmes where companies can participate and work together to co-create products and solutions. For example, in defence, when there is co-creation of aircraft technology, it could then be a joint IP between governments. Whether it is then manufactured here in India or

elsewhere, India could be a co-owner of that IP and that is what makes this a powerful proposition for the future of combat.

Further, as India seeks to make manufacturing as a core part of its economy, there is also an opportunity for the country become the supply chain capital for the world. Singapore and other countries have been investing in programmes that create IP, and this in turn creates manufacturing and export opportunities, which create jobs in the market. There is a cost-arbitrage equation and a value equation that is pertinent to India, but to leverage it, the country will need to attract investment by investing in such programs.

Looking at the future, Rolls-Royce remains committed to developing the Indian aerospace industry and furthering Indian self-reliance. An excellent example of this is the Adour Mk804/Mk811 (which powers the Jaguar) which was made in India and continues to be supported by HAL in partnership with Rolls-Royce.



IAF Jaguars are powered by R-R engines

With a growing engineering footprint in India, we are working towards establishing a robust ecosystem that will engage in co-creation across the entire value-chain – from research, design and development to manufacturing, integration, maintenance and repair. This will further enable the vision of *Make in India*, not only make for India but for the world. India is among

the top 5 countries spending on defence, with the FY 2018-19 budget allocation for defence being pegged at around US\$ 45.61 bn³ (excluding defence pension).

The RoR Defence Service Delivery Centre (SDC) in Bengaluru, the only one in Asia, specifically supports the Indian Armed Forces and Hindustan Aeronautics Limited, and aims to further improve our

responsiveness, while enabling the customer to continually improve engine availability. The SDC will be able to respond to many queries in-country with its team of qualified Indian engineers, which is another source of pride.

RoR will continue to support today's fleets, including those that have been in service for many years. With this, India not only benefits from global best practices but also gets the best of research and development expertise. In tandem with the country's priority of indigenisation, we further support the IAF with technology transfer and training programmes. At the heart of all we do is the mission to help power the people that protect our skies.

At this time, as we nurture our 85 years' relationship with India, we re-commit ourselves to build on our shared legacy and to co-create the future of Indian combat, in line with the country's growth vision of indigenisation and self-reliance. 🦅

Kishore Jayaraman

President, Rolls-Royce, India and South Asia



The Hawk trainer

First Brazilian Gripen E (F-39)



First flight of Brazil's Gripen E fighter aircraft (39-600) was on 26 August 2019, flown by Saab test pilot Richard Ljungberg from Saab's airfield in Linköping. Duration of the flight was 65 minutes and included test points to verify basic handling and flying qualities at different altitudes and speeds. This is the first Brazilian production Gripen E and will join the joint test programme as a test aircraft, the main differences being are that 39-6001 has a new cockpit layout, with a large Wide Area Display (WAD), two small Head Down Displays (sHDD) and a new Head Up Display (HUD). The Brazilian Gripen Es are designated as F-39 and the first aircraft will have tail number 4100.

Second batch of Qatari Rafales



Five more Rafales have been delivered to the Qatar Emiri Air Force, being based at Tamim Air Base. These comprise 3 single-seat Rafales plus 2-seat Rafale DQs. These join five earlier Rafales delivered to Qatar in June 2019.

66 F-16 Block 70/72s for Taiwan



On 27 August 2019, the US State Department approved sale of 66 Lockheed Martin F-16 fighters to Taiwan, these being the F-16C/D Block 70 variant. The \$8 billion deal, according to US Secretary of State Mike Pompeo, is consistent with past US policy. "We are simply following through on the commitments we've made to all of the parties." The Government of Taiwan plan to upgrade air defences in the wake of increasing Chinese military incursions into its air space. A spokesman for the Taiwanese president stated that the new F-16s "would substantially enhance our air defence capabilities to help Taiwan's self-defense and maintain the people's freedom and welfare".

Sukhoi Su-57E unveiled at MAKS 2019



Export version of Russia's fifth generation fighter aircraft, the Sukhoi Su-57E was formally 'unveiled' to the public on 27 August 2019 at the MAKS-2019 show outside Moscow. According to Rostec State Corporation the Su-57 has entered series production after the Russian Aerospace Force ordered 76 of them, the first of which is to be delivered end of 2019. Specifically mentioning India as prime export target for the Su-57E, Deputy Director Mr Vladimir Drozhzhov of Russia's Federal Service for Military and Technical Cooperation (FSMTC) had earlier told TASS news agency that "India should resume the fifth generation fighter aircraft development programme with Russia once again".

More F-35I Adirs for Israel



The Israeli Air Force has received two more F-35I Adir fighters, which arrived at Nevatim Air Base on 14 July taking the inventory to 16 aircraft operated by 140 'Golden Eagle' Squadron. The Israeli government had approved the purchase of 50 F-35Is and the first two examples were delivered to Nevatim in December 2016. Three more followed in April 2017, then came further pairs in September and November that year. In June 2018 three aircraft were handed over and two in November.

Su-35s delivered to Russia's Western Military District



Three more Su-35S multi-role fighters for the *Vozdushno-Kosmicheskoye Silye Rossyskoy Federatsii* (VKS, Russian Aerospace Forces) were handed over to the 790th Fighter Aviation Regiment (790 IAP) at Khotilovo, in Russia's Tver region. The new fighters were flown directly from the manufacturing plant in Komsomolsk-on-Amur more than 5,592 miles (9,000km) away, with three refueling stops en route. Khotilovo air base, which is part of the 6th Air Force and Air Defence Army, headquartered in St Petersburg, is receiving Su-35S fighters to replace its existing Su-27s.

Uzbekistan orders Su-30SMs

The Uzbek government plans to purchase new Su-30SM fighters from Russia, the aircraft acquired using a Russian export credit. Russia's Federal Service for Military Technical Cooperation (FSVTS) has confirmed Uzbekistan's interest in the Su-30SM, but the number of jets involved has not been announced. The Uzbek Air Force has some 30 first-generation Su-27 and six two-seat Su-27UB fighters, but none are currently operational.

Canada's new fighter programme

According to reports, the Eurofighter Typhoon has been withdrawn from the Canadian new fighter programme, as the UK Ministry of Defence and Airbus Defence & Space announced stating that the Typhoon would not compete for the 88-fighter deal. This leaves three aircraft types in the fray, including the Boeing F/A-18E/F Super Hornet, Lockheed Martin F-35A and the Saab Gripen E. Two key factors were announced ruling out further Typhoon participation, first being compliance with US-Canadian security agreements which would add too great a cost to aircraft whose manufacturing and supply bases reside outside North America as also the industrial offset element in the RFP: Typhoon follows withdrawal of the Dassault Rafale. The contract award is expected in early 2022, with the first aircraft delivery "as early as 2025".

UK and Italian industry 'SOI' on Tempest

On 11 September 2019 at the DSEI, UK defence companies (BAE Systems, Leonardo UK, Rolls Royce and MBDA UK), together with key Italian Industry (Leonardo Italy, Elettronica, Avio Aero and MBDA Italy) announced their intent to partner on the Tempest future fighter programme, signing a Statement of Intent ('SOI'). The parties will work together to define an innovative concept and partnership model which will include knowledge sharing, product definition and technology development for the joint development of future combat air systems. The signing of the SOI follows a commitment by the UK and Italian governments to work closely together on Combat Air Capabilities, including on systems such as Typhoon and F-35, as well as on the Tempest, the UK-initiated next-generation combat air system. "Both governments confirmed a common desire to maintain strong industrial bases in order to access key capabilities and secure prosperity for both nations".



Photo : Vayu team at DSEI

The MAKS 2019 airshow



Beginning with the now traditional mixed Su-27 and MiG-29 formation flypast, five new aircraft types were presented by Rostec apart from several new generation avionics, communication, EW systems as also new engines and airfield equipment at MAKS 2019. The highlight was public premiere of the MC-21-300 medium-haul airliner, developed by the United Aircraft Corporation. Also on display was a model of the Russian-Chinese CRJ929 airliner fuselage as also the new Ilyushin Il-78M-90A aerial refueller. Other aircraft displayed were the Ansat and Mi-38 helicopters, the latter in VIP configuration plus the Ka-62 new medium multipurpose helicopter.

“MAKS is without exaggeration the key event in the business calendar for the entire aviation industry and for Rostec. This year we are demonstrating more than 250 types of equipment, as also 40 new systems apart from aircraft and helicopters,” stated Rostec General Director Sergey Chemezov.

US clears ‘Continued Support’ of PAF F-16s

The State Department has made a determination approving possible Foreign Military Sale to Pakistan for Technical Security Team (TST) continued support of the F-16 programme for an estimated cost of \$125 million. The Defense Security Cooperation Agency delivered the required certification notifying Congress of this possible sale on 26 July, 2019. The Government of Pakistan requested a continuation of technical support services; US Government and contractor technical and logistics support services and other related elements of logistics support to assist in the oversight of operations in support of the *Pakistan Peace Drive* advanced F-16 programme. The total estimated programme cost is \$125 million.

PAF-PLAAF Exercise Shaheen VIII



From late August 2019, the Pakistan Air Force was engaged in intensive air exercises with the People’s Liberation Army Air Force, essentially operating from Hotan air base north of Ladakh. The PAF deployed a large force of JF-17s, F-7PGs and Mirage III/5s while the PLAAF fielded a number of J-10s and J-11s.



While further details of the exercise are not publically available, the eighth edition of such an exercise confirms that the two air forces have developed close intra operability including coordinated air defence and ground attack operations and extensively involving ground-based fighter controllers, coordination with AEW&C aircraft as well as logistics support.

PLAAF Su-35s in operational service

According to several reports, the Sukhoi Su-35 (*Flanker-E*) has recently entered service with the People’s Liberation Army Air Force which is a significant boost for the PLAAF. Senior Colonel Wu Qian of China’s Ministry of National Defense, said that “the Su-35 is a multi-purpose fighter capable of air combat and precision strike against land and surface targets.” The Su-35 will significantly bolster Chinese forces operating over the South China Sea and the Taiwan Straits, the PLAAF recently conducting exercises with the type in the region near Taiwan. “Recently, the PLA Air Force dispatched multiple types of warplanes to carry out



real combat training exercises in the airspace over the sea to further enhance capability of safeguarding China's national sovereignty and territorial integrity," Wu said. "The island the PLA warplanes patrolled around is, of course, China's Taiwan Island."

The *Flanker-E* is arguably the PLAAF's most capable fighter along with the Chengdu J-20 next gen fighter, which is not fully operational yet. The Su-35, armed with BVR missiles such as the very long range PL-15, could be a threat for US aerial refueling tankers and other support aircraft such the E-3 AWACS. The *PL-15*, could enter service during the course of 2018, and has already been cited by senior US Air Force personnel "as a significant concern".

RAF's 'swarming' drone test squadron

The Royal Air Force plans to reform its 216 Squadron as a specialist unit for testing small 'swarming' UAVs. The disclosure follows the news that a consortium led by Blue Bear Systems Research Ltd has been awarded a Defence Science and Technology Laboratory contract to develop 'drone swarming technology'. The outgoing Chief of the Air Staff, Air Chief Marshal Sir Stephen Hillier, has said "the intention is to bring drone swarming to the frontline by 2026".

Portugal orders KC-390

Portugal will order five KC-390 aircraft, a flight simulator, electronic warfare systems, logistics support and personnel training. Minister of National Defense Joao Comes Cravinho said the aircraft, with its intercontinental range and true multi-mission capabilities, exceeds the capabilities of the C-130H Hercules of which the *Força Aerea Portuguesa* operates five. The new airlifters will replace the veteran Hercules, the oldest of which was ordered in 1976. The first KC-390 is scheduled to be delivered in February 2023 with one of the remaining four arriving in Portugal in each of the following years. Portugal is the largest international partner of the KC-390 programme. The type received its civil certification from Brazil's National Aviation Agency (ANAC) in 2018 and is now in full series production. Entry into service with the *Força Aerea Brasileira* (Brazilian Air Force) is expected to occur in the third quarter of 2019 with follow-on deliveries continuing thereafter.

Boeing P-8A Poseidon for RAF



The first of nine Boeing P-8A Poseidons for the Royal Air Force (RAF) made its flight at Renton, Wash in July and the programme has moved on to installation and check out at Tuskwila, Wash. Following this, the RAF Poseidons will fly to US Naval Air Station Jacksonville for additional preparation and training of RAF personnel before flying home to the UK. The RAF will take delivery of ZP801 later this year and this will deploy to the UK in early 2020. RAF P-8A Poseidon fleet will be employed for maritime surveillance, anti-submarine warfare and anti-ship warfare for the UK, and will increase protection of the UK's nuclear deterrent and *Queen Elizabeth*-class aircraft carriers.

C-130Js for Bangladesh



On 22 July 2019, a former Royal Air Force C-130J Hercules C5 was handed over to the *Bangladesh Biman Bahini* (Bangladesh Air Force, BAF). This 'short-bodied' Hercules, was earlier rolled out at Marshall's Cambridge facility during an official ceremony, the British firm carrying out comprehensive maintenance and modifications on five C-130Js including avionics upgrades and provision of medical evacuation and passenger transport capabilities. Ordered in two batches of two and three aircraft, all five aircraft are expected to be delivered to Bangladesh before end of the year.

Afghanistan Air Force expands



Under an aviation modernisation programme, the US DoD is delivering two UH-60A+ Black Hawks and five armed MD530F Cayuse Warriors to the Afghan Air Force every month, the current UH-60A+ inventory being 28 helicopters. The ultimate aim is to deliver 159 of these to the AAF, enabling complete replacement of the present Mi-17 fleet, being some 47 helicopters. There are also four Mi-35s on the AAF inventory, gifted by India. Meanwhile, the AAF has taken delivery of ten AC-208 Eliminator aircraft, to support the AAF's emerging intelligence, surveillance and reconnaissance (ISR) and precision-strike capabilities. Of the 19-strong A-29 Super Tucano inventory, 12 are in-country, with the AAF planning to establish an A-29 training unit at Mazar-e-Sharif.

'Final' CH-47Fs for Turkey



Aviation Command of the *Türk Kara Kuvvetleri* (Turkish Land Forces) have received the last four CH-47F helicopters of a total of 11 on order. In January 2015, Turkey's Undersecretariat for Defence Industries (SSM) approved plans to purchase an additional five CH-47Fs which were contracted in September that year.

Flottille 36F to operate UAVs

The French Navy's Flottille 36F, based at Hyeres, will become the service's first shipborne unmanned aerial vehicle (UAV) squadron. The unit will operate the S-100 Camcopters from the navy's *Mistral-class* amphibious assault ships.



Schiebel Camcopters S-100 trials in Finland

Chosen for test trials by the Border and Coast Guard Division of the Finnish Border, Schiebel's Camcopter S-100 Vertical Takeoff and Landing (VTOL) Unmanned Air System (UAS) carried out a five-day maritime surveillance demonstration aboard Offshore Patrol Vessel *Turva*. The intense flight trials took place at the end of August in the Gulf of Finland, by day and night, the S-100 carrying out given scenarios "including searching, locating and recognising objects as well as surveillance for maximum situational awareness."



The test were part of the ongoing *Valvonta2-project* (Surveillance2) which is led by Finnish Border Guards and funded by European Maritime and Fisheries Fund (EMFF). To carry out its assigned tasks, the S-100 was equipped with the state-of-the-art L3Harris Wescam MX-10 Electro-Optical/Infra-Red (EO/IR) camera, the Overwatch Imaging PT-8 Oceanwatch wide-area maritime surveillance payload and an Automatic Identification System (AIS) receiver.

NATO Multinational MRTT Unit established

A ceremony was held at Eindhoven Air Base in the Netherlands on 10 July to mark formal establishment of the Multinational Multi-Role Tanker Transport Unit (MMU). The Multinational MRTT Force (MMF) encompasses eight A330 MRTT aircraft, which belong to NATO, five stationed at Eindhoven and the other three in Cologne, Germany. The MMF programme was initiated with an agreement between Luxembourg and the Netherlands in November 2014, including planned acquisition of the first two aircraft. Germany and Norway joined in June 2017, resulting in five more aircraft being added. Belgium signed up on February 14 last year, boosting the fleet to eight aircraft.



Bulgaria orders F-16V



Bulgaria is to acquire eight LM F-16V Block 70 multi-role fighters. These new-build aircraft – six single-seaters and a pair of two-seaters – are scheduled to replace the current *Bulgarski Voenovazdushni Sili* (BVVS, Bulgarian Air Force) MiG-29s and deliveries are due to be completed in 2023. Deputy Defence Minister Atanas Zapryanov has said that the country also plans to buy an additional batch of eight F-16s as a follow-on deal.

Second Phenix for French Air Force



The *Armée de l'Air* (French Air Force) has taken delivery of its second A330 Phenix Multi-Role Tanker Transport (MRTT), which arrived at Base Aérienne 125 Istres-Le Tube and was accepted by the *Direction Générale de l'Armement* (DGA, General Directorate of Armament) and is the first to be equipped with a medical evacuation capability, as the air arm moves towards declaring full operational capability planned for the end of October. The operating unit is the 31^e *Escadre Aérienne de Ravitaillement et de Transport Stratégiques* (31st Air Refuelling and Strategic Transport Wing), established at Istres in August 2014.

Pilatus ceases activity in Saudi Arabia and UAE

Switzerland's Federal Department of Foreign Affairs has determined that Pilatus must terminate all its activities in Saudi Arabia and the United Arab Emirates, since they are deemed to be a breach of "foreign policy objectives". On 26 June, the Swiss company was given a 90-day deadline to wind up technical support, parts management and repair of PC-21s used by the two countries.

China Airlines order B-777F freighters



China Airlines has confirmed its order with Boeing for three additional 777 Freighters. The original deal was for six of the widebody freighters, with the Taiwanese carrier originally committing to three examples. The six freighters have a combined list price of \$2.1 billion.

KrasAvia selects Il-114

Siberian operator KrasAvia will be the second (after Polar Airlines) as a customer for the upgraded Ilyushin Il-114-300 twin-turboprop. During the recent MAKS air show in Moscow, KrasAvia signed a preliminary deal with Ilyushin covering the supply of three aircraft which it intends to use as replacements for present Antonov An-24/26s.



Tunisair orders ATR72-600s

Tunisair Express has placed a firm order for three ATR 72-600s for “essential connectivity, both domestically and internationally”. Two ATR 72-500s are presently in service with Tunisair Express alongside a Boeing 737-500 and three Bombardier CRJ900s.

Airbus forecast : “over 39,000 new aircraft in next 20 years”



According to the forecast just released by Airbus, the world’s passenger and freighter aircraft fleet is set to more than double from the present 23,000 to almost 48,000 by 2038, with traffic growing at 4.3% annually, also resulting in a need for 550,000 new pilots and 640,000 new technicians. By 2038, of the 47,680 fleet, 39,210 will be new aircraft while 8,470 remain from the present. Offering airliners such as the A220, A320neo Family, the A330neo and the A350, “Airbus believes it will largely contribute to the progressive decarbonisation of the air transport industry and the objective of carbon neutral growth from 2020 while connecting more people globally”.

Philippines ACH160

A single ACH260 corporate helicopter has been ordered by an “undisclosed customer” in the Philippines. The helicopter will be used by the customer for private and business flights within the Philippines archipelago, the sale representing the first of the type in the Southeast Asia and Pacific regions. The ACH160 is an executive version of the helicopter, which features two wide cabin doors and electrical footsteps and is capable of carrying up to eight passengers.



Fourth C919 flies



The fourth COMAC C919 flight test aircraft made its first test flight on 1 August from Shanghai Pudong International Airport. During its 85-minute maiden flight, the aircraft completed “a number of test points and initial control inspections of various aircraft systems”. The aircraft will be used mainly for avionics testing, take-off/landing performance, automatic flight system and natural icing trials. According to COMAC, activities on the three other C919 test aircraft which have carried out flight tests at Yanliang, Dongying and Nanchang, along with static and other ground verification tests “are in steady progress, and the development of (the) C919 will enter the phase of high-density, high-difficulty and high-risk flight tests”.

Korean order for Dreamliners



Korean Air Lines is to enhance its Boeing 787 Dreamliner fleet with a commitment, unveiled at the Paris Air Show, for 20 more Dreamliners and signing of an agreement to lease ten more from Air Lease Corporation. These will comprise ten 787-9s and ten 787-10s, while the ten leased aircraft will be 787-10s. Korean Air Chairman Walter Cho said the 787 “will become the backbone of our mid and long-haul fleet for many years to come”.

Air France orders A220



Air France are to order 60 A220-300s which comprise 30 purchase options and 30 acquisition rights for the type. “These decisions reflect the Group’s focus on simplification. Making the fleet more competitive, by continuing its transformation with more modern, high-performance aircraft with a significantly reduced environmental footprint is key to achieving leading industry margins. Air France’s first A220-300 will be delivered in September 2021 and these will initially be used to replace the carrier’s 33 A319s and 18 A318s.

City-Jet and Nostrum merger

The merger between Ireland-based CityJet and Air Nostrum of Spain has gained European Commission (EC) approval. Air Nostrum is best known as a franchise partner for Iberia, but also provides wet-lease services for other carriers, and CityJet operates services under wet-lease. The carriers have highly complementary fleets, both operating Bombardier regional jets. Air Nostrum’s fleet includes 32 CRJs and CityJet’s fleet includes 22 CRJ900s acquired specifically for wet lease services.

The Airbus A350-1000 into service



Two UK airlines have put the A350-1000, Airbus’ largest twin-jet airliner, into service on long-haul routes. British Airways began flying its first A350-1000 from Heathrow to Dubai from 2 September. A week later, Virgin Atlantic put its initial A350-1000 into operation from Heathrow to New York. BA will receive 18 A350-1000s over the next three years and as well as Dubai, BA will

also fly the type to Toronto, Tel Aviv and Bangalore. BA’s A350-1000s, features the airline’s newly launched *Club Suite* business class cabin, with flatbed seats, aisle access for all seats, a privacy door and what the airline calls, “a new personalised service and a restaurant style dining experience”. Virgin Atlantic has ordered 12 A350-1000s configured with 335 seats (44 *Upper Class*, 56 premium economy and 235 economy).

737 MAX status

Boeing plans to submit software updates for the 737 MAX to the Federal Aviation Administration (FAA) for assessment and approval “soon”. The company is working towards a return of the 737 MAX to service “early in the fourth quarter of 2019”. The company has reduced monthly 737 MAX output to 42 aircraft per month even as Boeing faces a \$4 billion charge, which it said would be “multi-year” with a variety of concessions including cash payments and preferential delivery positions and tailored service payments. The company has made a \$2.9 billion loss for the second quarter.

777X delays

First flight of the Boeing 777X has been postponed to early 2020 because of development issues with the aircraft’s General Electric GE9X turbofan engines. As per the Company statement “the 777X programme is progressing well through pre-flight testing. While the company is still targeting late 2020 for the first delivery of the 777X, there is a significant risk to this schedule given engine challenges, which are delaying the first flight until early 2020.”



Boeing had rolled out the first 777-9 flight test aircraft in March 2019 and originally planned to fly the aircraft in June. However, a problem with the stator vane in the second stage of the GE9X’s high-pressure compressor discovered during early reliability testing has forced a redesign that will push back engine certification into the autumn and, in turn, the expected first flight date into early 2020. Despite the delay, Boeing insists it is still planning for the 777-9 to achieve type certification and entry into service by the end of 2020.

Irkut MC-21 at MAKS-2019



Irkut Corporation (as part of UAC) took part at the Moscow International Aviation and Space Salon MAKS-2019 where it also presented the MC-21-300 new generation passenger aircraft. Two more aircraft were at the static display, one of them, equipped with a two-class passenger cabin, available for customer visits.

China conducts drills with modern tanks and robots

The Chinese Army has recently conducted various combat drills at altitudes of upto 14000 feet over several days during which they also tested new weapons including 'battlefield robots' and frontline tanks on a 'snow-covered plateau' so as to be battle-ready for plateau warfare to the west of the country, alluding to the borders with India. In 2017, India and China were locked in a 73-day military standoff near the Sikkim border in Doklam (Donglang in Chinese.)

Meanwhile, the PLAAF and PAF have been engaged in Air Exercises, operating from Hotan airbase in southwestern Xinjiang (see map opposite).



"In preparation for potential plateau warfare, China has used, for the first time, some of its most powerful weapons and equipment, including Type 99A main battle tanks and battlefield robots to a snow-covered plateau in combat exercises," China Central Television (CCTV) reported in a report. The military drill, which used live ammunition, the report said, could have been carried out on the Qinghai-Tibet plateau (India is west of the plateau).

BAE Systems Upgraded Mk 45 Gun Systems for US Navy



BAE Systems will deliver five Mk 45 naval gun systems to the US Navy under a recently issued \$70.6 million contract to upgrade existing guns to the Mod 4 configuration, increasing their firepower and extending their range. The Mk 45 is the lightest, most compact, and most widely deployed 5-inch fully automatic naval gun in the world, with more than 260 deliveries to the US Navy and the navies of 10 other allied nations. The Mod 4 configuration consists of a structurally strengthened gun mount that increases firing energy by 50 percent, enabling munitions to travel faster and farther. A new fully digitized control system provides significantly greater computing power and features a touch-screen user interface.



IRKUT'S AIRCRAFT



For advanced pilot training

Yak-130 combat trainer in flight

Irkut Corporation have expanded the deliveries of one of its “bestsellers”, the Yak-130 supersonic combat trainer aircraft, now to countries across the world. In December 2017, the first six aircraft of this type were inducted into the Myanmar Air Force. With this, the number of countries operating the Yak-130 is now five, which includes Russia, Myanmar, Algeria, Belarus and Bangladesh.

According to the Russian MoD, the Russian Air Force currently operates more than 80 Yak-130s which are slowly replacing their outdated L-39 jets. Irkut has continued to deliver a long-term contract of Yak-130s to the aviation training centres of the Russian Air Force. “In terms of its flight and performance characteristics at subsonic speeds, Yak-130 is in fact closer to the latest ultra-maneuverable fighters of the Russian Air Force such as the Su-30SM and Su-35.”

The Yak-130 is equipped with a wide range of weapons weighing up to 3000 kg,

that includes R-73E short-range missiles, precision air bombs with the KAB-500Kr guidance system and a wide variety of unguided aircraft weapons, enabling the aircraft to take on various targets at the same time.

The Yak-152 on the other hand, which is currently in flight testing phase, has higher capabilities than most of the existing competitors. With its maximum takeoff weight of 1490 kg, the aircraft is fitted with a diesel engine of 500 hp which

operates on aviation kerosene. The Yak-152 is designed for over 10,000 flight hours and is of rugged design.

A unique feature of the Yak-152 is its SKS-94M2-152 ultra-light catapult system, which is a newly installed technology for emergency escape. The escape system is triggered when the handle of the bailout is pulled, the pilot shoots the container with a parachute stacked within, allowing for the breaking of the cockpit glass and opening the parachute within 0.2 seconds. 🛩️



Yak-152 trainer in flight

IMDS-2019, ARMY-2019, MAKS-2019

Rosoboronexport's display and export of defence systems



was given to the air defence missile system S-400 *Triumph*, air defence missile and cannon complex *Pantsir-S1*, anti-tank missile systems of the *Kornet* family, the *Terminator* fire support combat vehicle and many other new products in the area of fire arms and close combat assets.

A number of new generation products were also displayed for representatives of foreign naval forces states, who visited the International Maritime Defence Show in Saint-Petersburg in July. The manufacturers displayed the full-scale replica of the *Rubezh*-ME coastal missile system, multi-purpose integrated radar system *Zaslon*, air defence missile system *Redut*, different ships of Russian production, including the

Rosoboronexport (part of the Rostec State Corporation) had achieved excellent results in 2018. "Military aircraft and helicopters have traditionally taken the lead among the products supplied by Rosoboronexport to the world market. In 2018, we exported combat aircraft, helicopters, UAVs, engines and equipment for Air Forces worth over \$6 billion stated Alexander Mikheev, Director General of Rosoboronexport.

The organisation also provided support at large international armament exhibitions held in Russia in 2019, the company sponsoring the International Maritime Defence Show IMDS-2019, the International Aviation and Space Salon MAKS-2019, as well as the International Military-Technical Forum ARMY-2019.

"The Maritime Defence Show, ARMY and MAKS are always memorable and meaningful events, which are attended by practically all our foreign partners and potential customers from the majority of the world regions. Here one observes all trends of the Russian defence industry, assess the highest level of development of technologies and design. Rosoboronexport is an inherent participant and a traditional supporter of these exhibitions, which consistently enter the 'Top 5' of the largest shows in their respective segments. They constantly give us the maximum monetisation out of all the exhibition events in the world," stated Director General Alexander Mikheev.



Visitors to the ARMY-19 exposition had the opportunity to inspect numbers of newly-designed products, which are of a "potentially breakthrough character" for the world market, including Kalashnikov assault rifles of the newest 200th series, new generation special vehicle Tigr-2, the Viking and Tor-E2 air defence missile systems, combat vehicle of a squad equipped with the Gibka-S MANPADs to counter unmanned aerial systems, as well as new solutions in the area of electronic countermeasures. Pride of place

Karakurt-E small missile ship of project 22800E.

For air force delegations and guests at the International Aviation and Space Salon MAKS-2019 in the Moscow region's town of Zhukovsky on 27 August, was shown the 5th generation Su-57 fighter, light military transport aircraft Il-112V, multipurpose and super manoeuvrable Su-35 and Su-30SM, training aircraft Yak-130, combat helicopters Mi-28NE and Ka-52, military transport helicopters Mi-171SH and Mi-17V5, plus a host of other aerospace products. 🦋

IAI's Heron TP Medium Altitude Long Endurance (MALE) Unmanned Aircraft System (UAS)



The Heron TP has been fully operational since 2010 and is currently operated by the Israeli Air Force. It has recently been selected by Germany for their SAATEG MALE UAV requirement, and other countries are showing significant interest in acquiring the Heron TP as well.

Configuration

With a length of 14 metres, wingspan of 26 metres and maximum takeoff weight of 5,670 kg, the Heron TP is the largest unmanned aerial system operating with the Israeli Air Force. The aircraft has a distinctive twin-tail boom which provides control surface redundancy and extra surface area to facilitate the mounting of numerous antennae across both booms. This configuration reduces signal interference and allows for multiple simultaneous uses, while leaving the fuselage and wings clear for mission payloads. The multi-mission Heron TP has the capacity for 2,700 kg of internal and external stowage for payloads and fuel and has 12 hardpoints spread across the centre fuselage and nacelles. These hardpoints can be fitted with a standard BRU rack, which can accommodate numerous payloads and special kits like the Survival Kit, Air Droppable (SKAD)


pod. All mission and sensor data will be transmitted to the GCS (Ground Control Station) and other authorised secure users in real time via dual-redundant SATCOM or Line-Of-Sight data links.

Performance

The Heron TP has an endurance of over 30 hours in mission configuration and over 35 hours in ferry configuration. It can operate at altitudes up to 45,000 ft. at speeds up to 220 *ktas*. The system comes with a state-of-the-art Ground Control Station where operators can perform all mission functions which includes programming flight path of the UAV and controlling the various sensor operations.

The Heron TP is powered by a 1200 shaft horsepower Pratt & Whitney Canada PT6-67A turboprop engine, and is capable of speeds, climb rates, and altitudes which are unique in the MALE UAV category, thus making it ideal for long operations and for high/hot/ heavy conditions.

Control of the Heron TP is via GCS which transmits signals using satellite or line-of-sight link. Within the GCS are bays (operator stations) that control the UAV. Two bays are adequate to control a UAV, its systems/payloads, and provide redundancy. The GCS can also be scaled up with more bays as is necessary. One of the benefits of having nearly 50 years of lessons-learned experience with UAVs is the level of automation that IAI has developed. For example, taxi, takeoff and landing of the Heron TP is fully automated, carried out from the GCS which feeds GPS coordinates along with knowledge of airfields. Most UAV operations require a forward located Launch and Recovery Element (LRE) to operate the platform away from home base. The Heron TP UAS, however, does not need an LRE as it can use its satellite data-link command and control capability to land and re-launch from remote operating strips without the requirement of on-site specialised equipment.

The Heron TP is capable of Automatic Taxi, Take Off, and Landing (ATTOL), thus there is no requirement to preposition personnel at remote landing sites. 

Courtesy IAI





The ASW, ATLC and All-Weather Performance of GA-ASI's SeaGuardian

In October 2017, GA-ASI demonstrated remote detection and tracking of submerged contacts. The MQ-9A used sonobuoys to gather acoustic data and track underwater targets. The demonstration successfully paired sonobuoy receiver and data processing technology onboard the MQ-9A

SeaGuardian is maritime version of the MQ-9B SkyGuardian from General Atomics Aeronautical Systems, Inc. (GA-ASI), arguably is the world's most advanced Remotely Piloted Aircraft (RPA). MQ-9B has been selected as a sole source RPA for the UK Royal Air Force (RAF) as the Protector RG Mk1 and for Belgium.

The MQ-9B boasts a long list of features. SATCOM Auto Takeoff and Landing Capability (ATLC) is part of the package, designed to help minimise the aircraft's launch and recovery footprint and reduce manning and equipment requirements at a Forward Operating Base (FOB). This capability allows aircrew at a Main Operating Base (MOB) to land, taxi and launch the aircraft from a separate FOB, requiring only a small team with a ruggedised laptop at the FOB.

The MQ-9B is a ground-up redesign of earlier variants. This was done in order to earn certification to fly in non-segregated airspace and integrate seamlessly with manned aircraft. GA-ASI expects the MQ-9B to achieve certification in the early 2020s, when the aircraft will initially meet NATO STANAG-4671 airworthiness standards, and subsequently commercial

airworthiness certification standards in cooperation with the US Federal Aviation Administration (FAA).

The Detect and Avoid (DAA) system that GA-ASI has developed for the aircraft consists of a radar, Traffic Collision Avoidance System (TCAS), Automatic Dependent Surveillance-Broadcast (ADS-B), and the ability to blend that surveillance onboard so as to alerting and maneuvering guidance to the pilot at the Ground Control Station (GCS). It enables the RPA to also detect other platforms and safely remain well clear in coordination with air traffic control.

Both MQ-9B SeaGuardian and SkyGuardian are capable of all-weather day/night operations. The cold weather engine start capability allows ground operations down to -41°C. It also has an Electro-expulsive de-icing system (EEDS) for wing leading edges, anti-ice heated engine inlet, heated pitot tube and static ports, and lightning protection.

GA-ASI is also developing an Anti-Submarine Warfare (ASW) capability. In October 2017, GA-ASI demonstrated remote detection and tracking of submerged contacts using an MQ-9A RPA. The MQ-

9A used sonobuoys to gather acoustic data and track underwater targets. The data was transmitted to the MQ-9A, processed onboard, and then relayed to the aircraft's GCS. The demonstration successfully paired sonobuoy receiver and data processing technology onboard the MQ-9A.

Future developments are planned which include MQ-9B SeaGuardian's ability to carry and dispense sonobuoys and to transmit the acoustic data via BLOS SATCOM. 🦋

Courtesy: GA-ASI



GA-ASI's Certifiable Ground Control Station (CGCS) will be used to fly the MQ-9B. In October 2018, the CGCS made its first flight

AI combined with Optronics Solutions is



“The fighter Pilot’s best digital partner”

Scenario:

You are a fighter pilot taking off on a critical strike mission.

The tactical situation on the ground is evolving so quickly that the allied forces requesting fire support are unable to provide the enemy artillery positioning.

But they need help—and fast.

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

“The new pod designed by Thales is the fighter pilot’s best possible partner aboard” says Emmanuel Vialle, a former fighter pilot himself and today Thales product line manager for airborne optronics. “I can act faster and smarter. AI combined to

optronics solutions, provides me with an unmatched visible color and infrared image quality, and with real-time data analysis for automatic target detection and recognition”.

Flying with your digital partner

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

“Overflying the area of interest, I first use the Permanent Vision™ which brings me a clear awareness of the environment through the pod’s imagery integrated in a 3D mapping display. As I have no precise

ideas of the enemy positions, I start big data collection—taking thousands of pictures in a few minutes”.

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

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

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

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

Thales leadership in providing this unique critical success factor to fighter missions is the result of fifty years of optronics experience and leading expertise in digital technologies including AI, Big Data and Connectivity.

The solution is multi-platform and “plug and fly” for fighter aircraft from a variety of manufacturers. “It is the ‘connected sensor’ that we needed for true connected collaborative combat, to operate and adapt simultaneously”, Emmanuel Vialle concludes with a big smile. 🦋

Emmanuel Vialle

Former Fighter Pilot and Thales Product Line Manager for Airborne Optronics activity

“Transformation Capabilities”



400th F-35 delivered Fleet Surpasses 200,000 flight hours

The F-35 fleet has achieved 200,000 flight hours across global operations, a significant milestone demonstrating the programme’s progress and growing maturity. Within the same week, the F-35 Joint Programme Office and Lockheed Martin had delivered the 400th production F-35. “The F-35 air system is a key enabler of our National Defence Strategy and delivers the combat proven, advanced capabilities our warfighters and partners need to meet mission requirements,” stated Vice Admiral Mat Winter, Programme Executive Officer for the F-35 Joint Programme Office. “This 400th delivery is a significant milestone as the F-35 Enterprise continues to grow and expand around the world. The collaborative efforts across the JPO, US services, partners and industry remain focused on driving costs down, quality up, and faster delivery timelines across our development, production, and sustainment lines of effort.”

The 400th production aircraft is a US Air Force F-35A, delivered to Hill Air Force Base, Utah. The production total is comprised of 283 F-35A, 87 F-35B and 30 F-35C deliveries. The 200,000 flight hours includes all F-35s in the fleet comprised of developmental test jets, training,

operational, US and international aircraft. Among the three variants, approximately 125,850 hours were flown by the F-35A, 52,410 hours by the F-35B and 22,630 by the F-35C.

“These milestones are a testament to the joint government, military and industry teams designing, building, sustaining, maintaining, operating and flying F-35s around the globe,” stated Greg Ulmer,



Lockheed Martin’s vice president and general manager of the F-35 Programme. “The F-35 is delivering transformational capabilities to the warfighter and with every delivery and every flight hour, the enterprise gets smarter, more mature and more effective.”

So far, 400 F-35s have been delivered and are now operating from 17 air bases

worldwide, more than 800 pilots and over 7,500 maintainers trained. Ten nations are flying the F-35, eight countries have F-35s operating from a base on their home soil, seven services have declared Initial Operating Capability and three services have revealed their F-35s have been used in combat operations.

The enterprise is on track to deliver 131 aircraft in 2019, up 40 percent from last year. The F-35 programme is expected to complete Initial Operational Test and Evaluation (IOT&E) this year and officially transition from the System Development and Demonstration phase and into full rate production and focus on our development, production, and sustainment lines of effort.

“With stealth technology, advanced sensors, supersonic speed, weapons capacity and superior range, the F-35 is the most lethal, survivable and connected aircraft in the world. More than a fighter the F-35’s ability to collect, analyse and share data, is a powerful force multiplier that enhances all airborne, surface and ground-based assets in the battlespace enabling men and women in uniform to execute their mission and return home safely.”



Courtesy: Lockheed Martin


Safran: Partnering Indian Aviation



“Safran is committed to being a full-fledged technology partner in development of the Indian aviation industry, mainly as supplier of engines and/or equipment and support services for both airplanes and helicopters.” The company is the leading supplier of turbine engines for helicopters deployed by the Indian Armed Forces with more than 1,500 helicopter engines now in service.

Safran-HAL, a joint venture with Hindustan Aeronautics Limited (HAL) in Bengaluru produces CFM56 and LEAP components for CFM International. In 2010 a facility was opened near the Hyderabad airport by CFM International, the 50/50 joint company between Safran and GE, to provide maintenance training for operators of CFM56 engines. More than 500 maintenance engineers and technicians are trained in this facility every year. In April 2017, Air India and CFM International celebrated the delivery and entry into service of the airline's first LEAP-1A-powered A320neo aircraft. The first aircraft has the distinction of being powered by the 100th LEAP-1A production engine.

Safran is also one of the leading suppliers of wheels and carbon brakes for the Airbus A320 and Boeing 787 commercial jetliners in service in India.

The Shakti / Ardenid 1H1 engine powers the ALH Dhruv helicopter (*lead image*). Certified in 2009, the 1,400 shp engine was co-developed by Safran and HAL and is now built in Bangalore, under the designation, Shakti largely with Indian-made components. 

CFM56 engine fleet surpasses One Billion engine flight hours

On 24 April 1982, the first-ever airliner powered by CFM56 engines, a Delta Air Lines DC-8-72 powered by the CFM56-2, took to the skies. In the years after that, CFM International would go on to add seven additional engine models that, today, power more than 20 different commercial and military aircraft types for more than 600 operators across the globe. Recently, the CFM56 fleet established a new world record by becoming the first aircraft engine family in aviation history to achieve one billion engine flight hours. This milestone also represents the fastest accumulation of hours ever; the fleet reached 500 million hours in November 2010 and more than doubled that total in just over eight years.

Since the first engines were delivered some 37 years back, CFM has established a reputation for world-class customer and product support. There are more than 250 technical service representatives on-site with airlines in more than 50 countries, with more than 40 maintenance, repair and overhaul (MRO) provider facilities around the world.



Flypast on Bastille Day



Rafale takes off from BA Evreux (Alex van Noye)

Commemorating the French Revolution, an annual National Military Parade ('défilé') traditionally takes place in the French capital Paris on 14 July every year. The impressive military parade along the magnificent Champs Elysees includes marching columns, armoured vehicles and others, climaxed by a flypast over the parade.

The aircraft participating this year operated from various airbases, including from BA Orleans (C-130 Hercules), BA Orleans (A400M Altas) BA Avord (E-3F AWACS), BA Istres (C-135F), BAN Landivisiau (Navy Rafales), BAN Lahn-Bihoue (Navy support aircraft). In special cases, including for refueling purposes, airbases closer to Paris such as BA Evreux, BA Villacoublay, BA Creil are also made available.

In July 2019, BA Evreux was designated at the main airbase and in the morning, Rafales and Mirage 2000s took off from runway 04 alongside some foreign types such as Spanish and RAF Eurofighters, German Tornado and a Belgian F-16. Later, all French aircraft returned directly to their



Spanish Eurofighter at BA Evreux (Alex van Noye)



Luftwaffe Tornado takes off from BA Evreux (Alex van Noye)

home bases, while the foreign aircraft landed at BA Evreux, apart from the Dutch F-16 which had flown from its home base of Volkel and then returned there after the flypast.

It was for the last time, that a C-160G Transall Gabriel flew over the parade along with the CASA CN235, since the former type is now being phased out. 🦋

Report by Joris van Boven and Alex van Noye. Also photos from SIRPA. AIR/French Air Force



Mirage 2000 of the French Air Force takes off from BA Evreux (Alex van Noye)



Enroute Paris for the Bastille Day flypast, Mirage 2000D



French Air Force CN235 at BA Evreux (Alex van Noye)



Royal Air Force Typhoon takes off from BA Evreux (Alex van Noye)



Dromaders from Athens

The rapid firefighting water bombers of Greece

European aerial firefighting services are mainly activated during the summers when hot and dry conditions prevail, especially around the Mediterranean. Greece has an interesting mixed force of aircraft and helicopters for just the task.

The most common aircraft type for the purpose is the large sized, bright red-yellow coloured Canadair-Bombardier CL-215 Scoopers and CL-415 Superscoopers amphibians. Less known, but an important asset in the Greece firefighting fixed wing inventory is the PZL M-18 Dromader.

I was offered a close look at these aircraft, based at Tatoi-Dekelia, just north of Athens, which is home base of the Dromader flying unit 359 Public Services Air Support Squadron (MAEDY).

It was April when we spoke with Hellenic Air Force Major Petros Kazakos,





The water-bomber squadron of Greece

one of the Dromader pilots, on eve of the expected 'action' and just before the aircraft were detached to various locations for their summer operations from May to October. This was a very busy time for the unit as final maintenance was carried out, pilots on focussed training and the squadron on making preparations for their summer deployments.

The squadron has 21 aircraft, 18 PZL M-18B single seaters plus 3 PZL M-18BS twin-seaters, for pilot training. The Dromaders were built by the Polish PZL-Mielec aircraft plant, which is currently part of Sikorsky Aircraft Company. Delivered in 1983, the aircraft are powered by a single rotary piston PZL-KALISZ model Asz-621-M18 engine, giving the aircraft 967 horsepower and a top speed of 228 kmph. Since their delivery the Dromaders have incorporated many Greek-origin modifications including on the wing, fuel tanks, increasing capacity by more than 70% and flight time from 2,5 to 4,5 hours. Additional improvements were made on the type's overall agility by installing new flaps with extended angle capacity. Major Kazakos also mentioned that the Hellenic Dromaders are different than those from other operators as they were modified by 359 MAEDY installing a hydraulic water drop hatch instead of a mechanical one. This has provided pilots the extra option to release the water over a 3-12 seconds time frame, instead all at once. Further, by installing a foam generator in the water tank, the pilots now have a selection of options for fighting fires.

The single seat Dromaders are detached, mostly in pairs throughout Greece which

normally include locations like Andravida AFB, Kalamata AFB and Santorini AFB. A detachment of two aircraft has about 12 ground crew and 6 pilots. The day shift includes 3 pilots, of which 2 are involved with flying operations while one is in command to coordinate activities.

Water bombing is only executed by daylight owing flight safety regulations. The 359 MAEDY Dromaders can operate from first light (30 min before sunrise) till last light (30 min after sunset). When airborne, a pilot can fly up to 3 hours and when needed, another pilot will take over for the next 3 hours. Major Kazakos explains that this sequence plan is in place in consideration of flight safety. "If the fire location is some 10 miles distance, one can do about 10-12 water drops over the 3 hours time frame". As the job has to be carried out with full concentration, under difficult circumstances and last not to forget the high temperatures, it is necessary that another pilot takes the next shift, in order to avoid signs of fatigue.

The Dromaders have a response time of 15 minutes to get airborne, during which time, the pilot makes his provisional flight plan towards the reported fire location, ground crew then fill up water tanks to avoid unnecessary periods of high waterload. A portable GPS is used to reach the fire location and once on the scene, the pilots first fly an orbit above the fire location to orientate themselves on wind direction, obstacles such as electric cables and pylons, area height differences in order to determine the right approach to target the fire spot. The minimum height for pilots drop their water load is 10 meters and they must avoid flying through smoke haze to keep their view free.

Major Kazakos concludes that there are no other means for water bombing. "It is just training and experience which makes one flexible, adapting to every situation and thereafter carrying out accurate and precise water bombing – where and when needed".

Text and photos : Peter ten Berg



Idris & Bilkees Latif

“The Fragrance Lingers on”

It was sometime in the summer of 1980 when as a Flying Officer, I was on an operational detachment at Srinagar. The Air Chief decided to come visiting the station – and when the Chief comes calling, the young make themselves scarce! The traditional evening Officers’ Mess function saw the young ones cloistered in the bar, away from the ante room where the main reception was going on. The Chief doesn’t come to the bar, and we were ‘safe’, – so we thought, till in walked Air Chief Marshal Idris Latif and a very radiant Mrs Bilkees Latif and startled us ‘elbow benders.’ The couple stayed for around ten minutes but that was the remembrance of a lifetime! Down to earth, the couple put us, awestruck youngsters, at ease with their relaxed talk and down to earth demeanour.



(Left) : Air Chief Marshal Idris Latif shows the vintage Wapiti cockpit to Prime Minister Indira Gandhi along with Air Marshal Lakshman Katre

Idris & Bilkees Latif
“The Fragrance Lingers On”
Editor Ushi Kak
KW Publishers Pvt Ltd., New Delhi
ISBN : 978-93-87324-85-5

The ‘friendly, no-airs’ attitude of the Latif couple, despite their position in society and the IAF hierarchy, is what stands out in the numerous testimonials that form the book ‘*Idris & Bilkees Latif: The Fragrance Lingers On*,’ edited by Ushi Kak. The couple enriched the lives of so many, from Shri Hamid Ansari of the Foreign Service who met him as the Chief of Protocol (and who rose to be India’s Vice President) to a Flt Lt’s wife who was invited for a cup of coffee “...to the last house down the road” by a stranger “...

who had the serenity of a glowing full moon on a calm night”, the young lass least realising that she was the wife of Air Commodore Latif, the Air Officer Commanding, who had dropped-in to say hello to the youngest bride at Air Force Station Poona !

Air Chief Marshal Latif was a man who wore many hats in his lifetime, as so did Bilkees Latif. The book is accordingly divided in six segments, each dealing with a particular facet of the couple’s life. So, from accounts and remembrances about their life in the Air Force (more about this a little

later) the book moves to the years spent by the Chief as the Governor of Maharashtra where the couple involved themselves with the common man. The Chief, as Mr Julio Ribeiro, the then Commissioner of Mumbai police puts it, was deeply involved in the rehabilitation of riot victims and the rebuilding of communities. Mrs Latif was not far behind and formed SHED – ‘Society for Human and Environmental Development’ : to serve the youth and women living in the slums, especially in Dharavi. She put her position of the first lady of Maharashtra



As Chief of the Air Staff, Air Chief Marshal Latif with Air Marshal 'Timky' Brar

to noble effect by interacting with different government ministries and organisations to advance programmes for health and hygiene and detection, prevention of cancer as also for communal harmony amongst communities. Her work in Dharavi earned her a *Padma Shri* from the President of India.

when he truthfully admitted in a briefing that he needed to be 'educated' on the specialist equipment his squadron was using – he calls it "an expression of trust."

From flying in the Burma campaign in World War II to being in pivotal positions of command, Air Chief Latif had seen it

The Latifs took their charm and experience to Paris when the Air Chief was later appointed as Ambassador to France, perhaps the only instance till date of a retired service chief being sent as the head of a diplomatic mission of a major nation. But all this was a culmination of his scintillating career in the IAF right from his young days. As Air Chief Marshal AY Tipnis recounts in his tribute, he heard the name 'Latif' when he was just 10 years old – his elder brother was a cadet in the Joint Services Wing who waxed eloquent about a Sqn Ldr Latif every time he came on leave – his close interaction with the cadets, his motivational talks and above all, his vision of an emerging India.

Air Chief Marshal Krishnaswamy remembers Air Chief Latif's modesty

all, but it was the modernisation that he brought into the IAF that makes him stand out. He was instrumental in inducting the Jaguar and preparing the way for induction of the Mirage 2000, aircraft that are the mainstays of the IAF even now.

Air Marshal BD Jayal narrates Air Chief Latif's forward thinking as he writes that "*His professionalism, planning foresight, humility, and most of all, his ability to make every member of the team feel special made his leadership style unique.*" AVM Kapil Kak reminisces how he witnessed first-hand at Poona, "*.....his unique alchemy: the pinnacle of professionalism, unimpeachable integrity, unfailing pursuit of excellence,and most of all empathy, particularly towards personnel below officers rank and civilian.*"

And a steadfast partner in the life of a no-nonsense Air Chief Marshal Latif was Bilkees, the social activist, a personification of Indian graciousness and charm and a



Air Chief Marshal Latif with the King of Bhutan during a State visit

wife wedded to the IAF. The embodiment of humility, charisma and professionalism in the Latif couple is brought out vividly in Ushi Kak's collection of reminiscences by people, from diverse walks of life and social strata, whose lives were enriched by them – old black and white photographs of their early life, some in sepia, add to the aura of the couple.

'*Idris & Bilkees Latif: The Fragrance Lingers On,*' is delightful reading for aficionados of the Indian Air Force and for those who wonder whether there can be a *melange* of the grace of royalty and commitment of a social worker, an amalgam of power and humility and a blend of these two in these times. 🦋

Air Vice Marshal Manmohan Bahadur



Air Chief Marshal Latif with then President of India, Neelam Sanjiva Reddy

The Chief for all Reasons



Air Chief Marshal Idris Latif reviews parade at an Air Force Day at Palam

‘Chief’ to the Air Force, ‘Idris Bhai’ to his friends, ‘Uncle’ to his younger family, but all of these were amalgamated for me, a ‘fan’ who was privileged to know Idris Hasan Latif, the quintessential officer and gentleman.



No. 9 Squadron (“Wolf pack”): the “official” crest and the “stylised” version

I was first introduced to him at Bombay when Air Marshal Latif and his Begum visited Air Force Station, Cotton Green, he then being AOC-in-C Central Air Command. Bilkees Latif was a cousin of a friend’s wife from Hyderabad and soon enough, we became ‘family’! The Air Marshal was intrigued at my ‘knowledge’ of matters aviation, and particularly about the Indian Air Force and we were to share this enthusiasm into the decades ahead.

There are so many memories : he was Commodore Commandant of No.9 Squadron (*Wolfpack*) but the unit lacked a formal crest (the original No.9 Squadron RIAF). When this was commissioned, the artist made a very childlike drawing which unfortunately, before it could be ‘smartened up’, received the President’s approval and so marked for posterity. The

Air Marshal however asked me to find an imaginative commercial artist to create a stylised crest which I did and this was (unofficially) adopted and today adorns many places around the premises of No.9 Squadron.

And so, he became Chief, and Air House has never been that gracious as it was during those three years. Apart from formal functions on Air Force Day, we were privileged to be invitees at several dinners (a particular one will stand out in my memory forever – more on that anon).

When their daughter Mariam got married, we were at the Reception held in the lawns of Air House but soon pandemonium, the sudden heavy downpour catching those present by surprise. Except for the Chief and his wife who marshaled (pun !) everyone to the sanctity of rooms and

verandahs of 23 Akbar Road and the party went on, with dignity if a little moistly !

Now for that dinner. Air Chief Marshal Latif was the CAS when the Government of India selected the Anglo-French Jaguar as the IAF's deep penetration strike aircraft (DPSA), after several years of intense evaluation and negotiations. The formal contract was signed in April 1979 and teams from the IAF sent to the UK for conversion training even as the Indian Air Force prepared for induction of this next generation combat aircraft. In remarkably quick time, the IAF selected pilots, engineers and logistics officers who were seconded to the UK for orientation including training with the Royal Air Force, aircraft and engine manufacturers.

Air Force Station Ambala was suitably upgraded with new facilities and there was general excitement in the air as the IAF was finally to receive an aircraft it had long sought. And then, the Government changed.

For reasons which do not need elaboration here, the 'new boys on the block' soon began to query the choice of aircraft selected and began an insidious campaign in the media and parliament, threatening to cancel the contract or, as minimum, restrict the numbers to just 40 as initially ordered and abort the balance 110 Jaguars, all to be licence-built by HAL in India (sounds familiar today ?!).

Yours truly had, meanwhile, crafted what was considered a very timely article published in the *Illustrated Weekly of India* which examined, threadbare, the rationale behind selection of the Jaguar. As the introduction put it : *"No acquisition of defence hardware has been bombarded so intensively with controversy as that of the Anglo-French Jaguar international, the Deep Penetration Strike Aircraft (DPSA) which are have chosen in preference to the French Mirage F.1 and the Swedish VA 37 Viggen. The Jaguar is a highly specialised aircraft corresponding closely to the prime need for low-level offensive support and deep-penetration strike. Used in combination with the MiG-21 for top cover, it will make the IAF one of the most balanced tactical air forces in the world"*.

The Indian Air Force was delighted, the Jaguar's detractors not. So, the hostility was also now directed towards the writer of the article (me) and soon began strange telephone calls hinting that one's antecedents were being examined, queries on how much money was given for writing this etc. etc. !



The Air Chief who simply loved the article, soon enough heard about – and understood – the game. Shortly, an invitation arrived for a formal dinner at Air House where me and my wife were the only 'civilians' amongst virtually all PSOs of the Air Force as also the entire MoD hierarchy. Air Chief Marshal Latif pointedly introduced me to the then Defence Secretary (whose name is omitted but will be well known to readers as he too was involved with certain nefarious people), stressing how much the Indian Air Force 'owed' me for its image building and raising morale of the service, with my continuing writing in Indian and international journals about the Indian Air Force, its evolution and

history, particularly stout defence against scurrilous articles by hostile writers. I think the point was made and all silly phone calls ceased thereafter.

Countering the propaganda

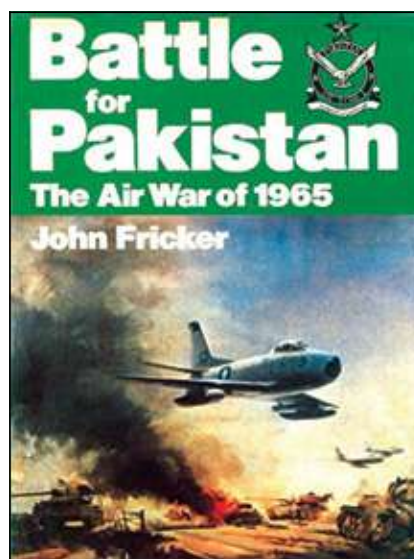
Another example of the Chief's faith in my flying the IAF's flag : a new magazine, with the venerable Khushwant Singh as Managing Editor, had carried major excerpts from the book 'Battle for Pakistan' authored by the well known British aviation writer and historian John Fricker. Air Chief Marshal Idris Latif was incensed and within an hour, I was at his office when he 'directed' me to counter what he considered was not only 'rubbish' but to set the record right, once and for all. He sent for the Director of Air Intelligence to make available all official records of the 1965 air war so that I could put together this official history for publication in that magazine.

Easier said than done ! Data and information were tardy and had to be painstakingly collated from individuals and whatever records were still at Vayu Bhawan and Mr Khushwant Singh gave a final deadline for submission of the counter-article. Well, the counter was managed – and the rest is history (again pun !).

I could go on and on but must cease as my memory is *runneth over*, recalling this wonderful human being and leader of the country's air arm during its most transitional years. 🦋

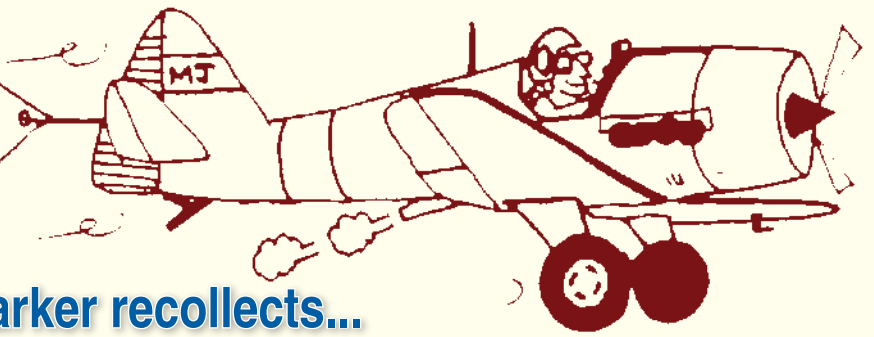
Pushpindar Singh

(Founding Editor *Vayu Aerospace Review* and President *The Society for Aerospace Studies*)

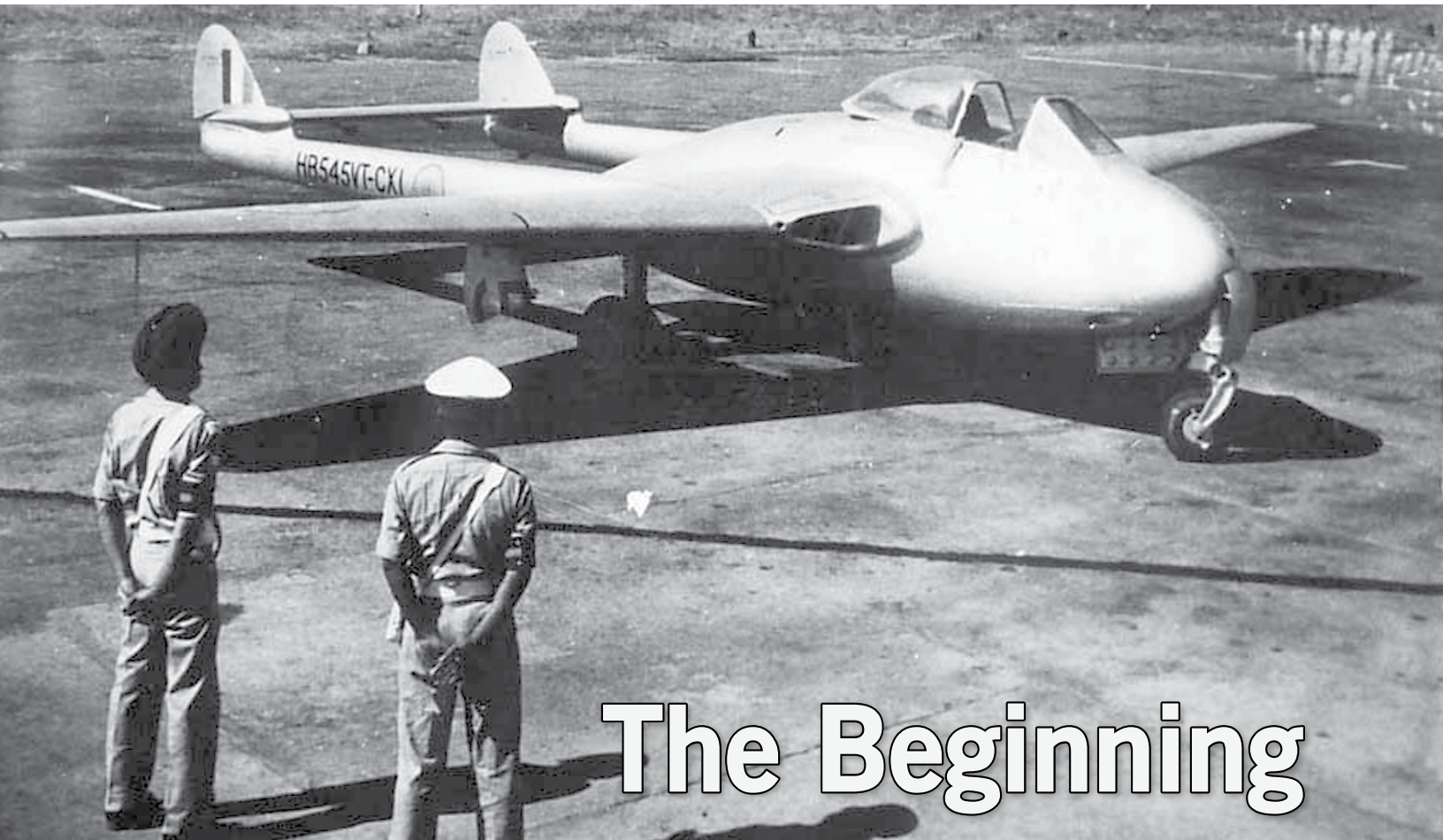


Cover of the controversial book on the 1965 Air War

Ancient Aviator Anecdotes



Air Vice Marshal Cecil Parker recollects...



The Beginning

The jet era in India began in November 1948 with arrival of the Vampire jet fighter-bomber from the UK at Kanpur (*photo above from the records of Vayu.*) It was however only in mid-1949 that the first jet flight was formed with No.7 Squadron of the RIAF. At that point of time, my generation had just joined college and our knowledge of aviation was restricted to having seen propeller-driven aircraft during World War II and movies of various air aces. Newspaper reports and radio broadcasts explaining this revolutionary new means of aircraft propulsion caught our interest, imagination and spawned dreams of becoming a jet pilot!

In 1950, the FPSC (forerunner of the UPSC) invited young male Indians to appear for its entrance exam for a commission in the GD (P) / Flying Branch of the IAF. Along with a large number of my college mates I appeared for the same but not too many of us cleared it and numbers continued to reduce at the Selection / Medical Boards. Eventually just two of us from my college

joined the 48 other young lads from all over India in 1951 for our 18-month pilot training on Tiger Moths and Harvards. Of the 30 of us who graduated, 13 were sent on to do fighter conversion on Spitfire Mk.XIVs and Tempest IIAs. At the end of 1952, three of us coursemates reported on posting to No. 7 Squadron at Palam. We were barely out of our teens, had about 200 hours of flying, with stars in our eyes and yet never seen a jet aircraft before!

Type trainers, simulators and ejection seats were still of the future hence our training to fly these silver jets with twin booms comprised the study of pilots notes, briefings, familiarisation, tests by the senior pilots and ground handling. The 'solo check' consisted of a written test, fully-kitted strapping into the cockpit, manual depression of the booms to indicate take-off / landing aircraft attitude, supervised start-up, taxi to the runway, vital actions for Take Off followed by the first half of the T/O, last half of the landing and return to dispersal.

We were now cleared to do our very first solo on jet aircraft without ever having left the ground in one ! The next day of good weather I was launched solo and a senior pilot was the ATC (Air Traffic Control) to monitor and render help if required. The moment I 'unstuck' and got airborne, I immediately missed the familiar sight of the long fuselage / propeller in front which had hitherto helped in maintaining required aircraft attitude. I now found myself literally seated in the nose with the engine / propulsion behind me! After the initial few minutes, when the aircraft was actually flying the pilot ! I got the new feel and then began to enjoy flying a jet. After 30 minutes of handling overhead the airfield, I descended to base, did the mandatory overshoot followed by a full stop landing; the usual congratulations and celebrations at the bar followed.

I was even more elated than I had been after my very first solo in the Tiger Moth but for the first time I truly missed the presence of my flying instructor (as at AFA & CTU) who had patiently helped me analyse and learn from every solo sortie. Of course there were peers and seniors to help but I now realised the meaning of 'self-learning', that is analysis and learning from the experience(s) of self and others. This gradually develops skills, knowledge and self confidence. With more experience, one learns also that there is a very thin line between uncontrolled self-confidence and over-confidence. It comes to all of us and young fighter pilots need to recognise, respect and stay on the right side of this line where thought always instinctively precedes action in the cockpit. This is the real beginning of an aviator's professional maturity.

"Be Remembered for Good"

Throughout service in the air force, we serve under a commanding officer (CO) in all ranks. The CO is the seniormost officer and is responsible for performance of his unit in attaining its task. For officers he is also the IO (Initiating Officer) for the ACR (Annual Confidential Report) and thus influences an officer's career. COs

are selected for their demonstrated performance of professionalism, leadership and management skills. In training establishments, the CI (Chief Instructor) is the de facto CO.


I recently had the pleasant surprise of an overseas call from an old CO of mine. Since I am the same age as our air force, I estimated him to be well into his 90s. His memory was excellent and we enjoyed our reminiscences going back over half a century! As I have a hearing disability, I always request my wife to monitor my calls as I sometimes miss soft-spoken details. After the call she asked me if I remembered all the COs I had served under and, if so, to test my memory and list them. After a few errors / corrections, I did so and list them below :

1952 Zafar Shah: 1953-54 GK John/MPO Blake: 1955 JJ Bouche: 1955 WJ Fernandes: 1955-57 ED Masillamani/CA Neelkantan: 1957-58 SA Hussain: 1959-60 BB Marathe: 1960-61 SA Hussain: 1961-62 DIM Springett: 1962-66 HN Bysak/DE Bouche/AL Bajaj/NC Suri: 1966-69 SR Powar/PM Wilson: 1969-72 HR Chitnis/TJ deSa/MS Dandekar: 1973-75 RC Suchanti: 1975 GK John: 1975-77 Randhir Singh: 1977-79 E Dhatigara/LM Katre: (1980 – Course Abroad – No CO): 1981-83 Mohinder Singh/K Balam: 1983-85 EPR Nair/Vir Narain: 1985-86 DA LaFontaine/MM Singh:

To readers from other than my air force generation, this medley of names will perhaps mean nothing, but I am able to put a face, personality and memory to each individual name. During this period of 34 years, I had 19 postings (four of which were for less than six months) and served under 29 COs (two names appear twice). 23 of them had a single-engined pilots background and include three air chiefs. The list also includes one transport pilot, three navigators and two army officers ranging in rank from Sqn Ldr to Air Mshl / Lt Gen. In the early years, like all junior officers, contact with the CO was close and personal as in a squadron. As one rose in rank, appointment and experience, this becomes less so and, in my last assignment, I never met either of my COs during the tenure at all.

Most of the officers I reported to directly were friendly, helpful and from whose varied backgrounds and experiences, I learned a great deal, both in the air and on the ground. Much of this learning was to be of help in my own six CO-appointments.

A recent advertisement in the media for a certain liquid product is promoted with the catchphrase, "Be Remembered for Good". As a long-retired ex-CO (thrice) / Stn Cdr / AOC (twice) / Commandant, it appears to me that the slogan (from which the title for this anecdote is borrowed) is a pretty fair yardstick of one's past performance !

(For readers who have enquired about previous issues of AAAs, please visit website – <http://www.vayuaerospace.in/ancient-aviator-anecdote.html>) 



In the photograph above with Vampire of the Aircraft Testing Unit at Poona are seen Wg Cdr H Moolgavkar, Sqn Ldr CD Subia, Fg Off GD Clarke, Fg Off GV Kuriyan and Flt Lt Micky Blake, some of whom were the COs mentioned.

25 Years Back

From Vayu Aerospace Review Issue V/1994

“Air Force Fire Power to Improve”

“Strike power of the Indian Air Force, the fourth largest in the world, would be stepped up significantly after the current phase of modernisation,” Air Chief Marshal SK Kaul stated at the Air Force Day parade at Palam on 8 October 1994.

Upgradation of the MiG-21 fighter has already begun with its Russian designers being awarded the contract for giving the fighter a fresh lease of life for the next fifteen years. Similarly, superior avionics were to be integrated on the ground attack MiG-23BN and the mid-life up-date of MiG-27 and Jaguar deep penetration strike aircraft was on the cards.

“Prioritise Defence Needs” : PM

Prime Minister PV Narasimha Rao has called for “reprioritising” defence efforts to focus on the multiple threats faced by the country, both from outside and within. Addressing the combined commanders conference at New Delhi on 21 October, the Prime Minister said the challenges being faced by the nation required a response of equal magnitude.

India’s Defence Spending “Low”

According to statistics given in a recently published volume of the *Asian Strategic Review* (ASR), after sliding down the defence expenditure chart in previous years, India has now dropped to bottom of the list of top ten defence spenders in Asia for the year 1993-94. On the contrary, India’s defence expenditure at 2.53 per cent of its Gross Domestic Product (GDP) ranks well behind its two most important neighbours: Pakistan (5.53 per cent) and China (6.88 per cent). In terms of per

capita defence expenditure, India trails at just (US Dollars) \$ 8 compared to the Chinese \$18.74 and Pakistan’s \$23. While the Pakistani and Chinese armed forces per 1,000 citizens number 6.55 and 2.69 respectively, India is trailing behind at 1.23 in 1994.

India “interested” In Sukhoi Su-30

According to Russian defence officials, India has “displayed considerable interest” in the Russian Sukhoi Su-30 combat aircraft, but has not so far made any official request for these aircraft. These officials were quoted by the Russian news agency Itar-Tass as saying that several Indian military delegations had visited Russia recently and had “unofficially” discussed the possibility of India acquiring the Su-30.

Indo-Pak Arms Race “Threat To Regional Security”

The US Defence Secretary William Perry expressed concern over what he called “a nuclear weapons race” between India and Pakistan which, “posed a threat to regional security ... we seem to be on the brink of a nuclear weapons race in the subcontinent, where relations between India and Pakistan have been tense for years”.

Women Pilots of the IAF

A new chapter in the IAF’s history was written when 22-year old Flight Cadet Narita Kaur Deol, a trainee woman pilot in the IAF, flew a HS.748 transport in command while six trainee transport pilots waited their turn to fly at Yelahanka Air Force Station near Bangalore. The remaining seven, after 120 hours of total flying, moved on to Yelahanka for Stage III training which ends this December. All in their early 20s (average age 22), and none more than five-feet five in height, the ladies

will get their ‘wings’ and their commissions after successfully flying the more powerful An-32.

Lufthansa takes “Driver’s Seat” in Modiluft

Lufthansa has taken over direct charge of all crucial functions in Modiluft including finance and administration, operations, maintenance, commercial, corporate controlling and planning. “Lufthansa and Modiluft are now in the second chapter of as three-stage strategy (the first one . was a basic lease agreement, where the German flag carrier also gave support functions like aviation know-how and pilot training). The third stage, which is related to the future, is the option to have direct investment.”

Successful launch of PVLV-D2 and IRS-P2

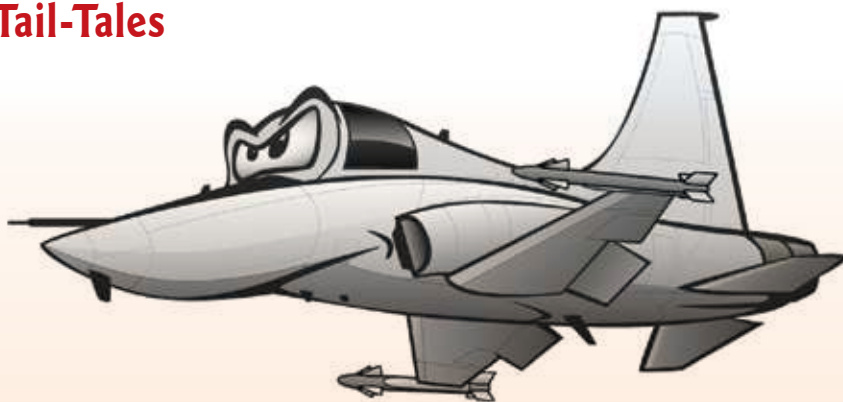
With successful launch of the Polar Space Launch Vehicle (PSLV) D2 from Sriharikota on 15 October 1994, and putting into polar sun synchronous orbit a remote sensing satellite some 17 minutes after blast off, India has become the fifth nation in the world, after the USA, Russia, the European Consortium and China, with such capability to place 1000-kg ‘satellites into 900 km sun-synchronous orbit.

Indian Space Plans

The ISRO Chairman K Kasturirangan is surprised at the concern in the United States over India’s successful launching of a remote sensing satellite. He said that the Indian space programme was scientific, with civil applications and its objectives had been clearly spelt out. He said that objectives of the programme had been laid down “in our ten-year profile” which was universally available, there was no element of surprise in the successful launch of the Polar Satellite Launch Vehicle (PSLV).

Tale Spin

Tail-Tales



The IAF's first Rafale will have 'RB 001' as its alpha numeric identity, reportedly chosen as initials of the new CAS. Initially, the IAF chose its aircraft serial numbering as per the Royal Air Force pattern but soon went its own way and not always consistently. First Hunters sported 'BA', the Canberra 'IF', the Gnat 'IE' but then came the Russian-origin MiG-21s which just had the alphabet 'C', while the Sukhoi Su-7s had 'B'.

In the 1980-90s came various versions of the Jaguar ('JS'; 'JT'; 'JM'), the Mirage 2000s were 'KF'; 'KT', the MiG-29 'KB', the swing wing MiG-23s were 'SM', MiG-27s were 'TS' and the latter Sukhoi Su-30MKIs have 'SB', even though all aircraft tail numbers are nowadays being airbrushed off in official IAF releases.

'RB' is not alone in having his initials perpetuated for posterity : all prototype / technology demonstrator / limited series production LCAs sported the Programme Director's initials 'KH' while the HTT-40 basic turboprop trainer has 'TSR' in honour of the then C/MD of HAL.

Legends of the Air Force will still be remembered ...

Alphabet Soup

Continuing the theme, during a period of the IAF's history, aircraft serials simply followed the alphabetic sequence : 'A' was the Hunter (also today's Hawk); 'B' the Su-7; 'C' the MiG-21; 'D' the Marut; 'E' the

Ajeet; 'F' the Canberra; 'H' the Avro 748; 'K' the An-32; 'L' the An-12; 'U' the Kiran and 'Z' the series of helicopters (vigilant readers will find some gaps!).

There are 26 alphabets in the English language, 50 in Hindi; we have flexibility!

Against the tide

Fingers crossed : Saga of the Hindustan Turboprop Trainer-40 will be written in

its procurement but may well receive larger numbers of the HTT-40 than first envisaged because of subsequent circumstances ...

The indefatigable designers at HAL have informally named HTT-40 as 'Phoenix', the mythical bird of legend, and will it may be !

Royal Flight

Handout photos from Thailand's Royal Government show consort Sineenat



letter of bold, even as this aircraft is steadily achieving development milestones, the latest achievement recorded in pages of this Issue. The intended launch customer has been somewhat reluctant to commit on

Wongvajirapakdli at aircraft flight controls. The Palace has also released images and a biography of King Maha Vajiralongkorn's newly anointed royal consort including action-packed photos of her undergoing various drills.

India too has had heads of Government with pilot wings, while a US Presidential hopeful of the past was a fighter ace.



Afterburner

THE IAF's HISTORY ENSHRINED HIMALAYAN EAGLES

by Pushpindar Singh



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Foundation



Volume II

Consolidation and Expansion



Volume III

World Air Power



IAF Squadron Histories

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