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Sukhoi T-50 formates with MiG-29M2 over Zhukovskiy during the Russian Air Force's 100th Anniversary celebrations (photo by Vladimir Karmozov).

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VAYU

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34 'Ongoing strategic transformation'

In this exclusive interview with Vayu on eve of the IAF's 80th Anniversary, Air Chief Marshal NAK Browne, CAS gives readers an assessment of the progress made in transformation of India's air arm towards becoming a high tech and well trained force. The LTIPP 2012-27 is commented upon as are the people-centric reforms and welfare processes.



38 The Role of Technology

Air Marshal M Matheswaran, Deputy Chief of Integrated Defence Staff (PP & FD) at headquarters IDS writes on such a role in crafting a National Aerospace Strategy. He articulates on the fact that major powers of the 21st Century will have to evolve into becoming air and space powers.



47 Continuing Transformation of the IAF

The IAF is in the midst of major equipment renewal which process involves the induction with several new advanced weapon and combat support systems which will transform the Service over the next decade. An article by Vivek Kapur, presently with the IDSA.



56 Face of the Future

Angad Singh analyses status of the Indo-Russian joint venture in developing the PAK FA / FGFA, with information on the aircraft's design, flight testing, armament, radar and engines. The tactical and strategic impact of the FGFA will dramatically alter the balance of power in the region. Plus a special graphic on the 'growth' of the IAF from 1st to 5th gen fighters.



61 The IAF at 100 : a wish list

What will the IAF look like in October 2032 ? In his inimitable style, Ravi Rikhye projects the trends in terms of number of aircraft, satellites, ABM defences, UCAVs, PGMs, supporting special mission aircraft but also the intangibles, particularly the need for efficient 'management', which is the name of the winning game.



73 'The Right Stuff'

Air Commodore Jasjit Singh, DG CAPS focuses on flying training in the IAF, with some introspection on several high level Committees which looked at this imperative requirement in the past decades. Shortage of the right training aircraft types and infrastructure has impacted on the Service and emphasised is the need for far greater attention on flying training in the future.



77 YAK-Attack

Test Pilot Peter Collins flew the Yak-130 during his visit to Irkutsk in eastern Siberia to test-fly and evaluate this new combat air trainer. His first hand report.

82 New Generation LIFT

Vayu's UK editor Richard Gardner looks at the increasingly tough air battle being fought in the world's defence market for advanced and lead-in fighter trainers. Leading the pack remains the BAE Systems Hawk but several other entrants are potential players.

93 'Squall' at 100 Feet

The well known NDTV presenter Vishnu Som, who is also a great aviation enthusiast and has flown and reported on some of the world's latest fighters, flew the Dassault Rafale during a recent visit to Istres in France. His sortie on the Rafale was "a dream come true".

97 Riveting the Relationship

Vayu was invited to Long Beach in California to visit the facility where the Boeing C-17 Globemaster III heavy airlifter is manufactured and to witness the 'major join' ceremony which signaled final assembly of the IAF's first C-17 ('India I'). The editor also recalls his flight in the very first C-17 to visit India in mid-1995.

130 Looking Back - Into the Future

Air Chief Marshal OP Mehra, who was CAS during 1973-75, recalls some vital aspects of his years as Air Chief. In fact, he was present on the occasion in New Delhi when Vayu Aerospace Review (then Vayuyan) was formally released by Defence Minister Swaran Singh in November 1974. Also, excerpts of ACM Mehra's interview in that very first Issue.

Also :

The Russian Air Force turns '100', New Vistas in Indo-Russian Cooperation, Man's Curiosity on Mars, Archival material on 'Formation of the IAF', 'The Inheritance' (1947), Air Marshal Bharat Kumar's 'Against the Hordes' (1962), 'Longewala 1971', 'First of the Many' (MiG-21F), 'Requiem for the HPT-32', 'Rolls Royce Relationships', 'The Future by Airbus', 'Birds in Paradise'.

Regular features :

Commentary, Outlook, Professional View, Aviation & Defence in India, World Aviation & Defence News, Vayu 25 years back, Tale Spin.

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AN EADS COMPANY

The Indo-Russian fighter

The FGFA is the flagship of the Indo-Russian partnership. Both countries say it would be the world's most advanced fighter. But interviews with Indian designers who have overseen the project suggest significant disquiet. There is apprehension the FGFA would significantly exceed its current \$6 billion budget, because this figure reflects the expenditure on just the basic aircraft. Crucial avionics systems would cost extra.

On the positive side, Indian designers say the FGFA project would provide invaluable experience in testing and certifying a heavy fighter aircraft that is bigger and more complex than the Tejas light combat aircraft (LCA), India's foundational aerospace achievement. The Russian and Indian Air Forces each plan to build about 250 FGFA, at an estimated cost of \$100 million per fighter. That adds up to \$25 billion each, in addition to the development cost.

The FGFA's precursor has already flown. In January 2010, Russian company Sukhoi test-flew a prototype called the PAK-FA, the acronym for Perspektivnyi Aviatsionnyi Kompleks Frontovoi Aviatsy (literally prospective aircraft complex of frontline aviation). Now, Hindustan Aeronautics Limited (HAL) will partner Sukhoi to transform the bare-bones PAK-FA into an FGFA that meets the Indian Air Force (IAF)'s requirements of stealth (near-invisibility to radar), super-cruise (supersonic cruising speed), networking (real-time digital links with other battlefield systems) and world-beating airborne radar that outranges enemy fighters.

But Sukhoi insists the PAK-FA already meets Russia's requirements, said NC Agarwal, HAL's former design chief, who spearheaded the FGFA negotiations until his recent retirement. HAL worries Russia might ask India to pay extra for further development, particularly the avionics that transform a mere flying machine into a lethal weapons platform. That would leave the \$6-billion budget in tatters.

The IAF clearly wants a top-of-the-line FGFA. According to Ashok Nayak, former Chairman HAL, the IAF has specified 40-45 improvements that must be made to the PAK-FA. These have been formalised into an agreed list between Russia and India, the Tactical Technical Assignment. A key IAF requirement is a '360-degree' AESA (airborne electronically scanned active) radar, rather than the earlier radar that Russia developed. Either way, India would pay Russia extra: either in licence fee for the Russian radar; or hundreds of millions, perhaps billions, for developing a world-beating, 360-degree AESA radar.

Nor is the IAF clear on whether the FGFA should be a single-seat fighter like the PAK-FA, or a twin-seat aircraft like the Sukhoi Su 30MKI. A section of the IAF backs a single-seat fighter, while another prefers two pilots for flying and fighting a complex, networked fighter. During the ongoing preliminary design phase (PDP), for which India paid \$295 million, the two sides would determine whether developing the PAK-FA into a twin-seat aircraft (inevitably more bulky) would reduce the FGFA's stealth and performance unacceptably. "The single-seat FGFA is essential for the IAF, and we will transform the Russian single-seat fighter into our single-seat version with a large component of Indian avionics. The twin-seat version will depend on the PDP conclusions," said Nayak.

The PDP also requires Sukhoi to hand over design documentation to HAL, providing it a detailed insight into the

design processes of the PAK-FA. Since India took years to decide to join the FGFA project, HAL missed out the design phase entirely. The 18-month PDP, which terminates this year, will be followed by the 'R&D phase', which could take another seven years, said the HAL chairman. The FGFA would be designed in both countries. About 100 HAL engineers already operate from a facility in Bangalore. Another contingent would move to Russia to work in the Sukhoi design bureau.

But the most valuable learning, say HAL executives, would take place during the FGFA's flight-testing. "Unlike the basic design phase which we missed out on, we will actually gain experience during flight testing. This phase throws up dozens of problems, and we will participate in resolving these, including through design changes," said Agarwal.

HAL designers also relish the FGFA's specific challenges. For achieving stealth, its missiles, rockets and reconnaissance payloads are concealed in an internal bay under the wings. Before using these, a door slides open, exposing the weapon for use. The Russians clearly believe HAL possesses useful capabilities, including the ability to design the AESA radar. Also attractive is India's experience in composites.

"The LCA programme has generated a high level of expertise in composite materials within the National Aerospace Laboratory and some joint teams. The FGFA requires 'higher modulus' composites, which can withstand the 120-130 degree Centigrade temperatures that arise whilst flying at Mach 1.7 speeds," said Agarwal. Despite the continuing imponderables, HAL believes the FGFA project provides genuine technological skills, far more useful than licensed manufacture. Agarwal says, "We will pay some \$6-7 billion to France for the licence to build the Rafale in HAL. In the FGFA project, a similar sum would bring in genuine design knowledge that will help us in the future."

Ajai Shukla, in Business Standard

Big bang long due

India has opened itself to foreign supermarkets and airlines despite intense pressure against either decision. Recent Cabinet decisions will help two of the country's vital sectors that are in dire need of capital, and more importantly, restructuring. They were long overdue. Even a partial rollout of multi-brand global retailing is better than none. The 7% of India's workforce employed in retailing are an extension of the immense disguised unemployment in agriculture. The pushcart seller ekes out a marginal existence because he did not have a factory job waiting when he left the farm. Unless manufacturing can absorb a larger chunk of the population moving out of agriculture, retailing will remain India's unhappy hunting ground. Life here is not pretty. India has one shop for a hundred people. The atomisation of the industry robs shopkeepers of any pricing power that would allow them to scale up. Operating in the informal sector, 98% of the trade has no access to the institutional supports of business like credit. As it exists today, India's retail business has hardly any hope of acquiring the efficiencies of a modern industry. Despite this, there has been no widespread reaction to large-format selling. The cash-and-carry wholesale trade was opened up to foreigners nearly a decade ago, and Metro and Carrefour have expanded their footprint. Walmart has set up back-end infrastructure for big-box stores after the government opened up this side of the

Roos Royce

business to international players. Meanwhile, India's corporate retailers have also come up with the proof of theory as well as proof of execution.

Indian aviation faces challenges from a deteriorating external environment as well as the teething problems of a young industry. The losses they pile amounts a major chunk of the money that goes down the tube for the industry worldwide. Huge for a country that flies less than 5% of the global air traffic. At the heart of the problem is a business plan gone wrong. Indian airlines have in the recent past been on a reckless shopping spree for aircraft that are flying empty now. Private airlines have a point when they complain taxes on fuel and airport fees bump up the cost of flying in India by 60%. Alongside a policy that did not allow foreign airlines to buy into Indian carriers, this exerts an enormous cash squeeze. Of late the government has bestirred itself, taking up piecemeal aviation reforms. Airlines flying abroad can now import cheaper fuel, but the logistics are daunting. Bilateral route agreements with other countries are open to private Indian carriers. With the ban on foreign airlines buying into local ones lifted, the industry could see some consolidation.

From Hindustan Times

Surprise change of course

It may not have come at dawn, but in many ways the leaking of BAE Systems' pursuit of a possible combination with the European aviation giant EADS has all the flavour and impact of a surprise military strike.

At a stroke it has shredded perceptions about the UK defence contractor's strategic priorities, which had appeared to lie across the Atlantic in the massive US defence market. Instead, BAE has chosen to pursue a tie-up with EADS in a deal that would create a sprawling European champion with interests spanning civil aviation and space, as well as being partly controlled by the French state.

Not only does this represent a complete strategic volte face; it is one that can only place a question mark over the British group's valuable position as a prime contractor to the Pentagon. BAE has yet to enumerate what benefits – aside from the questionable one of brute balance sheet heft – will accrue from the deal. But for these to outweigh the strategic risks, they would need to be substantial.

The discussions with EADS are not yet complete, so it is hard to say what the eventual structure might be. However it seems conceivable that the two groups will seek to mimic the sort of transnational arrangements favoured by Unilever, which in effect has two companies, one British and one Dutch, with a common board of directors. This in theory makes it easier for both sides to keep certain sensitive pieces of their operations under discrete control.

Whatever arrangements there are will need to address US sensitivities about technology transfer. In spite of France's return to Nato's military structures, Washington is likely to insist on safeguards to prevent high technology leaking from BAE to its European colleagues. Such concerns will not be confined to the US. There will be UK sensitivities too given its policy of allowing BAE to become a near-monopoly supplier to the Ministry of Defence in critical spheres of military procurement.

Satisfying these concerns can only limit the financial advantages of the combination. To these must be added the complexity of navigating the management and control issues that have bedevilled EADS, with its rigid system of allocating top management jobs to French and German nationals in equal proportion. BAE's chief executive, Ian King, may have surprised his shareholders with his sudden change of direction. In the coming days however he will need to explain more fully the merits of his march to the east.

From Financial Times

The enemy lies within

The attack on Pakistan's Kamra air force base, for which the Pakistani Taliban has claimed responsibility, is one more sign — as if more were still required — that the country's enemy lurks within its boundaries. Militants wearing air force uniforms infiltrated the base that is rumoured to house a part of Pakistan's nuclear arsenal, in a manner reminiscent of the May 2011 raid at PNS Mehran, and at the General Headquarters in Rawalpindi two years earlier. Armed with RPGs and automatic rifles, and wearing suicide vests, they damaged one aircraft at the base and killed at least one airman. Though the militants were eventually eliminated, the question Pakistan should be asking is why no lessons were learnt from the earlier attacks. In an address at the Kakul Military Academy on Pakistan's Independence Day, Army chief Ashfaq Parvez Kayani said the country needs to fight terrorism and militancy for its own sake. But it is unclear how far the military has addressed the spread of radicalism within its ranks, or if it even sees this as a problem. After the PNS Mehran incident, a journalist who wrote that militants had developed extensive links within the Navy paid with his life; the Pakistani media openly blamed the country's Inter-Services Intelligence for the killing. In the latest instance too, the attackers seemed to have insider knowledge of the sprawling air base located at Attock in the Punjab province. A Pakistani newspaper had only a few days ago warned that the Tehreek-e-Taliban Pakistan was planning a raid on a PAF base, giving August 16 as a possible date, but even with such specific information, the military was caught unawares.

While General Kayani's remarks and a much-speculated upon military operation in North Waziristan cannot be ruled out as triggers for the attack, the problem really lies with how the Pakistani state continues to see some militants as useful to strategic regional objectives, with others to be tolerated so long as they do not undermine Pakistani interests. The differentiation between "good" and "bad" militancy has led to such deep-rooted confusion that it is no longer clear to anyone what those interests are. Otherwise, let alone the Lashkar-e-Taiba that targets India, why should a state and its political class tolerate a group like the Lashkar-e-Jhangvi, that kills with impunity citizens of a particular religious denomination? Addressing the roots of extremism, militancy and terrorism will need nothing less than an overhaul of the ideological drivers of the Pakistani state — the reliance on an exclusivist reading of Islam, the negation of provincial aspirations by a Punjab-centric establishment, the domination of the military — but the country is clearly not yet ready for this.

From The Hindu

Pilatus



Resolve the problem of roles and missions

Formation of Indian Army Dhruvs

A national daily recently reported that highly classified documents pertaining to weapon system requirements and acquisition plans of all the three services along with those of surveillance equipment for the intelligence agency, RAW, had been received by the Central Bureau of Investigation and the Enforcement Directorate from an erstwhile American associate of an Indian arms dealer, Abhishek Verma. He was first probed in the 2005 Navy War Room leak case and, along with his wife, was recently arrested for attempting to bribe government officials. Whether Verma's political lineage has any bearing on the tardy pace of progress on such cases can only be a matter of conjecture, but as the range of his activities unravel, one can only hope that they do not draw members of the uniformed fraternity into their vortex, since of late they have already been buffeted by far too many scandals — many of their own making.

This shocker comes on the heels of a serving lieutenant colonel being honey-trapped by a female ISI operative from Bangladesh, and the more embarrassing case of a major recruitment scandal at the National Defence Academy which has already resulted in two colonels

being arrested. One of them was the commandant's staff officer, and the commandant himself was 'attached' to facilitate fair investigation. As if this dose of alarming news were not bad enough, it coincided with reports that two erstwhile army chiefs were being called to depose before the CBI in the infamous Adarsh Housing scandal that was perpetrated in the name of Kargil heroes and their widows.

It is worth recalling that when General VK Singh had taken over as chief in 2010, he had identified his primary goal as "restoring the internal health" of the army. Since the integrity of the internal health of any professional armed force should normally be taken as given, clearly his concerns on this score should have set alarm bells ringing amongst the entire national security establishment leading to remedial actions on a most urgent basis. Indeed this should even have taken priority over modernisation of the force, as the finest of modern weapon systems will do nothing in the hands of a force whose internal health needed attending to. Instead, not an eyebrow was raised and it was business as usual in the corridors of South Block and, indeed, the hallowed precincts of Parliament.

If the rather turbulent end of the erstwhile army chief's tenure is any yardstick, notwithstanding many other areas of his achievement, he met with little success in his endeavours to restore the internal health of the army. That skeletons continue to tumble out of the army's cupboards and that there are differences within the senior echelons of the army merely add weight to this unfortunate belief.

To students of national security, this comes as no surprise as restoring the internal health of a million-plus force that is heavily committed on two hostile borders and on providing internal security support to the civil administration in Jammu and Kashmir and areas of the Northeast cannot be the task of one lone chief with a handful of army commanders. It requires the combined will and support of the entire national security apparatus ascending right up to the legislature. Unfortunately, no such urgency has been felt amongst our sanguine security managers. It should by now be clear that no amount of modernisation, technology or force augmentation would provide the nation security if the internal health of its armed forces — and more specifically, the integrity and morale of its human resources — is under stress.

In an interview to *Sainik Samachar* on taking over, General Bikram Singh, the new COAS, had stated, "All commanders must endeavour to create a climate during their command tenures that hinges on our cherished core values, professional ethos and is conducive to growth and cohesion." This writer's interpretation of this message as related to any professional armed force is one of personal integrity, putting the interest of the nation and one's subordinates above one's own, and a professional ethos that translates into a cohesive war-fighting machine, which, in modern warfare, must translate into joint war-fighting and not be limited to any one force.

That is why one read with great disappointment reopening of the turf war by the army over attack and medium helicopters, a role presently with the Indian Air Force, which, for very long, the Army has cherished. It has been reported that the army chief has made a strong pitch for this transfer with the national security adviser and the defence minister clearing a panel headed by the Deputy Chief of Integrated Defence Staff (perspective planning and force development) and comprising representatives from various services is studying the subject. The unfortunate conclusion is that it is business as usual within the army leadership and certainly contrary to the spirit of professionalism and cohesion that the chief has spelt out, from a joint warfare perspective.

The evolution of technology is driving capabilities that are essential to warfare in any medium, land, sea or air. This is also adding to an exponential increase in costs. However, the main objective of joint war-fighting is to exploit the core competencies, unique strengths and capabilities of each of the armed forces towards a common military aim and to do it both efficiently and cost effectively. This, in turn, implies innovative ideas on integration and the consequent avoidance of duplication and redundant capabilities through subjective judgments on roles and missions and weapon-system procurements.

History tells us that with the advent of air power and birth of air forces as independent services, there were continuing inter-service turf wars in Western countries, which affected the institutional psychology of each service in

their own ways. These have been resolved through clearly defining the roles and missions of each armed service. So what we are witnessing in India is nothing new, only that we are reluctant to adopt established scientific analysis techniques over subjective and parochial mindsets and move on.

For a constructive way forward, it would be prudent to first resolve, once and for all, the issue of roles and missions for each of the three services. To arrive at this there are adequate scientific and engineering tools of joint warfare analysis that will keep the emotions and subjectivity of yesteryears at bay. To start with, let the disagreement on the ownership of attack or medium helicopters be subjected to this scientific study, shorn of emotions and subjectivity.

Next, let all other grey areas of roles and missions be subject to the rigour of the same scientific analysis. Once these scientific analyses are completed, let Parliament legislate on what is the

warfare capabilities to fulfil their assigned missions, secure in the knowledge that solutions being applied are the optimum from operational and cost-effectiveness angles.

In order to get to the very root of the internal health weaknesses of the armed forces, there is yet one more unfinished agenda. For too long have we attempted committees and task forces to study the issue of defence management, of which the latest Naresh Chandra Committee report is presently under consideration. Invariably, the best that the cream of our talent has produced in the past is what constitutes the lowest common denominator. Even this is then subject to selective implementation.

Without appearing pessimistic, there is little reason to believe that the latest effort will be any different. We are reaping the results of this prolonged neglect today and the daily shockers are the inevitable consequence. The time has now come for Parliament to appoint a blue ribbon commission to look at the



Indian Air Force Mi-17

abiding role of each of the services within which the missions it is formally tasked to perform. This will, once and for all, cast historic turf wars aside and let the services focus on developing joint

entire aspect of how defence management is to be organised and executed in India, followed by legislative directions.

It is time to start afresh, before it is too late.

Air Marshal (R) Brijesh D. Jayal

“NEVER AN EASY DAY”



On the SEAL helicopter that pranged at Abbottabad

The ‘truth’ is out! Someone had to leak an account of the Osama bin Laden raid on 2 May 2011 at Abbottabad, but that it would come from one of the Navy SEALs who took part, is the most surprising element. It turns out that Mark Owen, the author, is actually Matt Bissonette, a SEAL himself.

While the assault on bin Laden’s hideaway in the heart of a cantonment town was expected to be a stealthy one,

affording minimum time to the occupants, what queered the pitch was crash landing of the first helicopter, a modified Sikorsky Blackhawk. As per Owen, “... the hover was rough and it was apparent the pilots were having trouble holding station. It felt like they were wrestling the helicopter, trying to force it to cooperate...the pilots never had an issue during rehearsals. Something was wrong.” And then, “the wall around the compound quickly passed

by as we headed for the ground. When the helicopter rotated ninety degrees (right), the tail rotor barely missed the wall seconds before impact, I felt the nose dip one minute the ground was rushing up at me, the next minute, I was at a dead stop ..the blades didn’t snap off.”

What went wrong? If the helicopter rotor blades had hit the ground, there would have been mayhem and fatalities for sure. Depending on the gravity, the mission may well have had to be abandoned as the casualties would have required evacuation. That is what happened in *Operation Eagle Claw*, that ill-fated effort to rescue the American hostages from Iran in 1980. Could it have been ‘power settling’, as some had conjectured immediately after the raid? That would require the Black Hawk helicopter to be overloaded, but to think that the pilots had not calculated the all up weight correctly would be stretching one’s imagination that would be too simplistic, and in that case the helicopter would have hit the ground where it was trying to hover. Surely, there were checks and double checks done by independent teams on all facets of the mission ? As Owen writes in the book, practice runs had been done and all that Admiral William H McRaven, the Special Op boss had told the pilots, was to get the assault team on



Saab



ground safely, "...and they will figure out the rest." There was no engine failure either, as Owen says that when he moved from under the crashed helicopter, he felt as if he was going through a hair-dryer, because of the exhaust gases of the still running engines.

From a description of the helicopter's behaviour it appears to have experienced LTE : loss of tail rotor effectiveness. The give away is the extremely unsteady hover causing the pilot to give a radio call, "Going round", implying that he was abandoning the landing by increasing power (collective) and lowering the nose to take off at that low height : that is the ninety degree right yaw and the dip of

the nose that Owen had felt. It was too late and the helicopter was too low for recovery. This is a phenomenon that is explained and discussed in helicopter flight schools. That it happens and helicopters still come to grief is not the surprising part; that it should occur in what was perhaps the most important mission in the contemporary history of American Special Forces, is what would be analysed far and wide.

The tail-wheel equipped Blackhawk came to rest with its tail boom perched on a wall, as per a sketch in the book. So, there was a Blackhawk standing almost parallel to the ground, with the front fuselage on its front two wheels and the

tail supported on a 12-foot wall which is why the rotors did not touch the ground. Were it not for the circumstances under which it happened, it would indeed have been classified as 'funny' !

The Indian Air Force is acutely aware of the seriousness of LTE, as our operating altitudes are far in excess of what any country operates at. Landings at 19,000 feet are done routinely, and foreign military aircrew hardly believe that this happens on a daily basis! For the US Navy Seals, 'the only easy day was yesterday,' as Owen puts it in the book.

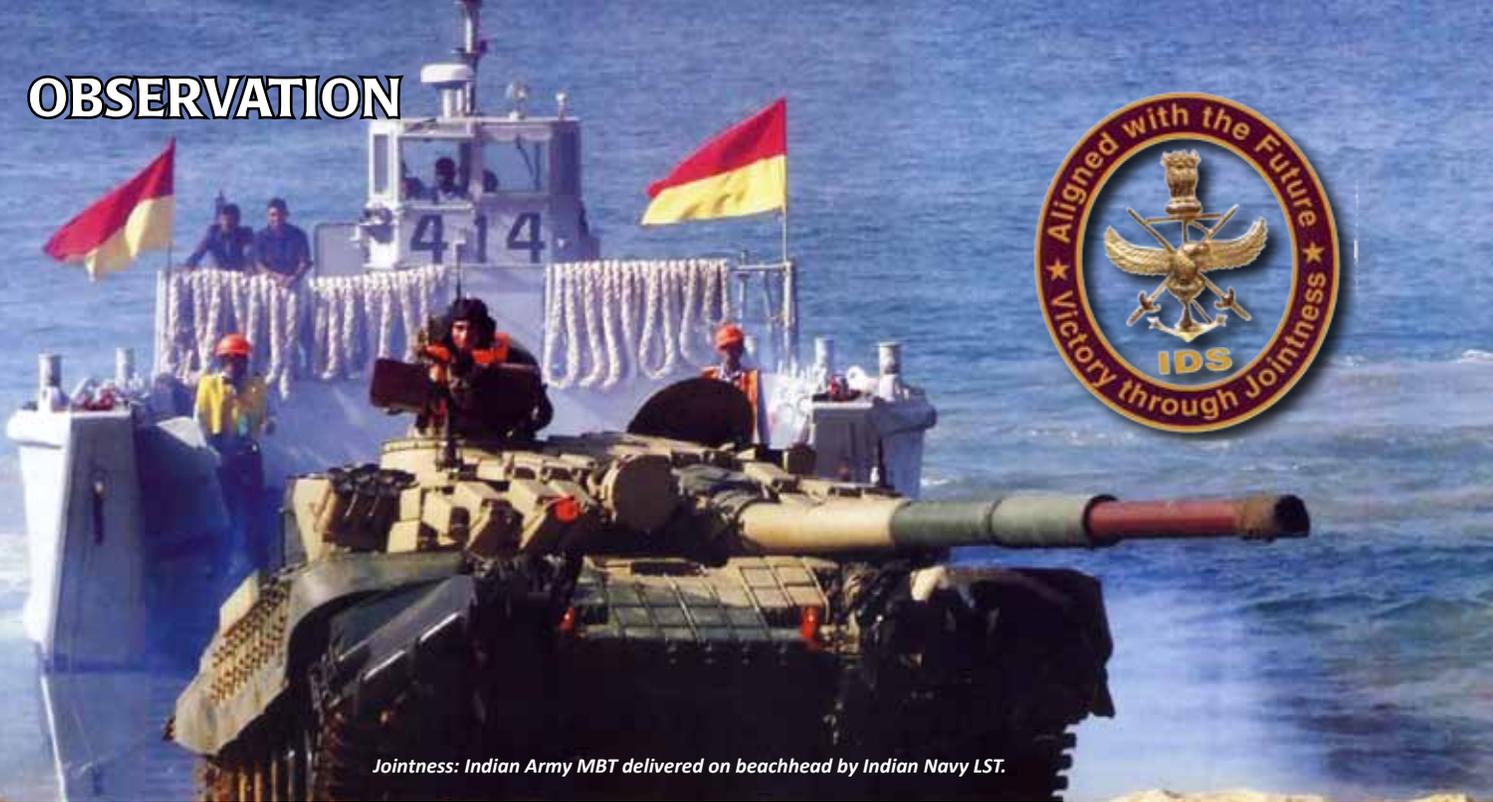
For IAF helicopter aircrew, operating at those dizzy Himalayan heights, there is NEVER an easy day !



Air Vice Marshal Manmohan Bahadur VM

A serving officer of the Indian Air Force, he is an Experimental Test Pilot from the French Test Pilots School, a graduate of the Air Command and Staff College, USA and a post graduate in Defence and Strategic Studies from Madras University. He has commanded a frontline Helicopter Unit and two Flying Bases, was the Contingent Commander of the first IAF United Nations Mission in Sudan and Head of Training Team (Air) at Defence Services Staff College, Wellington. As Asst Chief of Air Staff, the author was the operational head of Transport and Helicopter Operations of the Indian Air Force for two and a half years. He is presently the Asst Chief of Integrated Defence Staff. His core interests concern Air Power and Strategic Affairs.

Views expressed are personal.



Jointness: Indian Army MBT delivered on beachhead by Indian Navy LST.

Sound recommendations on defence reforms

The noted American strategic analyst George Tanham succinctly expressed some years back that “Indian elites show little evidence of having thought coherently and systematically about strategy.” It is indeed paradoxical that an ancient and profound civilisation surviving the vicissitudes of time and countless upheavals, now a 65 years young nation, located geographically in one of the most violent expanses of the world and having fought five externally foisted wars since its independence, has in reality, hardly looked into its defence needs in an institutionalised and systematic manner. The status-quo and pacifist mentality of the Indian psyche is, perhaps, reflective of a primordial and philosophical adherence to outdated moorings which are inconsistent with the security challenges which now confronts India in a seriously troubled and politically unstable neighbourhood.

The serious debacle and ignominy suffered by the nation in 1962 at the hands of the Chinese had prompted the then government to constitute the Henderson Brookes Committee to go into the reasons of the defeat. Their Report, even 50 years after the event, still remains shrouded, inexplicably, in secrecy for reasons which are difficult to gauge. Despite the 1965 and 1971 wars with Pakistan or even with Pakistan becoming a nuclear state in 1998, continuing border and maritime

tensions with an increasingly powerful and belligerent China, no periodic security reviews were ever undertaken. However, the 1999 Pak perfidy in Kargil which definitely did surprise the Indian establishment, prompted the government to form an all-encompassing high powered commission, the *Kargil Review Committee* (KRC) under the widely respected K Subramanyam to delve deeply into all aspects of Indian security. The latter, in one of his last interviews before his demise had expressed that “India has lacked an ability to formulate future-oriented defence policies, managing only because of short-term measures, blunders by its adversaries and force superiority in its favour.”

The KRC did a commendable job in comprehensively analysing and recommending measures to tone up security in India in all its myriad nuances and complexities. Most of the major recommendations of the KRC, further streamlined by a specially constituted Group of Ministers Committee in 2001, mercifully, have been implemented in letter if not in total altruistic spirit! Some critics of the KRC have, however, opined that its reforms “had failed to deliver.”

Ten years having elapsed since India’s first comprehensive security review and increasing multi-faceted security problems both within and external in the country,

led the present government constituting the *Naresh Chandra Committee on Security Reforms*. This 14-member Task Force was mandated to review the unfinished tasks of the KRC Report and make suggestions relating to the higher defence management structure of the nation and also examine why some of the critical recommendations relating to intelligence and border management were found wanting. It is pertinent to note that the KRC had previously observed that “...the political, bureaucratic, military and intelligence establishments appear to have developed a vested interest in the status-quo.”

The Naresh Chandra Committee commenced work in mid 2011 and has very recently submitted its report to the government. Its findings have yet not been made public and its Report is currently under consideration of the Cabinet Committee on Security (CCS). Nevertheless, like most “state secrets” in India, some of its major recommendations have found their way into the public domain and are currently under animated discussion among security analysts, think tanks and the media. Though it will be grossly unfair to carry out much meaningful appraisal of the Report, without the entire review being made public, some initial comments on some of the vital issues raised will be in order.

A major observation of the Naresh Chandra Committee has been that uniformed officers from the three services must be posted to the Defence Ministry in adequate numbers as the uniformed community must have a greater say in matters of national security. It has lamented that despite the Service Chiefs and the highly specialised Services Headquarters staff being at their disposal for advice in the management of national security, the political establishment is totally relying on the feedback of Defence Ministry civil servants, drawn from diverse professional backgrounds not even remotely connected with security matters.

According to media sources, to include and enhance the status of Service Chiefs in the national security decision making processes, the Task Force has also recommended amendments in the Business Rules, namely the 'Government of India Allocation of Business Rules' and the 'Government of India Transaction of Business Rules' framed in 1961. Surprisingly, under these enactments, the Service Chiefs do not even find a mention and the Defence Secretary, under these Rules is responsible for the "Defence of India and every part thereof." In addition, the Defence Secretary is deemed to represent the three service chiefs in most forums ! To any objective bystander or an ordinary citizen of India, such glaring and basic omissions are more than unacceptable.

One of the major and widely endorsed recommendations of the KRC had been the establishment of the office of the Chief of Defence Staff, a five star rank officer, to act as a single point military adviser to the government and handle the tri-services commands including the vital Strategic Nuclear Forces Command(SFC), Andaman and Nicobar Command, the Defence Intelligence Agency etc. However, the Naresh Chandra Committee has, surprisingly, recommended a slightly toned down version of the CDS by suggesting another 4 star rank officer from any of the three services (making it a total of four 4 star officers) to act as a permanent Chairman of the Chiefs of Staff Committee (COSC) and according to media reports, this appointment will also replace the Defence Secretary to render tri-service advice to the government---an aspect which will now naturally meet

with stiff resistance from South Block 'babus' . Among the three services, as is widely known, the Indian Air Force, for not very professional reasons, has been in opposition to the CDS concept (mentioned to me also personally some years back by a former senior Cabinet Minister), a posture which also suits Defence Ministry bureaucrats. Even the government currently has stated its position on the CDS that " the views of political parties are being ascertained." Thus in the absence of total unanimity on the decision to have a 5 star rank CDS, some feel that the committee's recommendation can be temporarily agreed to and utilised, in the interim, in creating more cohesion among the three services. The Special Operations Command, which this Task Force has recommended for synergising the special operations of the three services, could also be put directly under command of the COSC as also the urgently needed tri-service Cyber Command as and when it will be raised (not recommended by the Task Force yet).

All in this country, in uniform and out of it, must appreciate the simple fact that large armed forces encompassing multi-dimensional strategic forces including land, sea, nuclear and aero space, cannot be left to the whims and fancies of any single service and have to be deployed and operationally employed in an integrated manner for which jointness, unity and economy of effort among the three services is sine-qua-non. This is only possible with a CDS overseeing the entire gamut of operations and other aspects of all the three services as is the practice in the powerful military nations of the world. One day, I pray that a dedicated pan India political leader, will address the problem of true jointness for the Indian Armed Forces, over-ride any individual service parochialism and get the three services to truly integrate for the larger national good.

The Naresh Chandra Committee has reportedly made many more useful recommendations. It correctly has opined that India must prepare militarily to deal with an assertive China as it simultaneously seeks to enhance cooperation in diverse fields with it. It notes that China will continue to utilise Pakistan as part of its grand strategy for containing India in a "South Asian box."It

has suggested that the Indian Army be given management of the Indo-Chinese borders and retain overall operational control over all forces deployed on the Sino-Indian border.

The Naresh Chandra Committee, has further cautioned that Pakistan remains unable and unwilling to set its house in order. Its Army continues with its myopic and self destructive policies of using Islamic terror groups to promote terrorism in India and Afghanistan and seeks strategic depth in the latter country. The committee has recommended that India must employ all political diplomatic, economic and military measures to ensure that Afghanistan does not fall a victim to Pakistani efforts to convert Afghanistan into a fundamentalist vassal state.

The Naresh Chandra Committee has also made sound recommendations regarding better liaison between the MOD and the other ministries like the MHA and MEA by various institutionalised measures. This committee has also stressed the need for an agency to tackle militancy and terrorist activities across the nation---perhaps alluding to a set-up like the widely debated National Counter Terrorism Centre which most states have been opposing till date.

With the Report being studied by various ministries and relevant organs of the government, it will be in order that the Report be made available to the public at large so that concerned think tanks and analysts could also give their considered views on matters of vital national import. Importantly, the government, once the CCS clears the Report and any other suggestions for improving national security are formally approved, must ensure its speedy and faithful implementation. Some days back, the Prime Minister at the DRDO Awards function, had himself expressed that "as we look around us, a net deterioration in the international strategic and security environment becomes too obvious." It is time the Indian state not only becomes sensitive to the many formidable security challenges it will face in the foreseeable future but be more than prepared to successfully confront them as it gears itself for a larger regional and global role.

*Lt Gen (R) Kamal Davar
Former DG, Defence Intelligence Agency*

Sikorsky

First FGFA (prototype) for IAF in 2014

On his return from Moscow in mid-August after attending functions at the 100th anniversary of the Russian Air Force, Air Chief Marshal NAK Browne, CAS IAF said that, “The first prototype of the FGFA is scheduled to arrive in India by 2014



after which, it will undergo extensive trials at the Ozar air base (Maharashtra)... We are hopeful that the aircraft would be ready for induction by 2022.”

The second FGFA prototype will follow in 2017 and the third in 2019. The FGFA will receive certification by 2019, following which series production will commence at HAL’s Nasik Division. According to the LTIPP, the first FGFA squadron of the Indian Air Force will form in 2022-23, with some 200 aircraft, mostly single-seaters, to be received by the Service.

The governments of India and Russia signed a Preliminary Design Contract (PDC) valued at an estimated \$295 million on 21 December 2010, as part of a formal agreement to co-develop the aircraft. The comprehensive design and development contract is estimated at \$11 billion, of which India’s share would be half, at \$5.5 billion. According to reliable sources, “Russia has already given the draft R&D contract to us, which will include the cost of designing, infrastructure build-up at Ozar, prototype development and flight testing. HAL design engineers and test pilots will be based both in Moscow and Ozar during the design and development phases upto 2019.”

A senior team from HAL led by T Suvarna Raju, Director Design & Development and including several design engineers and technologists, plus Indian Air Force test pilots were reportedly in Moscow in late-August for review and planning for detailed design of the FGFA. It is also learnt that Tikhomirov NIIP will design and build the AESA radar for the FGFA, the group having earlier developed the Bars PESA radar, currently fitted on IAF Su-30MKIs.

IAF’s first C-17 in “join” ceremony

On 31 July 2012, at Boeing’s massive Long Beach facility, the IAF’s first C-17 Globemaster III was “joined” in a ceremony, where Indian Embassy, senior Indian Air Force and local elected officials drove ceremonial rivets into the aircraft (see article *Riveting Relationships*).

The Government of India had signed an agreement with the US government on 15 June 2011 to acquire ten C-17 airlifters, making the IAF the largest operator of this type after the USAF. The first two IAF C-17s will begin flight trials in early 2013 and then ferried to India in May, to be based at Hindan with the newly raised No.81 Squadron.

“This is a proud day for the highly skilled Boeing workforce and our newest customer to celebrate a major production milestone,” said Bob Ciesla, Boeing Airlift vice president and C-17 programme manager. “We are preparing for India’s first C-17 to enter flight test on schedule early next year, and we look forward to providing for India’s current and future needs and continuing to support C-17s long after they are delivered.”



Side view of IAF’s first C-17 in final assembly hangar

Boeing has meanwhile delivered 245 C-17s worldwide, including 217 to the U.S. Air Force, which are on active duty and to Air National Guard and Reserve units. A total of 28 C-17s have been delivered to Australia, Canada, Qatar, the United Arab Emirates, the United Kingdom and the 12-member Strategic Airlift Capability initiative of NATO and Partnership for Peace nations.

New Su-30MKI Squadron at Halwara

The newest IAF Squadron to be equipped with the Sukhoi Su-30MKI is No.220 (‘Desert Tigers’) which was formally inducted into Western Air Command on 25 September 2012. Photograph shows Air Marshal Arup Raha AOC-in-C Western Air Command with Wing Commander Sharad Aneja, CO No.220 Squadron at the ceremony that morning.



Panasonic

First DRDO AEW&C test aircraft at CABS

On 23 August 2012, the first modified aircraft for Airborne Early Warning and Control Systems arrived at HAL airport, Bangalore and was received by an enthusiastic crowd from CABS, its work centres, CEMILAC and IAF officers. The aircraft and the flight crew were welcomed by Dr S Christopher, Programme Director, and Dr K Tamilmani, Chief Executive, CEMILAC.



The acceptance of the aircraft was completed over a period of 15 days at Embraer facilities in Brazil, by a team from CABS, CEMILAC, DGAQA and the IAF and was flagged off from Embraer, Brazil on 17 August 2012, and flown across multiple continents to arrive in India. The aircraft was ferried with several mission system external components of DRDO including the Active Electronically scanned Array Antenna with passive electronics fitted onboard. Development flight trials in India will begin in early 2013.



Brahmos missiles on Sukhoi-Su-30MKIs

Integration of supersonic Brahmos cruise missiles on Su-30MKIs of the Indian Air Force, worth over Rs 6,500 crore, is “progressing”. The air-launched missile system would significantly add to the conventional offensive capabilities of the IAF and the Brahmos would be mounted on 42 Su-30MKI fighters with some 216 Brahmos missiles ordered. Two prototypes of the Su-30MKI fighters would be fitted with the missile for test trials in the first phase, probably in Russia, after which the balance 40 Su-30MKI fighters would be integrated with the missile in India.

Some modifications to the fuselage will be undertaken for BrahMos carriage (in Russia), the balance by HAL/DRDO in India which are required to accommodate the nine metre-long missile, which is lighter than the other variants and has additional rear fins for aerodynamic stability. The entire project would be executed in India by Brahmos Aerospace and Hindustan Aeronautics Limited (HAL), with Russia providing design and technical consultancy.

Tejas to take part in ‘Iron Fist’

The Tejas Light Combat Aircraft will take part in the forthcoming air exercise ‘Iron Fist’, to be held in February 2013 at Pokhran near Jaisalmer, according to Air Marshal Anjan Kumar Gogoi, AOC-in-C South Western Air command. This will be the first “public” weapons demonstration by the Tejas, which has recently completed weapon trials in Jamnagar and Uttarlai, in preparation for initial operational clearance.

Bombardier Global 5000 in Indian colours

Photographed at Shannon Airport enroute to Tel Aviv on 25 June 2012, arriving from St. Louis Downtown and still with Canadian registration C-GHVB, this Bombardier Global 5000, was originally destined for a Maltese customer. According to European defence journals, it is speculated that the Indian Government have been evaluating a system similar to the Raytheon-developed Global Express-based Airborne Stand-Off Radar (ASTOR) system deployed by the Royal Air Force.





First Bombardier BD-700-1A11 Global 5000 for Indian Air Force.
(photo: Seigi N taken at Ben Gurion, Tel Aviv, Israel)

However, other reports refer to the recent acquisition of two Bombardier 5000s, equipped with multi-mission airborne reconnaissance and surveillance systems by the little known Aviation Research Centre (ARC) of the Cabinet Secretariat, which will replace the earlier Gulfstream aircraft fitted with obsolescent systems. Incidentally, the ARC celebrated its golden jubilee on 1 September 2012, well reported in the national press.

157 HU inducts Mi-17 V5s

First of the ten Mi-17 V5s allotted to the newly raised No. 157 Helicopter Unit (HU) was inducted at Barrackpore airbase in end-June 2012. The helicopter was flown to the airbase by



Wing Commander AR Verma, CO of the Unit and inducted after a brief ceremony, presided over by AOC-in-C EAC, Air Marshal S Varthaman.

CAE contracted for IAF Hawk training

BAE Systems has awarded CAE a five-year contract to provide maintenance and support services for India's Hawk synthetic training equipment. CAE India will provide on-site maintenance and support services at Indian Air Force Base Bidar where the IAF operates the Hawks, two Hawk cockpit procedures trainers, and a Hawk avionics part-task trainer. CAE India will provide a range of training support services, including hardware and software engineering, troubleshooting and logistics support.

20 additional Hawks for IAF

A further 20 Hawk advanced jet trainers are being requested for by the IAF, which would expand the IAF's inventory of the type to 143 aircraft. According to BAE Systems, "in partnership with Hindustan Aeronautics (HAL), production of the 66 Batch 1 Hawk trainer aircraft has been completed in India. Deliveries



of materials and equipment in support of licence production of the 57 Batch 2 aircraft continue and aircraft assembly in India is progressing to schedule. Quotes are now being submitted for an additional 20 aircraft."

'Avro' 748 replacements sought

The Defence Acquisition Council (DAC) has approved the procurement of 56 new transport aircraft to replace the HAL-assembled Avro (BAE) 748s currently in service with the Indian



Air Force. Approval for the \$2.18 billion programme was given by the DAC in July and a request for proposals will be issued within the next few months. The first 16 will be acquired directly from the manufacturer with the balance 40 to be assembled in India under a novel private sector/foreign collaboration scheme.

Initial delivery schedule of PC-7s

The IAF is expected to receive its first Pilatus PC-7 Mk.II basic trainers from January 2013, the first batch consisting of six aircraft to be delivered at a rate of two a month. An initial training course on the PC-7 Mk. II will commence in July 2013 and Pilatus will complete delivery of all 75 trainers to India by 2014. The IAF has recently seconded a team of flying instructors and maintenance personnel to Pilatus in Switzerland for conversion training.



The IAF has an option to extend scope of the contract with Pilatus, adding further PC-7s to the original order. The deal also stipulates that Pilatus establish an in-country depot-level maintenance capability, as well as ensuring that there is transfer of technology to Hindustan Aeronautics Ltd for licensed production of 106 PC-7 Mk IIs in India. If this option is exercised, with Government of India approval, the indigenous HTT-40 basic turboprop trainer programme will effectively have been abandoned at the design stage itself.

Admiral DK Joshi is Chief of Naval Staff

Admiral Devendra Kumar Joshi PVSM, AVSM, YSM, NM, AVSM, ADC, took over on 31 August 2012 as the 21st Chief of Naval Staff of Independent India and the 19th Indian to take command of the Indian Navy. In a traditional ceremony, outgoing



CNS Adm Nirmal Verma ceremonially handed over the Chief's telescope to Admiral DK Joshi.

In his maiden message to the Navy, Admiral DK Joshi said that he was "in gratitude for having been given the honour and privileged opportunity to Command the Navy". He stated "for the Navy to fulfil its mandate as a maritime power for national prosperity, 24x7 attention would need to be paid at all levels to ensure that there are no gaps in our security preparedness". He emphasised that "to achieve security related objectives, the man-machine interface is crucial and the Navy would need to professionally re-audit, train and consolidate its preparedness to optimise the existing capabilities as well as harness the full potential of the transformational new capabilities being inducted".

Admiral DK Joshi is a specialist in Anti-Submarine Warfare. In his distinguished service spanning nearly 38 years, he has served in a variety of Command, Staff and Instructional appointments.

Admiral Joshi's Sea Commands include the guided missile corvette INS *Kuthar*, guided missile destroyer INS *Ranvir* and the aircraft carrier INS *Viraat*. He subsequently commanded the Eastern Fleet. After his elevation to Flag rank, the Admiral served in the Integrated Headquarters in all nodal Branches: in the Personnel Branch, as the Assistant Chief of Personnel (Human Resource Development), in Warship Production and Acquisition as the Assistant Controller of the Aircraft Carrier Programme (ACCP), and thereafter in the Operations Branch both as Assistant Chief of Naval Staff (Information Warfare and Operations) and as the Deputy Chief of Naval Staff.

Before taking over as FOC-in-C Western Naval Command, he was at the helm of inter-service integration, first as the Commander-in-Chief of the Andaman and Nicobar Command, the only tri-service integrated Command. Later, he served as the Chief of Integrated Defence Staff to Chairman, Chiefs of Staff Committee (CISC).



Vice Admiral Shekhar Sinha is FOC-in-C Western Naval Command

Vice Admiral Shekhar Sinha, earlier Chief of Integrated Defence Staff to Chairman, Chiefs of Staff Committee (CISC) has been appointed Flag Officer Commanding-in-Chief (FOC-in-C) Western Naval Command with effect from 31 August 2012 when the incumbent Vice Admiral DK Joshi took over as Chief of the Naval Staff.



Eurojet

Vice Admiral Shekhar Sinha was commissioned on 1 June 1974 in the Executive Branch of the Indian Navy as a fighter pilot. During his distinguished service spanning over 38 years, he has served in a variety of Command, Staff and Instructional appointments. A qualified Flying Instructor, he has over 2700 hrs of flying on 18 different types of aircraft, majority of which was on the Sea Harrier from the aircraft carriers INS *Vikrant* and *Viraat*. He has commanded both Sea Harrier Squadrons and Air Station INS *Hansa*, at Goa. His sea commands include ICGS *Ranjindan*, INS *Saryu*, INS *Shakti* and INS *Delhi*. In the Flag rank, Admiral Sinha has held a wide array of appointments such as Flag Officer Naval Aviation (FONA), Assistant Chief of Naval Staff Air [ACNS(Air)], the Flag Officer Commanding Western Fleet (FOCWF) and Controller Personnel Services (CPS) before taking over as the Chief of Integrated Defence Staff to Chairman, Chiefs of Staff Committee (CISC).

In that latter position Vice Admiral SPS Cheema has been appointed as Chief of Integrated Defence Staff to Chairman, Chiefs of Staff Committee (CISC).

Visits of the Army Chief

Chief of Army Staff General Bikram Singh has made continuous visits to key Commands and Corps during August. At Western Command, he reviewed operational preparedness of the Western Army and interacted with senior formation commanders. The Army Chief had earlier visited South Western Command at Jaipur, where he focussed on “the external and internal challenges facing the Army and collective efforts required in overcoming the same through a sense of commitment and professionalism”.



On 9 August 2012, General Bikram Singh, along with Western Army Commander Lt Gen Sanjiv Chachra visited XI Corps to review the operational preparedness and was briefed by the Corps Commander and interacted with other senior officers. He expressed “satisfaction on the state of operational readiness.” “While addressing all officers in station, he emphasised on the



“requirement of maintaining the highest standards of operational preparedness and discipline.”

General Bikram Singh later made a three-day visit to Ladakh on 17 August 2012, where he was received at Leh airfield by Army Commander, Lt Gen KT Parnaik, Northern Command and XIV Corps Cdr Lt Gen Rajan Bakshi.

The COAS also visited the Siachen Base Camp and forward posts in Eastern Ladakh during second day of his visit to Ladakh and was briefed by the formation commanders, then also flew over the line of actual control and Siachen Glacier on the eastern Karakoram Range.

Defence offsets policy “eased”

With defence offsets policy planned to bring \$30 billion into the domestic industry over the next decade, the Government of India has further eased defence offsets norms to recognise technology transfers by global arms firms as eligible for discharge of offset obligations. Defence offsets, first promulgated through the Defence Procurement Procedure (DPP) of 2006, makes it mandatory for global defence companies winning Indian contracts worth over \$60 million to invest back 30-50 per cent of the deal in the domestic defence industry, thus aiming to energise the defence sector within the country.

The revised DPP has eased the direct defence offset norms to include civil aviation, homeland security and related capacity building to be eligible for discharge of obligations. Offsets in defence purchases are common among many nations buying weapons from foreign sources. "The revised policy recognises TOT as eligible for discharge of offset obligations," as per the revised Defence Offsets Guidelines (DOG) approved by Defence Minister AK Antony-led Defence Acquisition Council. The DOG believes that the objective of defence offsets has been spelt out clearly in the revised policy. "Key objectives of the defence offset policy is to leverage capital acquisitions to develop Indian defence industry by fostering development of internationally competitive enterprises, augmenting capacity for research, design and development related to defence products and services and also encouraging development of synergistic sectors like civil aerospace and internal security."

Delivery of Air India's first 787 Dreamliner

On 6 September 2012, Air India's first Boeing 787 Dreamliner flew into Santa Cruz Airport at Mumbai. "Today is a great day for Air India as the most technologically advanced and fuel efficient airplane in the world joins our fleet," said Rohit Nandan, Air India Chairman & Managing Director. "The 787 will allow



Air India to open new routes in a dynamic marketplace and provide the best in-flight experience for our passengers."

Air India is the fifth airline in the world to take delivery of a 787 Dreamliner and this delivery is the first of 27 Dreamliners for Air India. The airliner is equipped with 18 business-class seats and 238 economy-class seats and has the range and capability to allow Air India to deploy the Dreamliner on many routes including to the Middle East, Europe, Asia and Australia.

Air India's first 787 Dreamliner was assembled in Everett, Wash. and delivered from Boeing's South Carolina delivery centre. The 787 Dreamliner features a host of technologies that provide "exceptional value to airlines and unparalleled levels of comfort to passengers". It is the first mid-size airplane capable of flying long-range routes, enabling airlines to open new, non-stop routes preferred by the travelling public.

49% foreign stake allowed in Indian Air Carriers

In a dramatic policy announcement by the Government of India on 14 September, foreign airlines can now invest a 49% equity stake in India's domestic carriers, a step that is expected to give a boost to cash-strapped airlines of India. The Cabinet Committee on Economic Affairs have approved the proposal which would pave way for much-needed equity infusion into India's airlines passing through acute turbulence as most of them are in dire need of funds for operations.

"The cabinet has approved the proposal of allowing foreign airlines to pick up to 49% stakes in Indian carrier. Though FDI of up to 49%, 75% and 100% was there in aviation sector, foreign airlines were not allowed," stated Civil Aviation Minister Ajit Singh. Current FDI norms allow foreign investors, not related to airline business, to directly or indirectly own an equity stake of up to 49% in Indian carrier.

Allowing foreign airlines to pick up stakes in Indian carriers has been a long-pending demand of the aviation sector. Most of the Indian carriers are suffering losses because of high taxes on jet fuel, rising airport fees, costlier loans, poor infrastructure and cut-throat competition. Except for IndiGo, all airlines have posted losses in the financial year ending on 31 March. Kingfisher Airlines, which is burdened with a debt of over Rs 7,000 crore, has been in the forefront of pushing for permission to allow foreign airlines to invest in domestic carriers, while Jet Airways and IndiGo have expressed reservations saying allowing global players in would lead to cartelisation and takeovers of Indian carriers.

The opening of the sector to foreign airlines may, however, bring good news for passengers who would benefit from more competitive fares, better product and services and better international connectivity. Foreign carriers such as British Airways and Virgin Atlantic Airways Ltd have reportedly expressed interest in investing in Indian carriers.

Air India's revival status "dismal"

Civil Aviation Minister Ajit Singh has said that the country cannot "wait forever" for Air India's revival and that the government does not wish to spend anymore public money to revive it. "It is difficult to spend public money anymore on Air India in the current economic scenario. There are other carriers waiting in the wings," Mr Singh said. He added that with no money coming, the airline must become competitive with the rest of the world at the earliest. The government had recently



Civil Aviation Minister Ajit Singh

announced a Rs 30,000 crore package for reviving Air India over a period of eight years, but subject to the airline meeting set performance indicators. "If they don't meet these standards, the government will not provide the money. This is precious public money," he emphasised.

The national carrier had suffered a loss of around Rs 600 crore due to the recent 58-day-long pilots' strike in May. The strike was called to protest the management's decision to train pilots of the former Indian Airlines to fly Boeing 787 Dreamliner aircraft.

The Minister lamented the financial and other crises facing the Indian aviation industry and added that the government is also carefully examining issue of the Kingfisher Airlines (KFA), which has been facing pressure to shut down its operations temporarily. "Until we address the safety issues concerning the airlines, we will not initiate any move," he said.

'Only 16 AI flights recovering costs'

Only 16 of Air India's 184 daily flights between April and June met total cost of operations and the national carrier's total accumulated losses since 2007-08 have crossed Rs. 28,000 crore. A route-wise analysis of AI routes have revealed that nine services were not even meeting fuel cost while 90 services were meeting fuel cost but not meeting cash cost. The aviation minister said 69 services were meeting cash cost but not meeting total cost while only 16 services "met total cost of operations."

"AI has completed integration of 74% processes and integration of 23% processes is in progress. The remaining 3% processes are yet to be initiated. Manpower integration is one of the important processes which is yet to be completed," Mr Ajit Singh said.

The employee-aircraft ratio in AI is 258:1. In order to rationalise manpower for achieving optimum utilisation of manpower resources and as part of turn around plan, the airline board has given in-principle approval to a voluntary retirement scheme for all permanent and confirmed employees.

Go Airlines and Lufthansa Technik in contract

Go Airlines (GoAir) and Lufthansa Technik have signed a 10-year component support contract, effective from August 2012, for the carrier's present and future fleet of 20 A320 classic and 72 A320neo aircraft. The contract covers most spare parts required for regular maintenance of A320 classic aircraft and will also cover the new A320neo fleet of GoAir which is expected to enter into service from 2016 onwards. The component support will be handled via the Lufthansa Technik Group network.

Spare parts shall be supplied to the airline's bases at Mumbai and Delhi. The contract also provides GoAir access to Lufthansa Technik's technical operations WebSuite, whereby both parties shall observe 'just-in-time inventory' management. This will enable further efficiency gains for both parties. The maintenance and repairs of the components will be done at Lufthansa Technik facilities. GoAir shall be supported by a dedicated customer support team in addition to Lufthansa Technik's general 24/7 AOG Desk.

SpiceJet posts 51% growth in revenues

SpiceJet has recorded a successful quarter that saw growth in passenger traffic and further increase in market share to 18.6% by 30 June 2012. Revenue for the first quarter ended 30 June 2012 increased by 51% to Rs 1407 crore as compared to Rs 931 crore of the quarter ended 30 June 2011.



SpiceJet has also returned to profitability after five successive quarters of losses. The average revenue per passenger in the quarter under review increased 24% as compared to the corresponding quarter a year ago. Load factor during the June 2012 quarter was 80.3% up from 78.9% during the same period last year. The airline currently operates more than 300 daily flights to 37 Indian cities and 3 international destinations, with a fleet consisting of 35 Boeing 737-800/900ER aircraft. Spicejet has also acquired 12 Bombardier Q400 aircraft for enhancing connectivity to Tier II and Tier III cities.

Lufthansa continues "upgrade-programme" in India

A few days after Lufthansa became the first airline to bring the all new Boeing B747-8 to India, the German airline officially inaugurated its brand new lounge at Delhi's International Airport on 13 August 2012. Offering "unparalleled comfort and style to Lufthansa guests", this first lounge in Asia designed according to the airline's new global design concept marks a major new investment benefiting passengers departing from India. The



generously spaced Lufthansa Lounge spreads across 3,767 square feet and seats 131 travellers. It is conveniently situated near the boarding gates in the main atrium of Terminal 3.

Lufthansa's new lounge concept includes enhanced design elements like poster walls and comforting accessories. The walls are designed with wing-view motives to give guests a feeling of sitting inside an aircraft. Specially manufactured designer furniture includes ergonomically designed lounging chairs in an exclusive area. On offer are complimentary hot and cold dishes and snacks and a beverage offer ranging from spirits and wines to fresh juices. Workstations and Wi-Fi internet create a comfortable work environment for those who want to catch up with their business before take-off.

Jet Airways and Lufthansa Systems in IT for flight operations

Jet Airways is expanding its cooperation with Lufthansa Systems by using the NetLine/Ops operations control system. According to a contract signed recently, Jet Airways will be working with the NetLine/Ops operations control solution, making it even easier for airlines to optimise flight operations control and respond quickly to irregularities, even if they occur on short notice. This kind of flexibility minimises fast-growing costs. NetLine/Ops is a component of the Integrated Operations Control Center Platform (IOCC) from Lufthansa Systems.



As Nikos Kardassis, CEO Jet Airways said, "On-time performance is a key differentiator for any airline. As a responsive, customer-centric organisation, it is critical that we handle any planned or unplanned deviation from schedule with minimal inconvenience to our guests. The selection of the state-of-the-art NetLine/Ops system from Lufthansa Systems for our Operations Control Centre will help us achieve this, and will enable us to deliver superior on time performance. The implementation of NetLine/Ops will further result in optimising our operational efficiency, resulting in overall organisational productivity." Lufthansa Systems has welcomed the expanded cooperation with Jet Airways. "We are proud that Jet Airways has decided for an additional solution from our portfolio. With Lido/Flight and NetLine/Ops, we will help our customer to strengthen its leading market position in India and play an even larger role internationally as well," said Dr. Gunter K uchler, Member of the Executive Board at Lufthansa Systems.

GoAir spreads services to Northern India

GoAir has introduced a new flight from Lucknow to Delhi and Mumbai from 21 August 2012 onwards. The flight schedule offers daily return product which is a part of GoAir's strategy to strengthen its position in North India and connecting it to major



cities in Eastern, Western and Southern part of India. Currently GoAir operates from cities in Northern India including Delhi, Chandigarh, Jammu, Srinagar, Leh, Patna and Jaipur. With this new service, GoAir's total flights to and from Lucknow amount to 42 per week, connecting onwards to Bengaluru, Kolkata, Goa, Ahmedabad, Pune, Srinagar and Nanded.

GoAir has the youngest fleet in the industry and a consistently high on time performance. It is the only low cost carrier in India offering a business class service which is particularly appreciated by corporate and SME customers. GoAir has recently entered into a contract with Germany-based and worldwide market leader Lufthansa Technik for maintenance and spare parts for its A320 fleet. Across the domestic market, GoAir services 22 destinations with 707 non-stop and over 2,000 connecting flights per week. It has a young fleet of 13 aircraft. Additional new aircraft will be added within the end of this financial year.

Forecast: 1,450 new airliners for India

It is estimated that India's commercial aviation fleet will grow more than 4.5 times in size over the next 20 years, according to the *Boeing 2012 India Current Market Outlook* released on 4 September 2012. "Over the next 20 years, airlines in India will need 1,450 new airplanes worth \$175 billion. Over 60 million passengers will fly within India this year. Over the next twenty years, the forecast passenger growth is expected to be driven by an underlying economy with long-term growth projections of twice the world average and supported by the continued economic prosperity amongst a growing segment of the large Indian population, higher discretionary incomes, business progress and easier access to airports."

The biggest demand for airlines in India continues to be for single-aisle airplanes such as the A 320 / A320 neo, Next-Generation 737 and new 737MAX. Globally, Boeing projects a \$4.5 trillion market for 34,000 aircraft over the next 20 years, driven by an increase in deliveries to India, China and other emerging markets. That forecast represents the traffic growing at 5.0 percent annual rate over the next 20 years and the world fleet is expected to double by 2031.

INS Arihant to commence sea trials

India's first indigenous nuclear submarine is being prepared for sea trials. The 6,000-ton INS *Arihant* ('Destroyer of Enemies') was unveiled in 2009 as part of a project to construct five such



vessels which would be armed with nuclear-tipped missiles and torpedoes.

"*Arihant* is steadily progressing towards operationalisation, and we hope to commence sea trials in the coming months," stated outgoing CNS Admiral Nirmal Verma. "Our maritime and nuclear doctrine will then be aligned to ensure that our nuclear insurance comes from the sea". *Arihant* is powered by an 85-megawatt nuclear reactor, can reach 44 kilometres an hour (24 knots) and will carry a 95-member crew.

Admiral Verma also stated that 43 warships were currently under construction at local shipyards while the first of six *Scorpena* submarines under contract would join the Indian Navy in 2015, sixth by 2018. The Navy is also poised to induct eight Boeing long-range maritime reconnaissance P-8I aircraft from 2013.

Naval Air Station at Campbell Bay

The Naval Air Station at Campbell Bay on Great Nicobar Island, was commissioned as Indian Naval Ship *Baaz* by Admiral Nirmal Verma, then COAS on 31 July 2012. INS *Baaz*



is situated at a distance of about 300 nm from Port Blair and is the southernmost air station of the Indian armed forces. INS *Baaz* is currently equipped to operate aircraft capable of short field operations from the runway of about 3500 feet. Runway will be progressively lengthened to enable unrestricted operation of all category of aircraft including heavy aircraft. The base will also be bolstered with modern airfield instruments and navigation aids.

Speaking on the occasion Admiral Nirmal Verma said that "the archipelago, separated as it is by more than 650 nm from our mainland, offers a vital geo-strategic advantage to India. Not only do they provide the nation with a commanding presence in the Bay of Bengal, the Islands also serve as our window into East



and South East Asia. They also sit astride some of the busiest shipping lanes of the Indian Ocean, most carrying strategic cargo for East Asian economies".

Admiral Nirmal Verma also stated that "Port Blair will be home to amphibious platforms, naval offshore patrol vessels and fast attack craft as the Navy's robust acquisition plans progress".

One of the primary functions of INS *Baaz* will be to provide information, based on airborne maritime surveillance. Admiral Verma added that airborne surveillance using Dornier 228s and UAVs remains invaluable to building Maritime Domain Awareness. The commissioning ceremony was attended by Lt Gen Naresh Marwah, (CINCAN) Commander-in-Chief Andaman and Nicobar Command and Vice Admiral Shekhar Sinha, then (CISC) Chief of Integrated Defence Staff to Chairman Chief of Staff Committee.

Navy's Financial Information System inaugurated

On 11 August 2012, Defence Minister AK Antony dedicated the Indian Navy's Financial Information System (FIS) to the nation. Lauding the Navy's initiative as a major step forward in the field of financial management Antony hoped the "other two services and all the other departments of the Government of India will follow this timely and useful initiative of the Indian Navy."

The Defence Minister urged for "judicious utilisation" of the nation's fiscal resources, stating that despite a gargantuan budget of almost 200,000 crore, "we will not be able to find resources as per the aspirations of the armed forces fully." He stressed this aspect saying "Every rupee that we get from the Indian Tax payer we must utilise properly, effectively, and as per priority."

He went on to state that the FIS "is another step in the series of measures to bring about more probity, accountability and transparency in our public dealings and financial transactions."

Earlier at the function, the Vice Chief of Naval Staff Vice Admiral RK Dhowan confirmed that the Indian Navy had fully utilised its allocated budget for the last six years. The Indian Navy has consistently maintained a healthy ratio of capital budget to revenue budget. For the year 2012-13 the budget allocation for the Indian Navy stands at 68:32 for capital: revenue budget.

Requirement for Naval Barak-1s

According to New Delhi-based sources, the MoD has “withheld” the Navy’s case for additional Barak-1 anti-missile defence (AMD) systems, already fitted on 14 frontline warships, including aircraft carrier INS *Viraat* and three new *Shivalik*-class stealth frigates. While the MoD has accepted the “critical operational urgency” for acquiring the 262 Barak-1 missiles at a cost of over \$140 million, it indicated that “the pending CBI investigation has stalled the case”.

The CBI investigation has not progressed over last six years, and the Navy may even be forced to seek fresh legal opinion. The Navy has curtailed even practice firings of the Barak-1 AMD systems integrated into the 14 warships as part of their “combat management systems”. The recent Naresh Chandra Committee report has held there is a need to relook at the entire process of “cancelling” arms contracts or “blacklisting” defence firms since this can prove counter-productive to the nation’s security.

The earlier NDA Government had finalised the initial Rs 1,160 crore deal for nine Barak-1 AMD systems, along with 200 missiles worth Rs 350 crore, from Israeli Aerospace Industries (IAI) and Rafael in October 2000. This was considered necessary to counter Pakistan’s acquisition of sea-skimming Exocet and Harpoon missiles after the indigenous Trishul AMD system failed to meet stringent requirement.



Subsequently, under the UPA-I government in October 2006, the CBI registered FIR in the Barak kickbacks case. While the “probe” lingers, the DRDO are developing long-range surface-to-air (LR-SAM) and medium-range SAM systems in collaboration with IAI. While the LR-SAM project to arm naval warships is worth Rs 2,606 crore, the MR-SAM for IAF is pegged Rs 10,076 crore. With effective interception ranges of 70-km each, their deliveries will begin from 2013 onwards.

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Indian Coast Guard Dornier 228 of CGAS 744 flies low over protesters wading in the water near the Koodamkulam nuclear power plant in Tamil Nadu on 13 September. Opposition against fuel loading of this nuclear power plant had earlier been dismissed by the Supreme Court of India but as protestors took to the sea in thousands, the TN Police and Coast Guard mounted vigil on land, water and air to prevent untoward incidents.

Commissioning of ICGS *Rajkiran*

Indian Coast Guard Ship *Rajkiran*, third of the series of eight Inshore Patrol Vessels (IPVs), was commissioned on 29 August 2012 at Vishakhapatnam by Vice Admiral Anil Chopra FOC-in-C Eastern Naval Command. The 50-metre indigenous IPV displaces 300 tonnes and can achieve a maximum speed of 34 knots, with an endurance of 1500 nautical miles at economical speed of 16 knots. Equipped with state-of-the-art weaponry and advanced communication and navigational equipment, it makes an ideal platform for undertaking multifarious close-coast missions such as surveillance, interdiction, Search and Rescue, and medical evacuation, the special features of the ship include an Integrated Bridge Management System (IBMS), Integrated Machinery Control System (IMCS) and an integrated gun mount with indigenous Fire Control system (FCS).

ICGS *Rajkiran*, which means "Royal Light", will be based at Haldia Coast Guard Region (North-East).

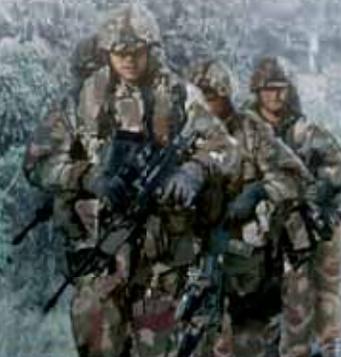
I-Day greetings from space

As she orbited earth on board the International Space Station, Indian-American astronaut Sunita Williams displayed the Tricolour and wished Indians on eve of the 66th Independence Day. "I wish India a very happy Independence Day for August 15... India is a wonderful country and I am

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very proud to be a part of India," she said in her message. "Of course, you know that I am half Indian. My father is from Gujarat. So, I am familiar with culture and customs of India. I am so proud to a part of this [Independence Day] celebration," Williams said, displaying India's national flag.

Sunita Williams along with Yuri Malenchenko of Russia and Japan's Akihiko Hoshide had left for the ISS aboard a Russian spacecraft Soyuz TMA-05M on 15 July from the Baikonur cosmodrome in Kazakhstan.

ISRO scores a 100

The Indian space programme attained yet another milestone with successful launch of the Polar Satellite Launch Vehicle (PSLV) carrying two foreign satellites from the Satish Dhawan spaceport at Sriharikota, in Andhra Pradesh on 9 September 2012. This is the Indian Space Research Organisation's (ISRO) 100th mission, which began with an experimental satellite called Aryabhata launched by a Russian rocket in April 1975. Incidentally, 2012 also marks 50 years of the start of the programme beginning with sounding rockets launched from Thumba in Kerala.

The presence of Prime Minister Dr Manmohan Singh to witness the launch reaffirmed the government's support to the agency. The PM said the launch was a "testimony to the commercial competitiveness of the Indian space industry and is a tribute to Indian innovation and ingenuity." He also brushed aside criticism about public expenditure on space exploration saying "a nation's state of development is finally a product of its technological prowess."

The launch firmly establishes PSLV as ISRO's workhorse rocket, which has had 21 successful launches in a row. Besides India's remote sensing and earth observation satellites, PSLV has launched 27 foreign satellites so far. The PSLV mission was purely a commercial launch carrying SPOT-6 satellite of EADS Astrium of France and PROITERES, a 15-kg satellite from the Osaka Institute of Technology of Japan. The 715-kg SPOT is the heaviest foreign satellite to be launched by the Indian space agency.



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Commissioning of ICGS 'Karaikal'

Coast Guard Station *Karaikal*, the fifth CG station on the Puducherry - Tamil Nadu coastline was commissioned on 25 July 2012. The station is part of ongoing efforts by the Coast Guard to strengthen coastal security and augment patrolling along the east coast along with preventing illicit activity such as infiltration and smuggling.



Coast Guard Station *Karaikal* will function under the administrative and operational control of Commander Coast Guard Region (East) through the Commander Coast Guard District Headquarter- 5 located at Chennai.

Flight test of Prithvi (P-II)

The DRDO-developed surface to surface Prithvi (P-II) missile was again flight tested on 25 August 2012 from Launch Complex III, Integrated Test Range (ITR) at Chandipur, the launch carried out by the Strategic Forces Command (SFC) as part of regular training exercises.

The Prithvi II, with a range of 350 kms, is India's earliest developed and inducted tactical ballistic missile. Guided by an accurate Inertial Navigation System (INS) and controlled by thrust vector and aero-dynamic control systems the missile impacted the predefined target in the Bay of Bengal with a high accuracy of better than 10 metres. The single stage Liquid Propelled Vehicle developed by DRDO, has been inducted into the Army and Air Force.



Lars-Olof Lindgren to lead Saab business in India

Mr Lars-Olof Lindgren has been appointed head of *Market Area India* from 1 December 2012. Former ambassador of Sweden to India, having held that position for five years before joining Saab, his experience and relationships with the Indian and Swedish governments and industries "will further reinforce Saab's

long-term commitment to the Indian market".

As Saab President and CEO, Håkan Buskhe said, "India has been identified to be one of Saab's most important markets and we look forward to welcoming Lars-Olof who, with his considerable experience of India, will enable us to contribute significantly to the country's defence industry, forge new relationships with the Indian private sector and build strong, collaborative partnerships. We are delighted that he will be leading the India team at a crucial juncture where we are looking at significantly scaling up our business in India."



According to Lars-Olof Lindgren, "Sweden and India's defence collaboration has reached an important phase where companies such as Saab have an important role to play. Swedish technology can play a vital role when India continues to develop an indigenous defence industry for the future, supplying both India and the Global market with advanced products. In order to accomplish this, we need to continue to forge relationships with Indian partners. I am proud to take on the role as head of Saab's business in the country. During my years as ambassador to India, I have followed Saab's efforts on this market with great interest. I look forward to be a part of this high technological global company which has been very clear with its increased ambitions in a number of different markets. It will be very interesting and stimulating to lead this work in India."

Saab MoU with Pipavav

Saab has signed a Memorandum of Understanding on strategic investment with the Indian company Pipavav Defence and Offshore Engineering Co Ltd., as also a Technical Partnership Agreement (TPA), which is continuation of an ongoing co-operation between the two parties and covers the format for further co-operation and relevant projects.

These agreements are a part of Saab's strategy to increase its presence in India, "an important and large market and offer business possibilities for several parts of the organisation". The MoU covers an investment by Saab of approximately MSEK 250 through a suitable structure, subject to all necessary approvals, during the coming months.

"Saab has a long-term strategy to grow in India and this new agreement is one important step in that direction," said Håkan Buskhe, President and CEO at Saab. Pipavav is today one of the strongest private players in the naval domain in India and has ambitions also in other defence areas. It therefore fits well into Saab's product portfolio".

The two companies had earlier jointly formed the *Combat System Engineering Group*, which analyses naval combat system design and architecture. The companies are also exploring next generation combat management systems for the Indian Navy and Coast Guard.

AgustaWestland

Mazagon Dock in JV with private shipyards

To enhance self-reliance in defence shipbuilding and producing state-of-the-art naval vessels “within the timelines and pricelines that are globally competitive,” the Government of India has issued guidelines for formation of JVs. Mazagon Dock Limited (MDL), the country’s premier warship building yard, has signed Share Holder Agreements (SHA) for setting up Joint Venture (JV) with private shipyards, Pipavav Defence & Offshore Engineering Co. Ltd. (PDOECL) Mumbai, and Larsen & Toubro, for construction of surface warships and conventional submarines respectively.

The joint ventures will “leverage strengths of the respective JV partners in the public and private sectors to work out a collaborative strategy for taking the nation towards self sufficiency in warship construction. MDL may further explore the feasibility of diversifying its product profile by entering into partnerships with other eligible leading shipbuilders as well.”

Saab implements National Automatic Identification System (NAIS)

Saab have implemented the *National Automatic Identification System (NAIS)* along the Indian coast line for the Directorate General of Lighthouses and Lightships (DGLL), which will also be used by Indian Navy, Coast Guard and DG Shipping. The National Automatic Identification System was inaugurated by Minister for Shipping, Thiru G.K. Vasana, at a formal ceremony in Chennai.

This *National Automatic Information System (NAIS)* provides coverage to entire Indian Coast, with 74 lighthouses now fitted with the Saab systems. Automatic Identification System (AIS) provides real time merchant traffic information and the web server allows access to live data over internet. The project comprised installation of sensors and equipments along the Indian coast for regional and national control centres. Saab has implemented the entire gamut of project which included installation, commissioning, training and support, along with their Indian partner, Elcome Marine Services.

Elcome Marine Services has partnered Saab in India for this project. Elcome has delivered the whole network, VSATs, leased lines, installation, project management, design, and installation. Elcome, with support from Saab, will be maintaining the system for 10 years.

HAL propellant tank for ISRO

HAL has delivered the first “fully indigenous” fourth stage propellant tank (PS4) of Polar Satellite Launch Vehicle (PSLV) to Indian Space Research Organisation (ISRO). “The indigenisation effort has resulted in foreign exchange savings of Rs 1.2 crores”, said RK Tyagi, Chairman, HAL. The PS4 tank is a part of the fourth stage of PSLV and will carry 1.6 tonnes of liquid propellant Mono-Methyl Hydrazine (MMH) as fuel and

Mixed Oxides of Nitrogen (MON-3) as oxidiser during the flight. The machining of all parts for this tank is carried out at HAL and the welding work carried out at Liquid Propulsion Centre of ISRO and HAL. This successful indigenisation has been achieved with of coordination amongst four government agencies HAL, BHPV, Midhani and ISRO.

GSAT-10 prepared for Ariane 5 launch

India’s GSAT-10 telecommunications satellite, which is one of the two payloads for Arianespace’s Ariane 5 mission in September 2012, underwent pre-flight preparations at the Spaceport in French Guiana, including a solar panel deployment test. This checkout step involves the extension of its multi-segment solar panels, validating proper operation before they are definitively stowed against the satellite in the final liftoff configuration. The test uses an overhead latticework that supports the solar panel’s weight, simulating zero gravity conditions of space as the panel opens to its full length.



GSAT-10 was developed by the Indian Space Research Organisation to meet the growing need for Ku- and C-band transponder capacity and will eventually become part of the Indian National Satellite (INSAT) system of geostationary spacecraft, representing one of the largest domestic communications satellite networks in the Asia-Pacific region.

Also included with GSAT-10 is the GAGAN (GPS and GEO augmented navigation) payload, which will support the Indian government’s implementation of a satellite-based regional capability to assist aircraft navigation over Indian airspace and in adjoining areas.

Agni-II missile test launched

An Agni-II IRBM with a strike range of 2000 km was launched on 9 August from Wheeler Island, conducted from a mobile launcher from the Launch Complex-4 of Integrated Test Range (ITR) and “all mission parameters were met during the trial of the indigenously developed missile.”

The Agni-II Intermediate Range Ballistic Missile has already been inducted into service and this was a “routine launch” carried out by the Strategic Forces Command (SFC) with logistic support provided by the Defence Research and Development Organisation. “The 2000 km range versatile missile, already inducted and part of countries arsenal for strategic deterrence, was launched as a training exercise by the armed forces,” according to a scientist from the DRDO. The two-stage missile equipped with advanced high accuracy navigation system, guided by a novel scheme of state of the art command and control system was propelled by solid rocket propellant system, he said.



BrahMos missile trials

Another BrahMos supersonic cruise missile was launched from the test range at Chandipur on 29 July 2012, the missile test fired from a ground mobile launcher from launch complex 3. While induction of first version of Brahmos missile system in the Indian Navy commenced from 2005 on INS *Rajput*, it is now also operational with two Regiments of the Army. Development of the air launched version and the submarine launched version of the missile system is in progress. Three Regiments of the Army will be Brahmos-equipped, the third to be deployed in Arunachal Pradesh.



DRDO awards for 2011

DRDO Awards for the year 2011 were presented to select scientists, industrialists, distinguished persons from academia and DRDO labs, at a recent function organised at DRDO Bhawan, New Delhi in presence of Prime Minister Dr Manmohan Singh, Defence Minister A K Antony and others. “We have to change our current bureaucratic system of administering scientific and technical departments, particularly if we have to inspire young scientists to participate enthusiastically in the task of building India into a scientific and technological powerhouse,” stated the Prime Minister of India, stressing on the need to attract and retain high quality scientific manpower in defence research and development. The DRDO awards are given every year to honour individual scientists and teams for their contribution in furthering DRDO’s efforts for self-reliance in developing cutting edge defence technologies.

Earlier, Dr Vijay Kumar Saraswat, SA to Defence Minister and Secretary, Deptt. Of Defence R & D reiterated DRDO’s commitment of providing “cutting edge defence technologies of world class standards to serve the operational requirements of the Indian Armed Forces and achieve higher levels of self reliance in defence technologies”. Dr Saraswat stated “the percentage of indigenous systems through the Acquisition route has significantly increased from the earlier 30% to almost 60%, thanks mainly to DRDO-developed weapons & platforms”, but underlined the importance of augmenting production capabilities.

Unveiling the roadmap, Dr Saraswat stated, “Our major goals for the year ahead include flight test of Interceptor missile for targets of 5000 km range-class, first flight of Nirbhay, our sub-sonic cruise missile, and first flight of an AEW&C system in India with all systems integrated. In the 12th Plan, we will launch a number of major programmes which will mark a paradigm change in force preparedness including SR-SAM for tri services, Pravira for protection of Critical Infrastructure, micro-nano satellites with Launch-on-Demand capability and G-SAT6 based Communication system.”



Dr K Tamilmani, Distinguished Scientist and Chief Executive, Centre for Military Airworthiness and Certification (CEMILAC), Bengaluru has been conferred with the DRDO *Technology Leadership Award* 2011. He received the award from the Prime Minister Dr Manmohan Singh on 31 July 2012. This is presented to “exceptional scientists for their valuable technological contributions and leadership qualities in the critical projects of National importance.”

“On-going strategic transformation”

VAYU Exclusive Interview with Air Chief Marshal NAK Browne, PVSM, AVSM, VM, ADC, Chief of Air Staff, Indian Air Force on eve of the IAF’s 80th Anniversary



VAYU: On eve of the 80th anniversary of the IAF, kindly give our readers an assessment of progress made in transformation of the air arm towards becoming a high-tech and well trained force in facing external challenges posed by the country’s potential adversaries.

CAS : The IAF today is confidently moving ahead on its growth path towards acquiring state of the art cutting edge technologies and our progress in this regard has been good. One must realise that our modernisation plan is a continuous process involving new inductions as well as upgrades of the existing platforms and equipment. We expect that this process will be completed by 2022. In addition, the skill enhancement of air warriors is another important focus area for us and we are proud of our accomplishments in this area. However, there is still a lot of ground to be covered and I am sure that we will be able to meet all emerging challenges confidently.

VAYU: Which are the priority areas in the IAF’s modernisation plans over the next five year plans, up to 2022 ?

CAS : IAF’s modernisation plan essentially flows out of the Long Term Integrated Perspective Plan (LTIPP 2012-27) of the Services, which is spread over the next 15 years. In principle approval has already been accorded to the LTIPP as well as the 12th Defence Five Year Plan. Our aim is to undertake a comprehensive capability enhancement plan which includes the upgradation of the combat potential of our fleet both in terms of numbers and lethality, upgradation of the Air Defence systems by induction of modern sensors and weapons as well as networking them, and enhancement of airlift and helilift capability to meet future challenges to our security. Emphasis is also being given to enhancing the quality of training by inducting modern trainers and simulators, and modernisation of the

operational and technical Infrastructure to provide the desired combat support.

Over the next five years, IAF plans to induct additional Su-30MKI, Light Combat Aircraft, Medium Multi Role Combat Aircraft, Very Heavy Transport Aircraft, Medium Transport Aircraft, Attack Helicopters, Heavy Lift Helicopters, Medium Lift Helicopters, Recce and Surveillance Helicopters, Light Utility Helicopters and Basic, Intermediate and Advanced Trainer aircraft.

VAYU: The IAF’s emphasis on ‘People First - Mission Always’ has been imbibed rather well. How exactly has this impacted on multi discipline training and skill enhancement ?

CAS : The IAF vision statement ‘People First Mission Always’ underscores the fact that the man/woman behind the machine is the ‘pivot factor’ that will eventually decide the outcome of any operational endeavour. Renewed emphasis on the empowerment of our air warriors, stems from our on-going strategic transformation wherein it is absolutely essential that the technology leap is ably exploited by a set of professionals who can derive the maximum advantage in any prevailing operational situation. To achieve these desired levels of capability, a gamut of processes are required to be benchmarked spanning the functions of recruitment, training, concept development and administrative support, to name a few.

People-centric reforms and welfare processes are underway in the IAF to prepare the air warrior for the next-generation battlefield. A number of initiatives have been instituted for optimised resource utilisation and many more such initiatives would follow which address all the multifarious issues concerning our force empowerment.



Air Chief Marshal NAK Browne, Chief of Air Staff at his office in Vayu Bhawan on 26 September 2012.

IAI

VAYU : Selection of the Rafale as the IAF's MMRCA has largely been greeted with satisfaction notwithstanding competitor criticism. Do you expect that the contract can be finalised within the current financial year ?

CAS : The MMRCA programme is currently at the stage of contract negotiations with the vendor and the project is progressing well. The Contract Negotiation Committee (CNC) is presently engaged in discussions on technical issues, offsets, ToT, contract clauses etc with the vendor. The scope of MMRCA project is vast and we have to be very thorough with all the processes involved. The CNC is working hard to finalise the contract document, and the contract is expected to be finalised by the end of this financial year.

VAYU : Please comment on the progress made in upgradation programmes relating to the Mirage 2000, MiG-29, Jaguar and An-32, and the advantage there upon in keeping these 'legacy' types in frontline squadrons of the IAF for at least another two decades.

CAS : The IAF operates a capability mix of aircraft and equipment. Modernisation and upgradation are the ongoing processes as a part of our long term plan to maintain a high combat potential at all times. As a part of this plan, the Mirage 2000, MiG-29, Jaguar and An-32 fleets are presently being upgraded to enhance their combat relevance and meet the requirements of the future. All these platforms will remain with us for at least 30 more years!

VAYU : At what stage is the process of integration of the Su-30 MKI with the BrahMos air launched supersonic cruise missile ?

CAS : The technical feasibility of integrating BrahMos air version missile on Su-30MKI aircraft has been ascertained and Russian designers will be participating in the programme during design phase. The approval for the proposal is expected shortly by the Government and the contract will be signed with M/s BAPL thereafter, paving the way for the integration activities to commence.

VAYU : What are the long term plans for lighter fighters in the IAF's force levels? On one hand, the IAF is yet to induct the Tejas LCA Mk I, under development for the past 25 years and yet the IAF has upfront funded the LCA Mk II with there being virtually no progress over the past two years.

CAS : In view of the changed environment, envisaging the need for an extended reach, the IAF is now moving towards acquiring better, more reliable and potent weapon systems involving the latest generation combat aircraft. Towards this, we have now commenced procurement of aircraft like the Su-30 MKI and are looking at inducting the Rafale and the FGFA. Even though there have been some delays, the IAF plans to induct six squadrons of LCA by 2021-22. The first squadron is planned to be raised at Bangalore and will thereafter be stationed at Air Force Station Sulur. The LCA being a D&D aircraft developed indigenously had to go through a series of development, design and material modifications thereby leading to the delay. A lot of lessons have been learnt while going through this extensive process and accordingly the LCA MkII is planned to be equipped with a more powerful engine, for which the RFP has already been issued to GE for the GE-414 engines.

VAYU : Space is no longer for just benign and scientific research. What steps have the IAF taken to acquire commensurate technology to combat threats from hostile space-based weapon systems ?

CAS : Firstly let me reiterate that there are no space-based weapons. However, as we all know space has been and can be used as a medium of transition for SSMs to attack and address adversary's key installations. On this count, DRDO has successfully developed the requisite technology to safeguard the nation against such threats.

VAYU : Sunita Williams, an astronaut of Indian origin serving with NASA, has once again highlighted the inherent equality of women with men where attitude and determination are concerned. Is the IAF rethinking of inducting women as fighter pilots and potential astronauts in the near future?

CAS : The IAF is the only Service which has opened up all branches for induction of women as SSC officers except for fighter stream of Flying Branch. It is our considered decision not to permit women officers in the fighter stream as of now, and presently there is no rethink on this issue.

VAYU : What in your view have been the most memorable events in the annals of the IAF during the past two decades and what is your vision of the form and shape of the Indian Air Force at its centenary in 2032 ?

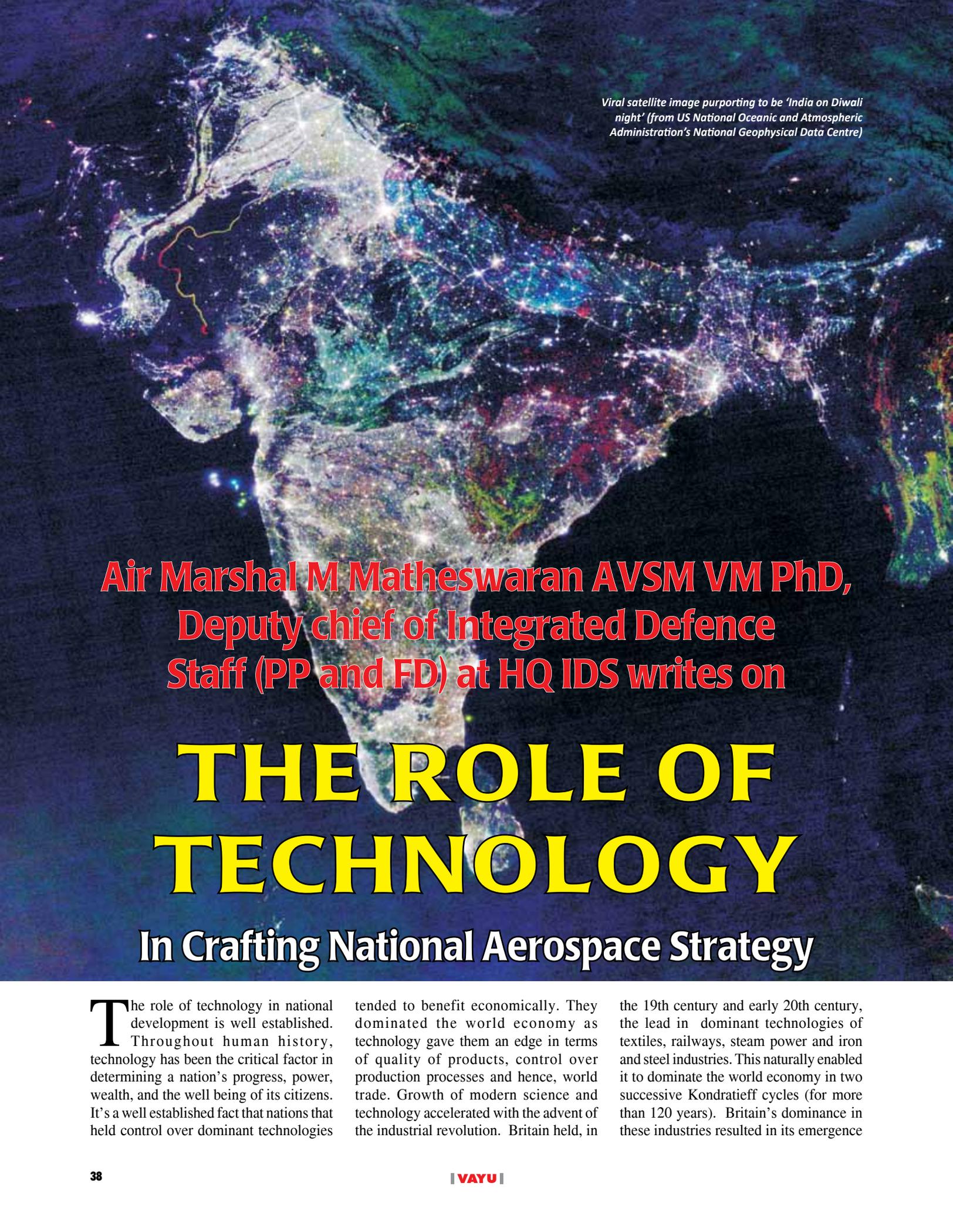
CAS : At the operational level, IAF's air operations during the Kargil conflict clearly stand out amongst our many other significant achievements. It showcased our ability to adapt, prioritise and deliver in a hitherto new operational environment. The images of the pinpoint LGB attacks on Tiger Hill by our Mirage aircraft as well as the destruction of main logistic node at Muntho Dhalo will forever remind us of IAF's professionalism and resolve. In the past two decades the IAF has made significant progress both in terms of upgrading our air combat potential as well as in empowering our people to prepare for the Air Force of tomorrow. On one hand we have inducted the Su-30, C-130, Mi-17 V5 combat platforms and on the other our air warriors have scaled Mount Everest, swam the English Channel and executed some daring rescue missions. The feeling of satisfaction earned while providing relief to our distressed countrymen during their times of need is indeed unmatched.

I am happy with our progress with regards to our transformation plan. As our nation grows economically and assumes a larger regional role, our national interests too grow correspondingly. By 2032, I envision an IAF which has multi spectrum, strategic capability and which can respond effectively to any challenge which our nation faces in the future.



The Air Chief being interviewed by Gp Capt JC Malik, Vayu's Executive Editor

Airbus Military



Viral satellite image purporting to be 'India on Diwali night' (from US National Oceanic and Atmospheric Administration's National Geophysical Data Centre)

**Air Marshal M Matheswaran AVSM VM PhD,
Deputy chief of Integrated Defence
Staff (PP and FD) at HQ IDS writes on**

THE ROLE OF TECHNOLOGY

In Crafting National Aerospace Strategy

The role of technology in national development is well established. Throughout human history, technology has been the critical factor in determining a nation's progress, power, wealth, and the well being of its citizens. It's a well established fact that nations that held control over dominant technologies

tended to benefit economically. They dominated the world economy as technology gave them an edge in terms of quality of products, control over production processes and hence, world trade. Growth of modern science and technology accelerated with the advent of the industrial revolution. Britain held, in

the 19th century and early 20th century, the lead in dominant technologies of textiles, railways, steam power and iron and steel industries. This naturally enabled it to dominate the world economy in two successive Kondratieff cycles (for more than 120 years). Britain's dominance in these industries resulted in its emergence

Elbit

as the world's most powerful empire in economic, military and technological terms. The most important result of the two world wars was the unleashing of the industrial and technological might of the United States. The USA took the lead in the 20th century in the dominant technologies of electricity, automobiles, chemicals, electronics, synthetic materials, and petrochemicals. Quite naturally, USA became the dominant power by the end of the Second World War. 20th century saw the emergence of new technologies in areas of nuclear science, aviation, space, computers and communications. While nuclear age that began with the demonstration of the atomic weapon, soon emerged as a major technology in power generation, medicine etc. It took nearly the entire 20th century for the other four technologies to mature and then drive each other resulting in their exponential growth. It also resulted in the emergence of information technology, which, in turn, has become the driver of all technological developments in the 21st century. Fusion of these sectors and their inter-dependencies have resulted in the phenomena of aerospace power and technologies. In effect, the beginning of the 21st century coincides with a new Kondratieff cycle wherein aerospace and information technologies are its dominant technologies. The USA is the world leader in these technologies but other countries would aspire to challenge the dominant power for obvious gains of trade, economy and military power.

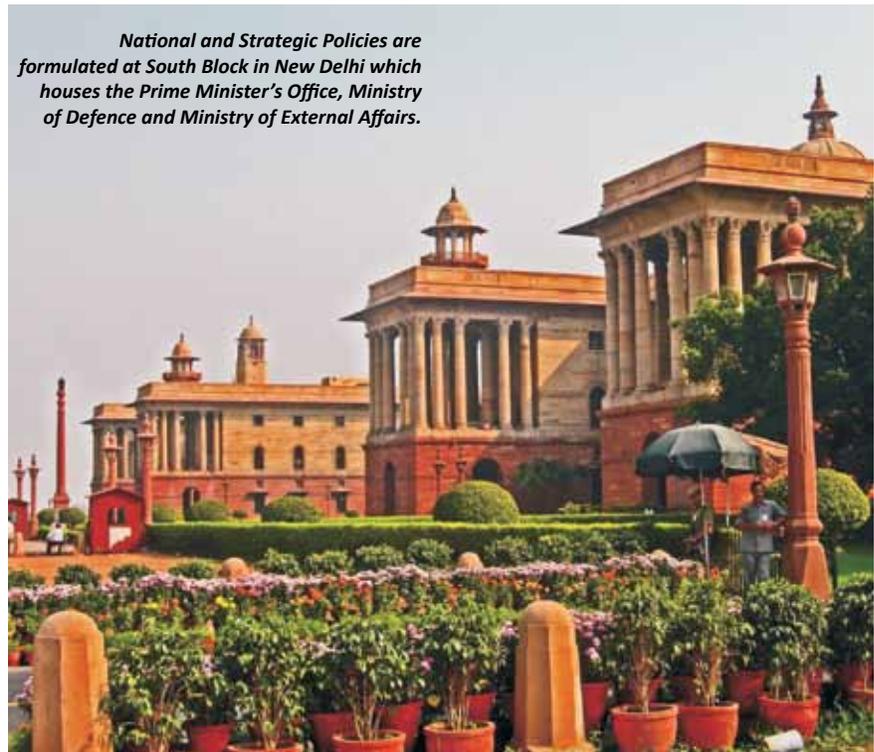
Rise of the Military Industrial Complex

Great Power struggles of the 19th century fueled the rise of military technology industries. Sweden's Alfred Nobel (guns and explosives) and Germany's Alfred Krupps (large calibre guns and barrels) pioneered military technology innovation and global dominance in their respective technology areas through high standards of manufacturing, production volumes and innovation. Ship building (including submarines), communications, reciprocating engines, petroleum, and finally aviation-followed suit giving a critical mass to defence technologies. Intense rivalry amongst the Great Powers, and flow of resources and wealth from their colonies fuelled this

explosive growth in defence industries. Diffusion of technology through trade and globalisation in Europe and America was a natural process. The two world wars and the resultant weakening and collapse of the European empires enabled USA to become the world's centre of gravity for military technology. Modern military industrial complex (MIC) gained momentum in the second-half of the 20th century largely due to the intense rivalry during the Cold War. Both USA and the Soviet Union embarked upon extensive research in various fields of aviation, space, computers, communications and many resultant sub technologies. These were the foremost technologies and, hence, consumed enormous investments in R & D. The spin-off effects into the civil domain were equally significant and enormous. The MICs contributed immensely not only to the economic might of the Super powers, particularly the USA, but more importantly to project power and preserve or enhance their areas of influence. When the integral need for

mid 20th century. As a result defence industries were in an exclusive domain. Developments in computers, aviation, and space technologies accelerated the innovation and digitization in these areas. The concept of dual use technologies was a natural development, and led to diffusion of civilian and military technologies. The result of this new technology dimension was the expansion and diffusion of the military industrial complex. Thus we now see industrial majors such as Boeing, GE, Mitsubishi, BAe etc functioning successfully in both military and civilian technology domains. This is particularly significant in aerospace sector. The economic success of MICs and their critical share in national GDPs are the primary reasons for many countries venturing to establish viable defence industries. However, establishment of a successful MIC needs implementation of a very deliberate technology strategy that would enable the nation to establish a large number of small and medium industries in the dominant technology of the day,

National and Strategic Policies are formulated at South Block in New Delhi which houses the Prime Minister's Office, Ministry of Defence and Ministry of External Affairs.

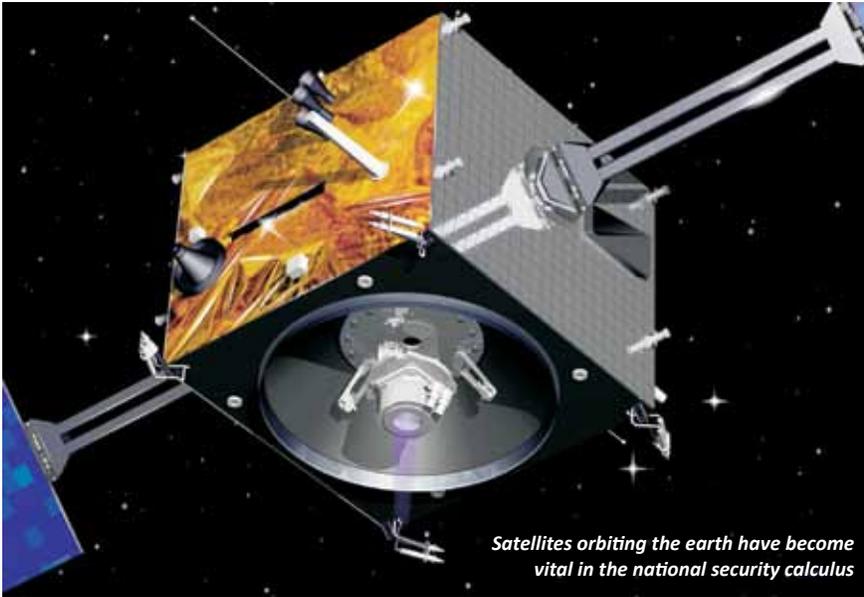


strengthening the economic linkages of the MIC was ignored by USSR it soon resulted in its collapse.

The division between military technology and technology for civilian use were clear and well defined until the

which is the domain of aerospace and information technologies. Countries such as Britain, France, Germany, Sweden, Israel, Brazil, and Japan have very vibrant aerospace industries that compete with the leaders – USA and Russia. Even countries

GE



Satellites orbiting the earth have become vital in the national security calculus

such as Australia, South Africa, South Korea and East European nations such as Poland have successfully broken into this fiercely competitive market. China, which lacked access to advanced technologies for a long time, has turned the corner. Having achieved rapid industrialization to become the world's workshop, China has leveraged its huge economic potential in the last twenty years to successfully plug the critical gaps in its aerospace capability. That there is a clear and deliberate national aerospace strategy in play is clearly evident.

Technology Denial Regimes

The concept of formalised technology denial mechanisms is a post-Second World War development. Demonstration of the nuclear weapon prompted the USA to look for measures to prevent its spread. Growth of dual use technologies led the Great Powers to devise mechanisms to ensure they remain within their control. Over the next three decades various instruments such as Wassenaar Arrangement, Nuclear Suppliers Group, Australia Group, and Missile Technology Control Regime etc were evolved to restrict the flow of technology and create monopolized technology denial regimes of developed countries. All developing and communist countries were denied access to these technologies thus impacting on not just their military capability and industrialization but their overall growth in economic, health and social spheres. India has been one of the most affected

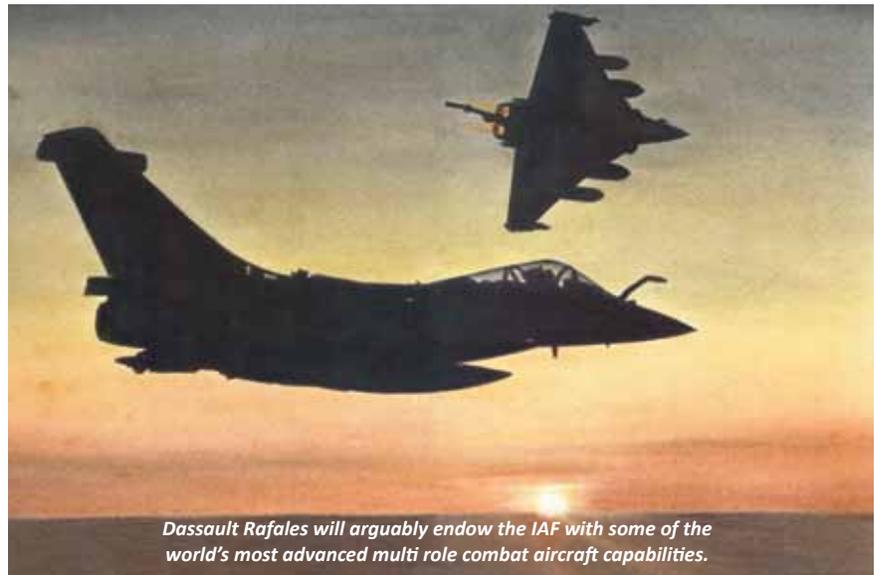
by the technology denial regimes and continues to be denied dual use technology in spite of positive developments such as the Indo-US nuclear treaty.

Relevance of Aerospace Technologies

Since the 1950s growth in Aviation and Space sectors has been exponential. This was assisted by equally rapid growth in Computers and Communications. The four sectors are interdependent and drive each other's growth. Effectively these form the core of aerospace technologies with resultant Information Technology as a critical element. Their development has also ushered in the knowledge age technology. In short it signals the end of the

Industrial age in the developed countries. That explains the shift of industrial age industries largely to countries like China, Brazil, South Korea, and to a limited extent to India. Missing out on knowledge age industries (aerospace sector) could be catastrophic as it could lead to permanent economic and technological dependency. As a result countries like India and China will necessarily have to follow a leapfrog strategy to acquire and master critical technologies. This will need a very carefully developed technology strategy that enables development of a large number of SMEs in the private sector, while major houses or system integrators could be from combinations of private and public sector industries with significantly large proportion in the private sector. China's governance system makes it easier for it to implement the centralized strategy as is evident. It will need far greater effort and the involvement of many organizations, agencies and ministries to craft a national level aerospace strategy for India. Examples of the success of a well defined strategy in India is already evident in areas of Space and Atomic Energy. ISRO and DAE, operating in an environment of extensive and strong denial regimes, have been able to achieve significant successes essentially because of clarity of purpose, unfettered access to funds and freedom to follow their strategy. They have been able to achieve very efficient return on investments.

The importance of aerospace technologies now transcends military



Dassault Rafales will arguably endow the IAF with some of the world's most advanced multi role combat aircraft capabilities.

Boeing

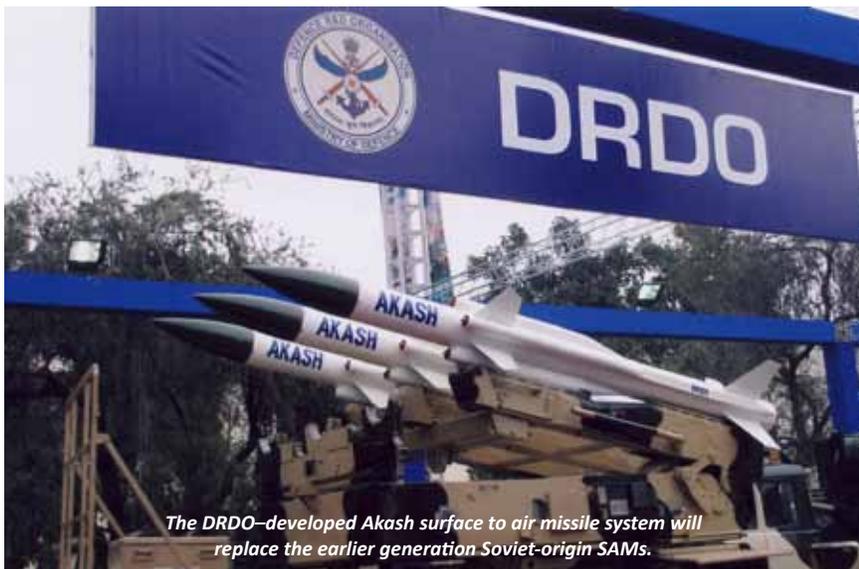
domain and is far more relevant in the civilian sector. These are critically relevant in a host of applications; navigation in space, air, land, and sea based vehicles; communications, entertainment, remote sensing, oceanography, meteorology, construction, town planning etc. Design and development depend on a host of aerospace applications for efficient execution. Policies and strategies, therefore, will have to factor leapfrogging strategies to achieve mastery over critical technologies such as aero engines, radar systems, sensors, control systems, algorithm development, material engineering, avionics etc.

Aerospace Power and Indian Armed Forces

The first effective example of joint operations by ground forces and air forces

of airpower in modern warfare; whether in air, space, land or sea was established unambiguously.

The Indian Armed forces have recognized the critical relevance of aerospace power in the national security calculus. While the IAF, in particular, and the other two services have focused on enhancing their war-fighting capabilities through appropriate modernization plans, thought needs to be given to the need of anchoring these capabilities firmly in the Indian industrial and technological capabilities. The IAF as the prime proponent of aerospace power has transitioned into the 21st century aerospace technology era in a smooth manner. It has demonstrated the fastest operationalisation of new capabilities such as aerial refueling and AWACS as



The DRDO-developed Akash surface to air missile system will replace the earlier generation Soviet-origin SAMs.

was in the early 1930s when the Luftwaffe operated the newly built Stuka bombers in conjunction with the ground forces in Spain. They employed it to perfection in 1939 in the Blitzkrieg against Poland, and in their masterful exhibition of combined arms tactics, using armour and airpower, against France and the Low Countries. The Gulf War of 1991 demonstrated a host of new aerospace technologies inclusive of precision weapons, sensors and night operations; vital dependency on space for communications, intelligence, command and control; vast computing and processing capability to address an overload of information, and all this contributing to provide a near real-time situational awareness. The dominant role

compared to the other leading air forces. The IAF is already a force that is network-centric, precision intensive and well on its way to create significant expeditionary capability. Post 2020 the IAF's main fighters will be the FGFA, Su-30 MKI and the MMRCA. These will form the backbone of IAF's offensive capability while the indigenous LCA, along with older Jaguars and Mirages will form the tactical component. Similarly IAF's airlift capability will be quite significant with C-17, C-130, ALH, MLH and HLH becoming the main stay. Similarly, Indian Navy's aerospace capability would have gone up by many notches through operationalisation of its aircraft carriers, LRMR aircraft, and the naval version



of the indigenous LCA. Indian Army's aviation corps would revolve around a large number of armed ALH and the LCH. Air defence modernization involves acquisition of a large number of radars and missile systems for all three services. Space has become a vital centre of gravity for all three services as they increasingly depend on it for communications, intelligence, and a host of allied services. By 2020 the IRNSS (Indian Regional Navigation Satellite System) would be fully operational, thus making the armed forces fairly independent of the GPS or GLOSNOS.

National Aerospace Capability

While the military aerospace power of the country is quite potent and in consonance with the country's stature as an important global player, the fact that much of this power is import dependent is a matter of concern. India's aerospace infrastructure is almost exclusively in the public sector. Having started from scratch, the government was right in initially creating the public sector units like HAL to meet our requirements through license production. However, the absence of a strategy or policy to encourage private industries in the aerospace sector and the inability to create a competitive environment has led to serious technology voids. Since the Public Sector Units have focused almost entirely on license production and have had the armed forces as their captive markets, they did not find

the need to benchmark their products to international quality. Besides, as the PSUs followed a cost plus format which ensured that they always made profit irrespective production quality and efficiency, the economic viability has never really been questioned or analysed.

It is only in the last decade or so that the private sector has been encouraged to venture into defence industries, aerospace in particular. However, the results have not been very encouraging so far. The reasons are many and some of them are listed below:

- ★ Absence of genuine competition is major flaw. DPSUs have invariably been nominated for various projects in preference to the private sector. This is a serious demotivating factor.
- ★ Policy of not allowing defence exports has had a severe impact on technology development in the country. Firstly, DPSUs focused only on internal requirement where volumes have never been high enough to invest on some of the high tech machines and tools for design and production. This implies that some of the high-tech production processes are never mastered by the country. Secondly, it has had a negative impact on quality control and production efficiency. IAF has consistently had problems with HAL on issues of quality and timely delivery. HAL's products are not of international quality, a result that flows from its culture that lacks export orientation. Inability of HAL to sell the ALH anywhere in international market is proof of this serious flaw.
- ★ The industry often complains about the lack of a level playing field when pitted against the PSUs. There is a significant element of truth in this complaint. But more importantly the absence of a culture of innovation in the DPSUs stem primarily from their lack of competitive experience and union mindset.
- ★ Indian private sector is quite reluctant to invest in aerospace sector which is capital intensive. There is a lack of genuine R&D culture in the private sector. Aerospace industries' capital intensive characteristic and its need for long gestation period should be well understood in order to bring about realistic appreciation of project



Even though HAL has over 60 years of design & development experience on basic training aircraft, and had proposed the HTT-35 turboprop trainer in the early '90s, lack of strategy has resulted twenty years later on the import of similar aircraft to meet the IAF's urgent requirement for a basic training aircraft.

requirements. These issues could be addressed only through a global outlook and export orientation.

- ★ Aerospace capability needs the creation of a large infrastructure of small and medium industries (SMEIs). This needs a deliberate strategy.

While India has achieved significant successes in the Space sector, (mainly due to a focused strategy of ISRO), aerospace industry has suffered due to the absence of a clear strategy. India's Kaveri engine and LCA projects have encountered significant cost and time overruns. While some important capabilities have been achieved in the LCA (fly-by-wire being the most notable), it is still critically dependent on imports. Its critical equipment and material such as the engine, radar, weapons, sensors, carbon fibre for its composite

wings, its unique actuators etc are all imported. Similarly, the Kaveri engine, which has already overshot time and cost estimates, has a long way to go for its completion. Indian industry is seriously deficient in its ability to make hi-tech components for various weapon sensors. Indian IT industry is yet to realize its full potential in the hi-end defence electronics. The primary reason is the reluctance to invest in capital intensive and long gestation period projects.

Need for National Aerospace Strategy

The need for a national aerospace strategy has never been more acute than now. The debate, however, is quite old. The need for a national aeronautics commission was articulated in the 60s and 70s. In



HAL's design & development bureau had worked on an advanced jet trainer to meet the IAF's requirement in the mid '80s but procrastination resulted in the project being abandoned and the similar Hawk AJT being imported two decades later.



With accumulation of leading edge technologies in the areas of composites, mission computers, and flight controls, the Aeronautical Development Agency (ADA) can well progress to the next generation Advanced Medium Combat Aircraft (AMCA), a model of which was displayed at the last Aero India Show.

1976 a committee under the chairmanship of the late C Subramaniam was set up to find a solution to this issue. It, however, never materialised as the organisations involved could not agree to a common framework. The result is that nearly 40 years down the line we do not have single major aerospace industry in the private sector. Large amount of investments have been made in the public sector but with little commensurate success. The critical deficiencies in the aerospace sector continue to exist. We continue to depend on imports for critical technologies even in indigenously made aircraft and weapon systems. Such deficiencies could only be addressed through a well planned national strategy. As a first step the strategy should aim to leverage our large purchases for accessing critical technologies. This

should be followed simultaneously by developing many system integrators and create a competitive environment. The core of the strategy should focus on development of a large number of small and medium industries in the aerospace sector, encouraging and assisting all methods such as start up companies, joint ventures, co-design and co-development ventures and 100% export oriented ventures. Companies should be encouraged to become economically viable in a globally competitive environment which necessitates benchmarking products for international market. Obviously, our policies governing export of defence related products need a thorough review. We could take a leaf out of the Japanese and South Korean models to address the issue of competitive aerospace industry



The Tejas Light Combat Aircraft programme has been extended far beyond even revised dates but the Mk.I is now close to initial operational clearance (IOC). Its two-seat operational conversion trainer version has great potential for export, as a cost effective and potent lead in fighter trainer (LIFT).

development. China, which had similar problems until recently, seems to have adapted the Japanese model successfully to plug the critical gaps in its aerospace capabilities. Most developed nations laid out their aeronautical development strategies quite early in the 20th century. The UK revised its old policies and released a revised aerospace strategy in the last decade. So has the European Union.

The strategy will need to address a final critical requirement, that of development of the right human resources. The quality of aeronautical engineering in the country is at best average to poor. It will naturally reflect in the quality of our research and development, industries, innovation and entrepreneurship. Industries must be encouraged to invest in R & D, and support university projects and education in the aerospace sector.

It is quite evident that major powers of the 21st century will have to be air and space powers, in short aerospace giants. Almost all elements of aerospace technologies have dual use characteristics. The implication is quite evident – one is that mastery over these technologies will have immense economic and military benefits to the nation. It will also accelerate the social development the nation. The flip side is that these are hard to get technologies and will be heavily controlled through various denial regimes. India is an emerging power with a huge population and massive developmental and security needs that can translate into a huge market. Quite obviously we are large buyers of equipment and technology. We need to leverage this attractive market of ours to get access to the critical technologies. This will need a deliberate and well thought out national level aerospace strategy.

The visible power and military cutting edge of India's aerospace capability resides in the IAF, which celebrates its 80th anniversary on 8th October. This cutting edge capability needs to be linked to a strong national capability in aerospace technology. A larger holistic view needs to be taken to develop this capability through a well crafted national aerospace strategy.

(Based on lectures given by Air Marshal M Matheswaran at various Seminars.)

Continuing Transformation



The Indo-Russian FGFA programme is based on the Sukhoi T-50 prototype and will radically transform the balance of air power in South Asia from 2022 onwards.

of the Indian Air Force

The Indian Air Force is in the midst of major equipment renewal, which process involves the induction of several new advanced weapon and combat support systems that are likely to transform the IAF over the next decade. The IAF is additionally expected to address other problems, such as manning shortages, training shortfalls and organisational inefficiency which it currently faces, in innovative ways to transform itself into a much more potent and “able-to-deliver” force.

While no clear announcement of the IAF’s planned transformation exists in the public domain, it is possible to shed light on the direction being taken from media and open sources. The on-going transformation is aimed at developing the IAF’s capabilities, which is not necessarily aimed at any other country, but rather to make it capable of delivering what is required of it. Given the very nature of air power and seeing the track record of the IAF since its inception in 1932, the question is not “if” but “how,

and at what pace”, the IAF will transform over the next five to ten years.

The Union War Book tasks the IAF with the Air Defence of all Indian territories. It is towards this responsibility that the IAF is in the process of inducting modern Surface-to-Air Missiles (SAMs), such as the indigenously designed and built Akash to replace older Soviet-era Pechora and Osa-AK SAM systems. Further, the collaboration with Israel towards developing a variant of the existing Barak SAM to meet the IAF’s Medium Range SAM (MR-SAM) project



The IAF’s fleet of 6 Jaguar squadrons is being upgraded to DARIN III standards and the type will continue in service for the next twenty years.



The indigenous Akash SAM will replace legacy Russian types, such as the Pechora and Osa-AKM.

continues. This system should see induction within the next five years in parallel with increasing numbers of the 25 km range indigenous Akash SAM. Induction of at least four more Aerostat radar systems imported from Israel should also be completed within the next five years in view of the acceptable performance of the first two such systems purchased by the IAF. In addition to imports of aerostat radars from Israel, a simultaneous induction of indigenous Aerostat systems designed and built by the Defence Research and Development Organisation (DRDO) should also commence in five years and lead to about eight to ten such indigenous systems being in service ten years hence. These aerostats could, it is expected, be supplemented by larger numbers of indigenous *Rohini* and *Reporter* ground-based radars.

The current fleet of three A-50 Phalcon AWACS could be expected to increase to a total of five such aircraft within the next five years. Starting at about three to four years from now, the DRDO-developed indigenous EMB 145-based AEW&C platform should start to enter service, increasing to six such platforms in the next ten years. The radar network (ground and air based) and SAMs would be backed by an air defence aircraft force

comprising of primarily the Tejas LCA aircraft supplemented by a few MiG-21 Bison (its phasing out will begin seven to ten years from now) and MiG-29 upgrade aircraft. A limited number of Su-30MKI and Rafales could also be expected to be assigned for air defence duties depending upon the situation.

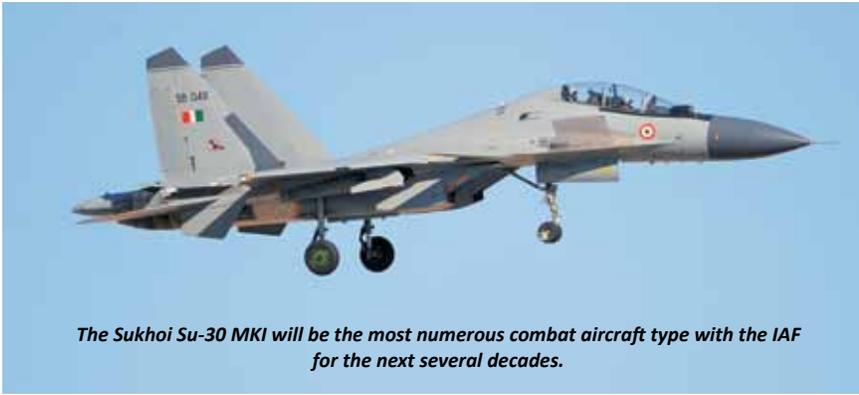
In ten years time, the indigenous ballistic missile defence (BMD) system based on the Swordfish radar (a modified and enhanced partially indigenous Active Electronically Scanned Radar [AESA]

radar derived from the imported Israeli Green Pine radar) and the Prithvi and Advanced Air Defence (AAD) missiles should be approaching initial operational capability (IOC) in parallel with possible inductions of Israeli Arrow and/or American Standard Missile (SM)-III systems in smaller numbers. The BMD capability should be able to protect vital areas of the hinterland as well as forward based forces against known Pakistani and Chinese ballistic missiles on minimum energy, lofted and depressed trajectories.



Aerostat radars will close the gaps in surveillance of airspace along Indian borders.

Dassault



The Sukhoi Su-30 MKI will be the most numerous combat aircraft type with the IAF for the next several decades.

Evolving Shape of the IAF

The aircraft fleet of the IAF is likely to undergo major changes as well. The Su-30MKI, numbering about 270 aircraft, would continue to form the high and heavy end of the fleet. The low end would be comprised of the Tejas LCA which, by then, would be in final operational clearance (FOC) configuration. The

current three squadrons of MiG-29 would be well into their upgrade and would be available in upgraded form about five years hence. Likewise, the three squadrons of Mirage 2000H would also be available in upgraded form in a similar timeframe, as would six squadrons of Jaguars.

The rotary wing fleet should retain the same inventory more or less with the



Scenes like this, with an IAF Mirage 2000H in formation with a USAF F-15 during air exercises, will become increasingly familiar in the near future. The Mirage 2000s are currently being upgraded and will remain in frontline service for another 20 years.



The Tejas LCA Mk.I should reach FOC by 2015 and equip two squadrons while the Mk.II would add to this force after several years of further development.



The present fleet of A-50 Phalcon AWACS will be augmented by additional aircraft complemented by DRDO-developed AEW&C platforms, becoming a key force multiplier for the IAF.

most significant changes being the entry of larger numbers of Dhruv Advanced Light Helicopters (ALH) as well as upgraded Mi-8/17/17-1V/ 17-V5. In addition, the Light Combat Helicopter (LCH) will be inducted starting about five years hence in parallel with Apache Longbow-III attack helicopters.

In the fighter category, the most significant change should be completion in development of the Indian Fifth Generation Fighter Aircraft (FGFA) from the Sukhoi T-50/PAK FA baseline by the end of this decade and the commencement of induction of FGFA into service starting about ten years hence against a total order of 200 or more. Older aircraft types would be retired in a phased manner so that the available numbers of aircraft



The large force of Mi-17 V5 helicopters will bolster the IAF's tactical airlift capability.

to the IAF does not fall excessively until the force level required has been built up with new inductions. This could see the MiG-21 Bison, MiG-29 and Mirage 2000 upgrades continue in service well into the 2020s, with carefully staggered phase out of these fleets commencing from 2025.

The IAF's airlift capability would also be considerable as, in the next five to ten years, all 16 C-17 Globemaster III aircraft and a total of twelve C-130Js would be in service and be supplemented slowly with the Indo-Russian collaboratively developed Multi-role Transport Aircraft (MTA). The Il-76 should be commencing retirement from service about the same time as would the considerable force of An-32s.



Boeing's C-17 Globemaster III heavy airlifter will greatly enhance the logistic support of land forces along the high mountains and also be used for special missions.



The Barak 8 will be basis for the IAF's MR-SAM systems.



The DRDO - developed Astra BVR missile.

Weapon induction should also see a change with the indigenous Astra missile becoming the standard Beyond Visual Range (BVR) standardised across all IAF aircraft fleets in the next ten years. The short range close combat missile of choice is likely to be the Russian R-73 and its newer variants plus the Israeli Python 5. Once the Astra is in service, there could be indigenous development of short range close combat missiles either derived from it or developed independently. For precision attack, the Helina (an air launched variant of the Nag anti-tank missile) with an imaging infra red (IIR) seeker backed by an upgraded variant of the currently available algorithm able to discriminate targets including moving targets even in heavy clutter, should be the standard fit across all types of IAF aircraft. Indigenous Precision Guided Munitions (PGMs) with satellite navigation-laser designation/terrain matching/optical hybrid guidance systems developed indigenously should become available in the five to ten year period given that work on such weapons is being pursued, albeit at a slow pace, because these fall under unfunded private research at a few DRDO laboratories in the absence of firm IAF orders and sanction to develop such weapons.

MBDA

Network Centric Warfare Capabilities

Within five years, the IAF would have its proprietary AFNET network fully in place with enhanced encryption features implemented. The Integrated Air Command and Control System (IACCS) should also be ready with all its modules including encrypted jam resistant wireless component, thus giving the IAF fully networked war fighting capabilities. The data link system embedded in the IACCS architecture would enable high situational awareness for all war fighters and the battle commanders even at “remote from the battlefield” locations. The IAF would, in ten years, be moving towards dynamic targeting of ordnance. It would be in the process of developing capability to data link with, say a missile in flight, to reassign its target or modify its attack profile on the fly.

The IAF would be developing Two Stage to Orbit (TSTO) craft in consultation with and through the DRDO and ISRO, to ensure assured space access when required. Interest in micro-satellites for defence support tasks is also likely to increase in view of the fact that such small satellites can be launched by lower lift capability launchers or even from aircraft with suitably modified boosters at much shorter notice than heavy satellites. Such rapid satellite launch capability is likely to be crucial for a networked organisation to operate effectively. Ten years from now this project could be expected to be at the technology

demonstration stage. The IAF should also at this time be commissioning dedicated research into Directed Energy Weapons (DEW) at institutes of higher learning and research centres in the country.

Genuine Collaboration

There are a few salient features of the planned transformation of the IAF over the next five to ten years that merit attention, with the IAF moving towards advanced capabilities in platforms and systems.

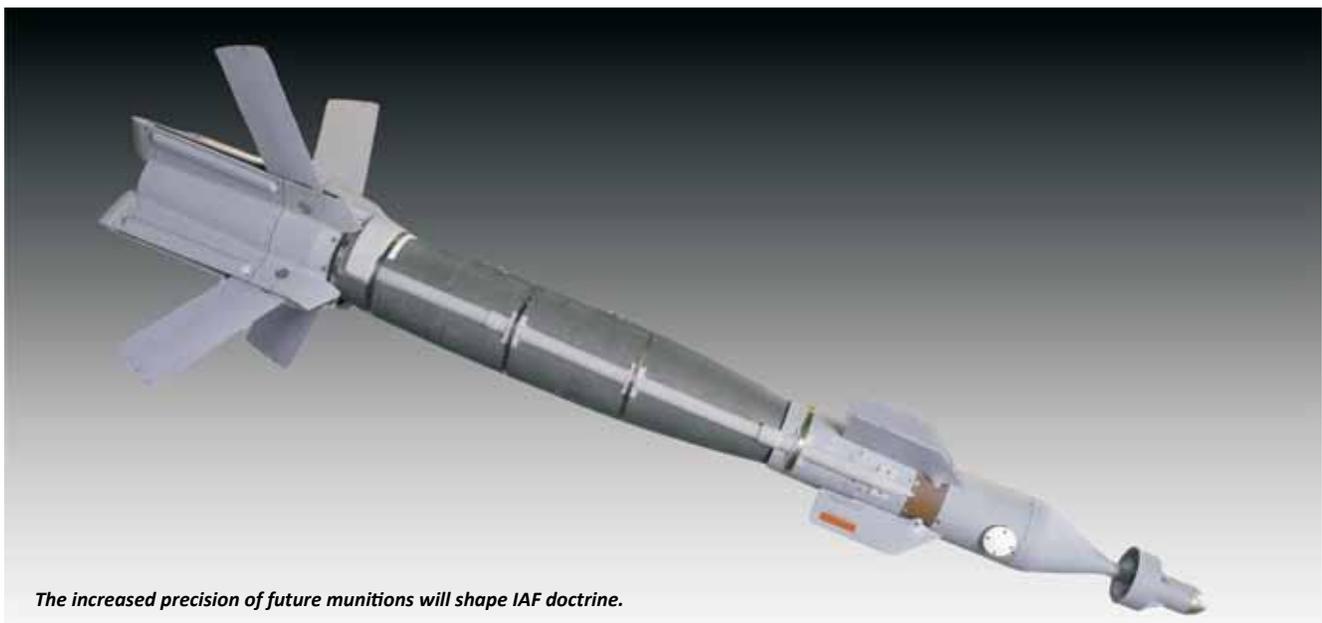
The focus is slowly shifting towards indigenisation, which will mean production of all major and crucial systems within the country. Between licensed production (which leads to obtaining “know how”), technology transfer, and “know why” (which leads to actual technology transfer and gains in design and development skills), the latter are being preferred. For instance, this aspect may have played a part in the choice of the PAK FA over the F-35 JSF offer from the US. The MTA, MRSAM and other projects also demonstrate a bias towards collaborative development rather than “buy and make” as seen in the MMRCA deal; this MMRCA licence manufacture agreement may have been found acceptable in view of the great time pressure to induct aircraft at the earliest given the currently falling numbers of fighters due to unplanned retirement of a few squadrons from IAF service.

Several high-end systems for the IAF have been developed totally indigenously in the public and the private sectors of the

Indian aerospace industry. These include the secure and encrypted pan Air Force wide area network (WAN), AFNET, IACCS, and the Advanced Command Air Tasking System (ACATS), to name a few. Other noteworthy indigenous systems in or about to enter service are the Reporter and Rohini radars, Tejas LCA, Dhruv ALH, LCH and EMB 145-based AEW&C system.

Purchases of defence and civil equipment from foreign sources are now accompanied with offset clauses varying from 30 to 50 per cent. Thus, there are great opportunities for foreign companies to enter into genuine collaboration with Indian players in the public and private sectors of the aerospace industry in India to design and develop new systems and platforms leading to a win-win situation for both sides, given India’s proven ‘frugal engineering’ and Information Technology (IT) skills. Just these two proven skills available in India justify the setting up of joint ventures (JVs) in the aerospace field by foreign technology giants with Indian companies, quite independent of bidding for any civil or military contract and its offset requirements.

Foreign governments and companies will require to shed their erstwhile “sell and maybe give a license to make” policy in favour of genuine from-the-ground-up collaborative design and development. A step in this direction has been made by the Indo-Russian Brahmos project. More than the original Brahmos project, this is more



The increased precision of future munitions will shape IAF doctrine.



Increased use of satellites will significantly add to the IAF's Integrated Air Command and Control System.

applicable to the new hypersonic variant of the Brahmos missile being developed jointly. The Indo-Russian collaboration for the PAK FA fifth generation fighter aircraft (FGFA) wherein India is partly funding a substantial part of the project in exchange for design involvement and development of a variant to meet India's specific needs is another tentative step in this direction.

Organisational and Structural Changes

The IAF is likely to resolve its current manning issues through the induction of women in all branches and jobs, while at the same time evolving a gender neutral short-service cadre that is assisted to find employment in other sections of the economy post-tenure. This would form a ready reserve force for recall during periods of hostility with a permanent commission cadre at its core. There is also likely to be greater emphasis on multi-skilling of personnel from the initial training period itself in order to improve upon productivity and efficiency of IAF manpower. The IAF should also be in the process of completing a re-organisation of its organisational structure and cadre to promote flexibility and efficiency while minimising costs.

The transformation of the IAF will, however, be dependent upon and be influenced by a few major factors:

- ✈ Growth of the Indian economy: only robust growth of the economy can ensure adequate funding for the various projects already sanctioned or awaiting final clearance.
- ✈ Fructification of a few long period indigenous technology development initiatives, especially in sensors and their integration.
- ✈ The geo-political scenario: an increased perceived threat of military confrontation with India's neighbours would spur on the programmes discussed above, while a benign security situation would lead to less urgency to build up capabilities rapidly. The latter situation may further result in other military or non-military programmes taking higher priority for allotment of resources, possibly leading to inadequate allotment of funds and consequent slippages in schedules for IAF's modernisation.
- ✈ Any serious natural disaster could potentially disrupt the transformation process both directly (through the impact of such a disaster on the laboratories, etc., involved in the work) and indirectly (through the need to re-prioritise the entire national effort and resources towards disaster alleviation efforts).
- ✈ A major unforeseen technology breakthrough in India or abroad that could make the entire transformation effort redundant.

The IAF's transformation process is likely to progress in the manner indicated above. It is important to note that true technology co-operation with foreign vendors who have access to advanced technology is likely to be the greatest challenge and opportunity for foreign as well as Indian companies operating in the aerospace field.

In effect, being a technology-dependent organisation, the IAF has been in a state of transformation for most of its existence. However, the speed of technological advancements has led to greater emphasis on its current transformation. This process, over the coming decade, appears poised to add to the IAF's combat potential in a major way through induction of advanced weapon and combat support systems. These changes span the induction of new aircraft, radars, and networking equipment to organisational and manning changes. All the aspects of this transformation share the common characteristic of being tailor-made to make the IAF more efficient and effective in execution of the tasks entrusted to it by the nation.

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FACE OF THE FUTURE



IAF's FGFA will be the world's most advanced fighter in first half of the 21st century.

Genesis

In the late 1980s, the then-Soviet Union outlined the need for a next-generation aircraft intended to eventually replace its MiG-29s and Su-27s in front line service. Two projects were proposed to meet this need – one from the Sukhoi design bureau and the other from Mikoyan (Article 1.44). In 2002, Sukhoi was chosen to lead the design for the new combat aircraft. The Tekhnokompleks Scientific and Production Centre, Ramenskoye Instrument Building Design Bureau, the Tikhomirov Scientific Research Institute of Instrument Design, the Ural Optical and Mechanical Plant (Yekaterinburg), the Polet firm (Nizhny Novgorod) and the Central Scientific Research Radio Engineering Institute (Moscow) were selected shortly thereafter for the development of the avionics suite of fifth-generation airplane. NPO Saturn is lead contractor for the engines.

As early as December 2005, the possibility of India joining the Russian fighter programme was being mooted (*Vayu I/2006*) and discussions between the two countries continued into the

following years. In August 2007, the then Russian Air Force Commander-in-Chief, Alexander Zelin, was quoted by Russian news agencies as saying that development stage of the PAK FA programme was complete and construction of the first aircraft for flight testing would begin. The prototype aircraft, with the designation T-50, first took flight on 29 January 2010. In December of that same year, shortly after Russian President Dmitry Medvedev's state visit to India, a memorandum of understanding for preliminary design of the Indo-Russian Fifth Generation Fighter Aircraft (FGFA) was signed between Hindustan Aeronautics Limited (HAL), and Russian companies Rosoboronexport and Sukhoi (*Vayu I/2011*). The contract called for the production of over 200 fighters for the Indian Air Force.

Programme Overview

The Indo-Russian joint-venture for the development of the PAK FA/FGFA will borrow heavily from success of the Brahmos project. The FGFA, according to the plan, will be different from the Russian PAK FA and specific to

Indian requirements. The variation is said to be similar in concept to the Su-30MKI programme, where the Indian aircraft differs from the baseline Russian Su-27/30 aircraft with the addition of a second seat, changes to the airframe and engines, along with a multi-national avionics suite.

Composites are used extensively on the PAK FA/FGFA and comprise 25% of its weight and almost 70% of the outer surface. It is estimated that titanium alloy content of the fuselage is 75%. Russian expertise in titanium structures will be complemented by India's experience in composites gained from the LCA programme. HAL plan to contribute largely on composites, mission computers, avionics and cockpit displays.

A total production of around 500 aircraft (both PAK FA and FGFA) is planned, with options for further aircraft available to both partner nations as well as other export customers. The Russian Air Force are projecting a requirement of 200 single-seat and 50 twin-seat PAK FAs while Indian Air Force is said to be considering 166 single-seat and 48

twin-seat FGFA. At this stage, Sukhoi is expected to carry out the bulk of production work for the programme, but HAL's work share is set to increase as the FGFA variant progresses, with aircraft destined for the IAF to be produced domestically.

Aircraft Design

Although essential information about the PAK FA/FGFA remains classified, officials from both countries have openly stated that it will feature stealth technology, the capability to supercruise, and incorporate advanced avionics such as AESA radar and automation systems to reduce pilot workload. It is to be outfitted with the next generation of air-to-air, air-to-surface, and anti-ship missiles.

The T-50 is superficially similar to the Lockheed Martin F-22 Raptor (the first, and currently the only production fifth-generation fighter) with a quasi-trapezoidal wing, leading edge extensions at the wing root and traditional control surfaces. Clearly these are design features that lend themselves well to low-observable fighters and Sukhoi has seen no reason to reinvent the wheel.

However, on closer examination, it becomes quickly apparent that there are significant parts of the Russian design that are unique. Instead of conventional rudders as on the F-22, the vertical stabilisers of the T-50 are fully movable. The wing root extensions feature unique vortex controllers that are likely to be useful both to generate lift and to aid manoeuvrability. Also of note is the large 'tail sting' between the engine exhausts, housing the brake parachute and a rearward-facing radar similar to the Phazotron N012 on the Su-35. The T-50 also incorporates an optical and infrared search-and-track system, which is probably based on the OLS-35 from the Su-35BM.

Judging by information made available since the programme's inception, it appears that the aircraft has been designed to be extremely agile in the air, at the cost of absolute stealth. However, Sukhoi's concern for minimising radar cross-section (RCS) is made apparent by the provision of two tandem main weapons bays in the centre fuselage between the engine nacelles. Each is estimated to be between 4.5-5 metres long. Bulged, triangular-section bays at the wing root augment the main bays.

Design changes to accommodate a second pilot for the Indian requirements for the FGFA are expected to create

significant challenges, not least of which will be maintaining the low RCS of the PAK FA design. Additionally, modifications to the life support system, wings and control surfaces will also be needed.

A second prototype aircraft joined the flight test programme in March 2011, with a successful 44-minute test flight. The first two prototype aircraft lack radar and weapon control systems. The third and fourth aircraft are intended to be fully functional and



Flight testing

The T-50's maiden flight took place on 29 January 2010, with the aircraft piloted by Sergey Bogdan, from KnAAPO's Dzemgi Airport in the Russian Far East.

more closely representative of the intended production standard. On 14 March 2011, one of the prototypes achieved supersonic flight at a test range near Komsomolsk-on-Amur in Siberia, and on 3 November 2011, the PAK FA programme achieved its 100th flight.

The test programme continues apace, with the third prototype taking flight in August 2012. This aircraft is the first prototype to be equipped with an AESA radar (likely a development of the Su-35BM's Irbis-E radar).

The fourth prototype is being prepared to join the testing programme later in 2012 or early in 2013. A total of 14 test aircraft are expected to be flying by 2015.

Armament

The PAK FA has a reported maximum weapons load of 7,500 kg. It has an apparent provision for a cannon forward of the starboard wing root, along with two main weapons bays estimated at 4.5-5 metres by 1 metre each. The main bays are supplemented with two small bays under the wing roots. It is expected that a large range of current and future Russian air-to-air and air-to-surface munitions will be cleared to function with the PAK FA/FGFA and its unique weapons bay layout.

In addition to being able to carry munitions internally so as to minimise radar return, the aircraft will also be able to carry weapons, avionic pods and fuel tanks externally should stealth be deemed low priority.

increase effectiveness against stealthy targets. According to Sukhoi, the radar will reduce pilot load and make use of a new data link to share information between aircraft.

Engines

The powerplants remain the most vague aspect of the FGFA thus far. Information on the engines is scant and often contradictory.



Radar

The PAK FA's radar complex is highly interesting. Along with the now de rigueur X-band AESA radar in the nose, the detection suite will also include L-band

radar antennae on the wing leading edges. Since most low observable aircraft are optimised against X-band frequency radars, the inclusion of long-wavelength L-band radars will

The initial test aircraft are powered by NPO Saturn 117 turbofans, a conventional design developed from the powerplants already installed on the Su-27 family of aircraft (including the Su-30MKI). However, it is expected that the final production aircraft will use engines similar to the variable-cycle AL-41F turbofans used on the ill-fated Mikoyan Project 1.44. A variable-cycle engine is said to be more complex to manufacture and maintain but yields significant advantages in thrust and fuel consumption across a range of flight conditions.

While the engines powering the present prototypes produce afterburner thrust in the region of 15,000 kgf (147,000 N), the production versions could go as high as 18,000 kgf (180,000 N) which would give the FGFA unmatched kinetic energy among all fifth generation aircraft types.

Together with immense thrust, the engines feature thrust vectoring and complex automation systems, to facilitate supermanoeuvrability. The engines will also incorporate infrared and RCS reduction measures.

PAK FA Specifications

[Data based on estimates from various sources]

Crew	: 1
Length	: 19.8 m
Wingspan	: 14 m
Height	: 6.05 m
Wing area	: 78.8 m ²
Empty weight	: 18,500 kg
Loaded weight	: 26,000 kg
Combat load	: 7,500 kg
Max. takeoff weight	: 37,000 kg
Powerplant	: 2 × AL-41F1 turbofans for prototypes, 147 kN (15,000 kgf) for prototypes; definitive engine to produce approx. 160+ kN (16,300 kgf) each with full 3D TVC
Fuel capacity	: 10,300 kg

Performance

Maximum speed	: Mach 2+, 2,100-2,600 km/h (1,300-1,560 mph) ; at 17,000 m (45,000 ft) altitude
Cruise speed	: 1,300-1,800 km/h (808-1,118 mph)
Ferry range	: 5,500 km (3,417 mi)
Service ceiling	: 20,000 m (65,600 ft)
Rate of climb	: 350 m/s (68,900 ft/min)
Wing loading	: 330-470 kg/m ² (67-96 lb/ft ²)
Thrust/weight	: 1.19
Maximum g-load	: 9+ g
Guns	: None on prototypes. Apparent provision for a cannon (most likely GSh-301)
Hardpoints	: Two main weapons bays, two auxiliary bays for short range AAMS, and six external hardpoints
Radar	: AESA N050 built by Tikhomirov NIIP. Presumably a development of Irbis-E designed for Su-35BM

The Indian Air Force and its FGFA

Given the close similarities between the Russian PAK FA and India's fifth-generation fighter aircraft (FGFA), most data remains common between the two types. However, the prototypes and testing presently underway are clearly representative primarily of Russian requirements. So what of the FGFA?

Air Chief Marshal NAK Browne, IAF Chief of Air Staff stated in August 2012 that "the first prototype of the FGFA is scheduled to arrive in India by 2014 after which it will undergo extensive trials at the Ojhar air base." A second prototype is expected to arrive in India in 2017 while a third would follow in 2019.

ACM Browne also mentioned that he was "hopeful that the aircraft would be ready for induction by 2022." This would be at the start of the 14th Five Year Plan.

The final phase of the agreement between India and Russia is set to be signed by early 2013, with India now appearing more likely to induct larger numbers of single-seat aircraft instead of twin-seaters as originally planned.

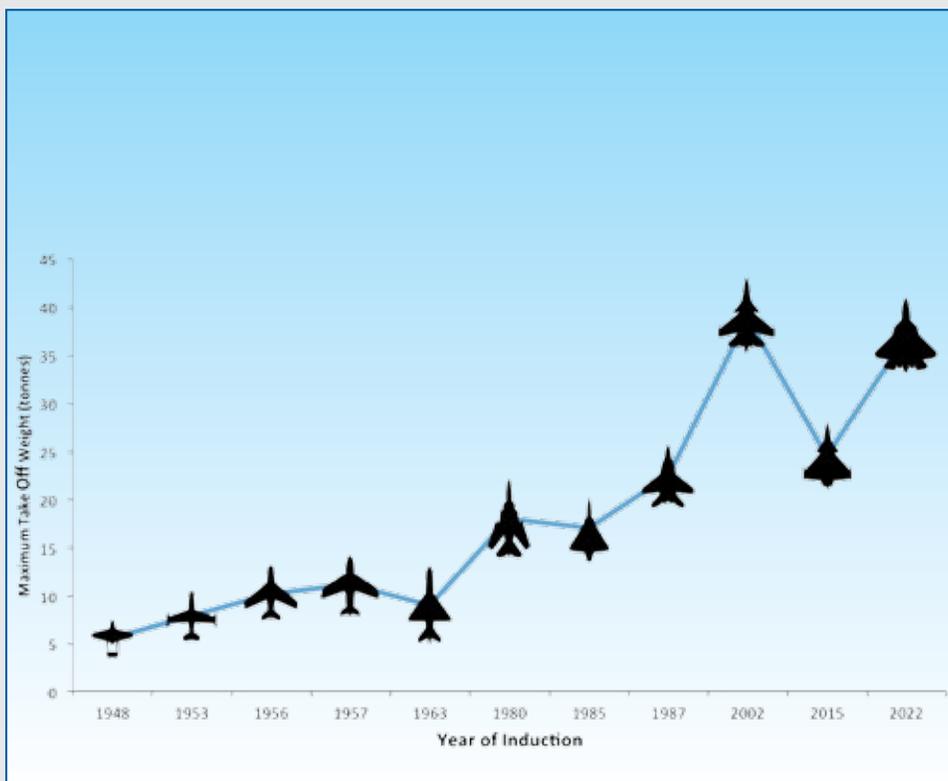
The Indian Air Chief put this change into perspective by comparing the planned FGFA to current fifth-generation stealth fighter programmes such as the F-35, saying that "a second cockpit will compromise the stealth capabilities by at least 15% apart from adding to the weight and reducing fuel capacity."



PAK FA (T-50) prototype in close formation with MiG-29UBT

'Growing' with the Indian Air Force : 1st to 5th Generation Fighters

Aircraft	Generation	Year	MTOW	Engine thrust
De Havilland Vampire	I	1948	5.6 t	1519 kgf
Dassault Ouragan	I	1953	7.9 t	2264 kgf
Dassault Mystère IVA	II	1956	10.2 t	3508 kgf
Hawker Hunter	II	1957	11.1 t	4600 kgf
Mikoyan-Gurevich MiG-21bis	III	1963	9 t	4100 kgf (D) 7098 kgf (W)
Mikoyan-Gurevich MiG-23	III	1980	18 t	8525 kgf (D) 12950 kgf (W)
Dassault Mirage 2000	IV	1985	17 t	6557 kgf (D) 9698 (W)
Mikoyan MiG-29	IV	1987	22.4 t	2x 5100 kgf (D) 8994 kgf (W)
Sukhoi Su-30MKI	IV+	2002	38.8 t	2x 5100 kgf (D) 7710 kgf (W)
Dassault Rafale	IV+	2015	24.5 t	2x 7648 kgf (D) 12543 kgf (W)
Sukhoi PAK-FA	V	2022	37 t	2x 8770 kgf (D) 14990 kgf (W)



Graphic by Angad Singh

Tactical and Strategic Impact

There is no question that induction of the FGFA into the IAF would dramatically alter the balance of power in the region. Sino-Pakistani relations notwithstanding, any force fielding over two hundred of the very latest and most capable combat aircraft in the world would completely dominate the skies over South and Central Asia.

By 2022, which is when the FGFA is supposed to be operational, the IAF will operate 12 squadrons of the Su-30MKI (possibly all upgraded to 'Super 30' standards), 9 squadrons of the Dassault Rafale MMRCA, 12 squadrons of legacy types (Jaguar, Mirage 2000, MiG-29), 2 squadrons of the Tejas light combat aircraft and the first FGFA squadron, for a total of 36 squadrons of combat fixed wing aircraft types.

Despite (valid) concerns about the absolute efficacy of the FGFA's stealth capabilities, the level of low observability already built into the aircraft will guarantee a change in all airborne engagements but most significantly the BVR (Beyond Visual Range) sphere. The FGFA's low radar signature would utterly outclass all 4+ generation types, putting them at an instant disadvantage in BVR engagements. Within visual range, the aircraft's emphasis on energy and agility should render a battle of manoeuvrability tilted in its own favour quite convincingly.

For now, the programme's impressive rate of growth and the impending arrival of the first FGFA prototypes give this writer cause for nothing but optimism.

Angad Singh

The Indian Air Force at 100 : A Wish List



A-50 Phalcon AWACS of the IAF have tremendously enhanced the air defence sinews of the country.

The IAF on its hundredth birthday in 2032 will superficially look much the same as it does today, but with about fifty percent more aircraft. However, in terms of capability it will be vastly different. First, it will have evolved into becoming an aerospace force. Second, it will be synergistically networked, yielding vast improvements in overall capabilities. And third, it will be information rich, with data forming a part of its combat power.

Trend I : Numbers of aircraft

Formed with just 4 Wapitis in 1933, by 1947 the IAF had nine squadrons flying Spitfires, Tempests and C-47s. By 1962, at the time of the Sino-Indian border war, the IAF had 25 squadrons and was the largest (barring China) and possibly the most modern Third World air force. It had 206 transport aircraft alone, with a

load capacity of 21,600 tonnes besides 660 fighters and light bombers. By 1971 it had perhaps 800 combat aircraft, 200 transports and 200 helicopters or some 1200 aircraft excluding trainers, making it the world's fourth largest air force.

In 2010, the IAF still had about 1200 aircraft excluding trainers, but including some UAVs, remarkable because air fleets

around the world have severely shrunk owing both to the increasing expense of aircraft and the NATO/Russia drawdown after the Cold War ended. Because of serious delays in replacing combat aircraft, the number of IAF fighters was down, but a corresponding increase in helicopters had taken place. So the IAF remained in global 4th place.



Ilyushin Il-78MKI mid-air refueling various frontline IAF fighters including the Sukhoi Su-30MKI, Jaguar Maritime while another Su-30MKI refuels Mirage 2000TH

Projecting 20-years into the future is an inexact business, but it is likely that the IAF will grow by about 25% to have around 1500 aircraft as hundreds of new fighters, transports and helicopters replace older types and as combat aircraft numbers increase. The number of fighters will increase to 700+, but the number of helicopters may reduce as types with greater capacity replace others, for example, Dhruvs replacing Alouettes and Lamas. The inventory of UAVs will increase dramatically. The mix of surface-to-air missile squadrons will change because Anti-Ballistic Missile squadrons will replace some regular SAM squadrons. Simultaneously Army and Naval aviation will have substantial increase in size and ability.

The possible fleet 2032

Fighters

- 200 FGFA (additional aircraft above current plans required to replace Su-30s)
- 250 Su-30 (older aircraft upgraded)
- 200 MMRCA
- 200 LCA (alternatively, more MMRCA or the AMCA ?)
- 100 UAV
- 50 UCAV

Transports

- 20 heavy lift (C-17 Globemaster III)
- 24 C-130 Super Hercules
- 50 Multi Role Transport Aircraft
- 100 new type to replace An-32
- 56 Avro 748 replacement
- 50 light transport aircraft (HAL-Do228)

Helicopters

- (Assuming current setup vis-à-vis Army Aviation continues)
- 200 medium utility
- 40 dedicated attack
- 30 heavy lift
- 120 Light Attack (LCH)
- 120 utility/FAC

Special mission

- 20 HALE types
- 20 mid-air refuelling tankers
- 20 AWACS/AEW&C
- 20 ELINT/EW
- 20 ground surveillance for Army support (mid-size JSTARS E-8 type)
- 12 Special Forces support (C-130 type)
- 10 VIP transportation

Trainers

- 150 AJT (LIFT)
- 200 IJT
- 200 BTA

SAM (launchers)

- 50 strategic ABM
- 100+ new medium type
- 120 Akash type

This comes to 850 fighters, 300 transports, 510 helicopters, 120 special mission aircraft, 550 trainers and 150 UAV/UCAVs totaling some 2480 aircraft, placing India ahead of Russia and becoming third largest in the world. Though these may seem fantastic numbers, India's economic growth has been underway only for 20-years. Using a 2012 GDP of US\$2-trillion and a very modest 6% annual growth, 2032 GDP should be about \$5-trillion. In turn this implies, at 2.5% of GDP, a \$125-billion defense budget. At 33%, the IAF's budget will be \$40-billion, approximately the entire defence budget in 2010. Of course, contemporary aircraft will be very expensive, say \$200-million unit cost for a fighter. But if India's growth gets to what it should be, 10% per year for 20-years before starting to slow down, the GDP will be about \$10-trillion, giving an air force budget of perhaps \$80-billion.

Trend II: The Indian Aerospace Force

By 2032, the IAF will have become the Indian Aerospace Force, as in air and space. Predicting this is easy, predicting what the space part of the Aerospace Force will look like is difficult to the point it becomes pure speculation. The problem, as always with India and with any aspect of India, is that between the possible and the actual lies an enormous gap. Warfare today depends on vast quantities of data. The side with the advantage in collecting, processing, and presenting data has an advantage greater than the number of aircraft. And it is in a data environment that satellites become crucial.

Satellites

In 2032 the IAF may have as many as 60 major satellites in orbit. Of these 24-36 will be required for global GPS, which has to be a high priority project because depending on anyone else for such a critical resource is just not advisable. The lower end is what the current US GPS system employs; the higher end is what the US requires in coming years.

Ten or more satellites will be required for communications, six or so would



The Sukhoi Su-30MKI will remain the most prolific combat aircraft type even in 2032.

Rafael



The Dassault Rafale has been selected as the IAF's M-MRCA with first squadron to be raised in 2016-17 with 18 direct supply aircraft and HAL Bangalore Complex preparing for bulk production of upto another 171 aircraft.

be for weather and some ten would be required for ocean and land surveillance. Ideally Indian satellites should cover the world, possibly requiring twice as many surveillance satellites, but at the minimum the IAF will have to cover Asia, the Indian Ocean, and the Western Pacific. Six or so would be for special missions such as ELINT. Additional to the number will be a 25% reserve combined with rapid launch capability. This is required because in a future war satellites will become the enemy's primary target.

It follows that an anti-satellite capability is required as Low Earth Orbit satellites can be attacked by ASAT missiles fired from fighter aircraft. Mid-altitude and geosynchronous orbit satellites will require long-range ASAT missiles. To make a difference to the outcome of war, a considerable ASAT capability is required, to neutralise between 30 and 50 satellites.

Another ASAT weapon that India will have to explore is the "killer dark" satellite. The US already has this capability, although details are classified. A small, but maneuverable stealth satellite is orbited and when required, homes in on and destroys an enemy satellite. It can do this on a 1-to-1 basis. It can also fire a couple of micro-missiles with warheads of perhaps 2-3 kg of explosive and then move on to another target. It seems unlikely India will have such a system deployed in the fourth decade

of the 21st Century, but certainly needs to start working on such killer satellites.

ABM Defences

The IAF will certainly have to make a big push on acquiring new ABM systems. The western theory of deterrence is that each side must leave itself vulnerable to the other and therefore to build defences against enemy missiles destabilises the balance. This theory is fallacious because it is a 2-player system, specifically set-up for the USA and the then USSR. It does not address nuclear proliferation where a number of smaller nuclear powers enter

the scene, nor does it account for irrational attacks, rogue attacks, or mistaken attacks. In reality, the biggest shortcoming is a moral one, because while the rulers can head for the bunkers, the populace is left completely exposed.

In the current Indian context the danger is from Medium Range and Intermediate Range ballistic missiles, and from nuclear-armed cruise missiles. Yet, if India wants to be a world power, it has to be prepared for attacks from any quarter, de Gaulle's *touts azimuths*. That requires defence against Intercontinental Range missiles.

Cruise missiles can be addressed at the same level as low-level aircraft attacks, so these do not require a new or a specially planned capability. Medium and Intermediate range systems can be countered by systems like the Israel-US Arrow, or the US Terminal High Altitude Air Defense (THAAD), which is a six-metre long missile. This is the area that the Prithvi Air Defence System aims to cover. For ICBMs, the US has been relying on a very long range interceptor and the Aegis sea/land missile system. The very long range interceptor's deployment has been slowed, because something else – as yet unknown – is in the works.

Actually, the ABM is very expensive. A single 6-cell battery with reloads can easily add up to \$1-billion, but a single nuclear warhead getting through will cost infinitely more than that !! Like the satellites/anti-satellite system, the ABM will cost big money.



Given as an example, the Northrop Grumman RQ-4 Global Hawk is a UAV used by the United States Air Force and Navy and the German Air Force for high-altitude, long-endurance surveillance (HALE).

Trend III : UCAVs and UAVs

The big question mark over the future shape of any air force is the Unmanned Aerial Combat Vehicle. It is possible that for the US, the F-35 fighter is the last manned combat aircraft the USAF will deploy. Even the new bomber, currently under planning, may be unmanned. The US has under development and test two 16-20 ton maximum takeoff UACVs, the Northrup-Grumman X-47B and the Boeing Phantom Ray. The X-47B is a candidate to replace Navy strike aircraft and will carry a 2-ton payload.

India's entry into the UCAV market is the Aura, which looks like a mini B-2 and will likely have a 2-ton payload. First flight is planned for 2016 and introduction into service for 2020. These targets are too ambitious but certainly Aura should – if all goes well - be in squadron service in the late 2020s.

UCAVs are of two types: remotely controlled and autonomous. A strike UCAV can be autonomous. It is, in essence, no more than a missile or bomb launching platform that is expected to return after delivering its payload. Just as a cruise missile can be programmed to fly a certain profile, and the programming can be changed enroute, the strike UCAV will have flexible flight profile programming.

Air superiority UCAVs, when they enter service, will have to be remotely controlled. This is a far more complicated process than may appear, which is why manned air superiority fighters are likely

to continue in service even in advanced countries into the 2050s. There is a chance that India's Sixth Generation fighter for the 2030s and beyond too will be unmanned.

UAVs

The IAF already operates several squadrons of UAVs. The current stable of Herons and Searchers, however, are virtual toys compared to what is to come. These 1-tonne vehicles are likely, by 2032, to have long been in the Indian Army's domain. Instead, the IAF will operate

vastly more sophisticated aircraft. The Indian Navy is already examining the 10-tonne Global Hawk with its 24-hour airborne capability.

The IAF will operate a UAV in the Global Hawk class and rather than take up space describing what it will do, it is simpler to say what it will not do. It will not drop bombs. It can do everything else. Some of the missions that it will undertake are:

- ◆ Wide area surveillance : a Global Hawk-class vehicle can monitor 100,000-square kilometers of ground per day. This



The DRDO concept of a medium altitude, long endurance UAV is seen in this model form.



The Boeing C-17 Globemaster III heavy transport aircraft will provide strategic airlift capabilities particularly for out of country contingencies (seen here during trials at Leh).

is invaluable to provide up to-the-minute assessments of enemy air and ground deployments

- ◆ ELINT/EW : the size of aircraft permits large sensor packages.
- ◆ Airborne command and control.
- ◆ Aerial tanker : to refuel other similar vehicles.
- ◆ Guidance and targeting : the vehicle will help control UCAVs and other aircraft
- ◆ Airborne ground surveillance radar : to track enemy ground troops.
- ◆ Border control : the vehicle will be linked to other border fence sensors.
- ◆ Battle damage assessment.
- ◆ Communication relay : particularly valuable along India's northern frontier.



The Indo-Russian multi-role transport aircraft (MTA) will fill the gap between the C-17 and new medium tactical transport aircraft.

If this technology is developed, it becomes possible to envisage an air force with large and ponderous transport aircraft loaded with 500-km BVR AAMs, say 50 transports with a total of 2000 missiles, protected by a small number of air superiority fighters. Similarly, such an air force will have 50 transports each loaded with 40 high-speed surface-attack missiles also of 500-km range. It is possible also to envisage transports equipped with anti-missile lasers. Such technology has been demonstrated by the US as part of its ABM programme. Of course, intercepting air-to-air and cruise missiles is a considerably simpler proposition than shooting down ballistic missiles.

Trend IV : PGMs/Smart Bombs

A most surprising aspect of the Kargil War 1999 was that the IAF dropped only 9 PGMs. Earlier, the US had embargoed India's acquisition of PGM kits and so India had to scramble to get kits from Israel, and displayed an unusual flexibility and initiative in converting some of its dumb bombs to smart configuration.

Today there is almost no point in using dumb bombs, even for ground support. Perhaps that should be amended to especially for ground support, because so much can go wrong when bombing just ahead of own troops. As for interdiction and deep strike, given the great risks of penetrating enemy airspace, when four aircraft with PGMs can do a better job than one hundred with dumb bombs, why waste money, time, aircraft and air crew? Currently the favorite are GPS-guided bombs because they are fire-and-forget weapons. Glide ranges of 15-to100-kilometers are possible and an aircraft can drop its ordnance far from its target and be on its way home before they even impact.

That the IAF's inventory of PGMs will increase exponentially is a given. Nonetheless, dumb bombs should not be entirely ruled out as it is possible that bomb aiming computers and sensors will increase accuracy to the point they are indistinguishable from PGMs. This will lower costs, plus confer a big advantage of PGMs and a PGM can be spoofed by interfering with its guidance system. A dumb bomb has no guidance system and once released, cannot be diverted.



Orders for Boeing's AH-64D Apache Longbow heavy attack helicopter are imminent.

BVR AAMs

A big unknown for the future is the role of Beyond Visual Range (BVR) air-to-air missiles. To date they have not been particularly successful because of the difficulties in identifying friend from foe. It seems to be only a matter of time, however, that satellites and high-flying UAVs take control of a BVR once launched, and guide it precisely to target.

Trend V : Supporting Types Helicopters

Any prediction about helicopters and the IAF in 2032 depends entirely on what the arrangement will be with the Army. It may be that all aspects of helicopters to do with direct support of the Army are shifted to the ground forces, in which case the IAF will retain only about 200 helicopters it requires

for support of its own forces. These will include heavy and medium lift helicopters, and light multipurpose types. If, however, the current system continues, then the IAF will grow to perhaps 400 helicopters of all types. If the Army's planned mountain strike corps get the helicopters that they want, then the heavier varieties will be flown by the IAF and the number could go well be over 600.

Transport Aircraft

The number of transport aircraft may not significantly change because new equipment arriving or planned is considerably more productive in any terms of ton-miles. The C-17, for example, can deliver three times the tonnage at high altitude compared to

Special Mission Aircraft

This category includes the AWACS, AEW&C aircraft, mid-air refuelling tankers, Special Forces support, VIP, ELINT/EW, and ground surveillance. The air tanker force in particular will have to expand as India's overseas reach expands. As each army corps can usefully utilise upto a dozen ground surveillance aircraft, in one sense it is almost impossible to have too many such aircraft.

Trend VI : Fighters

What is usually considered the core of an air force has deliberately been placed as last in this analysis. This is really to emphasise that whereas once attack and

these other aircraft may well outnumber the combat types.

With regard to fighters, the IAF has for decades lived with an exceptionally adverse problem, which is the propensity for 'ad hoc' procurements. There is no reason for a 36 combat-squadron force to have more than two types of fighters. The Indian Air Force, however, has had a jumble of aircraft types. In 1971, for example, it flew the MiG-21, Su-7, Gnat, Mystere, Hunter, Marut, and Canberra. In 2012, on its 80th anniversary, it still flies the MiG-21, but also the MiG-27, MiG-29, Su-30, Jaguar and the Mirage 2000, and with the Tejas entering service, late as it were.



HAL's Light Combat Helicopter (LCH) is under development for both the IAF and the Army.

the present Il-76. The MTA will be twice as productive as the An-32 because it is a jet and its speed is that much faster. In addition, the IAF will need several dozen light transports to ferry parts, cargo, and personnel around at short notice or for missions where an MTA will be too big and expensive. Few analysts or planners pay attention to this type of aircraft, but it is an important asset to enhance the overall productivity of an air force.

air defence/superiority missions were what air forces had as prime role, today their roles have multiplied. There are two ways to look at this.

One, an air force has become far more than an instrument for taking war to the enemy and keeping attackers off one's back. Two, to efficiently perform its core function, the air force now requires a panoply of other aircraft types, to the point

In contrast, the United States has shown that even with 150 squadrons of the Air Force, Navy, and Marine Corps, just three types suffice. Today this is the F-15/F-16/FA-18. Many squadrons of older aircraft such as the A-10 have been kept around simply because they were paid for, and in excellent shape to give more years of service. Tomorrow, the US seems to be heading for one fighter

for all its air forces. The US Marine and Navy will fly only the F-35 : they already fly only the F-18 (apart from the fading out Harriers). Aside from a handful of bombers and F-22s (it is unclear how long the F-117 will last, there are only 40 in any case), the entire first-line US Air Force will consist of just F-35s.

The US military not only will gain the benefit of scale pricing by using one fighter, albeit in different versions for each air arm, the maintenance will be enormously simplified. Just four decades ago, the US flew a bewildering variety of combat aircraft: B-1, B-52, B-57, B-66, A-4, A-5, A-6, A-7, A-10, F-4, F-5 (DACT), F-101, F-102, F-104, F-105, F-106, and F-111. Over the next 20 years, 95% of combat aircraft will become just one type.

Admittedly, India is getting better in this regard. By 2032, or during the next two decades, five current aircraft types will be retired, the Jaguar, Mirage 2000, MiG-21, 27 and 29. That will still leave India with four types, the Tejas, Rafale, Su-30, and FGFA, whereas there is really no excuse to have more than two, a heavy fighter and a light fighter.

Trend VII : The intangibles

An air force, like any other organisation, is a 'system'. Each part works with every other part. Inefficiency in one part degrades the entire system. For example, inadequate fighter pilot training negates the benefits conferred by high-performance aircraft. A shortage of the right kind of ordnance



Amongst leading anti-ballistic missiles (ABM), the Israeli Arrow is designed as a theatre missile defence system.



New shape in the skies: Northrop Grumman's X-47B is an unmanned combat air vehicle (UCAV) programme of the next generation.

reduces the efficiency of attack sorties. Sloppy maintenance procedures increase accidents and reduces available assets.

After World War II, the Germans complained they were defeated by superior logistics. Actually, they were defeated by superior American management, one objective of whom was to ensure an endless production of armaments and supplies. Ultimately it did not matter how skillful were the German generals, or how brave their pilots. Right from the start, the "efficient" Germans were plagued by the most atrocious inefficiencies in production of war material and of war supply. When the German Army invaded Russia, for example, it possessed no fewer than 2000 different kinds of vehicles.

Insulting as this might be to the creed of warriors, efficient management

Eurocopter



The DRDO is developing the Programme AD, based on the Prithvi

has long been the name of the winning game in warfare. The IAF, on the other hand, has from the start cultivated the ethos of the air warrior, not the ethos of efficient management. “Management is for clerks”! The reality is, it is not how brave individual pilots are. All that matters is how efficiently does the organisation generate output. The output in an air force’s case is the attrition imposed on the enemy and the speed with which air dominance is achieved. It is the number of targets destroyed with the least input. That falls in the realm of clerks, be they airmen or air marshals.

Inefficient and inadequate management has plagued the IAF from independence. Yet, if the IAF wants not just to be one of the biggest air arms in the world, but also one of the best, it must overhaul its management from start to finish. And particularly in a world of robotic warfare, personal bravery will count less and less, and management more and more. This is something the IAF must understand. It cannot simply go from decade to decade ignoring the reality that management comes before all else.

Conclusion: 2032

The sum of the parts exceeds the capability of the individual components is an old saying from the start of the cybernetic era. As a networked force, with every aircraft, and missile unit working together, the IAF’s capability will increase manifold despite a relatively small increase in



In 20 years, the IAF must have scores of major satellites in space orbit, for communications, ELINT, global GPS and 24x7 surveillance.

Raytheon



The Indian Air Force has been propagating its role as an 'Aerospace Power' for some time, as exemplified by this massive hoarding at a recent Air Force Day parade.

numbers of aircraft. Its future battles will involve bits and bytes as much as bombs and missiles. The gathering, processing, and presentation, and understanding of terabytes of data per second will be as important as the quality of its aircraft. The width of an air force's data pipeline will be as important as its logistics, if not more.

For example, an AWACs makes both the air defence and the strike components of the IAF far more efficient. Satellites that

permit every platform to talk to every other platform permit a greater productivity. Tankers not just allow longer strike ranges, they enable air defence aircraft longer times in the air. UAVs do a multiplicity of tasks and are particularly important for surveillance. Transports enable rapid shifts of air assets from one front to the other. UAVs provide rapid bomb damage assessment, again improving manifold the efficiency of strike assets

Still in 2032, fighters will remain the most important component of the IAF, but thanks to networking and too many different kinds of aircraft, the combat power of those fighters will increase enormously.

Perhaps, on its 80th anniversary this is a good time for the IAF to begin preparing for its 100th anniversary by changing its formal designation into becoming the **Indian Aerospace Force**.

Ravi Rikhye



The planned Indo-Russian Fifth Generation Fighter Aircraft (FGFA) will be based on Sukhoi's T-50 prototype, three examples of which are currently flying with another 11 to follow, the first of which will be delivered to the IAF at Ozar (near Nasik) in 2014 for trials and development activity.

“The Right Stuff”



Quartet of HAL HJT-16 Kiran Mk.IIs for Stage II flying training.

Photos by Peter Steinemann

Air Commodore Jasjit Singh on flying training imperatives of the IAF

In spite of six decades having flown past, I well recall my first days at the Air Force Academy, Begumpet as if it were yesterday. We had all sat down on the floor in neat rows when someone shouted “Attention” and the Chief Flying Instructor walked in; a short man who surveyed the assembled cadets almost in one sweep of his eyes. And then he started speaking. The crucial phrase I recall was: “If God wanted you to fly, He would have given you wings! Since you don’t have them, never forget that the machine is all metal, and you would be doing an un-natural activity. If you don’t want to dig a hole in the ground, you better handle it properly”

Looking back I wish he had also told some other groups and individuals that since God has not given Man any wings, they better make good aeroplanes in good time for young ones to fly in. But this was not to be. In fact design and development



The HAL HPT-32 has served as basic trainer for Stage I flying training but has been grounded since 2009.

of aircraft at HAL has been the weakest link in our aircraft industry.

As we celebrate 80th anniversary of the IAF, we also need to do some introspection about the Service. The Indian Air Force is now recognised world-wide as one of the most professional of fighting forces. Wars

of the past two decades clearly indicate the increasing importance - actually also pre-eminence - of aerospace power in general and Air Forces in particular. But the magnificent men can hardly get airborne without their machines ! One can recall another facet of our history which tells

us that some four centuries ago a quarter of the world's manufacturing output was made in India, second only to the 33% of China. But from then onward the country was progressively de-industrialised while the West developed into modern states and affluent societies based on the Industrial Revolution which had also helped them to colonise most of the world.

It would be a cliché worth repeating again that the world is in a state of transition, and India is changing and well established on the rising trajectory to become a major power in the international system, the recent hiccup of slowed GDP growth triggered largely by the continuing slow growth in the United States and the Euro-zone crises notwithstanding. Even China's economic growth has slowed down and is not very different than ours. From the perspective of our essay, the Indian Air Force is also in a state of transformation. Everyone believes that money is no longer the hurdle in managing that transformation though we are now spending a mere 2% of the GDP on defence.

But what we must not forget that it is now three years since the primary trainer of the IAF, the then HPT-32, stopped to be used for rookie pilot training after a series of problems culminating in two instructors getting killed in a flying accident. The engine problem was identified as the cause. Experience tells us that primary training is the stage when the trainee pilot not only learns to fly an aeroplane safely, but also competently and confidently. The primary stage of flying training is the foundation of flying in the Air Force. Global experience indicates that many weaknesses in flying at the primary stage could lead to accidents much later. The Lafontaine Committee found this to be fact and hence its recommendations for a suitable aircraft at each of the three stages of flying training. Hence while the cockpit workload of the trainee pilot should be light, the aircraft must present significant challenge in flying it properly. Since the HPT-32 was grounded and virtually retired from service, the Air Force was faced with the prospect of possessing no trainer suitable for ab-initio flying training. Hence it began using the HJT-16 Kiran jet trainer designed and used for the next higher stage of training, that is the intermediate stage. The Kiran is basically an easy aircraft to fly though its cockpit work load for an ab-initio trainee is rather high. So we have landed



The HAL-built Dornier 228 has provided an excellent platform for multi-engine pilot training before transport pilots move on to the HAL-built Avro 748 (below) or An-32.



up with a situation exactly opposite to the desirable option. But there are two points worth pondering over.

The first is that we are told every day that HAL has now come of age and the LCA (Light Combat Aircraft) designed by ADA (Aeronautical Development Agency) under the DRDO is ready to be inducted into service. It is often forgotten that the IAF had put up a requirement for such an aircraft more than three decades ago in early 1980s but it has yet to meet its specifications. Conceded that the LCA is a complex combat aircraft and hence would take more time, but one cannot help in asking that why is it that HAL/ADA have not been able to design a primary trainer in the past three years? Did somebody forgot to tell them? If so, who is that somebody? After all the IAF is the primary stakeholder of military aviation in India and it would naturally want the best and reliable of machines to fly and fight in. The second is that an urgent requirement of using an appropriate aircraft being acquired would take as much as another 3-4 years

before the new imported aircraft would physically enter service in numbers that would be compatible with the number of trainees, a full syllabus of 75 hours flying to make him fit for the intermediate stage where he/she would learn to fly a suitable aircraft safely with confidence to its limits! Meanwhile the Air Force has no option but to "manage" and that is being done though it clearly points to further problems emerging a few years later.

We don't have adequate numbers of Kiran aircraft for this additional task of primary stage flying also to be undertaken over 3-4 years in addition to its task as an intermediate trainer. The result will be that a much larger number of aircraft than the planned levels would become due for overhaul and life expiry creating a shortage at this stage of training. All hopes had been set on the IJT (Intermediate Jet Trainer) which was designed and flew in a matter of 18 months earning laudatory editorials in newspapers a decade ago. But it appears there are persistent problems adversely still affecting its entry into service.

The unfortunate reality is that this example of the primary trainer is not just the problem faced by the Air Force for the first time, but the basic issue pervades the country in many spheres. Normally the resources (technological/systems/finances) required to create a capability and/or assets should get priority in planning. But we seem to be quite content to alter the capability to fit the resources available at that time! Some people consider this to be a positive asset in terms of innovation, though it is more of a *jugaad* where the costs are paid in different “currency.”

The Cabinet Committee had sanctioned a force level of 64 (14 transport and 50 combat) squadrons for the IAF in early 1963, but this was reduced to 45 squadrons as an interim measure because resources were not available. And as time went by, we settled down to the new figure increasing it by four squadrons two decades later. Even this has been depleting in the past decade and we are

left with around 30-31 combat squadrons against the cabinet sanction of 50 combat squadrons and an interim approval of 39½ and it would take a decade to get back to that interim level while our neighbours are furiously modernising and expanding their air force capabilities.

Since I am relying on some history, let me not leave out the prolonged experience with the Stage 3 aircraft, normally called the lead-in fighter trainer. We have ultimately got the British Hawk flying in the Academy now for a couple of years. But by any logic we acquired around half the number that are really needed. And this can be made workable only by cutting down the desirable syllabus. The Lafontaine Committee had worked out a 100-hours syllabus for one year and laid down the capability that the trainee pilot must achieve by the end of the stage. This would have freed the operational squadrons from training of half-trained pilots! Another point, the media has been wrong in

assuming that the need for an aircraft at this stage, popularly called AJT (Advanced Jet Trainer), was felt/approved in 1982. In reality the aircraft at this stage for nearly two decades was the Vampire which went out of service in 1972. The *jugaad* was to send trainee pilots directly to MiG-21s and that too on a truncated syllabus! The result was an increase in accidents, including but not confined to landings : both MiG-21s and standardised training suffered.

The obvious choice when the Vampire was retired in 1972 was to have opted for the MiG-15U along with MiG-17 single seat fighter. The cockpit layout, emergencies and most procedures were common to the MiG-21 which had entered service in IAF in 1964. Incidentally, the Pakistan Air Force opted for this combination acquiring the aircraft from China and used them till turn of the century. But we were already committed to the indigenously designed HF-24 Marut (both two-seat trainer and single-seat



Top : The MiG-21U operational conversion trainer was performance used for Stage III or advanced jet training in absence of the long sought AJT for which the BAE Systems Hawk (below) was finally contracted for in 2004, with first deliveries to the IAF at Bidar in 2008.

fighter) as the Vampire replacement. The trouble was that the aircraft was under-powered, as per the HAL mark (pun intended) in the past. Hence the FTW (Fighter Training Wing) at Hakimpet, at an altitude of around 2000 ft and a runway which could not be extended due to terrain problems, was unsuitable and a new base would have had to be found. In the end neither did we go for the MiG-15/17 option, nor for the Marut Trainer option and started to use the MiG-21 and the Hunter at this stage.

Reverting back to the HPT-32 problem, an interested bystander would find it difficult to understand why we could not at least adapt the airframe to a different engine much earlier instead of waiting for a series of crises to remind us that the engine fuel-feed was not reliable? Is it that the concept of upgrade does not exist in our system? In fact, one believes that a quarter century ago, when the HPT-32 aircraft was just entering service, it had been pointed out that the aircraft was grossly under-powered. Going back even further, it is believed that the then Chief of Air Staff, now Marshal of the IAF Arjan Singh, had noted on file in early 1969 that we should think of fitting a turbo-prop engine on the proposed trainer which in his view was the global trend! But HAL pressed on with a piston engine and in order to make the trainer for the Air Force also saleable as small executive aircraft, had created a broader fuselage with additional seating capacity. Anyway, the aircraft was clearly underpowered which may well have been the reason for its problems emanating from cumulative use at full throttle.

The Lafontaine Committee recommended the induction of HPT-32 into service in 1982 since its predecessor, the HT-2 was getting old and its engine had become totally unreliable and a potential hazard leading to many accidents. Air Chief Marshal LM Katre, then AOC-in-C Western Air Command had learnt of the foundational deficit of being under-powered aircraft at that time. A few months later he took over as Chairman of HAL and was reported to have asked for a modification to fit a turbo-prop engine with the airframe of the HPT-32. Apparently trials with the aircraft, HTT-34, proved successful and the modifications to the airframe were minimal. But somehow, the aircraft was not introduced in the Air Force and merely occupied a corner of an HAL hangar in Bangalore – and may still be there!

One could live with such situations because we still do not have adequate control over technology and other resources. On top of it, we have not created adequate capabilities for design and development of aircraft. In fact the earlier design capability of HAL, the prime manufacturer of aircraft in the country, has been eroded over time and a large number of designers have left HAL during the past decade to take up jobs in the private sector. Thus there is a fundamental weakness in our aircraft industry that needs urgent attention.

Let us look at another side of the picture. In early 1972 Air Chief Marshal PC Lal, then Chief of Air Staff, had set up a Permanent Manpower Planning Committee at Air HQ. Its first report concluded that we must get out of cyclic changes in pilot intakes which cause serious problems in manpower and career planning. The worse situation that kept haunting the Air Force career planning was the large number of pilots trained during the 1962-67 National Emergency as a consequence of China's war against us. The assumption of training requirement was based on the projected requirement of 64 squadrons. In the event only 45 got created by 1971 though even then there was a huge surplus of pilots in the squadrons getting very little flying. The Committee worked out a long term plan on the basis of the total cadre of pilots and assessed the number of persons to be trained for a 45-squadron force so that a long-term steady state model of recruitment and training could be created. The training schedule was accordingly decided on a long term basis.

It is well known that owing to shortage of training aircraft and infrastructure we started to whittle down the old training goals of "service pilots" which required a combined training programme in 1st and 2nd stages with trifurcation taking place at the end of the 2nd stage when, in terms of the Lafontaine Committee report, the trainee pilot would have the standard of a "service pilot" which itself was spelt out in the Committee's report along with detailed syllabus at each of the three stages. One wonders whether that training syllabus and especially the defined performance level is still being pursued. Logically if the approach of the Permanent Manpower planning Committee was pursued, there is no reason why we have a shortage of over 600 pilots (as per the Defence Minister's statement last year) even after separating the training streams.

My main point in pointing to these events of the past is to emphasise that we need to pay far more attention to training in future. In the past, say till around the 1980s, we had focused almost entirely on the operational side of the Air Force. Training by and large got a much lower priority. It may sound surprising but till the Lafontaine Committee raised the issue, there was not even an ASR (Air Staff Requirement) for a Stage III training aircraft. The Air Force simply used the operational aircraft getting old, like the Spitfire, Vampire, etc. for the training role. Perhaps deciding on the earlier version of the MiG-21 was a consequence of this approach. The aircraft and weapons systems are getting more complex and high-technology based. All air forces operate at technological levels higher than that available in country. This is also so in the United States. This places a very high premium on training and so far IAF has displayed standards of performance in India and abroad which would be the pride of any modern air force. If this is the quality of our pilots with training which has faced so many challenges in the past, one can be confident that if training was to be given a higher priority, the standards would undoubtedly rise even further.

Linked to the question of (flying) training is the issue of what has come to be known as Professional Military Education (PME) in the United States. The Air Force is beginning to give greater emphasis on this aspect. Superficially there may be no difference between training and education. But training in the armed forces is about how to do things, while education requires how to think about doing it the best way. This is critical not only for flying standards but even more so for the leaders of tomorrow. But the focus on education should be on the acquisition of knowledge and not merely degrees since knowledge is the foundation for wisdom. And there is no doubt that a modern high-technology (and inevitably high cost) air force would require wise people to lead it in an uncertain world of tomorrow. God has not given wings to Man but it certainly has given brains to each one of them. It would be the greatest irony of life if Man was not to use the brain to the maximum and for the highest level of knowledge and wisdom.

Air Commodore (R) Jasjit Singh, AVSM, VrC VM, IAF Director General, Centre for Air Power Studies, New Delhi.

Yak Attack



Test Pilot Peter Collins visits Irkutsk and flies the Yak-130

In mid-May 2012, I was given a once-in-a-lifetime opportunity to travel to Irkutsk in eastern Siberia to test-fly and evaluate the Yak-130.

The Yak-130 is the Russian Air Force's advanced flight and tactical combat trainer and prepares student pilots to fly and fight in the latest frontline fighter and fighter/bomber types, including the RSK MiG-29/35 and Sukhoi's Su-27/30/34/35 series and, in the future, the PAK-FA T-50.

Irkut received its latest firm order for the Yak-130 (55 aircraft, plus 10 options) from the Russian defence ministry in November 2011. Additionally, the company has already responded to its first export success with the type, having completed delivery of 16 Yak-130s to the Algerian Air Force last year.

I was honoured to become the first Western test pilot to be invited deep inside Russia to independently carry

out such an evaluation. This is a highly significant marker in the desire of Russia's newly integrated aerospace industry to openly compete in the global aviation marketplace and to freely showcase the design, technical, engineering and production skills it possesses.

Opened in 1936 and strategically positioned between Moscow and Vladivostok, the Irkutsk production facility has manufactured more than 6,700 aircraft, including designs from the Antonov, Beriev, Ilyushin, Mikoyan, Petlyakov, Sukhoi, Tupolev, and Yakovlev bureaux. Irkut, now a fully integrated aerospace company, has its headquarters and design centre in Moscow. It is responsible, by value, for providing more than 30% of Russia's aircraft business revenue and 15% of the nation's arms exports.

The publicly listed company has a \$1 billion capitalisation by share and an

order portfolio totalling more than \$7 billion. With 14,000-plus employees and established links to Russian universities and research and development facilities in Irkutsk and Moscow, it has strong global aerospace potential.

In addition to the Yak-130, other types being produced, completed and upgraded in Irkutsk include the thrust-vectoring Su-30MKI for India - also assembled indigenously in partnership with Hindustan Aeronautics - plus the Su-30MKM for Malaysia, and another version for Algeria.

Such military activities are complemented by the start of production of the civil MS-21 single-aisle airliner, in the 130 to 212-seat class. Its design is led by Irkut, and the aircraft is due for entry into service in 2016. The MS-21 will feature an extensive use of composites for its airframe, along with international



collaboration with Western avionics and equipment suppliers. Each month, Irkut also supplies 12 shipsets to Airbus of the fuselage keel section, nose-wheel bay and flap fittings for its A320 family.

A tour around the production facility led by Alexander Veprev, director general of the plant, was impressive. Already vast, and with an additional new production line being constructed for the MS-21, the entire plant was alive with industry and equalled or exceeded in terms of modernity and efficiency anything I have seen in Western Europe.

Aerospace Powerhouse

Overall, the Irkutsk plant gave me the impression of being an aerospace powerhouse, with British, French and German computer-controlled milling and manufacturing machines working day and night to make and finish panels and components from solid ingots of aluminium alloy, titanium and stainless steel. Su-30MK-series aircraft - with more than 200 delivered from 294 on order for foreign customers - and Yak-130s filled the packed, dedicated parallel facility line-bays. The last of these was in excess of 500m (1,640ft) long and contained more than 20 Yak-130s and 10-plus Su-30s ready to receive engines and avionics. More were parked outside

or in the flight-test hangar awaiting ground and flight testing.

It was clear from the tour and a 30min period of cockpit familiarisation inside the hangar that the Yak-130 I was to evaluate is a seriously modern design. The Yak-130's genesis has its roots in a Yakovlev technology demonstrator, originally called the Yak-130D, which was started in 1991 in response to a Russian Air Force future advanced trainer competition to replace the Aero Vodochody L-39.

Between 1993 and 1999, a joint venture with Italian training specialist Aermacchi continued to develop the aircraft which eventually became both the Alenia Aermacchi M-346 and the Yak-

130. Both look similar externally, but the M-346 I evaluated for Flight International in 2006 took the route of Western avionics and engines to become a pure advanced trainer. The Yak-130, by comparison, has become not only a similar advanced trainer but also a true combat trainer.

Embedded Simulation

This has been achieved using open-architecture digital aircraft avionics compliant with a 1553 databus, a full digital glass cockpit, quadruplex-channel digital fly by wire (FBW) with digital channel back-up, and instructor-controlled and variable FBW handling characteristics to replicate a heavy, medium or light aircraft



Irkutsk plant Director General Alexander Veprev (left) highlights production skills for types including the Yak-130

type and embedded simulation. However, the Yak-130 also has nine hard points: two wingtip, six under-wing and one beneath the centre fuselage. It can carry a wide range of modern weapons and other stores, including external wing combat fuel tanks, bombs weighing up to 500kg (1,100lb), TV homing/cockpit-displayed guided bombs, rockets, a twin 23mm gun pod, R-73 infrared-homing air-to-air missiles, electronic countermeasures pods and chaff and flare dispensers, up to a maximum combat load of 3,000kg.

The type also has a head-up display (HUD) and a helmet-mounted sighting system (HMSS) with a double GPS/GLONASS receiver updating a laser ring gyro inertial navigation system for highly accurate navigation and precision targeting.



(photo: Vladimir Karnozov)

This transforms its capability into a highly potent light ground attack/fighter.

Irkut is also proud that the Yak-130 is designed to be part of a new and complete systems-type training approach, which also includes computerised classroom and simulator training devices, in-built and straightforward upgrade and modernisation options for aircraft software/hardware, and an external, computer-controlled and fully networked, integrated logistical support service. The type's life-cycle costs are lower by a factor of four to six than training on two-seat versions of the RSK MiG-29 or Su-27. This combined approach to training, logistics and delivery is the same as in the West, but Irkut claims its Yak-130 package also has a significant price advantage in comparison with any other advanced jet trainer in its class.

The aircraft is powered by two Ivchenko Progress AI-222-25 full-authority digital engine control powerplants, producing a combined total of 11,000lb (49kN) of thrust and with in-built fire detection and suppression. The same supplier's -28 engine will now be offered, increasing total thrust to 12,300lb.

Normal take-off weight with a full internal fuel load of 1,700kg is 7,250kg, giving a thrust-to-weight ratio of 0.70 with the current -25 engines or 0.77 with the -28 engines. This compares with 0.65 for the BAE Systems Hawk 128 or 0.49 for types such as the Aero Vodochody L-159B.

Maximum fuel capacity with two external combat tanks rises to 2,600kg. True airspeed can reach 572kt/Mach 0.93 and service ceiling is 41,000ft (12,500m).

The airframe is stressed to +8/-3g and Yak-130 can sustain a 7g level at a corner speed of 450kt (830km/h) at about 3,000ft, or 6g at 10,000ft.

Typical take-off speed and distance in a clean configuration is 113kt and 550m (1,800ft), with landing figures of 103kt and 750m. Crosswind limit is 30kt. The wing leading-edge slats, take-off/combustion flaps and stabiliser trim are all scheduled automatically by the FBW system, with the landing flap and very large top-fuselage airbrake selected by the pilot.

Unpaved Runways

Other features include an on-board oxygen-generating system, an auxiliary power unit for electrical start of the engines, ground cockpit air-conditioning, and emergency airborne electrical power generation.

The Russian aircraft differs from the M-346 in being cleared for unpaved runway operations by using a combination of engine-intake blanking doors that are scheduled by the FBW system on the ground, top-intake openings, large ancillary inlet doors, a trailing link undercarriage and low-pressure tyres. Additional and smaller top-inlet doors set further aft also open automatically at high angle of attack (AoA) or low airspeeds in response to high-power engine air-intake demands. The aircraft has automated onboard self-diagnostic test systems to reduce the needs of technical support. The rear-seat instructor pilot, as in the M-346, sits high above the front-seat student pilot, inside a separated but massive

bubble canopy. Both crew members are protected by the K-36 zero-zero rocket ejection seat and a command ejection capability. Each canopy top-section is fitted with a miniature detonating cord to shatter the canopy to coincide with seat ejection.

My safety pilot was Yakovlev chief test pilot Oleg Kononenko, recipient of the "Hero of Russia" award - no peer pressure there then! I was to take the front seat and fly the complete sortie in the role of a military assessment pilot. My objective was to try to quantify the breadth of roles the Yak-130 could realistically fulfil across the needs of a 21st century air force.

Our test base was within the Irkut production facility, 12km northwest of Irkutsk city centre, using Runway 14/32 at an elevation of 1,470ft. Weather on the

day was cloud base at 600m, cloud tops at 2,000m, visibility 8km and wind 320/25kt gusting 30kt. QNH was 948hpa and outside air temperature 10°C (50°F).

Our test aircraft was serial 02 - registered 131 - the Yakovlev engineering test and display aircraft. It is representative of the production standard but carries substantial additional internal test equipment. With 1,600kg of internal fuel and eight wing pylons installed, our all-up weight, including two pilots, was 8,040kg, and the aircraft was to be flown primarily in the FBW "medium aircraft" mode.

My flying clothing was Russian, including an external g-suit and ZSh helmet, which featured the frontal bracket to hold a monocular HMSS, although this was not fitted for the sortie. The cockpit felt wide, comfortable, rugged yet modern, uncluttered and logically laid out, with large buttons that could be operated with a gloved hand and with all switches forward of the 3-9 pilot body line.

Cockpit Displays

The forward cockpit was dominated by three, side by side, 6in x 8in (15cm x 20cm) multifunction display (MFD) electronic screens on the forward console. These support the digital displays of typical flight instruments on the left screen, a tactical situation map/navigation in the centre, and simulated embedded radar, weapons and electronic warfare equipment and aircraft system synoptics on the right. These can be changed by the pilot, however, using menu push buttons.

With this layout, the electronically displayed area of the Yak-130's MFDs is almost twice as large as in the BAE Systems Hawk 128, which uses three 5in x 5in screens.

Above the MFDs was the central up-front data controller (UFDC) and above that, the HUD. At either side of the UFDC were the HMSS detectors for cueing the infrared-homing R-73 missile. As in Alenia Aermacchi's M-346, I liked the twin-engine throttles, which are mounted on horizontal runners on the left cockpit wall, leaving the lower left side of the cockpit console clear for other switch panels.

The hands-on throttle and stick (HOTAS) mimicked the latest MiG-29M2/35 types. The radar, HUD, weapon-select modes and airbrake switches were on the throttles, while weapon triggers

and flight mode-connected buttons were on the stick. Although aircraft 02 had a metric Russian digital cockpit displaying altitude in metres and speed in kilometres per hour, Irkut can supply the Yak-130 with a Western digital cockpit showing these in feet and knots, and customise the HOTAS and MFDs to replicate other frontline fighter types. This will be an important selling point for further exports.

Entry to the cockpits for my sortie was via a small ground platform, but the aircraft does feature separate, side-nose-fuselage, fold-out steps for each. After strapping in, I could turn to see the tips of the horizontal stabiliser, so I estimated that my lateral field of view was about 320° and therefore ideal for air-to-air combat training.

The ejection-seat arm mechanism was simple: with the metal seat handle folded forward and abutting the rear of the central stick, the seat was safe, while hinging it back into the upright position and clear of the stick showed it to be armed.

The canopy is side-hinged to the right, counter balanced and closed manually for simplicity and robustness. The engine start is electric – we used ground electrical power – and is sequenced automatically through both engines in turn by the selection of only one start switch.

After the start, the engines were held at 85% of N1 for about 90s while the FBW and ancillary aircraft systems were checked via the synoptic pages on the right-hand MFD. With navigation systems loaded, we were ready to taxi about 3min after selecting start. The FBW system automatically scheduled the take-off slats, flaps and trim, an enhanced feature for training and one essential for any fighter that can potentially carry a combination of weapons with such a wide range of weights and dimensions.

Automatic Scheduling

Nose-wheel steering, in low mode, is permanently active via the rudder pedals and with the high mode (taxiing only) selected by a button on the throttle. Normal, symmetrical wheel brakes are regulated via a hand-operated vertical lever on the front face of the stick. While this is effective, my preference will always be for rudder pedal-mounted toe brakes. Excess thrust during taxi at this configuration and weight felt high, with the need for regular wheel-brake applications.

On the runway line-up, the aircraft was held on the brakes at 90% N1 and released as the throttles were slammed to the forward stop. The FBW automatic scheduling of the engine-intake inlet doors and top-inlet doors to open on take-off and close on landing is airspeed dependent and completely transparent to the pilot and the delivered thrust.

Acceleration was very brisk, with the rotate started at 190-200km/h (103-108kt) about 12s after brake release and using roughly 800m of take-off roll. After the rotate, the aircraft was immediately pitched up into a 20-25° climb, power was reduced to 90% N1 and gear retracted to respect the gear limit of 400km/h. The flaps and slats were scheduled up automatically by the FBW system, with no apparent trim change. The aircraft was levelled at 3,000m and 400km/h.

Above 550km/h, the FBW is a g demand/limit control law, but below this, it blends into an AoA demand/limit control law. However, the transition between these is completely transparent to the pilot and the Russian-designed FBW felt flawless throughout the flight.

Control breakout in any axis was very small and stick centring (using springs) was strong - with a spring-type response, stick-free. Small stick inputs generated a highly accurate aircraft response and control harmony was excellent, with aileron to elevator forces close to the classic 1:2 ratio. In cruise flight with the gear up, rudder-pedal deflection only generated a flat-nose deflection but with no secondary roll effect. The massive, top fuselage-mounted airbrake (out or in) was highly effective and caused little vibration over the vertical fin.

Quadruplex System

If three channels of the quadruplex system are lost, the FBW will automatically revert to the digital back-up channel, which an instructor pilot can also select for use in training. Even in this mode, the aircraft still felt responsive and accurate in flight, unlike the basic and limited get-you-home system found in earlier-generation FBW fighters.

Quick assessments of the instructor-selected heavy and light aircraft FBW modes made evident changes in stick forces versus the medium-aircraft setting, but were still completely fighter-like in their overall feel.

Back in medium mode at 3,000m, the aircraft decelerated to low speed, wings level and, with the FBW in first-limiter mode, the aircraft was pitched up to limit at 25° AoA. This was combined with an audio warning, in English, of “AoA limit”. For more advanced training, a second limiter setting of 35° is almost double that of many other advanced jet trainers in this category.

In both modes, the Yak-130 features anti-spin protection. We climbed rapidly to 10,000m and with all FBW limiters off, I entered into a two-turn spin to the left from a level entry. The spin mode was very stable in both the pitch and yaw axis and had a moderately low yaw rate.

Recovery was instantaneous when I centralised the rudder and pushed the stick forward to around neutral. Pulling out with 4g, I levelled at 6,000m. This was the first time I had ever spun a FBW jet and it felt like a very impressive capability.

Apparent speed stability away from trim was quite strong, but the stick-top electric pitch trim was very rapid to negate out-of-trim forces. At 5,000m, the manoeuvre boundary at 600km/h was buffet limited at about 4.5g. Maximum roll rate was 160°/s, as specified by the Russian Air Force, but this can be set much higher if required.

Hesitation rolls were very accurate to stop and start at the 90° points. From a 550km/h entry speed, a 15° AoA loop took 1,700m of altitude to complete, but when maintained at 25°, took only 1,000m.

In addition to its other FBW safety features, the aircraft has a disorientation button to bring it back to wings-level from nose-high or nose-low situations. Both were highly effective.

Weather conditions prevented us from assessing the air-to-ground weapons modes, but the Yak-130 features an

automatic pull-out mode from a dive attack if the aircraft senses danger of ground collision.

Throughout the sortie, I flew the aircraft through the HUD, designed to be common with systems used on most Russian Air Force MiG-29s and Su-27s. It reminded me, somewhat, of the Panavia Tornado GR1. My only strong recommendation to Irkut, especially when it assesses upgrades for future export, would be to consider fitting the latest-generation wide-angle HUD - one that supports the latest wide display of flight, navigation and weapon symbology – as its potential deserves this.

HUD Directed

We recovered to Irkutsk, autopilot connected and HUD directed, for an ILS approach on to Runway 14. The aircraft has the impressive additional capability - as a fighter - to complete an autopilot-coupled ILS autoland. However, as a result of the tailwind conditions, the approach was converted from a low overshoot at 60m into two visual circuits then on to Runway 32, which I flew manually. Downwind speed was 300km/h, base turn 270km/h and final approach 250km/h, transitioning into 10° AoA for the final landing.

The pilot-selected final flap setting of 40° does cause a small amount of aerodynamic buffet over the horizontal stabiliser, but its effect is minimal. The aircraft was a joy to fly manually in the visual circuit, with accurate, soft touchdowns accomplished with ease. After a sortie lasting little more than 1h, we taxied in and shut down with 450kg of fuel remaining.

The opportunity to evaluate the Yak-130 was a personal revelation and I believe the aerospace industry is coming to the end of a period where aircraft have been subdivided as coming from the



Peter Collins after the flight

West or East. The design, technical and manufacturing skills on show in Irkutsk now equal those of Western Europe, and the far-sighted will embrace the possibilities this represents.

Some aircraft I have flown are good advanced trainers and some are good light-attack aircraft, but the Yak-130 comprehensively covers both roles with sophistication yet robustness, and docility yet potency.

Any air force commander would be delighted to have such a multi-role aircraft in his inventory; in part for the breadth of roles it can fulfil with competence and also because of its affordability and built-in digital future.

Russia has got the Yak-130 almost perfectly right and, for many countries, the training and fighter aircraft could come close to providing a one-type, 21st century air force.

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New Generation



The Dog Fight Is On

Richard Gardner looks at the increasingly tough air battle being fought in the world's defence market for advanced and lead-in fighter trainers.

After decades of successfully employing existing aircraft types to perform the functions of advanced jet trainers, lead-in fighter trainers (LIFT), tactical operational trainers and light fighter/ground attack platforms, the introduction of new generation front line combat aircraft with digital cockpits and integrated avionics systems has meant

that such existing generation of jet trainers has become obsolescent and in need of replacement. The latest multi-role combat jets, equipped with multi-function glass screens, helmet displays, and in some cases direct voice controls, offer pilots hugely expanded situational awareness in the cockpit environment. What has gone on before in terms of capabilities

of advanced trainers has, in most cases, been adequate, thanks to regular cockpit upgrades, plus increasing use of ground simulators, but this approach has not been sufficient to fully bridge the gap between elderly trainer platforms and the ever more demanding front line training needs.

However it is even more fundamental than this. In order to fully exploit the

LIFT



The BAE Systems Hawk

outstanding all-round performance of aircraft such as the Su-35, Rafale, Gripen and Typhoon, and in the not-too distant future, the F-35, pilots need to become fully immersed in not just the modern way of flying in fly-by-wire agile aircraft, but also how to use the platforms within a more integrated air operation, encompassing high levels of data transfer, target sharing and network centred command and control environments. This is rapidly becoming a whole new way of air warfare and the training for it has to start at the earliest stages possible so as to be efficient and affordable. This is why the time has come for air forces and naval air arms to bring their advanced trainers into line with what future pilots will need to do over coming decades. Then too, this has opened up a valuable new market for suitable air platforms that can offer a lot more than just easy handling and good cockpit visibility. The new products on offer provide a virtual air academy in the sky. In conjunction with advanced simulators and desk-top training tools, they are changing the very culture of flying training - and the battle has begun to secure the market.

Leading the pack

The most widely used advanced jet trainer in recent times has been the BAE Systems Hawk, which first entered service with the RAF in its T1 variant in 1976. Since then nearly one thousand have been built, with many

modifications and improvements along the way, including more powerful Rolls-Royce Adour engines, upgraded cockpit systems, strengthened airframe and provision for carrying air-to-air and air-to-ground weapons and a radar system. The US Navy adopted a navalised Hawk, featuring aircraft carrier-rated landing gear with provision for catapult launches and arrested landings, and assembled under licence by Boeing as the T-45 Goshawk, which remains the standard USN advanced jet/lead-in fighter pilot trainer today. Both Canada and Australia adopted modernised Series 100 Hawks, with glass cockpits and upgraded avionics suites. Many operators of earlier generation Hawks have subsequently upgraded their cockpits and avionics. An example is the Finnish Air Force, which has recently selected Esterline CMC Electronics and Patria to re-fit its Cockpit 4000 avionics package to 26 Hawks. This includes an open-architecture mission computer, wide-angle HUDs and multi-function display screens. HAL is now building a large fleet of Hawk Mk.132s for the IAF and Indian Navy after initial deliveries were made from the UK production line. Orders have been received, so far, in three batches and the type is expected to continue in Indian production through the next decade.

The Hawk Mk.128 version, known in the RAF as the T2, retains just around 10% of the original Hawk T1 structure and systems, but externally looks almost



Alenia Aermacchi's M-346

the same as other late Series 100 models. Designed with an all-new integrated systems architecture that will allow for easy future system upgrades or replacements, the new Hawk is planned to have a service life of at least 30 years. The T2 is being promoted in export markets as the AJT (Advanced Jet Trainer) and earlier this year 22 were ordered by the Royal Saudi Air Force to train Typhoon pilots. Even more recently, the Royal Australian Air Force has announced that it is to modernise its existing 33-strong Hawk Mk.127 fleet to bring all aircraft up to this latest 128/AJT standard. BAE Systems is currently conducting sales campaigns in the Middle East and Asia to sell AJTs as replacements for earlier Hawks and other older jet trainers. A major sales campaign is aimed at offering a variant of the AJT to meet a US Air Force requirement, known as the T-X, to replace its 50-year old T-38 jet trainers, but is up against strong competition.

The Hawk AJT's integrated mission system allows trainee pilots to use interactive synthetic data and image inputs to simulate a high proportion of advanced training and operational training scenarios. The Head Up Display is driven by a dual inertial navigation unit/GPS system and the pilot has at his disposal three large multi-function cockpit displays which include moving map and a simulated air-to-air radar pictures. This integrated system is just

part of a wider layered training approach that has created a complete interactive pilot training schedule. The sophisticated real-time datalinks enable pilots flying live training sorties to operate with other aircraft or simulated ones, with computer-generated tactical exercises allowing attack profiles, cross-country navigation and dog-fighting with cockpit display data provided just as if all the participants were real. Every aspect of the training mission is recorded and afterwards trainee pilots and instructors can de-brief to gain maximum value from the flight. This new way of advanced training starts in the classroom with each student having a Personal Learning Device, which gives access to all the course material and AJT system guides. This can be used with the Desktop Trainers for systems training and basic flight simulation. Therefore, students progress to the Flight Training Devices, which comprise three very large screens simulating a fast jet cockpit and a hand controller.

As well as "flying" this simulator, they also learn to interact with the mission system to become more familiar with navigation and some basic elements of tactical flying. The Full Mission Simulator (FMS) allows a very realistic full airborne mission to be practiced before the student goes on the first real training flights in the T2/AJT. By this time, all the flying, systems control and mission tactics will already be

very familiar, greatly reducing the time required for live flying training. This has the benefit of taking students to an advanced stage of training, quicker yet in more depth than before, but needing fewer repetitive flying sessions to achieve the training goals. This translates into less airframe hours flown and fewer training aircraft required. The re-configurable cockpit displays in the AJT can replicate the symbols, systems and procedures as found on the fourth generation combat aircraft they would shortly be flying, making the transition an easy step rather than a giant leap. This is the true value of a new generation multi-layered training solution.

A new winner

The Alenia Aermacchi M-346 dates back to initial studies in the 1980s which identified high thrust/weight ratios, great agility, digital flight controls and advanced avionics as key components in the next generation of advanced combat aircraft. It was clear that to provide a suitable training platform to prepare future pilots for such advanced combat aircraft, an optimised new trainer would require a shared philosophy and similar handling characteristics to these new fighters. The Russians were also thinking along similar lines, and discussions led to a joint co-operative agreement between Alenia and Yakolev to adopt the prototype Yak-130



The Yak-130

Irkut



as the basis for further development. The ultimate goal of the Italian manufacturer was to offer a new advanced trainer that could become the chosen common platform for a European-wide pilot training scheme, known as the Eurotrainer Programme. This aircraft would also become an attractive export product. While the *Eurotrainer Programme* became bogged down as governments failed to agree on co-ordinating joint requirements and the vexed question of funding such a large-scale scheme, Alenia pressed on with development as a private venture. Although it took the basic Yak-130 configuration as the baseline for its own M-346, the Italian trainer became a very different machine in almost every detail, with major aerodynamic and structural design changes, new engines, new avionics and flight control systems.

The M-346 is built around two Honeywell/Avio F-124 engines, providing a high thrust/weight ratio close to unity and a very agile performance, which is claimed to be closer to that of today's new operational fighters than any of its rivals. The M-346, like the latest Hawk, has at its heart an advanced integrated mission computer with embedded simulation replicating all the key systems and weapons of typical 21st Century operational fighters,

such as missiles and radar, even though these are not actually carried. However, the M-346 has a fully digital fly-by-wire control system which gives the trainer a very flexible flight performance capability representative of the handling of specific types of operational platform that will be flown by the trainee pilots when they have graduated. The quadruplex FBW controls, which have a high level of built-in flight envelope protection, can be re-programmed to give students a more challenging flying task as they progress through their training and the aircraft's aerodynamics and high thrust also give it a Mach 1.17 top speed, allowing transonic and supersonic handling to be experienced.

Alenia has struggled to get the M-346 launched onto the market after the first prototype flew in July 2004. The Italian Air Force upgraded its MB-339 trainers with new avionics and cockpit displays, so its launch requirement for a new advanced trainer was reduced considerably. Without endorsement from the manufacturer's own government, sales hopes might be dashed, so in order to give export prospects a boost, the Italian government eventually placed an order for 15 M-346s for the Italian Air Force. It was speculated that it may use some of them to re-equip the national aerobatic team, the *Frecci*

Tricolori, which would certainly expose the new trainer to a very wide high-profile audience, and might well increase export prospects. The first six Italian Air Force aircraft, with the designation T-346A, have now been completed and evaluation flights are now getting underway. The first export breakthrough appeared to come with the announcement that the UAE was to buy 48 M-346s, but over three years this commitment has failed to be converted into a firm order and in the meantime the Italian jet has received more tangible backing from the air forces of Singapore and Israel. The Republic of Singapore Air Force will take an initial two deliveries from a total of 12 aircraft on order before the end of this year. In July this year, Italy signed a contract with the Israeli Defence Ministry which will see a fleet of 30 M-346s delivered in a government-private partnership arrangement to be provided by Elbit Systems and Israeli Aerospace Industries. This package will result in the Italian-built aircraft being used to replace ageing Douglas TA-4 Skyhawk operational trainers. A slow starter, maybe, but Alenia's M-346 is a winner in performance terms and is now looking as if it is well placed to significantly increase its future share of the market for advanced and tactical mission training.

The Yak-130

So what happened to the original Yak-130? The answer is that it has developed along separate lines to the M-346, but has also been the subject of considerable development since it first took to the air in April 1996. While the Italian aircraft has firmly set its sales targets within the military communities seeking an advanced trainer, its Russian cousin (and rival) has broadened its own appeal so that as well as presenting itself as an all-round training introduction to the world of advanced fly-by-wire combat fighters, it is also itself a formidable ground attack and lightweight fighter. Russia has exported many examples of its impressive Su-27/30 and MiG-29 family of combat aircraft, and sees the Irkut Yak-130 fitting in well as a suitable advanced training vehicle for this class of fighter, and also a lead-in tactical mission trainer taking pilots closer towards operational status and conversion onto the combat types in squadron service.

There is nothing 'Cold War' about the Yak-130. It was the first all-computer designed Russian military aircraft back in the late 1980s and since then has emerged with a fully integrated open architecture avionics system, with three multi-function glass cockpit displays and digital fly-by-wire controls. Unlike the M-346, the Yak-130 is strictly subsonic, and also unlike the Italian jet, it is built as an all-metal aircraft (the M-346 has a high proportion of composite components). The mission computer and FBW software is re-programmable so the aircraft can fly with similar characteristics to selected operational types in Russian service. As well as replacing the venerable Czech-designed L-39 jet trainers in widespread advanced training service in Russia, the Yak-130 will over the coming years take on more pre-operational tactical training. The first training unit to re-equip with it took initial deliveries in 2009, but students did not get to start the new syllabus until 2011. Additional deliveries have increased the strength of the first training unit and so it should be fully equipped by the end of this year.

The suitability of the Yak-130 for a more aggressive war-role could be seen when the type was put on static display and also limited flying demonstrations during the recent Farnborough International Air Show.

What looked like engine intake covers caused consternation in the show flying control centre as at one stage officials thought the aircraft was attempting to take off with the engine covers still in place! They didn't realise that the Yak-130 has a unique double intake system which features main intake door baffles and auxiliary intakes in the mid fuselage which, with a built-in APU and low pressure tyres, allow operation from very rugged grass and gravel-covered airfields. The closing main intake doors protect the engines from Foreign Object Damage, such as small stones.

In an attack role, the current Yak-130 can carry 6,614 lbs of weapons on nine pylons, including a centrally-mounted twin barrel 23mm cannon pod. A more optimised single-seat attack version is under discussion, which might be put into production as a replacement for the Su-39 *Frogfoot* light bomber. This would have increased-thrust engines, more weapons and sensors, added pilot armour and a multi-function radar within a modified nose profile. Present Irkut production prospects envisage a market over the next few years taking a good share of perhaps 250 aircraft, some of which would probably be lead-in fighter trainers, with a dual operational role. Current Russian Air Force orders cover 55 aircraft following an initial 12. A naval trainer is another possible variant which may be developed later. So far, the only export customer is Algeria, which has taken 16, though the former Libyan government intended to take delivery of a batch, as does the embattled Syrian government. Bangladesh is said to be negotiating for 10. The Russian Rosoboronexport organisation is fully supporting efforts to promote the Irkut Yak-130 to a wider customer base and it remains to be seen if it can break into more traditionally Western oriented markets. (*See accompanying article on flying the Yak-130*)

High flying Eastern Bird

The KAI T-50 owes much to the Republic of South Korea's experience building the F/A-50 within a close relationship with Lockheed Martin, its partner on the two programmes. In turn, the F/A-50 incorporated much feed-back from the massive international success of the F-16 over a 30 year period, although

this new jet was an original Korean initiative and has helped KAI become proficient at designing and manufacturing a modern supersonic aircraft that is world-class. Making a debut at western air shows this year in Europe, Korean Aerospace Industries has developed its T-50 as a two-seat advanced and lead-in fighter trainer for the ROKAF, but is now seeking new export outlets. The national aerobatic team, *The Black Eagles*, made a big impression on UK audiences when it visited Britain during the past summer air show season, and at the Royal International Air Tattoo and RAF Waddington shows achieved 'Best Aerobatic Team' titles, a most honourable win, especially on the home territory of the famous RAF Red Arrows!

The T-50 has a genuine Mach 1.5 performance, which together with its advanced cockpit and avionics systems brings it closer to the flight agility, situational awareness, speed and general flying capabilities of front-line combat aircraft than any of its most immediate rivals. But as a "new kid on the block" KAI, even with the help and gravitas of defence giant Lockheed Martin, still has a sales mountain to climb before it can make a real breakthrough into this hard-fought global market. However, it may have an ace in its hand. The forthcoming USAF T-X advanced trainer competition could be worth orders for as many as 600 new aircraft. All would no doubt be assembled in the USA, but the close involvement of Lockheed Martin in the T-50 programme will help make a strong "Buy American" case when this competition approaches a conclusion. The competing BAE Systems and Finmeccanica bids will stress each company's US inward investment record for sure, but as the aerospace world has seen in the case of the USAF KC-135 tanker replacement competition, enormous domestic US political pressure can become the key issue, pushing other factors into second place. Little doubt that should the KAI-LM T-50 win the T-X competition, its fortunes in global export markets could be transformed overnight. In the meantime KAI is looking at possible shorter-term export prospects in Poland and the Philippines to keep up its sales momentum as deliveries to the ROKAF continue.

REQUIEM FOR THE HPT-32



An analysis of what went wrong and how the situation can still be retrieved

(Photograph by Peter Steinemann.)

The Indian Air Force began operating the HAL-designed and built HPT-32 as its basic trainer from the mid-1980s. These aircraft are powered by the Lycoming AEIO-540-D4B5 piston engine. Of 142 HPT-32s built, around 115 of these aircraft are currently in IAF's inventory but unfortunately the fleet has remained grounded since mid-2009. Grounding of the HPT-32 has caused great problems and severely impacted on flying training programmes of the IAF, leading the Government to take fast-track steps to import turboprop trainers to meet the urgent requirements of basic training.

During its operational history, the HPT-32 fleet has suffered several accidents and incidents which are of great concern to the IAF and the country. The vast majority of these accidents and incidents were due to irregular fuel flow to the engine. The fleet was grounded several times for investigation, modifications, rectifications, with both the IAF and HAL involved in addressing the problem until the 'final' grounding after a fatal accident on 31 July 2009 in which two instructors were killed.

It is reported that 77 engine stoppages in flight have occurred since induction of the HPT-32 and there were 15 fatal

accidents on type since its induction. Detailed reports on various accidents clearly reveal, and both IAF and HAL are clear, that the engine was not root cause of these accidents, but fuel starvation to the engine was so. Unfortunately erroneous reports have attributed these accidents to "engine failures" or "engine problems." It is understood that engine manufacturer Lycoming did not receive detailed investigation reports for all accidents or engine shutdowns, but was often involved, on invitation of HAL and IAF, to assist in certain investigations including the fatal accident in 2009.

Development milestones of the HPT-32



It was in November 1965 that Air Headquarters first proposed eventual replacement of the HT-2 primary trainer by a newer generation trainer and suggested that HAL undertake a feasibility study for its design, development and manufacture. Air Headquarters updated their ASR to “accommodate contemporary changes in the pattern of pilot’s training” in May 1971.

In October 1974, HAL were once again asked to carry out feasibility studies which they did under the leadership of SC Das then Managing Director (Design & Development) of HAL. Designated HPT-32, the new basic, piston-engined trainer was to be powered by a 260 hp Lycoming engine. Air Headquarters issued a revised ASR in February 1976 and at the same time the MoD sanctioned development of the HPT-32 on basis of the feasibility report submitted by HAL in 1975. Design & Development to full clearance was projected as 5 years and along with design of the aircraft, the development of an indigenous piston-engine, designated HPE-4, intended for both the HPT-32 and Basant ag. aircraft, was sanctioned.

Design work on the HPT-32 began in February 1976 by an enthusiastic and efficient team at Bangalore and first flight of the prototype (X-2157) was made by the CTP, Wg Cdr Inder Chopra (later Chairman) on 6 January 1977, three months ahead of schedule. Flight testing continued thereafter to identify some design changes which were necessitated to improve aspects of handling and spinning characteristics and the second prototype flew in March 1978, incorporating these changes. Air Headquarters were still keen on further changes and RMS orders were only placed for the first batch of aircraft in 1983.

Development of the HPT-32 had meanwhile continued with modified landing gears, canopy and wing tip changes, the second and third prototypes being the subject of a weight reduction programme, the latter test flown on 31 July 1981. Further orders for HPT-32s were placed by the IAF on HAL for delivery over 4 years to 1989-90 but well before this, a decision had been taken in January 1979 to transfer the HPT-32 manufacturing facilities to



the Kanpur Division, essentially because of the spare capacity available there. The first HAL Kanpur-built aircraft flew at Chakeri in March 1984 and orders from the Indian Air Force and the Indian Navy kept the lines busy of some years.

The HPT-32 certainly gained from the experience the Kanpur Division had accrued from new production techniques and technologies on the Dornier 228 light transport aircraft, concurrently being built there, and delivered the first HPT-32 (X-3224) with re-designed wing having integral fuel tanks in November 1994. The Transport Aircraft Division’s R&D Centre incorporated a number of other modifications, thus continually improving the HPT-32 including incorporation of modern flight instruments and avionics, re-design of the rear canopy, modified wing nose box, wing root fittings to treble fatigue life from 2250 to 6500 hours, redesigned and customised thin sheet metal components with composite materials, thus increasing TBO from 600 to 1000 hours and in doing so, increasing all up weight from 1250 kg to 1310 kg.

The Indian Air Force ordered a high-powered committee to examine the whole issue and Lycoming was involved in the investigation. Review of technical data showed that there were a high number of random fuel starvation issues with the aircraft. Independent testing by IAF and HAL had not been successful in identifying any specific cause, however, it was clearly established that the aircraft fuel system was unstable – but no fault could be found with the Lycoming AEIO-540-D4B5 engine.

During this study HAL invited Gippsland Aeronautics, Australia (now Mahindra Gippsland Aeronautics (MGA)) to examine the airframe fuel system and provide an upgrade proposal to them. MGA found that the HPT-32 airframe fuel system was not compliant with the latest FAR 23 design standards and then offered to develop a working solution quickly to modify the HPT-32 airframe to be compliant with FAR 23, and also to ensure correct fuel feed throughout the flight envelope. This working solution, however, has not yet been developed, but key points noted are that the collector tank mounted aft of the main tanks was proven to ingest air when flown more than 6 degrees nose down as the tank become higher than the wing tanks. The design of the collector tank was marginal and while it holds approximately 10 liters, only has less than 3.5 liters as “usable fuel”.

Next, the fuel feeds from the rear of the wing tanks and therefore a low fuel situation aggravated flow during nose down attitude. Further, fuel supply lines from the collector to the engine were inadequate. The line from the collector tank has several connectors and unions; the diameter of the fuel line after the filter reduces to only 5/16th inch, indeed very marginal. Finally, the check valves from the wing tanks to the collector have a history of “sticking” and restricting flow to the collector tank. These slider type large valves require some cracking pressure to open and are prone to malfunction owing to dirt or foreign objects. Asymmetric fuel flow from the wing tanks is a common feature in the HPT-32.

After the July 2009 accident, HAL took additional improvement actions and resumed flights in October 2010. After about 30 hours of flying, an aircraft

had an engine stoppage on ground and HAL/IAF grounded the fleet again. Although there are no specific reasons for this engine shutdown, the report mentions “fuel flow divider performance” as one of the probable causes. In this context it was noted that the entire responsibility of engine maintenance, since induction, rested with HAL which not only overhauled the engine as per schedule, but also overhauled the fuel flow dividers, something that even engine manufacture Lycoming does not do. According to a Lycoming spokesman, fuel flow dividers should be overhauled by the manufacturer of the fuel flow divider, which is Precision Airmotive (PAM).

As per the records, a total of 126 engines were supplied by Lycoming to HAL from 1985 to 1995, Lycoming field engineers visited HAL every year until 2010 to provide support to the operators even beyond contractual obligations or commercial considerations.

It is learnt that, in January 2011, or some 26 years after shipping the first engine to HAL, Lycoming again deputed experts to work with HAL and the IAF, visiting both Bangalore and Kanpur for HPT-32 fleet recovery work.

After the January 2011 visit, HAL, IAF and Lycoming reportedly signed a joint summary statement indicating that the flow divider was not the root cause of the problem which contradicted the information noted during the October 2010 engine shutdown case. However, the manufacturer continues to pursue the flow divider as the significant contributor but does not send flow dividers to the OEM for servicing or overhaul.

The January 2011 visit was followed up with a visit by the Senior Vice President of Lycoming who reportedly held extensive discussions with HAL and IAF officials. Lycoming teamed up with HAL and IAF to develop a comprehensive ground test plan to validate performance of the aircraft fuel system and to ensure that the required liquid fuel supply to the engine was sustained. Apparently Lycoming once more strongly recommended that HAL should stop overhauling fuel system aggregates like the fuel injector and flow divider.

HAL has been modifying the aircraft systems over the years with the main thrust being on the fuel system. Several improvements like fuel return systems from servo to collector tank, baffle seals, EDP shroud, etc. have been installed, with some changes in flying protocol of landing back with certain minimum fuel being introduced.

The ground testing, as advised by Lycoming, was completed by HAL late in 2011, the ground test conducted at seven degrees descent angle, as the aircraft fuel system was most vulnerable at this attitude. HAL provided ground test data and Lycoming provided an engineering evaluation after reviewing the first and second ground test data, along with executive summaries of the October 2011 and February 2012 evaluation.

Despite detailed testing, exchange of data and evaluation, and consistent recommendations, HAL reportedly again asked Lycoming to establish acceptance criteria for HAL-overhauled flow dividers. Lycoming has repeatedly discouraged HAL from overhauling the flow dividers and fuel injectors, as even Lycoming does not do this and it remains unclear why HAL is hesitant either to procure new fuel aggregates or send existing aggregates to the OEM for overhaul.

It is understood that HAL and Lycoming have together completed six of the eight-step practical problem solving process which needs to be tested initially on the ground and then in the air, so as to verify effectiveness before implementation of full HPT-32 fleet recovery.

Even at then stage, the IAF could well rehabilitate the HPT-32 on the flight line by modifying a few aircraft to FAR 23 standards, as recommended by MGA, with Lycoming refurbished (or new) engines and PAM refurbished (or new) fuel injectors and flow dividers. The modified aircraft could be put through extensive ground and flight tests to fine tune the solution before adapting it for the entire HPT-32 fleet. This would make tremendous economic sense and also immediately address the IAF’s disruption of basic flying training within the shortest period of time.

Analysed by Vayu team with inputs from the Industry



Indian Air Force Hawk Mk.132 on the runway threshold at Bidar.

Rolls-Royce: Building on Relationships

“Placing complete responsibility for the management of one of your most important strategic assets is a bold step for any military force to undertake in peacetime. When a conflict situation breaks out this model is tested to the extreme and you must have complete trust in your partner to deliver assets when and where you need them.”

This is the essence of Rolls Royce’s availability-based support which company has these MissionCare contracts in place with most of the UK Royal Air Force’s (RAF) fleet powered by Rolls-Royce engines. Such contracts use a jointly incentivised approach to servicing where the emphasis is on maximising the number of engines available to fly and reducing the cost of support.

The contract to support the RB199 Tornado fleet began in 2005 and delivered a

50 per cent reduction in operating costs while consistently delivering the required level of engine availability to meet all mission requirements. However, in 2011 engine repair and overhaul work was transferred to the Rolls-Royce facility in Bristol – and within weeks the RAF’s Tornado fleet was flying combat missions in support of the UK’s Operation Ellamy over the skies of Libya. This led to a huge spike in flying activity and put the recently commissioned engine pulse line to the test.

Air Vice Marshal Simon Bollom, Director Combat Air for the UK’s Defence Equipment and Support organisation, said that despite the demands of flying combat missions from bases in Afghanistan, Italy and the UK concurrently, Rolls-Royce met 100% of its availability targets with the RB199, thus delivering a commitment to have operational engines available on an

aircraft within two hours, and delivering six RB199s a week.

“Without the back-shop support, none of that could have happened or been sustained,” Bollom said. Nick Durham, Rolls-Royce President for Customer Business, further explains “The customer placed a tremendous amount of trust in our expertise and capabilities in transferring engine responsibility to us. We proved that we could deliver against their normal requirements and that we could surge our capability level when the engines were needed most.”

Similar MissionCare contracts are already in place with several engine fleets in service with all branches of the armed services in the United States and the company is now looking to extend such benefits further into the 160-strong customer base.

Advantage for India

“We have a huge fleet of installed engines around the world and we are offering customers like India the opportunity to talk to us about what might work best to deliver a similar range of benefits for their engine fleets,” says Nick Durham. “Rolls-Royce has an excellent track record of developing successful partnerships and this is probably the key to establishing the required support capability around the world.”

new support programmes that draw on our experience, technologies and data and can deliver major improvements in capability and affordability to the Indian Armed Forces.”

Rolls-Royce is also devoting the same levels of innovation to further developing its servicing model as it does to developing new engines. President of Defence Services, Paul Craig, describes the next steps of an evolutionary journey:

can offer real-time support to operations across the globe, including Rolls-Royce engines in service in India. These can often offer critical technical advice that can keep aircraft available for missions.

However, Rolls-Royce is now looking beyond traditional propulsion support and into other areas where its capabilities can bring real benefit to the customer, such as fuel management and engine health monitoring.



Rolls Royce support team with frontline RAF Typhoon squadron.

Rolls-Royce believes that this new approach to engine-support, may also be of great advantage to India.

“India is a very important country for Rolls-Royce. We have one of the longest relationships here in the Defence industry going back to 1933 when we powered the very first squadron of the Indian Air Force.” says John Gay, Senior Vice President - Customer Business. “In addition, we have also been working closely with HAL for over 50 years so we have strong relationships. We are already in tune with our customers’ requirements and ways of working which makes us confident of being able to offer

“The MissionCare contracts are a step beyond the traditional services contracts where we just supplied spare parts and are an adaptation of the model that our colleagues in the Civil business had developed to support engines in service with the world’s airlines.

“We have also looked to leverage techniques and technologies developed in our other business units as we look to further expand the level of services we can offer to our military customers.”

Defence customers are now able to call upon the engine data and expertise held in Operations Centres based in the UK, Germany and the United States that

“We could go still further, offering support arrangements that combine engine and platform information and, at the top end, effectively provide enterprise management expertise, helping customers analyse and streamline their operations.” says Nick Durham.

“You have to have a good relationship and a high level of trust between both parties to enable an honest and effective dialogue to take place and to really reap benefits; and that is where we believe our longstanding relationships in India can help to deliver real value to the customer.”

SQUALL AT 100 FEET *



Vishnu Som of NDTV recently flew Dassault's Rafale "Superfighter"

*** The Dassault Rafale ('squall' in French) is a twin-engine delta-wing fighter aircraft designed and built by Dassault Aviation, described as being an omnirole fighter with semi-stealth capabilities. The Rafale is capable of simultaneously undertaking air supremacy, interdiction, reconnaissance and the airborne nuclear deterrent missions (Wikipedia).**

“We will now enter the yellow potato.”

“Excuse me?,” I ask Sébastien Dupont de Dinechin, a Rafale test pilot, otherwise known to his fellow pilots as 3D.

“Yes, look at the Head Level display, we enter the area which looks like a yellow potato and then we ‘pickle’ the weapon.”

“And then what?” I ask.

“And then we go home. The target no longer exists.”

I wonder - could modern air warfare really be as simple as this?

What 3D and I have been doing is thundering over the French countryside, at ultra-low altitude, in a state of the art Dassault Rafale, pride of the French Air Force, deep over



Vishnu Som (right) being briefed by Sébastien Dupont de Dinechin (3D) before the Rafale flight at Istres.

imagined enemy territory to a pre-selected target which we have now destroyed.

The yellow “potato” 3D is referring to is a graphical outline located in a high resolution display which we were both looking at as we commenced our attack - 3D in the front cockpit, me in the rear. Once “inside the potato,” well before we are physically close to the target, 3D depresses the trigger on his control stick, and an imaginary 2000 pound laser guided bomb ‘separates’ from the wing of our jet and follows pre-programmed GPS-based coordinates to strike the target with pin-point precision.

If this were a real conflict, 3D and I would be at a stage of our sortie fraught with danger: the enemy has

been alerted to our presence and we need to escape, evading ground based surface to air missile batteries and airborne fighter jets.

But we have a friend. 'SPECTRA' is her name.

Built into the Rafale fighter, SPECTRA is widely considered the world's most advanced fighter-based electronic warfare suite, a system which is the cornerstone of the Rafale's survivability against a host of the latest threats. SPECTRA is designed to detect threats and provides a multi-spectral threat warning capability against hostile radars, missiles and lasers. By detecting threats at long-range, SPECTRA allows the pilot to instantly select the best suited defensive measures combining radar jamming of ground and airborne radars and the deployment of infrared or radar decoying flares and chaff. In a best case scenario, SPECTRA would enable 3D and I to safely exit hostile airspace.

But not on this occasion. We have been detected. A lone enemy Mirage 2000 is trying to position itself behind us to get off a shot with an air to air missile.

Except we have the advantage.

The Rafale's RBE-2 Active Electronically Scanned Phased Array Radar (AESA), the heart of the Rafale's weapons system, is at the cutting edge of aviation technology. It detects targets at greater ranges and with far more accuracy than anything the Mirage has to offer. Capable of simultaneously targeting multiple enemies in the air, the RBE-2 AESA has a fixed plate in the nose of the Rafale filled with T/R (transmit-receive) modules which fire electronically steered radar waves across a huge expanse of the sky ahead, above and below us.

But the Mirage pilot is no rookie. His own electronic warfare suite would have told him he is up against a formidable threat and right now, he's manoeuvring to get outside the Rafale's kill zone. We manoeuvre as well but this isn't quite your Battle of Britain seat-of-your-pants flying experience. In fact, we can't even see the enemy with our eyes but he's there alright, his location clearly outlined on our heads-up-display which is now providing 3D a firing solution for his Mica beyond-visual-range air to air missile.

In just a few moments, 3D gets a SHOOT indicator on his head-up-display.



In the Rafale cockpit

There is no time to waste. A trigger press later, an imaginary Mica air to air missile blasts off one of the Rafale's wing pylons and begins tracking the enemy Mirage.

But wait. There's a problem. The Mirage has disappeared off our radar!

Will our 2 Million Euro Mica air to air missile miss its mark?

Hang on! There he is, back on our display once again!

"Are we launching another missile?" I ask.

"No" says 3D quickly providing the missile revised targeting data through a high-speed data link which points the Mica missile in the right direction so it can intercept the enemy Mirage. In moments, the Mica missile's own radar seeker goes 'active' by detecting the enemy jet.

The Mirage 2000 jinks around the sky in a last ditch effort to evade the Mica missile. But the writing is on the wall.

Notch that up as another kill for the Rafale.

We decide that's enough work for one day. Its time to head home without any further detection.

Now over the sea, the Automatic Flight Control System is activated to Terrain Following Mode and we drop to a sea-skimming altitude of 100 feet.

3D feels the need for speed and lights the afterburner, accelerating from a speed of 250 knots (463 kilometres per hour) to 600 knots (more than 1111 kilometres) in less than 20 seconds.

Its all incredibly impressive stuff as we return to our 'home-base,' Istres, near Marseilles in France.

Missions like what I experienced on my sortie on the Rafale are a snap-shot of what the Indian Air Force will be able to do in the not-too-distant future. The Rafale is the winner of the IAF's Medium Multirole Combat Aircraft (MMRCA) competition and was shortlisted by the IAF after coming up tops in the flyoff against the best fighters the US, Russia, Sweden and a European consortium had to offer. Dassault, the manufacturers of the Rafale are presently in top-secret negotiations with the Defence Ministry to arrive at a final price among a host of of details bound to accompany what has been labelled the world's biggest defence deal, easily worth more than 15 billion dollars for 126 jets.

Its not that the simulated mission I flew was extraordinary. Not at all. Ground attack and air-to air missions have been bread and butter operations of any competent Air Force since the First World War. What makes the Rafale experience different is the level of automation, the incredible man-machine interface and the highly fused sensor suite the French top gun employs. In simple terms, the Rafale does the same job with more precision and safety for the pilot.

Over the last few years, I have had the opportunity of flying a dozen odd sorties on some of the world's greatest fighter

aircraft including 4 of the 5 jets the Rafale had to beat to win the Indian Air Force's comprehensive trials conducted across the country. While each of the competitors, whether the Boeing F/A-18 Super Hornet (USA), the MiG-35 (Russia), the Gripen NG (Sweden), the Eurofighter (European Consortium), or the F-16IN (USA) are formidable platforms, the Rafale came out tops in perhaps being the most capable fighter in its present state of development.

An out and out 9 g fighter capable of dog fighting with the best of its lighter single engine rivals like the F-16, the Rafale also retains the ability of lifting 9.5 tonnes of ordnance for missions across the spectrum of operations in air warfare including nuclear strike. The Rafale can conceivably engage enemy fighters, strike ground targets and fire an anti-ship missile at a warship all in the same mission. With air to air refuelling and support from airborne early warning radars, the Rafale has demonstrated its ability in being at the forefront of international campaigns.

In March last year, pilots of the 1/7 Squadron based in St Dizier, not too far from Paris, flew a 9 hour long mission into Libya, in the first wave of attacks against Moammer Gaddafi's armed forces.

Using secure high-rate data links, Rafale fighters in the early days of the conflict were able to receive intelligence images and video real-time through a system called Rover (Remotely Operated Video Enhanced Receiver) from friendly forces on the ground. Using this information which was also shared with Intelligence analysts onboard AWACS

jets, Rafale fighters were instantly vectored to new targets. Using a combination of its Damocles laser designation pod, which can mark targets for laser guided bombs and its Front Sector Optronics system which provides high resolution images, pilots were able to accurately identify and hit targets at long ranges.

The 'hitting' itself was done, quite frequently, by a remarkable new munition, the AASM, a rocket boosted air-to-ground precision guided weapon, called the SBU-38 'Hammer' by NATO. Using the Hammer, Rafale pilots were able to designate upto 6 independent targets and hit all of them simultaneously. All the pilot needed to do was to 'pickle' (depress the trigger) once for the release of all 6 bombs. An incredibly versatile weapon system, the Hammer, it was seen, even had a robust capability against moving targets, an unprecedented capability for a weapon of its class.

For me, personally, the sortie on the Rafale, a rare privilege for a civilian, came out of the blue. With Rafale winning the IAF competition, there was really no need for Dassault the manufacturers of the jet, to make a statement in the Indian media. It was quite an honour then to be invited, a project that we at NDTV felt quite keen to take on.

I have flown on French fighters in the past as well. In fact, during the Kargil war, I was invited by the Indian Air Force to fly rear-seat in the very same Mirage 2000 which had hit Pakistani bunkers on Tiger Hill with laser guided bombs a few weeks earlier.

The Rafale was designed to ultimately replace the Mirage 2000 providing an incremental step up in capability compared to the older French fighters. Even though hundreds of Mirage 2000s have been upgraded over the years, the jump in capability from the Mirage to the Rafale has to be seen to be believed.

One of the most impressive technologies on offer in the Rafale is the advanced terrain following system which allows the jet to skim the surface of the earth using the Automatic Flight Control System (AFCS). Operational in two modes, the AFCS, allows the pilot to conduct a fully automated attack run ("hands off the controls") using either digital terrain following or a radar terrain following mode. With digital terrain following, the AFCS manoeuvres the Rafale over terrain (hills, valleys, peaks) based on a three dimensional map database which is pre-programmed into the AFCS software. An even more reliable way of coming in low to hit a target (or to escape) is by using the radar terrain following mode of the RBE-2 AESA radar which scans the terrain ahead and safely flies the jet over all obstructions before resuming nap-of-the-earth operations.

3D demonstrated both modes to me during my sortie including a hair-raising ultra-low level run over the sea at no more than 100 feet at a speed nearing 500 knots (926 kilometres per hour). This was, quite clearly, the most thrilling experience I have ever had on any fighter jet I have flown, far more thrilling than



Taxiing out from Istres

the gravity-defying “thrust-vectored” manoeuvres I have experienced on the latest generation of Russian fighters such as the Sukhoi Su-30 or MiG-35.

Racing over the Mediterranean, 3D tells me, over the Rafale’s voice-activated intercom, “Look Vishnu, no hands.” I look forward to see 3D’s raised hands in the front cockpit. He clearly isn’t kidding!

“At this altitude and at this speed, its safer for the radar to fly the plane than me” explains 3D. Just then, the Rafale banks to the left following the pre-programmed heading fed into the Rafale’s auto-pilot system, an even more incredible experience. For the next several seconds, I am overwhelmed by the sensation of the sea, now less than thirty metres from me, staring me in the face as we flash past. The Rafale suddenly levels out and then banks to the right, giving me another peak at this other-worldly experience.

We wrap up this part of the sortie with a high G manoeuvre, going straight to 8.5 G, which feels like being weighted down by 8.5 times one’s body weight.

I have been up to 9 G several times in the past but, in my experience, anything beyond 6 G is just painful. But its always a challenge, and I certainly wasn’t about to let go of the opportunity to experience 8.5 G onboard the French superfighter.

As we neared 8 G, at the apex of a sharp vertical climb, I began sensing the onset of a grey-out, with peripheral vision slowly disappearing. As the G forces increased, and my vision became a touch blurry, I realised I couldn’t be too far from a black-out (caused by blood racing from the head to ones feet). But high G manoeuvres like this last just a few seconds and soon we were back to straight and level flight.

To deal with the onset of high Gs, all pilots on the Rafale (like all fighters) don a G suit which slows down the flow of blood from the head during a high-G manoeuvre through the inflation of air into bladders around the waist and legs. However, unlike some of the other fast jets I have flown on, a chest extension to the G-suit (which squeezes the pilot’s chest to reduce the flow of blood to the legs) is optional - the angle of the ejection seat on the Rafale ensures that G forces can be dealt with effectively with only a standard G-suit kit.



After the sortie!

After a one hour, twenty five minute sortie, 3D guides our Rafale back to Istres, the landing speed of the jet significantly lower than what I have experienced on jets such as the American F-16. With a touch down speed a little over 200 kilometres per hour, the Rafale actually feels as if it were hanging in the air, particularly after all the high speed runs we had been doing all afternoon. This is a boon for pilots, particularly as they try to land on shorter runways. Engaging auto-throttle during the final approach to land, once the landing gear has been deployed, ensures that both airspeed and the angle of attack needed to come into land are automatically taken care of, the Rafale landing without any fuss whatsoever.

For me, the sortie on the Rafale was a dream come true, a chance to experience, first hand, a platform the Indian Air Force rates as the best fighter of its class in the

world. When the Rafale eventually enters frontline squadron service with the Indian Air Force (assuming negotiations actually end up in a contract), the IAF may well become the most potent Air Force in the world this side of the United States, all within the next 15 years. Flying a mix of Russian Sukhoi Su-30 heavy fighters, PAK FA stealth fighters being jointly developed in Russia and the Dassault Rafale, the IAF’s fighter fleet will have formidable capabilities - covering the entire spectrum of offensive and defensive air operations.

(Vishnu Som, NDTV’s Editor Documentaries, is an aviation enthusiast who has flown and reported on a range of fighter jets around the world. This article first appeared on www.ndtv.com)

Vishnu’s earlier article ‘Almost a Fighter Pilot’ appeared in Vayu’s Issue V/2010.

All photos from Dassault Aviation



Vishnu Som : ace fighter pilot!

Rivetting the Relationship



USAF and IAF aircrew with C-17 Globemaster III at Leh on 22 June 2010.

Boeing's connection with the Indian Air Force

When the first Boeing C-17 Globemaster III heavy airlifter of No.81 Squadron, IAF lands at Leh airfield in Ladakh, it would have been almost exactly 65 years since the first Douglas C-47 Dakota of No.12 Squadron, IAF flew into Leh. The connection ? Read on !

The past seven decades have witnessed the Indian Air Force's transport sinews strengthen and expand in a manner that could hardly have been earlier envisaged. The Dakota

barely carried two tonnes of load, or 20 troops, staggering over the high mountains to land at Leh, 11,554 feet above sea level. The Globemaster III can lift 75 tonnes of payload or 188

troops, seamlessly soaring over the Great Himalaya before descending to land at Leh, that same airfield but now much expanded and with a considerably longer runway and infrastructure.



Douglas C-47s of the Indian Air Force at Leh, circa 1948.



Part of the massive hangar at Long Beach, California, 'Home of the C-17 Globemaster III'

There is longevity in the relationship between Long Beach in California and the Indian Air Force. Through its merger with McDonnell Douglas, Boeing has had a long historical connection to Long Beach, California and thus with Indian aviation, both military and civil. Donald W. Douglas, founder of the Douglas Aircraft Company, had taken over the Long Beach facility in 1940 on the eve of World War II, having run out of production space at the Douglas plants already operating in Santa Monica and El Segundo in California. Production at the new facility began in June 1941 and there was no looking back.

Long Beach has spawned over 15,000 aircraft of all types, including the DC-3, DC-8, DC-9, DC-10, MD-80, MD-90 and MD-11 and B-717 commercial aircraft, as well as military aircraft as the famed C-47 Dakota (military variant of the DC-3), the B-17 (in co-operation with Boeing), the A-20, A-26, C-74, C-124, A-4D, C-133 till the present C-17 Globemaster III heavy airlifter.

In April 1967 Douglas Aircraft Company merged with McDonnell Aircraft Company, forming the McDonnell Douglas Corporation. Shortly after this, the tri-jet DC-10 made its first flight from Long

MAN (and) POWER of the C-17

The standard cockpit crew is two pilots plus one loadmaster to operate the C-17. This cost-effective flight crew complement is made possible through the use of an advanced digital avionics system and advanced cargo loading systems. In the cargo compartment, the C-17 can carry wheeled vehicles in two side-by-side rows. Three combat-ready infantry-fighting vehicles comprise one deployment load. One main battle tank (eg. the M1 class), can be carried.

The C-17 is powered by four Pratt & Whitney PW2040 series turbofans, designated as F117- PW-100 by the USAF, each producing 40,440 pounds of thrust. The engines are equipped with directed-flow thrust reversers capable of deployment in flight. On the ground, a fully loaded aircraft using thrust reversers can back up a 2 percent slope.

Beach which began a successful twenty-year production run with passenger, cargo and military operators. In 1985, with production programmes imminent for the DC-10, MD-80, MD-11 and C-17, McDonnell Douglas expanded the Long Beach plant by 2 million square feet, including a 1.1 million square foot C-17 assembly hangar, office buildings, storage facilities and sub-assembly buildings. The C-17 would go on become one of the premier military airlifters of the 20th century and is still produced in Long Beach today.

In August 1997, McDonnell Douglas merged with The Boeing Company in a \$16.3 billion deal and Douglas Aircraft Company, which was the commercial airplane manufacturing segment of McDonnell Douglas, was renamed as the Douglas Products Division then renamed as the Long Beach Division, of Boeing Commercial Airplanes in August 1998. Now, over 70 years after it first opened, the Long Beach facility continues to produce aircraft, serving as the final assembly site for the C-17 Globemaster III, although activity is getting somewhat diminished compared to peak years in the 1980s and 1990s and there are uncertainties about the C-17 production line beyond 2014.

First C-17 for the IAF

Vayu was specially invited by The Boeing Company as part of a select media visit to various facilities of the Company : the first part of this visit is covered in this Issue.



Air Commodore Sanjay Nimesh, Air Attache at the Indian Embassy in Washington DC, with rivet gun.

On 31 July 2012, at a ceremony within Boeing's massive C-17 Globemaster final assembly hangar at Long Beach in California, the Indian Consal General at San Francisco, N Parthasarathi along with Air Attache Air Commodore Sanjay Nimesh, senior Boeing officials and California politicians participated in the

'major join' ceremony, pneumatically driving in rivets to symbolically signal final assembly of the IAF's first C-17 Globemaster III ('India 1').

The forward, aft and centre fuselage and wing assembly were being co-joined, so to speak, inspiring Parthasarathi to proclaim that "we are practically riveting together the relationship between the United States and India". More forceful was the local Congressman Dana Rohrabacher of California's 46th district who pulled no punches when he stated that the C-17 was providing "most important ally India" the means to "defeat the forces of evil", specifically naming "radical Islam" and Pakistan's support of it as also a China which is "an adversary rather than of a friend". Rohrabacher is well known for his outspokenness and has recently moved a bill in US Congress seeking self determination for Baluchistan.

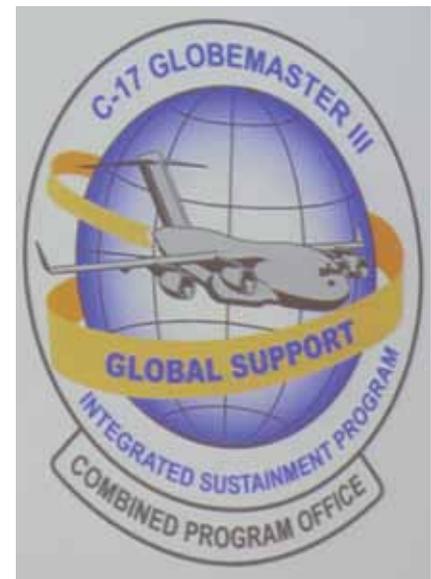
Actually, the key issue in Long Beach is the looming closure of C-17 production in 2014 should further orders not be forthcoming as this will impact local employment. By July 2012, Boeing had delivered 245 C-17s, most of these to the US Air Force which deploys them at 12 air bases but also to the RAF, RAAF, RCAF, Qatar, UAE and the 12-nation strategic airlift consortium of NATO. The

Indian Government ordered 10 C-17s for \$ 4.12 billion to be delivered in 2013-14 but may augment this by another 6 aircraft after the first batch has "demonstrated capability and reliability". This means that any additional Indian orders will be confirmed at the earliest on in early-2014 which brings it rather close to end of the production line.

The IAF's first C-17 will make its maiden flight in December 2012 with hand over to the IAF scheduled for January 2013 for "shake down flights" with the first two aircraft then flown to India in May 2013. Ten sets of IAF flight crews (two pilots and a load master each) are currently receiving conversion training with the USAF at Altus AFB in Oklahoma.

The GISP

The C-17 GISP is a public/private agreement designed around the concept



The C-17 Globemaster III Integrated Sustainment Programme (GISP)



Robert P Ciesla, VP Airlift and C-17 Programme Manager Mobility welcoming the gathering at Long Beach on 31 July 2012.



C-17 production serial 253 is first for the Indian Air Force ('India 1')



Mr N Parthasarathi along with Air Commodore Sanjay Nimesh and Indian Air Force team after the ceremony.

of performance-based logistics where the customer pays for readiness, not specific parts or services. Under the agreement, Boeing is responsible to the U.S. Air Force Product Support Manager for integration of all C-17 sustainment activities, including material management and depot maintenance support. The partnership capitalises on Boeing's expertise with Air Force depots to ensure readiness levels that meet the warfighter's needs.

The U.S. Air Force has partnered with Boeing on C-17 sustainment since the delivery of the first aircraft in 1993, transitioning to a system-level



Main wheels of 'India 1' landing gear : the C-17's landing gear system consists of a single nose strut with two wheels and two twin-strut tandem gear assemblies, one per side with three wheels per strut.



'Stars and Stripes' with 'India 1' : symbolic of the increasing military relationship between India and the USA.



The first time : C-17 Globemaster III of the USAF at Indian Air Force base Kalaikunda, June 1995

performance-based contract in 1998. International customers also use GISP for support, and include the Royal Air Force, Royal Australian Air Force, Royal Canadian Air Force, Qatari Emiri Air Force, the NATO Consortium (Strategic Airlift Capability), The United Arab Emirates Air Force and now the Indian Air Force. The U.S. Air Force recently approved a 10-year Justification and Approval (J&A) request for Boeing to provide continued, sole-source lifecycle support to the C-17 from FY2012 through FY2021. The current GISP agreement is a one-year contract (FY2012); subsequently, a five-year (FY2013-FY2017) contract

period will begin while FY2018-FY2021 remain as four one-year options.

A first-of-its-kind experiment in multinational airlift began in July 2009 with formal commissioning of the NATO-managed Strategic Airlift Capability (SAC) and the unit's first Boeing C-17 at Papa Air Base in western Hungary. A Boeing team provides total support for the three SAC C-17s, including flight line maintenance, materiel management and depot maintenance support, a first for Boeing GISP, providing total support for a customer's entire fleet.

The GISP programme has become a model for the future of sustainment.

Boeing is held accountable to achieve sustainment performance metrics and is paid accordingly. Boeing has supply support management in place for more than 95 percent of reparable parts on the C-17. The contract requirement of 87 percent parts Issue Effectiveness (delivery rate) is continuously exceeded. For the period of FY2004 to FY2011, GISP supply chain management achieved an average of 90 percent delivery rate for these assigned reparable items.

Boeing is responsible for supply support, supplier management, technical manual support, maintenance, modifications and upgrades, logistics



Dramatic photo of C-17 Globemaster III taking off from a short airstrip in the mountains.



Crowds in awe: C-17 Globemaster III of the USAF at Yelahanka during Aero India 2009

engineering services and field support services. Boeing personnel come into contact with the aircraft every day in the field, working alongside Air Force personnel to keep the C-17 fleet flying, with the best availability in airlift history.

On 6 October 2011, Boeing and the U.S. Air Force formally opened a combined programme office (CPO) at Robins Air Force Base, Ga. The CPO serves as GISP headquarters; on-site leadership includes the Boeing vice president/program manager for GISP. Other locations, including Huntington Beach, Calif., and San Antonio, provide GISP logistics, support and maintenance services.

In Indian Skies

The C-17 Globemaster III is no stranger in Indian skies. The first time this heavy airlifter came to India was in May 1995, to commemorate the 50th anniversary of the 'Over the Hump' operations in the Assam, Burma, China (ABC) theatre. The aircraft (0603) belonged to the 17th Airlift Squadron of the 437th Airlift Wing at Charleston AFB, South Carolina. Amongst the distinguished group on board were World War II veterans including some of the original 'Flying Tigers' fame. That C-17 flew into Delhi on 26 May

1995 and after ceremonies at India Gate, departed to Kalaikunda and thence to Dum Dum (Calcutta) before 'Flying over the Hump' to Kunming in China. Amongst the three Indians specially invited was *Vayu's* editor (see *Vayu* Issue III/1995).

In the years thereafter C-17s of the US Air Force have participated at various air shows at Yelahanka before being formally evaluated by the Indian Air Force in June 2010, with flights to Leh and various IAF advanced landing grounds where its remarkable short field performance was demonstrated. On a particularly hot day that summer, when the current IAF fleet was virtually grounded, the C-17 demonstrator carried a load of 30 tonnes to Leh with aplomb. The C-17 also flew in and out of the short airstrip at Gaggal in Himachal Pradesh with its 4620 foot runway at an elevation of 2525 feet.

In support of the IAF

A major aspect of India's C-17 purchase is the "performance based logistics" contract that the IAF has signed with Boeing, which binds the latter to ensure that some 85% of the C-17 fleet is always available and ready for operations. Boeing will position appropriate spares and maintenance personnel for this, drawing not just upon

depots in the USA, but as part of a "virtual fleet" that includes the six other forces that operate the C-17.

As Mark Angelo, Director C-17 GISP informed the visitors from India, this "single system process supplies 5 USAF Commands and 7 International Air Forces" and will include India. "The C-17 virtual fleet innovation is a true force multiplier. The C-17 base at Hindan in India is being set up, with supplies and equipment streaming in from Robin AFB, USA. Some 19 personnel will be running the facility at Hindan, including many recruited from India (mostly ex-IAF technicians for engineering support and field services. The objective is to maintain an average serviceability of 85%).

The C-17s will be based at Hindan Air Force Base, just north of Delhi where they will join the C-130Js of No.77 Squadron. The choice of 'creating' a No.81 Squadron for the C-17s is somewhat bemusing as this has no obvious logic especially when there are two transport squadrons number plated for several years, one of them (No.19) having a particularly distinguished record in war and peace. If a new squadron was to be raised (for reasons best known to the IAF and MoD,) this could well have been No.100 (there exists No.101 Squadron onwards)!



The Indian Air Force at 80

Formation of the Indian Air Force



The very first Indian Cadets at RAF Cranwell with their flight instructor (right to left) Subroto Mukerjee, Jagat Tandon, Bhupinder Singh, Harish Sircar, Sqn Ldr M Thomas DFC, AFC, Amarjit Singh and Aiyad Baksh Awan.

Archived from Document IOR : L/MIL/ 17/5/1800, India Office Library, London

The intention is to form one squadron of Indian Air Force officered and manned by Indians. In the initial stages officers are being provided from the Royal Air Force, to be replaced gradually as Indian officers become available. Other rank personnel are found partly by direct recruitment and partly from the R.I.A.S.C.

Officers and men of the IAF are subject to the Indian Air Force Act, India. Future recruitment of men for technical trades will mainly be carried out through the R.I.A.S.C. (M.T.) Training Establishment. This scheme will retard the intake of other ranks into the IAF for some time but beneficial effects of it on the squadron will be felt in subsequent years.

The Peace Establishment of the Squadron has been published on Royal Air Force Instruction No.35/1937.

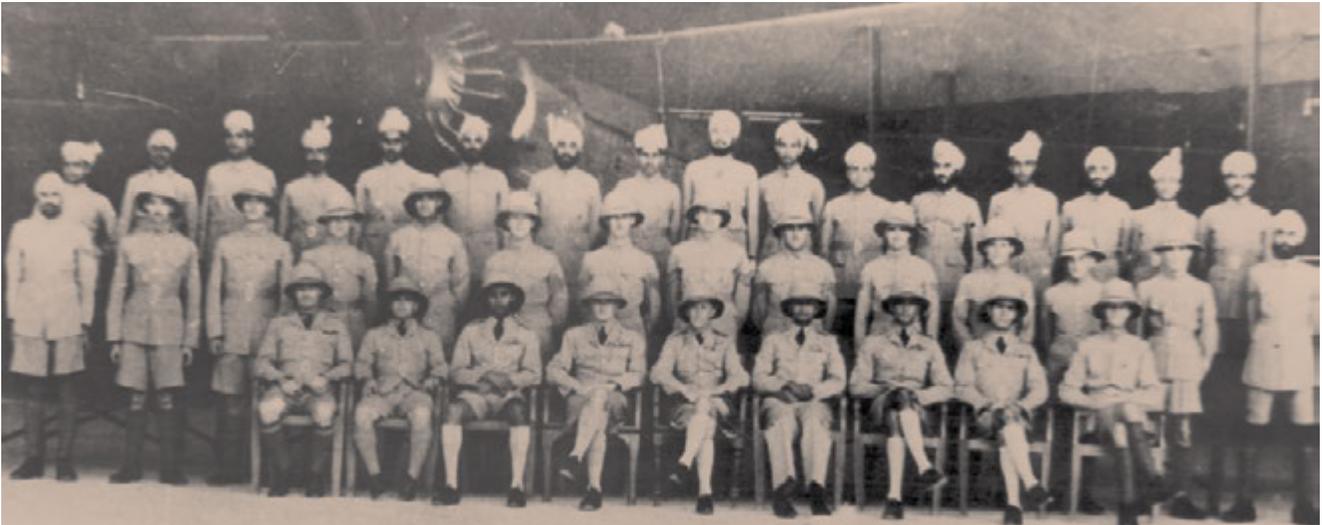
Officers : Cadets for training at the RAF College, Cranwell are selected by the Federal Public Service Commission, India after a competitive examination. Indian Commissioned Officers (ICOs) of the Indian Army are also eligible for secondment to the Indian Air Force. Selected officers will be seconded for a period of 4 years (the first years of which will be spent in flying training) on completion of which they will be retained to their present unit.

Seconded officers will be granted temporary commission in the General Duties Branch of the IAF as Flying Officers, with honorary rank corresponding to any relatively higher army rank held. They will receive IAF rates of pay and will be eligible for lease under rules in force of officers of the IAF.

Officers are granted commissions on Indian Commissioned Officers in His Majesty's Indian Air Force. The Commissions are issued in the name of His Majesty the King Emperor and are signed on His Majesty's behalf by the Governor-General.

Rates of pay for IAF officers :

Pilot Officer	Rs. 385 pm (consolidated)
Flying Officer	Rs. 465 pm (consolidated)
Flight Lieutenant	Rs. 570 pm (consolidated)
Squadron Leader	Rs. 880 pm (consolidated)
Warrant Officer, Class I	Rs. 135 pm
Flt Havildar	Rs. 140 pm
Hawai Sepoy I	Rs. 85 pm
Hawai Sepoy III	Rs. 55 pm



'A' Flight of No.1 Squadron at Drigh Road : Flt Lt C Bouchier of the RAF at the centre with IAF officers and Hawaii Sepoys.



For the first time together as No.1 Squadron, inspection of Wapitis at Ambala.

After completing their course at the Royal Air Force College, Cranwell, Officers are attached to British Units in England for a period of six months. The course at Cranwell lasts for 1 ½ years.

On being commissioned officers receive a free issue of a revolver. Binoculars are held in unit charge and are issued on loan to the Officers when required.

Provision of Aircraft and Equipment

It is anticipated that by April 1940, the Squadron will be sufficiently trained to require its full complement both of initial and of reserve equipment. The provision of aircraft and equipment has therefore been spread over the financial years 1934-35 to 1939-40.

Mechanical Transport : At present IAF flights utilise the mechanical



The approved insignia of No.1 (Army Cooperation) Squadron, IAF.

transport of the RAF Station to which they are attached. This is unsatisfactory as it affects the mobility of the flights as well as the RAF Squadrons with which they are located. A proposal is under consideration to provide the necessary mechanical transport as the IAF develops.

Location of Flights in early 1938

- 'A' Flight – Peshawar
- 'B' Flight – Drigh Road

The following moves are contemplated in April 1938

- 'A' Flight – Peshawar to Ambala
 - 'B' Flight – Drigh Road to Peshawar
 - 'C' Flight – To form at Drigh Road
- The final aim is to locate the Squadron Headquarters and three flights at Ambala.

Avi-Oil



The Indian Air Force at 80

The Inheritance



Spitfire Mk.XIV in the 'Chakra' markings briefly adopted by the RIAF.



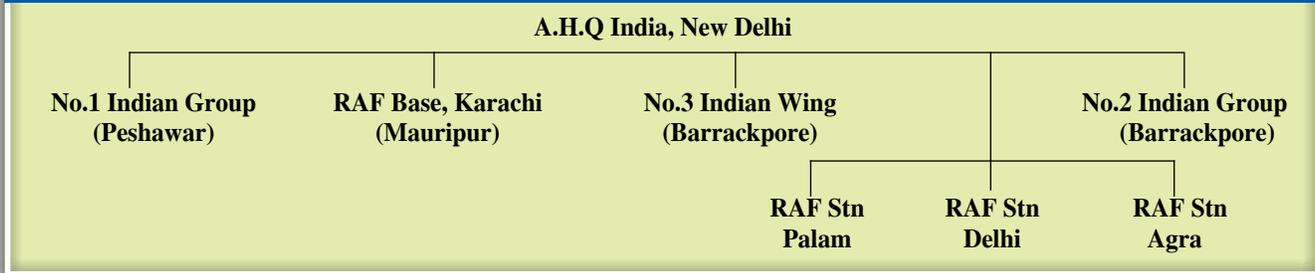
Tempest Mk.IIs, also in Chakra markings before delivery to India.

Inventory of aircraft in India, summer of 1947

Anson XIX : 19	A/c required by RAF, ferried to Middle East to replace Anson XII/XIX
Auster V : 26	None required and those not required by GOI to be handed over to DG for disposal.
Auster VI : 20	Already agreed to be handed over to GOI (9 May 1947)
Dakota I : 5	Accounting to AHQ India, on 9 June 1947 153 Dakotas held
Dakota II : 13	All these a/c which include 5 VIP Dakotas (KG 507, FD 879, KG 723, FL 542 and KG 765) are to be withdrawn from India.
Dakota IV : 153	The difference between 153 held and 171 shown on Indian return on 10.8.1947 represents a balance due for return to the FLC against 219 Dakotas offered for leasing as surplus to RAF represents. It must be emphasised with no Dakotas are now surplus, RAF requires these all must be withdrawn.
Harvard II B : 148	Comprises 110 lend lease a/c and 38 Mutual Aid a/c : 82 lend lease Harvards being transferred to GOI together with 37 of Mutual Aid. The balance of 28 lend lease Harvards are offered to FLC for disposal and are Mutual Aid a/c struck off charge.
Hurricane IIC : 1	Not required by RAF; to be transferred to GOI
Oxford I : 9	Not required to be withdrawn, therefore available for transfer to GOI
Spitfire LF VIII : 61	12 a/c earmarked for sale to Afghan Government, balance available for transfer to GOI. If Afghan project does not materialise, these 12 also to GOI.
Spitfire PR XI : 3	Not required by RAF – a/c to be transferred to GOI
F.XIVe : 39	All Spitfire XIV a/c reported by AHQ (I) as being in poor condition.
FR XIVe : 75	No requirement for these a/c in RAF and financial authority sought to declare the a/c surplus to MoS for disposal. A/c can, therefore, be offered to GOI at disposal rates.
Spitfire F XVIII : 30	Arrangements made to return these a/c to UK
Spitfire FR XVIII : 69	AM signal OOX-4914 8th May refers.
Spitfire PR XIX : 14	Surplus to RAF requirement. Financial appeal sought to dispose : a/c can be handed over to GOI at disposal rates
Tempest Mk.II : 166	These a/c required by the GOI for mounting of RIAF units; GOI has accepted offer vide AHQ (I) signal 3 May 1947.
Tiger Moth II : 164	These a/c required by GOI
Vengeance IV : 7	To be transferred to the GOI
IV II : 14	
York IC : 1	This is the Viceroy's a/c (MV 102) and is to remain HM property and withdrawn from India when no longer required.

As listed above, the independent Government of India was cleared to receive 278 Spitfires (all marks), 166 Tempest IIs, 148 Harvard II Bs, 164 Tiger Moths and miscellaneous types.

Reorganisation of AHQ, India



Ground personnel of No.15 Squadron with Spitfire Mk.XVIII at Ambala.

With phased reduction of the RAF in India and reorganisation of the RIAF, following changes are notified :

No.229 Group

Will be disbanded w.e.f. 31 March 1947 and its commitment undertaken by No.1 Indian Group.

It is now the intention to place all RIAF units under two Indian Groups and thus necessary to transfer certain RIAF operational stations and squadrons in Nos. 2 and 3 Indian Groups into No.1 Indian Group w.e.f. 1 June 1947. Similarly, RIAF training units and certain maintenance administration units previously located in Nos 1 & 3 Indian Groups have been transferred to No 2 Indian Group w.e.f. 1 June 1947.

Units under No.1 (Indian) Group w.e.f. 1st June 1947

RIAF Station Risalpur
 RAF Station Peshawar (becomes RIAF Stn after No.5 Squadron moves)
 RIAF Station Poona
 RIAF Station (C&M) Ranchi
 RAF Stn Chaklala
 No.1 Sqn RIAF Peshawar
 No.2 Sqn RIAF Poona
 No.3 Sqn RIAF Risalpur
 No.5 Sqn RAF Peshawar (moving to Agra 30.06.47)
 No.7 Sqn RIAF Risalpur
 No.8 Sqn RIAF Poona
 No.9 Sqn RIAF Peshawar
 No.10 Sqn RIAF Chakeri (lodger unit, under 2 (I) Gp Stn)

No.12 Sqn RIAF Chaklala
 No.659 AOP Sqn RAF : Peshawar, Razmak, Deolali to be nationalised and stationed at Poona, Peshawar and Lahore.
 No.3 P.T.S. Chaklala
 HQ No.1 (I) Gp Comm Flt Peshawar
 No 42 Flt P&SS Peshawar (to reform as No.2 (Ind) Flt P&SS w.e.f. 1 July 47)
 No.2 Target Towing Flt RIAF Poona (on number plate basis w.e.f. 15 April 47)
 Air Support Control Unit Peshawar
 No.1 Demob Centre Lahore (disbanding 30.06.47)
 No.1 Hill Depot Lower Topa
 RIAF Stn (C&M) Kohat to disband July 47
 No.42 Flt P&SS Lower Topa

Units under No.2 (Indian) Group w.e.f. 1 June 1947

RIAF Stn Ambala : Advanced Flying School
No.2 EFTS Jodhpur
ITW Coimbatore
No.2 S of GT Tambaram (to be renamed No.2 GTS w.e.f. 1.6.47)
No.3 S of GT Hakimpet (to be renamed No.1 GTS)
Medical Training Centre Hakimpet (Functionally controlled by Air HQ)
Nav & Sigs School Tambaram
RIAF Depot Arkonam
RIAF Record Office Red Hills Lake (functionally controlled by AHQ (I))
RIAF Central Accounts office Red Hills Lake (functionally controlled by AHQ (I))
No.322 MU Chakeri (functionally controlled by AHQ (I))
No.1 Aircraft Repair Unit RIAF Lahore (functionally controlled by AHQ (I))

No.2 Equipment Depot RIAF (functionally controlled by AHQ (I))
No.341 (X) MU Pulgaon (functionally controlled by AHQ (I))
No.344 (X) MU Kasu Begu (functionally controlled by AHQ (I))
No.1 (Ind) Flt P & SS Bangalore (functionally controlled by AHQ (I))
No.3 (Ind) Flt P & SS Lahore (functionally controlled by AHQ (I))
HQ No 2(I) Group Comm Flt Yelahanka
AMES Tambaram (to be transferred to No.1 Group control on arrival at Risalpur)

Reduction of No.3 Indian Group to Wing Bases

The three IAF Groups were originally organised on a geographical basis corresponding with areas of the three Army Commands. It has now been decided to depart from this principle and to retain instead two Indian Groups, one controlling all operational squadrons and units and the

other responsible for the administration, training, and maintenance organisation of the RIAF. With introduction of the new system, No.3 Indian Group becomes redundant, first reduced to Wing basis w.e.f. 1 June 1947 (No.3 Indian Wing will remain in being till its remaining units are disbanded).

Units of No.3 ((Indian) Wing on 1 June 1947

302 MU (C&R) Manauri
325 (X) MU Jamalpur
313 MU Kankinare
RAF Hospital Cawnpore, disbanding 1 July 1947

Units of No.3 (Indian) Group to be transferred :

RIAF Stn Ranchi (C & R) to HQ No.1 (I) Gp w.e.f 31.05.47
No.10 Sqdn RIAF to HQ No1 (I) Gp w.e.f 31.05.47
(Lodger unit of HQ 2 (I) Gp at 322 MU Chakeri)



Ground personnel of No.3 Squadron with Tempest Mk.II at Poona.

Withdrawal of the RAF from India

* Air Ministry Mission proceeding to AHQ India on 18 July 1947 on temp. duty to advise and assist in certain aspects of the planning and implementation of the withdrawal of the RAF from India, led by Gp Capt LC Dennis.

* The staging posts at which HMG would wish to secure user rights are Mauripur, Palam, Poona, Dum Dum, Jodhpur, Allahabad, Ranchi, Ahmedabad, Bangalore, Hakimpet and Car Nicolar.

* Assume that the RAF withdrawal from India is to be completed by 31 December 1947, movement and shipping programmes to be co-ordinated with the Army.

* Officers and families to be repatriated earliest.

RAF Base, Karachi

Formed w.e.f. 1 June 1947 under direct administration and operational control of AHQ (I) to take over responsibilities of HQ No.1 Indian Group in respect of RAF under Karachi and, so No.1 Group can concentrate upon controlling all RIAF squadrons in India. (except Nos 301 and 320 MUs function under control of AHQ India).

Units comprising RAF Base Karachi

No. 301 MU, No.320 MU, No.1 Target Towing Flt, No 48 (Staging Post), Mauripur

Nos.10 and 31 Squadrons RAF (Dakotas)

No. 6 Squadron RIAF (until transferred to RAF Stn Palam) also with Dakotas

No. 43 Flight P & SS

SHQ Mauripur Dett, Jiwani

Transfer control of certain RAF units

To enable nationalisation of Nos.1 & 2 Indian Groups to proceed without hindrance and to facilitate the rapid disbandment of No.3 Indian Group AHQ (I) has assumed control of certain RAF units which are not required to back the RIAF. Consequent to the above, following units transferred from No.3 Indian Group to the control of AHQ India w.e.f. 15 May 1947 :

RAF Station Palam

No.34 (PR) Squadron
AHQ Comm Squadron
309 MU

In addition, following units transferred to RAF Palam;

No. 59 Staging Post, Nagpur for No.2 Indian Group, 31 May 1947, No.38 Staging Post Dum Dum from No.3 Indian Group 31 May 1947.

RAF Station, Agra

No. 5 Squadron RAF with Tempest IIs (to move from Peshawar to Agra w.e.f. 30 June 1947)

No. 20 Squadron RAF with Tempest IIs

RAF Stations Worli, Tambaram, Kolar, Yelahanka, Bhopal

B.P.O Bombay

B.A.O. Bombay

No. 337 MU Avadi

No. 305 MU Bombay

No. 312 MU Cochin

No. 343 (X) MU Whitefield

No.343 (X) MU 'C' Flt Gumnidipundi

No. 318 (X) MU Jubalpure

No. 344 (X) MU 'D' Flt Nowshera

No. 330 MU Poona

No. 44 Flt P & SS Bombay

Air Force Wing Combined Op Establishment Madh Island

RAF Signals Centre Bombay

No. 2 Demob Centre Jalahalli

No. 8 Hill Depot Wellington

Hydrogen Compressor Unit Bangalore

No. 2 BPU Bombay

No. 4 BSD (C & M) Tambaram

IATC Units (24 at various Universities)

[Issued by Air Commodore G Harcourt-Smith, Director of Organisation, 26 June 1947]





The Indian Air Force at 80

1953 : the last AOC Conference at Air Headquarters under the last C-in-C seconded from the RAF



*Sitting : Air Vice Marshal Subroto Mukerjee, Air Marshal Sir Gerald Gibbs C-in-C, Air Commodore AM Engineer AOT&ES
Standing : Air Commodore DAR Nanda AOP & O, Air Commodore Arjan Singh DFC AOC No.1 Operational Group and
Air Commodore RHD Singh AOC No.2 Training Group*



The Indian Air Force at 80

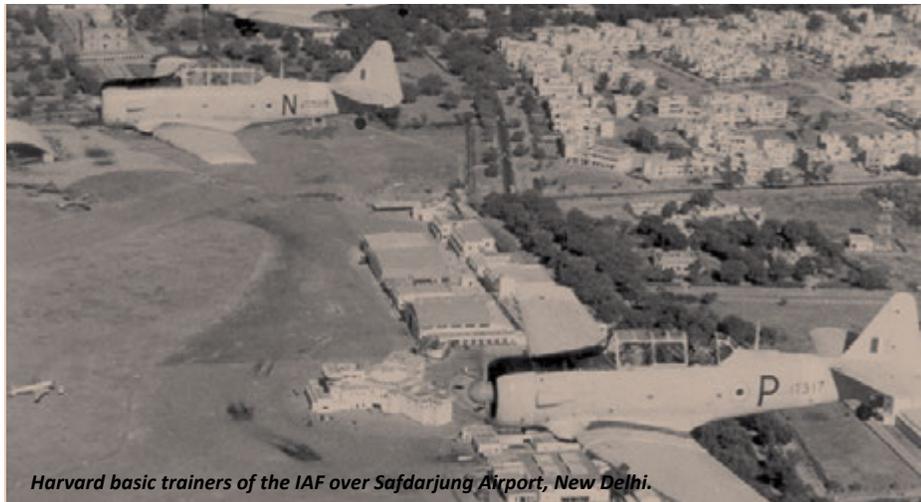
TRAINING TO FLY : 1947-2012



Tiger Moth elementary trainer of the IAF

The IAF had inherited a world war-tested flying training system in August 1947, although most of its permanent training establishments were 'left behind' in the newly-born state of Pakistan (Risalpur, Kohat, Chaklala). New IAF training bases were soon up and running and the expanding IAF got into its training stride, young cadets doing their initial flying at Jodhpur with advanced and multi-engine flying training at Begumpet and Hakimpet, near Hyderabad. Advanced Flying Training was at Ambala.

The fledgling flyers would first get airborne on dH Tiger Moths, move on to T-6G Harvards before being streamed off to fly fighters (via the Vampire T.55) or transport aircraft (the ubiquitous C-47 Dakota) and this pattern continued very well indeed for nearly two decades as the IAF steadily expanded and modernised its fleet with an array of jet fighter types (Ouragan, Mystere IVA, Hunter) and augmented the transport fleet with C-119 Packets, DHC-3 Otters, Ilyushin Il-14s and Avro 748s through till the 'seventies.



Harvard basic trainers of the IAF over Safdarjung Airport, New Delhi.



Vampire T Mk.55 of the IAF at Palam Airport



Tiger Moths at the Flying Training School, Jodhpur, circa 1955

Creating the Directorate

The proposal for creating a Directorate of Training at Air Headquarters (India) was sanctioned in 1942 and started functioning in 1943. But the year 1947 brought in its wake the trauma of the India sub-continent's division. Whilst in India's share came six fighter and one transport squadrons, Pakistan received two fighter and a transport flight. The training establishments which came to India's share on 15 August 1947 were the Initial Training Wing, Coimbatore; Elementary Flying Training School, Jodhpur; Advanced Flying Training School, Ambala; No.1 Ground Training School, Jalahali and No.2 Ground Training School, Tambaram.

One of the important achievements of the then RIAF was that within the very first two years of independence the entire flying training staff was 'Indianised', first to do so among the three Services.

The budding Air Force never got a chance to really settle down since almost immediately after independence, it was involved in operations against the Pak Army and infiltration in Kashmir. One impact of these operations and subsequent hotting up of the Punjab and J&K borders was that flying training had to be hastily shifted to the South, converting Jodhpur and Ambala into operational bases. The flying training schools continued to operate from makeshift bases till finally the Air Force College was established in the '70s.

In 1949, to build up the technical and maintenance staff, the Government entered into a contract with Air Service Training Limited, Hamble, UK, to establish and operate a technical college at Jalahali for training technical officers of the IAF. Consequently, the Air Force Training College (AFTC) was established in July the same year. By 1956, the entire teaching staff which hitherto consisted of foreigners was substituted by Indians.

Today, the major responsibility of imparting training rests with Training

Command of the IAF, headquartered at Bangalore. Localisation of flying training is however particularly dense around Hyderabad which can rightly be called the "cradle" for IAF pilots. Incidentally the civil aviation also runs a flying training establishment at Hyderabad (Begumpet).

The Air Force Academy

Plans to establish an Air Force Academy to fulfil the long term IAF training requirements were germinated in the mid-1950s but the acquisition of a



HALs HT-2 elementary trainer which replaced the Tiger Moth.



Line up of HAL HJT-16 Kirans at the Air Force Academy, Dundigal



suitably located, large site posed a problem. Apart from releasing the base at Jodhpur, where the Air Force Flying College (AFFC) had been established in 1957, for operational use, the establishment of a permanent Air Force Academy was necessary to bring together training of various categories of personnel, including pilots, navigators, signallers and non-technical Ground Duties officers, whose training establishments were spread across a thousand miles from Jodhpur to Begumpet and Coimbatore.

In 1966, the State of Andhra Pradesh made available to the IAF 6,000 acres (2428 hectares) of land near Dundigal village, 22 miles (35 km) from the twin cities of Hyderabad and Secunderabad, in an area characterised by rolling meadows, seasonal lakes and, above all, excellent flying weather. The site was adopted for development as the home of the AFA and the foundation stone was

laid by the President of India in October 1967, and construction proceeded rapidly. Phase I was completed in three years and the Air Force Flying College element arrived from Jodhpur on 12 December 1970. On 16 January 1971, the Air Force Academy was formally inaugurated and the very next day No. 107 Pilot Training Course began with T-6G Harvards.

Thousands of aspiring IAF pilots trained on the Harvard, this classic trainer serving with the IAF for 33 years before being phased out in the summer of 1975. At the AFA, Harvards were initially tasked for the intermediate flying phase, each flight cadet being given 85 hours on type before proceeding to the Vampire for advanced training or, after 1975, to the Kiran. An experimental, all-through jet course on Kirans was conducted in parallel with Harvard training in January 1974 before the indigenous trainer fully supplanted all Harvards a year later.

Basic Trainer Aircraft

Hindustan Aeronautics Limited (HAL) designed and built the piston-engined Hindustan Trainer 2 (HT-2) in the 1950s, which were employed for Stage I training till replaced by the Hindustan Piston Trainer 32 (HPT-32) in the 1980s.

As the HPT-32s were not available in sufficient numbers at that point in time, the IAF temporarily switched to all-jet

aircraft and pilots with disconcerting regularity. Finally in August 2009, after losing 17 aircraft, 19 pilots and Rs 160 crore on account of recurrent engine failure and in deference to the opinion of the CAG that “the HPT-32 was technologically outdated and beset by flight safety hazards”, the two-decade old fleet was abruptly grounded, leaving the IAF with a major crisis on its hands with no easy or quick solutions.

the urgent requirement of IAF, HAL sent out numerous Requests for Information (RFI) to foreign aerospace companies for collaboration in design and production of a basic turboprop trainer. Unfortunately, HAL has squandered the opportunity to develop a new aircraft of its own. After a “fast track” process of evaluation, selection and contract finalisation, the Swiss-origin Pilatus PC-7 Mk.II will fulfil

The Pilatus PC-7 Mk.II has been selected to meet the IAF's urgent BTA requirement.



training at Stage I on the Kiran jet trainer. However, this measure was neither cost effective nor professionally sound yet the IAF accepted the compromise as HAL had already begun series production of the HPT-32 and its availability in the near future “was certain”.

Unfortunately, the HPT-32 was afflicted with serious problems since its inception and there were no lasting solutions. The IAF had no option but to endure losing

As the service life of an aircraft can be predicted with reasonable degree of accuracy, there should already have been a clear plan in place for an indigenous aircraft to replace the HPT-32. Despite some dialogue that began between the IAF and HAL over six years ago for replacement of the HPT-32, as of now there is little progress to show in the proposed HTT-40 project, which was ‘launched’ in mid-2009. In response to

the immediate requirement of a basic training aircraft (BTA), the first batch scheduled to be received early in 2013.

Intermediate Jet Trainer

The HJT-16 Kiran jet trainer fleet has been in service since the early 1970s and its replacement should have been streaming in by now. Unfortunately, the HJT-36 Sitara Intermediate Jet Trainer programme, sanctioned as replacement for the Kiran, and one which began on



Second prototype of HAL's HJT-36 intermediate jet trainer at Aero India

a promising note, has for one reason or the other, not been making satisfactory progress. Considering that this is a basic aircraft with conventional technology, the inordinate delay in its development, which can prove to be detrimental for the training of the fighter pilot stream, is neither understandable nor acceptable.

HAL currently has an order for 12 Limited Series Production (LSP) IJTs, originally expected to be delivered to the IAF in 2010. But with reports of the new AL-55(I) engine encountering teething problems, this could have a cascading effect

and push deadlines for operational clearance, further aggravating the discomfort for the IAF as the Kiran fleet continues to reduce.

Advanced Jet Trainer

For Stage III training, the MiG-21FLs of MOFTU have given way to Hawk Mk.132s of the Hawk Operational Training Squadron (HOTS). For various reasons, however, the Hawk programme did not move forward at the desired pace. To address the urgency of inducting advanced jet trainers in sufficient numbers, the IAF had even begun exploring options for fast

track acquisition of another 57 aircraft for augmentation of the Hawk AJT fleet.

Even while the IAF was scouting for AJTs with foreign vendors, HAL initiated a project for development of an indigenous AJT to be positioned between the Hawk and the Tejas LCA in terms of size and weight. Designated as the Combat Air Trainer (CAT), it would have been all-composite construction, twin-engined configuration with a glass cockpit, modern avionics, capable of transonic speed with secondary combat capability. The project did not go beyond the concept stage.



During the final stages of AJT evaluation, the BAE Hawk competed against the Aero L-159 (also seen in this picture at Aero India).

“Robust and Responsive Training”



Indian Air Force fighter pilots and the MiG-29.

Then AOC-in-C Training Command, IAF, Air Marshal VR Iyer, had this to state in his address at the Seminar on ‘Training to Fly : Options and Systems in its 21st Century’ in February 2010.

As air forces modernise their fleets to meet new security challenges as well as look after their nation’s vital interests, pilot selection and training regimens to fly newly-equipped aircraft

must also be upgraded. The IAF is currently embarked on modernising its inventory with the induction of 4th and 5th generation fighter aircraft. These aircraft, along with other support

weapons will be linked and operated in a network centric environment. This will help compress the operational time cycle and the sensor-to-shooter loop. There would be a surfeit of information flow

into a cockpit and pilots would need to be trained to process this information and make quick decisions in order to achieve the mission objectives more precisely and efficiently.

Pilots are becoming more like system managers and tactical decision makers rather than just flyers, as in the traditional sense a few decades ago. It is against this back drop that the selection procedures and initial training becomes critical and the training pattern must suitably be modified to meet operational requirements and demands of modern generation military aircraft.

There is a natural fundamental difference between military training as compared with civil flying training. Civil training is primarily aimed at building up skills to follow a rigid set of rules and procedures, which have been agreed upon at an international agency and accepted by individual countries. Military training is however more country specific. Each country decides on the type of flying training required based on its threat perceptions and its aircraft inventory.

Selection Criteria

With the changing training scenario, new pilot selection and recruitment criteria will have to be devised, which would not only test the technical knowledge, skills and abilities of a trainee pilot, but would also evaluate the personality and other cognitive skills necessary for potential Commanders to succeed in operations later in their careers.

Indian military aviation training has continuously evolved and been refined since the IAF came into being. For decades, we have followed three distinct streams of training, i.e. for Fighters, Transports and Helicopters. But despite different sets of training patterns for distinctive types, it is necessary to have a common foundation for all pilots.

The HAL HPT-32 has been the IAF's basic trainer aircraft used to initiate trainees to flying. However, over a period, problems were encountered with this aircraft and as it reaches obsolescence, a proposal for induction of a fully aerobatic turboprop trainer as its replacement was floated.

It is expected that the Intermediate Jet Trainer (HJT-36) being developed by HAL will replace the present basic jet trainer (HJT-16 Kiran) for Stage II flying training of fighter pilots. This aircraft, with required standards of preparation, which would be contemporary, should be a good lead-in aircraft for training on the Hawk, the selected Stage III training aircraft for our fighter stream.

The recently inducted BAE Systems Hawk is now used for Stage III of fighter training and the quality of training is planned to be further improved with introduction of the Virtual Training System (VTS) in the aircraft. These and other associated measures have permitted the Indian Air Force to review the Op training syllabus of our frontline aircraft and reduce the time required for a pilot to achieve 'Fully Ops Status'.

The introduction of Dornier 228 aircraft for Stage II training of the transport pilot stream has facilitated enhanced intakes, timely accomplishment of training and exposure to contemporary avionics. A similar effort is also underway to enhance our Stage III training for transport aircraft trainees. The process of upgrading the An-32 is already underway but the Avro 748s are at the end of their flying life and are likely to be phased out soon; the IAF is actively looking for replacement of this aircraft, which is also expected to replace the Stage-III transport training aircraft.

Helicopter training is being carried out on HAL Chetaks which have served us well for Stage II training. New Mi-17 series helicopters will be soon on the flight line for Stage-III helicopter trainees. In the present concept of training, the simulator forms an intrinsic part of the training syllabus. The trainees have to undergo mandatory simulator sorties (treated at par with airborne sorties) at various stages in each phase prior to flying the airborne sortie. Simulator training brings about a quantum jump in the final output and in the long run, would promote greater mission effectiveness and enhanced flight safety.

It is our continuous endeavour to have seamless integration of simulator training with the actual flying syllabus. Greater thrust is being given towards upgradation

to High Fidelity Simulators. We do have simulators for fighter and transport aircraft training, but at present there is no simulator for our helicopter fleet. Efforts are on to fill this void. The process for acquiring simulators for the Mi-17 and ALH has already been initiated.

Systems Training

In the current world of high tech aircraft - and UAVs - the quality of the man behind the machine will still dictate the outcome of any conflict. Continuous tweaking of the current curriculum is designed to ensure that we constantly set and achieve the standards desired. Towards this, various Systems Training Schools (TETTRAs) have been upgraded so as to improve the quality of training imparted to both air and ground crew. Computer Aided Learning Systems (CALs) have been implemented and there are plans for online examinations in the near future - these schools are pitching the learning curve a notch higher.

To summarise, flying training in IAF has been going through a major transformation to adapt to rapid changes in technology with modern weapon systems entering frontline squadrons. Improving and reevaluating the training is a continuous process. It is necessary that the curriculum remains current, practical and concurrently build up situational awareness and operational orientation skills. This process has withstood the test of time. IAF pilots have delivered as desired in all situations, be it at war or in aid to civil power.

There is requirement for a robust and responsive training pattern that would ensure that the final 'product' is a highly skilled, confident and decisive pilot with good cognitive skills, who is ready to take on independent and unsupervised operations. This would ensure that the IAF retains the operational edge by fully exploiting the advantages of highly trained aircrew, network centric operations, precision attack-capable weapon systems and an appropriate air doctrine. The Training Command of the Indian Air Force are acutely aware of the onerous responsibility placed upon them and are continually striving to remain contemporary as well as set ever higher standards.



The Indian Air Force at 80



Dramatic scene as IAF Dakota paradrops supplies at the Sengge DZ during the 1962 conflict

AGAINST THE HORDES

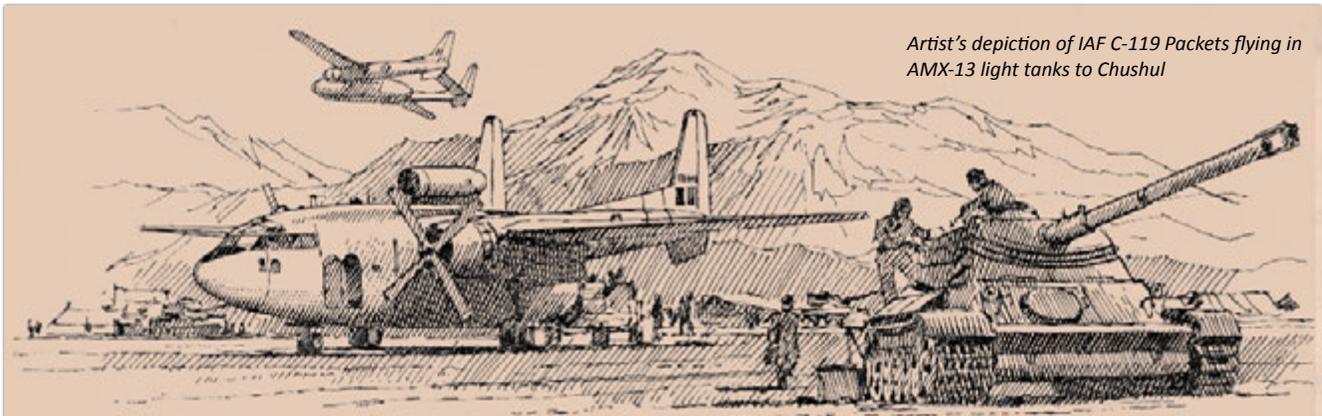
Air Marshal (R) Bharat Kumar writes on the vitality of Indian Air Force operations during the 1962 Conflict

A half century has gone by, but scars on the Indian psyche remain deep consequent to the humiliating military defeat against China in October–November 1962, even if it was only in the Kameng Division of NEFA that the Indian Army failed to offer meaningful resistance. A befitting reply was given to the Chinese elsewhere with disproportionate casualties inflicted even when heavily outnumbered and outgunned. In Ladakh where there were some pre-planned withdrawals against superior Chinese numbers, the Indian Army held its own in the Chushul sector. The courage and determination of

Indian troops in these battles have been covered by various military historians and war correspondents although not in as much detail as they deserve. However, the role played by the Indian Air Force in support of the Army before, during and immediately after the conflict remains virtually unknown and unsung. In fact, were it not for the IAF, the Chinese would have had a free run as the deployment and sustenance of troops had to be done virtually entirely by air. It was with IAF support that the Army was able to deploy, sustain and fight the Chinese. It is necessary, now at least, to document the

role played by the IAF both prior to and during the events of October–November 1962.

The Indian Air Force made its first foray into Ladakh during the Kashmir War of 1947–48 and its support of the Army in this state continued well after the ceasefire. Then the strategic situation changed significantly after the People’s Republic of China decided to “liberate” Tibet. The Indian Army created its first post in eastern Ladakh in 1950 and numbers were increased over the years. By 1954, the most advanced Indian Army post was at Chushul, on the extreme eastern



Artist's depiction of IAF C-119 Packets flying in support of AMX-13 light tanks at Chushul

end, these posts manned by the police and intelligence personnel. Since it was not possible to have posts everywhere owing to extreme logistic problems, nor did the IAF have the capability to support what would have been an ideal number of posts, there were long range patrols during summer months, which were supported from the air. Similarly, in the Eastern Sector, an Indian political officer took control of Tawang in 1951 and a number of Assam Rifles posts set up near the McMahon Line. These also had to be supported by air. The private Kalinga Airways was used to air maintain Assam Rifles posts initially but bulk of support for the civil administration and the Army had to be met by the IAF. At the same time, there were other commitments including support of the Army deployed in the North-East against Naga insurgents, aid to civil power, the UK courier and so on which kept the IAF engaged throughout what was actually peace time.

Logistic needs of army posts increases exponentially with increase in altitude at which these are located and hence the airlift requirements are far greater than required in the plains. Airlift requirements kept increasing with additional deployments as a follow up of the 'Forward Policy' but limitations of the IAF to cope with these increasing demands slowed down the deployment of additional posts. Considering these increasing demands, airlift capabilities of the IAF had to be increased which resulted in formation of additional Dakota squadrons and induction of the Fairchild C-119 Packet aircraft. The latter type had poor safety record owing to high incidences of engine failures as also runaway propellers, resulting in crashes and wreckage of these were scattered along the mountains as one proceeded towards various dropping zones in Ladakh. Later, in mid-1962 after jet-engine augmented C-119 Packets were inducted, the situation improved significantly although fewer than 20 of them were modified by the time hostilities commenced with China. Notwithstanding the unreliability of Packets, air crew carried on resolutely with their assigned task. By mid 1962, the IAF had three Dakota squadrons (Nos. 11, 43 & 49) besides the Paratroopers' Training School with its own commitments, three C-119 Packet squadrons (Nos.12, 19 & 48), one

THE TAWANG-SELA-BOMDILA AREA



(Map from 'History of Indian Artillery')

Il-14 (No.42) and two Otter (Nos.41 & 59) squadrons. Seven An-12s and nine Super Constellations, that had been phased out by Air India, were inducted into the IAF in mid-1962 which boosted the IAF's airlift capability to some extent though still well short of the desired level.

What were airlift capabilities of the IAF in September 1962, at the time when it became clear that there might be a 'hot war'? None of the squadrons except for the Il-14 and Otter units and No. 43 Squadron

equipped with Dakota Mk. IVs were up to unit establishment. Each of the Packet and Dakota squadrons had just 8-10 aircraft and the average serviceability varied between 60 and 65%. There was acute shortage of pilots too : the overall pilots' manning level in the Air Force was just 65% while the situation in respect of co-pilots was particularly poor in Dakota squadrons and it was common practice for the navigators to act as copilots. The intensity of flying effort was high and it



Fairchild C-119 Packet of No.19 Squadron IAF at Leh

was quite common for most aircrew to surpass the 100-hours-a-month limit. Still, none of the units could achieve their authorised monthly utilisation rate because of poor availability of aircraft and shortage of aircrew combined with usual bad weather in the mountainous areas of Ladakh and NEFA.

Flying conditions were rather primitive and unsafe. There were no landing aids at the airfields; no radar cover whatsoever; outdated and not-too accurate maps – the crew relied more on their experience than these maps. Cockpits (except for An-12s) were unpressurised and because doors were removed for supply drops, it was always cold and noisy in the cockpit. There were no weather radars and conditions would become rather difficult as it was

and Packets were powered by piston-engines and their normal operating ceiling was 12,000 feet above sea level but they had to clear either the Khardungla Pass (18,300 ft) or the Changala Pass (17,700 ft) to reach Thoise, Chushul and Fuckche airfields as well as various dropping zones in the sector or land at airfields in Ladakh well above their normal operating altitude. Similar was the case in the East where most dropping zones were well above 10,000 feet. Runways were of restricted length, take-offs and landings had to be done from one direction only and there were obstructions on approaches or on circuit; air crew had to use all their experience and skills each time they came in for landing. Aircraft had to operate in narrow valleys, which posed

but to withdraw to Daprijo, which post was thereafter continuously maintained by air. The second and more serious incident took place at Galwan in Ladakh in July 1962. The newly established Indian post there was surrounded on all sides by vastly superior Chinese forces. The Indians held their ground but all their surface supply routes were cut off, there was no alternative but to maintain them by helicopters. Notwithstanding risks of being fired at, the IAF not only maintained this till the post was overrun after the outbreak of hostilities on 20 October, but just a few weeks earlier, had turned over an entire company by helicopters in full view of Chinese troops!

The situation just before outbreak of hostilities was tense especially in NEFA. The Army had earmarked the 4th Infantry Division for the NEFA area but was able to deploy just one battalion in Kameng Frontier Division and a battalion minus in the Walong Sector of Lohit Frontier Division owing to various constraints. To meet various Army and civilian requirements, the IAF was tasked with delivering 18,000 tons each in 1961 and 1962 in this sector, most of it being air dropped. Things were to change from 8 September 1962 onwards. When there was Chinese resistance to Indian establishment of posts on Thagla ridge, orders were issued to “evict” the Chinese but there was no way that this order could be implemented owing to insufficient troops. It was thereafter decided to build up the force level at Thagla to a brigade strength. The additional troops could not be inducted by air but had to footslog all the way. However, their rations and other equipment as well as ammunition were to be air dropped. The Army selected Lumpu and Tsangdhar as dropping zones for this sector. These DZs were at an altitude of 14,500 feet with hill features of 16-17,000 feet on the approach or just after the drop which required precision flying. Both these DZs were of inadequate dimension and there were sheer drops on all sides with the result that loads not landing on the DZs fell into gorges and was not retrievable. Considering seriousness of the situation and the poor communication those days, AOC-in-C Eastern Air Command set up a camp at Gauhati to oversee these operations. He informed GOC IV Corps about unsuitability of these DZs and likely



common for the weather to pack up in the afternoons. It was therefore standard operating procedure to restrict flying over hills till mid-day, a practice frequently violated to ensure that the task was fully met. In the absence of radar surveillance, tactical procedures were evolved to ensure proper separation between aircraft, especially during bad weather periods or in case of an emergency. Different types of aircraft operating out of various bases, and during their return, had to follow pre-assigned altitudes and routes; alternate routes and altitudes were laid down in case of emergency. It was sheer luck that there were no mid-air collisions nor near misses.

The biggest problem the aircraft faced was that they had to operate well above their designed altitudes. Both Dakotas

special problems and required high level of concentration and flying skill. These were extremely hazardous missions but there was never an instance when flight commanders could not find more than one volunteer for the task.

In fact, IAF crews had to operate in near war-like conditions from 1959 onwards and the IAF was involved in two incidents before the ‘hot war’ started in October 1962. First of these is known as the ‘Longju incident’ that took place in August 1959 in NEFA. The Chinese were informed in July 1959 that the Indian forces planned to para drop a medical officer to take care of a sick commanding officer there. The Chinese attacked the post in August 1959, claiming that this was “across the McMahon Line.” Indian troops were outnumbered and had no alternative

heavy losses of the dropped supplies and suggested that some alternate sites be selected. The suggestion was not agreed to; the Corps Commander was adamant that supplies be dropped at these assigned DZs. HQ Eastern Air Command mustered all resources and obtained some reinforcements from Air HQ as well and commenced supply drops from 28 September 1962 onwards. The airlift capability, which was about 50 tons per day, was soon built up to 200 tons per day and additional airlift could still have been provided but there were serious limitations

nor local porters available to collect the dropped stores and deliver there to forward posts. Frontline troops had perforce to be utilised for this task, affecting their combat readiness. Thirdly, since aircraft were air dropping almost throughout the available daylight hours, troops on the ground did not have sufficient time to collect the retrievable loads. Thus the troops, who had marched up to Dhola and other locations in their summer outfits, were clad poorly and in most cases, had just pouch ammunition when operations began. Sadly, almost 80% of the dropped

in turbulent conditions of NEFA and can easily be lost in down drafts that are common in the hills. Notwithstanding such difficult conditions, the Otter squadrons completed their task well before the second round of fighting started. In fact, it was not possible to proceed to Walong after 15 November owing to heavy smoke caused by the Chinese setting jungles on fire. After outbreak of hostilities, Otters were utilised in casualty air evacuation, carried more than double the number of casualties than the aircraft was designed for and flew them to Tezu and beyond, to Jorhat.



DHC-3 Otter of No.59 Squadron landing at Kibithoo ALG during the build up of 11 Brigade in the Walong sector.

as far as numbers of aircraft that could be deployed and the weather, especially in the late afternoons which prevented additional flying. Besides normal stores, artillery guns were brought in by both Dakotas and Mi-4s which was not an easy task.

After the outbreak of hostilities, aircrew faced fire from small arms as well as anti-aircraft guns but luckily except for two helicopters, no fixed wing aircraft were lost. In fact, this was the rare period where there was not even a single major accident. Still, this herculean air effort, did not produce the desired results because of various reasons. Firstly, as predicted by the IAF, less than 40% of the loads landed at the DZ with the remaining rolling down into the ravines and gorges. Secondly, there were no pioneer units

stores were never collected. The same story was repeated when the IAF was asked to drop supplies at Senge meant for Sela and Bomdila during the second phase of fighting, which took place from 17 to 20 November.

What were outstanding features of the IAF's efforts in the Eastern Sector?

Besides the massive air effort used in supply dropping for the forward troops, the IAF carried out other outstanding feats. The two Otter squadrons (Nos. 41 and 59) operating from Tezu airlifted an entire Brigade (11th) to Walong, and it was this force that gave stiff fight to the Chinese and inflicted disproportionately heavy casualties on them. It was a remarkable feat in more than one way. The Otter is a light aircraft and gets thrown around

For fighter cover, some Hunters were deployed at Jorhat but there was no bowser available for refuelling them : it was not possible to take this by road as the bridges en route were weak and it would have taken an unusually long time to send it by train. An-12s were committed in Ladakh and could not be spared for the task. One of the bowzers was eventually flown in a Packet aircraft piloted by the AOC-in-C himself, from Tezpur to Jorhat after some accessories were removed and tyres partly deflated. Thereafter, these Hunters were ready for air defence tasks in that sector.

The rapid rate of Chinese advance was indeed demoralising. The likely duration of war and Chinese intentions were unknown. Army Headquarters

decided to induct two additional Divisions into the Eastern Sector as a precautionary measure and to cater for any contingency. These Divisions had to come from the Western Sector (Punjab) and South (Madras) and considering the evolving situation, there was no alternative but to airlift them. Aircrew took calculated risks and took off with aircraft loaded well beyond their stipulated maximum takeoff weight. Aircrew put in extraordinary efforts and there were many instances when the crew were at work continuously for more than 20 hours to ensure that troops and other equipment including

Dum airport (Calcutta) from where loads were transferred to IAF aircraft for further delivery to forward areas in NEFA.

The role played by helicopters in NEFA must also be mentioned. Initially, the handful of these were deployed for Commanders' reconnaissance missions as well as for communication and casualty air evacuation. As mentioned earlier, these were also used to support gun positioning and ferry ammunition. They were also used for photo reconnaissance albeit with hand-held cameras. But the most remarkable work by these rotary wing machines certainly was casualty

those hills can be extremely exacting and fatiguing, but it did not hold Williams back. Similarly, Mi-4 pilots flew as many as 30 passengers when they were evacuating personnel from the Tawang and Walong sectors, well above the maximum of 16 troops when taking off at sea level. Flight Lieutenant BS Kalra evacuated as many as 300 women and children from Tawang on 23 October 1962. Similarly, three Mi-4s of No.110 HU evacuated 4-500 wounded jawans over a period of three days.

The limited helicopter fleet was extensively used in this role during the hostilities, during the lull period as well as after the ceasefire; their maximum



Lockheed L.1049 G of No.6 Squadron at Tezpur, after flying in troops from western India (note Vampire PR 55 and Harvard on the flight line).

sandbags, barbed wire, engineer stores besides arms and ammunition were delivered to Gauhati, Tezpur and Jorhat in the shortest possible time. By now, some USAF C-130s were also involved but only marginally as most of their air effort was in the Ladakh sector. These aircraft ferried small arms and ammunition and other items to Dum

evacuation. Squadron Leader Williams evacuated a casualty at night with his instrument panel lit by a torch held by the patient on a stretcher. On another occasion, he evacuated 23 casualties in a single day in his Bell 47-G3, a helicopter that had a single pilot and could carry just one passenger, his last take off in pitch darkness. 23 sorties in one day in

period of activity was for casevac and dropping food and medicines for those personnel trying to get back into the plains in small batches from the hills. The helicopter fleet was to earn eternal gratitude from hundreds of army personnel for saving their lives. The helicopter crews faced fearful odds. As mentioned earlier, three helicopters were lost, two to

enemy fire and third captured intact by the Chinese and the commander (Squadron Leader Vinod Sehgal) and his passenger presumably shot dead. One of these helicopters as well as an Otter aircraft that had been left behind at Walong were recovered and made flight worthy after the ceasefire.

As far as the Ladakh sector is concerned, besides the Galwan episode, the IAF activated the then highest airfield in the world – Daulat Beg Oldi – at an altitude of 16,800 feet. A C-119 with jet pack landed there with 32 troops on 23 July 1962 and took off from there with about 14 jawans. Thereafter, Daulat Beg Oldi became an important anchor for the Army in the sector.

Although the situation had been heating up in NEFA, it remained rather quiet in Ladakh during September 1962; all the same there were apprehensions that the Chinese might overrun forward posts as a retaliation to military actions in the



The handful of Mi-4 helicopters played a major role in Ladakh.

two more regular battalions for defence of this sector. This was accomplished well before the second phase of hostilities, with most troops having been airlifted. Fortunately, the road to Leh from Srinagar had finally become operational in late August 1962 and some troops and stores were ferried along this road. Still, mainly due to the extraordinary efforts of the

as orders for evacuation of the post were issued that night, but DBO itself was not attacked by the Chinese as they believed that it was a ‘fortress’. IAF transport aircraft also carried out reconnaissance missions to pinpoint the enemy and assist in withdrawing forces from DBO and Galwan and air dropped supplies wherever required. Both Dakotas and Packets



Lockheed C-130A Hercules of the USAF flying supplies to Leh in November 1962

East. These fears came true as aircraft on early morning drop sorties on 20 October 1962 at DBO and elsewhere, were fired upon. HQ Western Air Command instructed all units to continue regardless with their normal routine. The build-up in this Sector had already started. 114 Infantry Brigade had two J&K Militia and one regular battalions, but needed at least

IAF, the Army could build up to a full Division (3rd Himalayan) strength in the Ladakh sector.

Although DBO came under fire from 20 October onwards and some forward posts were withdrawn, the IAF continued with its task of inducting men and material; an infantry company was inducted into DBO on 21 October even

were utilised for dropping supplies to beleaguered troops. Because of the high altitude, Mi-4s had to carry out roller takeoffs and landings and their payload capacity was restricted to less than six troops at most places. All the same they went into action and rescued at least 100 jawans from posts around DBO. It was not that all posts were lost as there were

many which the Army gallantly held on to. Throughout, these posts were supported both by fixed wing aircraft and the few Mi-4s. Evacuation of casualties to Leh and then onto Chandigarh continued through the weeks.

Situation in the Changchenmo and Galwan sub-sectors however got worse because continued bad weather prevented initial build up by air. Some posts in the sector had to be withdrawn not because of shortage of supplies and ammunition but in the face of overwhelming odds.

The epic battle in Ladakh was in the Chushul sector. During the first actions that commenced on 20 October, Chushul

landed even though Commander of the aircraft was aware that first 400 yards of runway had been rendered unserviceable by continuous pounding of the surface by aircraft landing earlier. A remarkable feat by any standards and symbolic of the IAF's professionalism and cooperation of the Army personnel involved in this airlift. Two batteries of 13 Field Regiment were similarly airlifted by An-12s to Chushul, and these were key in the heroic defence of Chushul in the battles which followed.

The IAF also dropped some boats for patrolling in the Spanggur Lake. In the meanwhile, defences of Chushul were strengthened by build up of 114 Brigade

which, protesting under the strain, kept disintegrating. By any account, it was a massive and stupendous air effort.

The Indus Valley Sector in Ladakh was another area where the IAF remained the virtual lifeline : Fukche remained active throughout with the Packets and Dakotas continuing sorties throughout the conflict and the only time when flying to Fukche was interrupted was because of bad weather and availability of aircraft owing to higher priority elsewhere.

The tempo of activity in Ladakh is best described in the Operational Record Book of No.19 Squadron. "When the Chinese suddenly attacked on 20 October 1962, apart from already allotted commitments, the new trying situation surged to the highest peak of demand and this Herculean effort was very well accomplished. The commitment towards the last crucial week was more than treble the amount of the entire month's planned target. The entire Squadron responded in commendable manner. The highest landing ground in the world, DBO, was abandoned on 22 October 1962 and the retreating columns were supported by the Squadron on drop missions throughout the route till the columns reached Saser Braganza. During one of the missions, an aircraft (IK 460) captained by Wing Commander Dhawan VrC was hit by enemy anti-aircraft fire on 23 October near Remo. Another aircraft captained by Flight Lieutenant KM Ponappa carried out an emergency drop at Tsogsalu in the twilight and landed at Srinagar, the first night flying in this phase of operation in Ladakh area. Since mobilisation at Chushul was priority, No.19 Squadron put all its concentrated effort to the maximum in this place." The story was the same elsewhere in Ladakh.

Let us look at the overall airlift figures. Before the hostilities, annual airlift of 18,000 and 25,000 tons were required to supply the NEFA and Ladakh area respectively; 70% of this total was airdropped. During the Chinese conflict, airlift of 600 tons and day became vital to these areas, but the Air Force, despite intense effort, was capable of providing only 400 tons, about 200 each to the sectors. After ceasefire, the British assessed that annual airdrop requirements for NEFA, Ladakh and adjoining areas were 153,000 tons and annual landed-on tonnage 95,000. Therefore, on a daily basis, the Army's requirement was for 387.5 tons



Flashback : Prime Minister Jawaharlal Nehru with Air Vice Marshal Subroto Mukerji after landing at Chushul in August 1952. Also seen in the picture are Karan Singh, Indira Gandhi and Sheikh Abdullah

airfield was defended by just one platoon and it was during this phase that Chinese tanks were seen approaching the airfield. There was nothing to counter this threat but the Chinese hesitated in continuing their advance. In immediate counter to this threat, it was decided to airlift AMX-13 light tanks from Chandigarh, a task that had never been attempted before. There were problems of clearances, weight, loading into the aircraft and managing the centre of gravity as well as lashing, challenges for both the Army and Air Force but this had to be tackled if Chushul was to be saved. The challenges were accepted : six AMX-13 tanks of 20th Lancers were flown to Chushul on 25 October with minimum fuel in the aircraft leaving no margin for diversion. The last tank was safely

under then Brigadier TN Raina. All these elements of tanks, field guns and patrol boats played their role in successful defence of Chushul airfield. The Indian Air Force transporting supplies to Chushul was continuously active except probably on 19th and 20th November when the airfield was rendered unserviceable owing to constant shelling by the Chinese.

Prior to hostilities, the airstrip at Chushul was used at the leisurely pace of one aircraft a day. During the hostilities it was subjected to at least six An-12 and about eight C-119 Packet sorties each day : the airfield became unserviceable frequently because of these heavy movements. By 13 November, 95 An-12 and 57 Packet C-119 sorties had landed at Chushul airstrip, the PSP sheets of

while the IAF's capability was just 200 tons – a shortfall of 187.5 tons. There was no doubt that the IAF's transport fleet needed to be significantly expanded to meet these needs. With induction of additional troops into forward areas, the airlift requirement increased further.

The United States Military Supply Mission in India carried out an assessment of the Indian airlift requirement in early 1963. Their conclusions were that :

- ★ minimum essential airlift necessary to support current troop strength and positions in peace-time was 117,000 tonnes per year.
- ★ desired peacetime airlift – approximately 50% higher than minimum essential airlift or 206,000 tonnes per year.
- ★ airlift necessary to support during conflict: 235,717 tonnes per year.

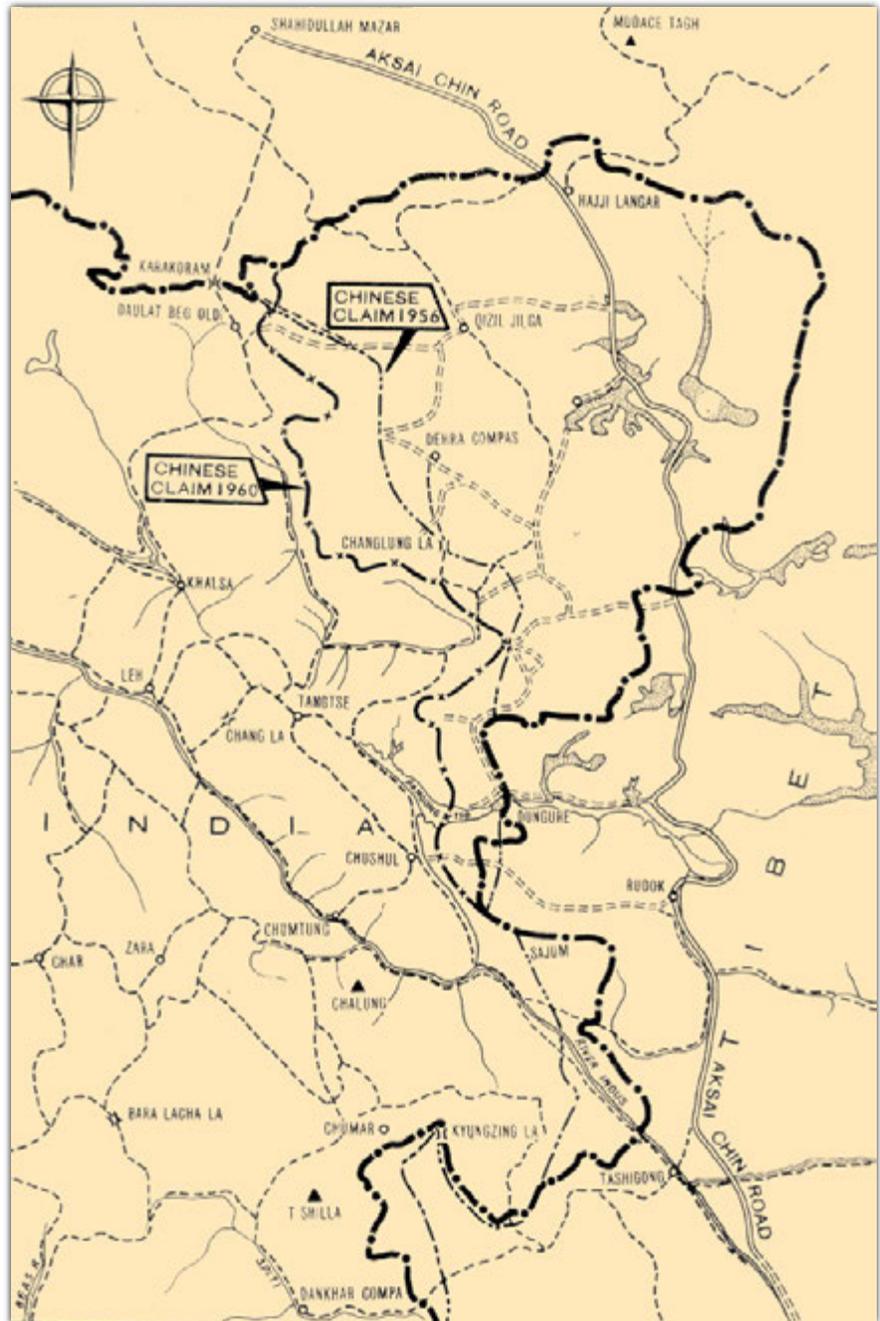
The wide gap in the IAF's airlift capability was apparent and rapid expansion of the air transport fleet was dire need if the Indian Forces were to face the Chinese with confidence.

No.107 Helicopter Unit was the only helicopter unit in Ladakh, its resources over-stretched, was initially earmarked for casualty air evacuation tasks as also resupply of critical posts; once hostilities broke out, there was a constant flow of casualties from forward areas to Leh for onward evacuation by fixed wing aircraft. The crews were on task from first light till sunset, every day. There were no complaints – everyone was seized of seriousness of situation.

The IAF's capacity was well short of that minimum essential for peacetime support. Notwithstanding this fact, it is to the credit of the IAF that there was not one instance either in NEFA or Ladakh where the troops had to withdraw from their posts because of shortfall in logistics support by the IAF. As a foreign military correspondent commented, the Indian Air Force "were crazy to fly in the prevalent conditions in which no other air force would have operated".

Thus, it could well be asked that if the IAF could mount such efforts during October and November 1962, what held it back in the earlier period? Indeed there was a surge in the air effort : the serviceability was improved to 85-90% and there was at least one instance where a pilot had flown 162 hours by the

THE LADAKH SECTOR –1962



(Map from 'History of Indian Artillery')

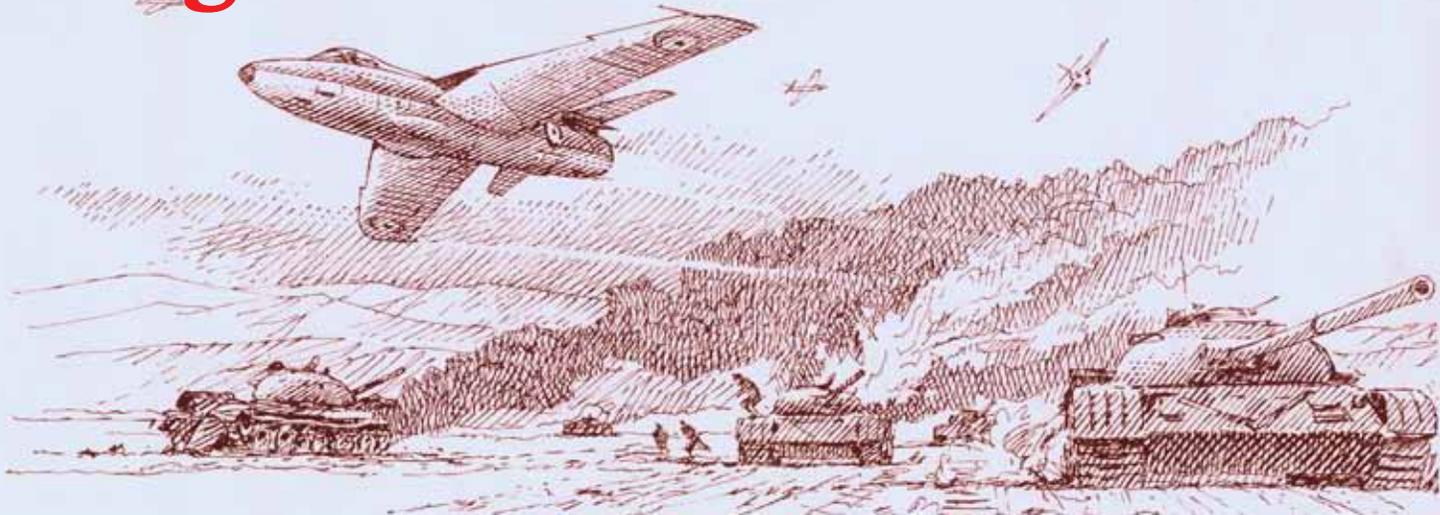
middle of that month! Various scheduled servicing were deferred and calculated risks taken by flying aircraft with some unserviceabilities. Personal comforts were never considered and not a single sortie was refused owing to fatigue factor. But this kind of air effort cannot be sustained for any length of time as was evident when serviceability fell to 50-60% in most IAF transport units during January and February 1963.

The support provided by the IAF in the trying conditions of Ladakh and NEFA

was indeed significant. Were it not for the IAF's support prior to and during the hostilities, it is more than certain that the Indian Army would not have provided the resistance to the Chinese that it did in 1962. Of course, if the combat fleet of the IAF had also been committed, then perhaps the Chinese would have suffered the same fate as they did in Vietnam in 1979.

Why the Government of India did not do so will be reviewed in the next issue of this Journal.

Longewala, December 1971



Artist's depiction of low flying Hunters of the IAF attacking T-59 tanks of the Pak Army at Longewala (Derek Bunce).

Air Marshal M S Bawa, PVSM, AVSM, VM ('Minhi' to his fellow Air Warriors), retired as AOC-in-C, Central Air Command. A distinguished fighter pilot and leader, he commanded the forward air base at Jaisalmer as a Wing Commander during the December 1971 war, strategised and directed the epic air battle of Longewala, an unprecedented and raw application of air power, with just four Hunters decimating an enemy armoured regiment in the sands of Longewala.

The following are excerpts from Air Marshal Bawa's book 'Fatal Embrace – Air Battle of Longewala 1971', a first hand account of the determined action by a handful of Hunter pilots which well may have changed the course of history.

The situation at Longewala in the Western Rajasthan desert was tense at dawn on 4 December 1971. The Pakistan Army had crossed the border and was poised to smash past thinly held Indian infantry positions. Hopelessly outnumbered, the lone company of 23rd Punjab could not expect any reinforcement from the 12th Infantry Division, Indian Army which was committed further north. Only a small element of Indian Air Force Hunters of the war-numbered No.122 Squadron (OCU from Jamnagar) was to take on T-59 tanks of the 22nd Cavalry, leading the 38th Baluch of 51 Brigade, 18th Division Infantry, Pakistan Army committed on this front. But the very elements seemed to conspire against them, for when the day dawned, the Pak armour was vulnerable and presented a clear target.

At 0703 hours, the first two Hunters were overhead flown by Sqn Ldr DK Das and



The arena: Hunter strikes against armour in Longewala, December 1971

Flt Lt R Gosain, who fired opening salvos of the battle which was to result in rout of the enemy's armour. On arrival over the Longewala area, Mission 01 Alpha called out, "Bravo, have you seen the tanks below?" Prompt came the reply, 'Alpha Bravo, there are hell of a lot of tanks here.' Alpha warned: "They are all spread out and advancing towards our positions." This signaled commencement of the attack. Leader of the mission was asked to engage the first tanks advancing and just within 60 metres of the Indian post.

The Indian Company below was forgotten, as the Pakistani tankmen and

Indian airmen confronted each other. Undeterred by the hail of tank machine gun fire, the Hunters came in virtually at sand dune height to strafe and rocket the T-59 tanks.

Even as Mission 01 was turning towards base, another pair of Hunters from Jaisalmer were on their way. The first Hunter strike had claimed two tanks destroyed and five others damaged. Morale soared even as the ground teams at Jaisalmer turned around and relaunched the Hunters as rapidly as possible.

The task allotted to the second pair of Hunters was to search, report and attack any tanks seen near Gamanewala Tar, about 15 km from Ramgarh, which was western gateway to the City of Jaisalmer and its capture could prove disastrous to the Indian Army, the Air Force - and the war. The pilots found no tanks near Ramgarh, only tank tracks. Continuing their search, the mission observed some tanks about three to four km from Longewala on the road towards Ramgarh. The pilots circled the area and estimated there were some 45 tanks (a regiment strength) in the area.

The Hunters engaged the tanks with T-10 rockets. Two more tanks were destroyed and six damaged. Only tanks ablaze were claimed as "destroyed" and those crippled as "damaged". Flying Officer D. Yadav recalled this fight as being like that between a mongoose and a snake. The tanks were now desperately moving in circles trying to evade the enemy air and also create some protection within the cloud of dust that their movement raised. Their effort was futile since the IAF fighters had unchallenged

freedom of the air. The tanks were vulnerable and systematically destroyed.

After the first two attacks, four tanks had been confirmed destroyed and eleven damaged. This swift retribution from the skies was unexpected and shocked the Pakistanis, made them pause and regroup. The fight continued with maximum vigour, but with odds now clearly tilted in favour of the Indian Air Force, even if some aircraft returned riddled with bullet holes. The tanks went writhing in circles, but yet firing back with their heavy machine guns whenever the Hunters got close. There was little time to patch-repair these so the Hunters flew on in that condition. To keep the enemy under constant observation, Army Krishak AoP aircraft orbited overhead (Major Atma Singh in particular) even while the Hunters were being refueled and rearmed. Spotting was now easy as the burning tanks became 'homing beacons'.

Although the thrust against the Longewala post had been foiled, there was no assurance that the enemy's offensive capability had been destroyed as they could continue their offensive in darkness. High rate of air effort had to be sustained for as long as the enemy's air did not disrupt or retard this. Every pilot had to await his turn, creating impatience among the aircrew at Jaisalmer. So by the time Sqn Ldr SDL Tully and KS Suresh got their turn for action, there was frustration with the system which had placed so few aircraft at Jaisalmer.

In one attack, 'Kuki' Suresh virtually met a tank head on. Both the tank and the aircraft guns fired simultaneously. The aircraft won, but the big flash that followed blinded Suresh momentarily and his pull out was delayed, the virtual deck level Hunter brushing the sandy dune with its jet exhaust cone, but recovering safely back to base. This mission claimed three more tanks destroyed and seven disabled. The continued absence of enemy air was baffling because, if the PAF were active, the situation could well have been different.

Later, when Tully and Gosain landed back at 1400 hrs, they reported three more tanks as destroyed with some 'B' vehicles also attacked.

Jaisalmer air base took a breather. The threat to Longewala post had been stayed, but more Hunter sorties were launched at dusk to observe enemy intentions and likely directions of either withdrawal or advance.

But the enemy armour force lay in shambles, their morale now shattered. With plans of overrunning Longewala, Ramgarh and then capturing the Jaisalmer



At the Victory Column : Babu Jagjivan Ram, Defence Minister and the Rajasthan Chief Minister with senior officers of the Indian Air Force. Third from left in front are Air Marshal Dilbagh Singh, Air Marshal Idris Latif and Air Marshal H Moolgavkar, all three who were to become Chief of Air Staff in the years to come. Second from the right in front is Air Marshal MS 'Minhi' Bawa.

airfield foiled, the enemy could scarcely have imagined that a small air element at Jaisalmer would pulverise their armoured thrust. Tanks and supporting vehicles lay destroyed, crippled, burnt or shattered, entirely the result of air action. Besides the absence of enemy in the air, was the near absence of own troops on the ground.

Actually the latter was good because the order to IAF pilots was to destroy everything that moved in the area and recognition would have been difficult.

The last Hunter missions found the enemy retreating along on the sandy tracks back to Ghabbar in Pakistan, but leaving scores of tanks, APCs and vehicles burning, bogged and abandoned all along the track.

On the morning of 6 December, Sqn Ldr NL 'Goofy' Gupta, was first to take off, the task assigned being to check on all routes leading to Jaisalmer, specifically those leading from Shagarh Bulge, as these approaches had remained unguarded. He found nothing but ultimately spotted an enemy vehicle concentration near Ghabbar which was attacked with cannon fire. The next aerial recon was carried out in the area covering Sadewala, Sandh Ghabbar and Longewala, with a view to checking if the enemy was attempting a hook from Sandh to Tanot to surprise 12 Div HQ in this area. No trace of the enemy was found but the Hunters attacked and destroyed vehicle concentrations near Ghabbar. The pilots, during their debriefing, reported that Ghabbar appeared to be the administrative echelon of the enemy.

The next mission was offensive in nature, flown by Squadron Leader RN Bali and Flt Lt G Kapur, to strike against armour and vehicles in the Kharo Tar area and force the enemy to withdraw. The pilots located

no tanks but attacked a vehicle concentration, setting ablaze at least ten of them.

The Indian Army had now begun to advance westwards and the IAF immediately shifted its objective from tactical recon and offensive support to close air support. The objective of own troops was Kharo Tar, with the Hunters overhead. Enemy tanks spotted close to the Border Pillar 638 were destroyed, but some Hunters were hit by concentrated machine gun fire but without serious damage. Interdiction of enemy's communication lines was resumed and the vital railway line running south to north continued to offer targets of opportunity along the Khairpur - Rahim Yar Khan section of the railway line. Many wagons and locomotives were damaged and a second train immobilised near the RYK Station.

News of the magnificent air action had now electrified the country. In two days, 5th and 6th December 1971, the sands of Jaisalmer witnessed the biggest destruction in history in the Marusthali. At last, on 6th December night, the balance of ten more Hunters arrived as per war plans. The CO of the now almost complete unit, No.122 Squadron, Wg Cdr DM 'Don' Conquest and his Flight Commander, Sqn Ldr GV Hingorani, continued to seek and destroy enemy targets wherever found. The enemy had suffered one of the biggest debacles in which a virtual regiment of T-59 tanks had been pulverised in the undulating Thar desert. One can only imagine as to what the full force of fourteen Hunters could have done in the remaining eleven days of war.

A Victory Column was later erected at Jaisalmer Air Force Base to commemorate the epic December 1971 action. An Indian Air Force Himalayan Eagle surmounts the column and one of the classic Hunters that took part is on permanent display in the area.



FIRST OF THE MANY



Rare photograph of the Indian team with Soviet officials on the outskirts of Moscow, August 1962. 'Babi' Dey on the extreme left, Suranjan Das, second last from right, AVM Ranjan Dutt (in white shirt plus tie at centre), Mr Soundarajan, Mr Jaishankar, Maj. Gen. Mikoyan and others. [Photograph via Air Commodore Vikram Singh].

Evaluating the MiG-21

Air Marshal Philip Rajkumar writes on the very first MiG-21 flown by Indian test pilots

First evaluation of this famous fighter was carried out by two IAF test pilots, Wg Cdr (later Gp Capt) Suranjan Das and Sqn Ldr (later Air Marshal) Partha Kumar 'Babi' Dey in Moscow in August 1962.

I interviewed Air Marshal PK Dey on 30 May 2012 at his residence in Bangalore and this is what he recollected about that evaluation done almost 50 years ago. He had his log book with him and was able to give the dates on which he had flown the evaluation sorties and the tail number of the aircraft :

'I was on deputation to Hindustan Aircraft Limited, Bangalore for test flying duties. In July 1962 I was sent to the United Kingdom to evaluate



Soviet Air Force MiG-21 F-13 (Type 74), 'Red 26', flown by the IAF test pilots

the English Electric Lightning. A few weeks after my return I was ordered to proceed to Moscow to join Wg Cdr Das to evaluate the MiG-21. The evaluation team included Air Vice Marshal Ranjan Dutt, Managing Director HAL, Mr Soundarajan, Deputy Secretary, Ministry of Defence and Mr Jaishankar, then Chairman, HAL. In those days the Chairman was based in Delhi. There was some difficulty in getting a seat on the Bangalore -Delhi flight but considering the urgency of the mission I was permitted to sit on the jump seat in the cockpit! Before departing for Moscow I was personally briefed by Mr VK Krishna Menon, the Defence Minister about the aircraft. He said it was “the world’s best fighter and held the world speed record”. He cautioned me not to be taken in by western propaganda and said “the Soviet Union was India’s staunch friend”.

Just outside Moscow, the entire team was initially taken to a large open field, where some marquees had been erected, so as to witness the flying display by a MiG-21. Major General Mikoyan, a cousin of the legendary designer Artem Mikoyan and the Communist Party Politbureau member Anastas Mikoyan were present at the field. Soon a MiG-21 did its high speed run, pulled up and vanished into the sky. We, the two test pilots, remained unimpressed by this display which could

Extract from Air Marshal PK Dey’s log book			
Date	Aircraft Number	Exercise	Duration
07 August 1962	26	Evaluation	0.35mts
08 August 1962	26	Evaluation	0.30 mts
08 August 1962	26	Evaluation	0.40 mts
09 August 1962	26	Evaluation	0.35 mts
10 August 1962	26	Evaluation	0.30 mts

have been done even by a Gnat light fighter. The other members were agog with excitement and kept saying that it was a superb aircraft !

Wg Cdr Das insisted that we two test pilots be allowed to fly the aircraft and carry out a proper flight evaluation. The Soviets balked at the idea and said that it would not be possible to fly the aircraft. Considerable ground preparation in terms of cockpit familiarisation and systems knowledge would be required and the training would take two to three months. At this point Maj Gen Mikoyan, who was fluent in English, intervened and said he would get permission for the Indian pilots to fly and train them himself !

The next day we met at the Kubinka air base outside Moscow and saw a MiG-21 F-13 (Type 74) for the first time. Wg Cdr Das and I sat in the cockpit in turn and were briefed by Maj Gen Mikoyan who stood on the cockpit ladder. When we said we could not read the cyrillic script on the switches and controls the General had specific captions typed in English and stuck them with glue himself ! That was the total ground preparation we had nor did we undergo any medical examination.

We thereafter flew the aircraft in clean configuration, wearing subsonic flying clothing. The aircraft could carry only 2 x K -13 air to air missiles but did not have a gun. I flew five sorties totalling 2 hrs and 50 mts and I think Wg Cdr Das flew the same number of sorties and hours. The aircraft had excellent performance and good handling qualities but was handicapped by the limited payload and range. We felt that Operational Command in Delhi should be apprised about these limitations and their views obtained. Air Vice Marshal Ranjan Dutt and others thought it was not necessary but Wg Cdr Das and I stuck to this. After a long delay, Ops Command was finally contacted and discussions with the Soviets started. The Soviets promised to have a gun installed in the aircraft to be supplied to India. But all this took time and we were able to finalise our report only after spending two more months in Moscow.”



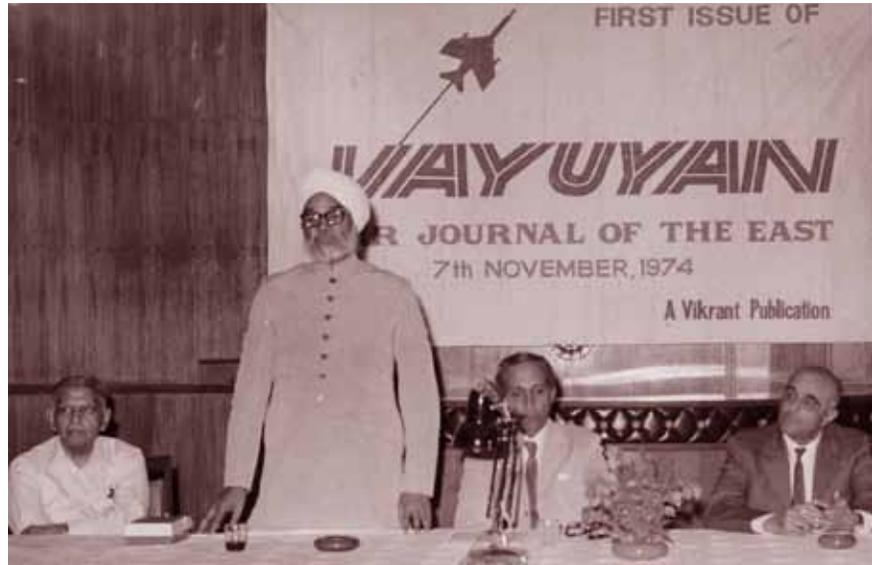


The Indian Air Force at 80

Looking Back – Into The Future

I assumed charge as Chief of the Air Staff on 15 January, 1973. When I took over, the impact of the 1971 War was not so much on operational readiness of the Air Force, because it had well proved its worth during the time of my predecessor, and I was convinced that arrangements made should continue, but some aspects of operational preparedness needed to be reviewed from time to time. At the Commander's Conference I therefore felt what was needed at that stage was to look at the future. To do that, I instituted studies for long-term programmes-in- being covering training, manpower, re-equipment and expansion of the force.

These plans were meant to cover upto the years 2000-2001. The emphasis in those plans was to ensure that adequate manpower was available to the Air Force, the right type of training to cope with phenomenal technological advances was given to the men and officers and what was more, that obsolescent aircraft would continue to be replaced over a period of time, bringing in new technologies so that striking power of the Air Force did not diminish in any way. However, the terminology used was "without sacrificing quality"; one had to ensure that the fat was removed and people got used to producing the goods in the required timeframe, without in any manner whatsoever forsaking quality.



At the launch on 7 November 1974 at the Imperial Hotel, New Delhi : Defence Minister S. Swaran Singh giving the key note address flanked by Mr.V. Shankar and Mr.Prem Bhatia. Air Chief Marshal OP Mehra, then CAS, is on the right.

*Air Chief Marshal OP Mehra, Chief of Air Staff during 1973-75, recalls some vital aspects of his years as CAS. In fact the former Air Chief was present on the occasion when the **Vayu Aerospace Review** (then **Vayuyan**) was formally released by Defence Minister Swaran Singh in New Delhi on 7 November 1974 in which his exclusive interview on 'The Indian Air Force in the Decade Ahead' was published (see excerpts that follow).*

This was virtually what I had advocated and practised as Chairman of HAL before taking over as the CAS. The problem of adequate technical manpower is an acute

one. This calls for establishing some specialist institutions to train adequate manpower to meet demands of the IAF vis-à-vis rapidly evolving modern technologies



The Gnat light fighter, built in large numbers by HAL was to be basis of the new 'light combat aircraft'.

pertaining to aerospace and the aviation industry.

While on the subject of technology-transformation I cannot but reminisce about the number of aircraft types that I flew during my Air Force career, starting with the Tiger Moth, then going on to the Audax and Hart and Wapiti, prior to my squadron being equipped with Hurricanes and Spitfires. Later in my career, when I was with Western Air Command, I also flew the Ouragan and Mystere IVA at Kalaikunda. Devon and Dakota transport aircraft were available to fly when one went on staff visits, utilising the aircraft from the Air Force Communication Squadron. After the Devon, I flew the Avro 748 and then the Tu-124.

By this time, I was Chief of the Air Staff. During my stay at Jodhpur, I had occasion to fly His Highness' personal Bonanza. I also flew four or five types of helicopters including the Chetak, Cheetah and Mi-4. I was briefed and cleared by Gp Capt Suranjan Das, HAL's Chief Test Pilot, to fly the HF-24 at Kanpur. I later flew the Jaguar two-seater in France when I went on an official visit the trip, very graciously arranged by the then Chief of the French Air Force. It entailed my spending a long weekend at the base where I met the test pilot who would be the co-pilot. He was instructed by the base commander to touch the controls only if I was indulging in any manoeuvre not deemed safe, considering my knowledge of the aircraft. I remember when I did a steep turn at around 6g, he tapped the control column and prevented me from continuing with the manoeuvre !

During my career, one of my surprise postings was as Chairman of HAL, which I assume was owed to some of my previous postings coupled with my views on the linkage between DRDO and our procurement policy. Earlier when I was Air Officer Policy and Plans, I had to deal with HAL and met with Dr Kurt Tank, the famed German designer of the HF-24. In one of my meetings, he invited me to his house. To a query as to why his design team did not include IAF/DRDO officers, his response was "we will discuss this aspect after we walk around the house". I was surprised to see a fully equipped drawing board in each of the three or four rooms. Answering



As CAS, Air Chief Marshal OP Mehra continued his keen interest in further development of the HF-24 Marut to a supersonic strike fighter, the HF-73 as it was to be known. Here he is seen (on the right) with SC Das of HAL, E.K. Pantel of MBB, AVM J.Zaheer and Air Cmde Bhatnagar.

my earlier question, he said this was "due to your caste system". On a query from me as to how caste system came into technology and design, his response was to enquire whether I was aware that a vast majority of Indian engineers, on graduation, discarded their drawing boards as they felt that draughtsmen were there to fill such a role.

The term *Light Combat Aircraft* (LCA) was initially conceived while I was at HAL. My view was that the Gnat which we were producing and for which we had considerable data from design drawings to detailed development and production, should be used as the basis on which to build an infrastructure whereby the Gnat could be converted into an LCA. I assigned



Trio of HAL HF-24 Maruts in formation flight

this task to a committee of engineers at HAL. After detailed discussions, it was suggested that we should redesign the Gnat to ensure that the fuel was not carried in extra-underwing tanks. We should find ways and means of carrying fuel in the main wing or within the fuselage, by changing geometry of the aircraft. The projected aircraft would be somewhat bigger in size, capable of carrying more weaponry underwing. This was noted, and we decided to designate the project as the 'Light Combat Aircraft', an expression that has stayed within our Air Force - but not as the successor Gnat !

Aeronautics Commission on the lines of the Space Commission or other autonomous organisations directly under the Prime Minister. The only outcome was that ADE (Aeronautical Development Establishment) was set up and entrusted with some tasks.

It is unfortunate that we did not take timely action on a vital aspect which even today we feel the need for. Very serious thought must be given to create such an agency which will be responsible to look after both the Air Force and civil aviation requirements. It must, as earlier visualised, be responsible for design & development,

years? Such delayed decision-making only results in greater outlays on the part of the government which a country like ours can ill afford. Unfortunately, the financial burden in delayed cases is not borne by our decision-makers but by the tax-payer and the under-privileged who then have to wait for their just needs to be met. And more than that, our defence forces are denied weaponry when needed. I may also mention that progress of our aviation industry was virtually ridiculed by the bureaucracy in not understanding that for a new aircraft project there is need for a number of prototypes and aero-



The LCA Technology Demonstrator I

This process went on for some time and we covered a fair distance to, at least, be able to produce a two-seater Gnat which could be employed for conversion training of new pilots on the Gnat aircraft. This concept of the LCA which I had visualised, I tried to progress when I was CAS but, unfortunately, found that the agencies concerned were not willing to accept this viewpoint.

Considering the varied problems, I advocated that we actively pursue the proposal initiated by me while at HAL, namely, the setting up an autonomous

then production and also product support, including technological updating, as also after-sales service. I really regret that an issue of such importance is a victim, like many other proposals, of bureaucratic ignorance, resulting in endlessly delayed decision-making.

It is time to introduce accountability in the decision-making processes in the Government of India. I see no reason why files keep floating from one Ministry to the other. Is it not advisable at some stage that all those concerned should sit together and take a decision on a matter rather than waste time for months and

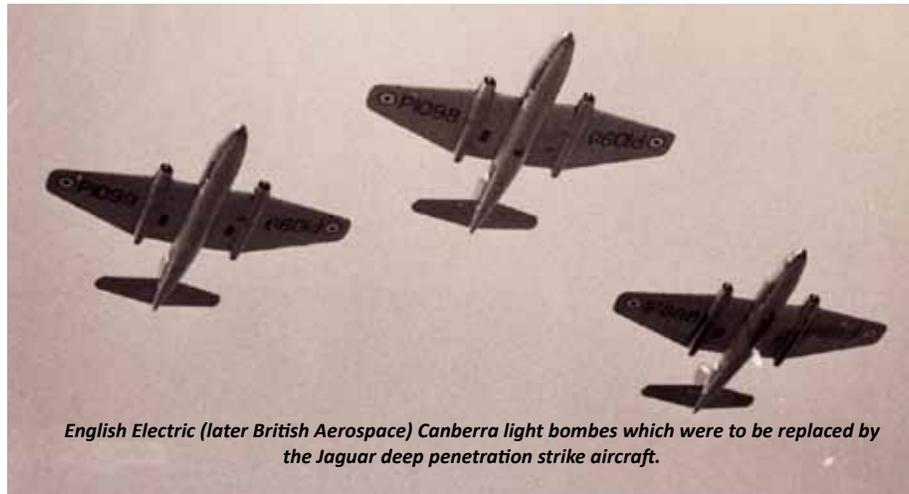
engines to be built during the development process. I had made great efforts to get the Government to agree to establish a second Air Force Academy at Tiruchirapally. It was my experience, also based on studies carried out, that we would soon be running short of pilots and, therefore, needed to increase the intake of cadets. This could be done by having another academy and the place selected for that was Tiruchirapally. For reasons best known, this plan was dropped and I regret to say that impact of that has been felt by the Air Force for a long time, particularly over the recent past.



The Indian Air Force at 80

My other two key projects were the formation of two specialist training units: the College of Air Warfare (CAW) and the Tactics & Combat Development Establishment (TACDE). Thus far as TACDE was concerned, it was of vital consequence to the future of the Air Force and the first lot of officers posted to this unit were hand-picked. I am glad to say that despite all the difficulties, TACDE has grown in size and stature and continues to render yeoman service to the Air Force. The College of Air Warfare, on the other hand, did not have much difficulty but took its own time to develop into an institution of the calibre that it is today. I am happy that the efforts that had gone into setting up these institutions, apart for the second Academy, have been vital to the Air Force.

Now touching 94 years of age, and having been commissioned within a decade of birth of the IAF, it is a matter of great pride for me to pen these lines on the occasion of its 80th Anniversary. The IAF's development and transformation—as sword-arm of the nation's security and defence—have been extraordinary. The ongoing process of its modernisation must, however, continue so that its combat potential as a deterrent is not diluted in any way. I believe that in the person-platform combination the importance of the former is as critical today as in the past. Building future IAF leadership through education, intellectual capacity enhancement and strategic orientation, therefore, constitutes a challenge. In addition, I have always believed that a potent air power capability demands a concomitant industry. There is much to be achieved in this area. As the major stakeholder, the Air Force must strive to drive the national aerospace policy and strategy. But this can only happen if the aerospace sector, including civil aviation, are conceptualised, organised and enabled to become a composite un-compartmentalised entity.



English Electric (later British Aerospace) Canberra light bombers which were to be replaced by the Jaguar deep penetration strike aircraft.

Extracts from an exclusive interview with Air Chief Marshal OP Mehra, Chief of Air Staff, Indian Air Force published in Vayuyan of November 1974.

Please give a reflection of the role of the Indian Air Force in the Seventies.

We have already reached the last quarter of 1974 and thus two fifths of this decade is nearly over. The Indo-Pak War of December 1971 has brought into focus the role that the IAF has played and should play against an aggressor. The IAF is a weapon of peace, and is primarily meant for the protection of its air space and support to the Army and Navy. Throughout its history the IAF has always been ready to defend the nation in the face of naked aggression. This fact has been more than amply demonstrated in the

past. Some of its very senior pilots had also flown in Europe in air operations against Germany. In 1947 in the wake of partition of the country, the IAF rallied to the defence of the nation in J&K. Had it not been for relentless action by its fighter and air transport forces, the fate of J & K at that crucial time might have been different. The IAF also saw action in Hyderabad and during the Goa operations. During the 1962 Chinese aggression, though the strike element of the IAF was not employed, its air defences were alert and air transport elements were used. In the Kutch Operations it was the air recce element which first detected the presence of enemy armour and later nullified its aggressive intentions. Once again during the 1965 Indo-Pak War the Air Force



Formation of Hawker Hunters of the IAF over New Delhi.



The MiG-21M was built by HAL in succession to the earlier MiG-21FL

accepted that we could do with some more, especially because our neighbour has and continues to acquire quantitative and qualitative enhancement of his defence forces; the additions of significance are in respect of armour, anti-aircraft and anti-tank weapons, ships and aircraft covering varying roles. It would be prudent on our part to have in being aircraft with a long reach, sophisticated fire control and navigation/attack systems so that should an occasion arise the same can be used to hit targets in a manner which would hurt the enemy's war potential most.



Vampire T.55 jet trainers of the Indian Air Force which were replaced by HAL HJT-16 Kiran jet trainers.

was engaged in its totality in the defence of the nation. The December 1971 War decisively proved the superiority of the Indian Air Force over that of the enemy and proved its calibre.

In accordance with national policy the IAF is equipped with air defence, close support, air transport, maritime support aircraft as also helicopters for communication and rescue duties. To support this force we have an Air Defence Ground Environment System which is being modernised and updated to keep pace with the IAF's current aircraft weapon systems. This has become essential as our neighbour has acquired some high performance aircraft, weapon systems and an air defence environment much stronger than before. The emergence of a friendly Bangladesh has changed the geo-political picture with a consequential impact on our strategy. The oil and food crises have created certain problems which have a direct bearing on defence spending on our part. There is need for

greater vigilance on our part during the latter half of the 70s.

The IAF, reputedly the world's fifth largest air arm, updated and strengthened much of its flying equipment in the period 1966-71. However, after December 1971 war some urgent decisions were to be taken on replacements : in current thinking, what are the priority roles sought for fulfilment by the purchase of new aircraft?

In the December 1971 war the IAF had sustained some losses of its fighter aircraft. This was understandable too, because of the forward policy which the IAF had adopted in this war by taking the air war into the heart of the enemy's land, by striking its air bases in broad daylight. This bold and aggressive policy paid handsome dividends by breaking the morale of the enemy and enabled us to damage/destroy its arsenals, oil reserves, harbour installations, radar stations as also air bases. We have been receiving some of our requirements indigenously, others are in the pipeline but it has to be

We have plans to develop the Gnat into a relatively inexpensive close support aircraft, and the HF-24 into an advanced strike aircraft capable of Mach 2 performance. The MiG-21M production has now replaced the MiG-21FL, the former being a more potent weapon platform. As two of these would be indigenous developments, we would have to wait their induction. Such projects by their very nature have a long gestation period.

In the maritime support and strike roles, the IAF badly needs more sophisticated/suitable aircraft. With the growing threat to our expanding merchant fleet and the Indian Navy and the threat of underwater weapons in greater numbers in the Indian Ocean, the need for a proper MR/ASW aircraft has been felt for a long time but invariably high cost considerations have deferred a decision with regard to such an aircraft. The 'Super Connie' at present being used in the MR role is totally inadequate for the purpose. As the numbers of MR/ASW aircraft

required would be small, indigenous manufacture can be ruled out. We have to acquire such aircraft by outright purchase. Unfortunately such aircraft are extremely expensive; each of them costing anything from Rs. 6 to 12 crores a piece depending on the avionics and weapons fit.

In the air transport fleet, the Dakota and the Packet are now very old. On merits they deserve a well earned retirement. The non-availability of special fuel for Packet aircraft in the world market is another factor which necessitates its early replacement.

There is also an urgent need to rejuvenate our fleet of training aircraft. The Vampire used for fighter training has more than outlived its usefulness. Due to insurmountable maintenance problems it cannot continue with safety any longer. In the Kiran we have an advanced trainer aircraft which can fulfil our current and foreseeable requirements. Its quantitative induction at the very earliest is overdue.

Not necessarily referring by names to specific aircraft types, please comment on the philosophy behind and a description in broad terms of the type of combat and support aircraft sought i.e. for ground support, long range interdiction, tactical transport support, basic training, weapon training roles.

Ground Support: The fighter-bomber aircraft used in ground support or close support of the Army is basically one which carries a fairly heavy ordnance load of a mixed variety. It should be able to carry bombs, rockets of various types, cannon and air-to-ground guided weapons. In addition most of such aircraft should also be capable of carrying cameras integrally or in pods for recce purposes. For such a role I would prefer a near sonic performance light weight, low cost highly manoeuvrable aircraft.

Long Range Interdiction: The deep penetration strike aircraft has to have a large radius of action at high speed and therefore large integral and external fuel holdings. In addition it must carry sufficient ordnance and an accurate delivery system to cause crippling damage to enemy installations. Survivability is better in a twin-engined aircraft. Self-defence capability if intercepted by enemy fighters is an added advantage. The IAF does not possess such a capability. As success in war depends on crippling the war making



Fairchild C-119G Packet with dorsal mounted jet engine for augmenting power, was obsolescent by the mid-70s.

potential of an enemy, one must “hit where it hurts most” and that too with telling effect. To do this one must have the right type of weapon systems but more than that the ability to use such weapon systems with skill and proficiency.

Tactical Transport Support: The IAF possesses the Dakota, Packet and Caribou for this role. These aircraft have reached a retiring age. Keeping in view our commitments it would be to our advantage—technically and operationally—to replace all these aircraft with a medium tactical support STOL aircraft. The selected aircraft should be capable of operating from small unprepared strips at varying altitudes and in a wide spectrum of temperature and pressure conditions. Such an aircraft should be capable of easy and rugged

handling, good manoeuvrability and low tail loading facility.

Basic and Advanced Training: The basic trainer with the IAF is the HT-2. The indigenously manufactured HJT-16 which has now entered service as an advanced trainer is a very useful aircraft for the role and has years of service ahead of it. As it is the policy of the Air Force to progressively move over to jet training for all its pilots, this aircraft would be used for all aspects of flying training from the very inception. The light piston engine aircraft (HT-2) would be utilised to assess flying ability/potential of all those who volunteer to fly. This training would be of a reasonably short duration but training on the jet trainer aircraft would have to be extensive so that our pilots can be prepared for handling the high performance and sophisticated weapon systems which are in the inventory of the IAF and of future ones which may replace them.

Weapon Training Roles: Basic weapon training used to be provided by the Vampire during the training phase. This will now be taken over by the current trainer in use. Operational training in squadrons would have to be carried out on respective types depending on the role of each squadron. This is the case even today.

In the use of air-to-air and air-to-ground weapons, as the cost of ordnance stores is increasing at a galloping pace, liberal use of live weapons for training is no longer possible. Progressively all Air Forces have to fall back on simulated training or use of “dummies” as the cost of explosives, including missiles, is exorbitant. In some cases weapons are replaced by cameras to assess the aiming accuracy.



Formal portrait of Air Chief Marshal OP Mehra as Chief of Air Staff.

Sweden and Switzerland in Gripen "pact"

On 28 August 2012, the Swiss Defence Ministry announced details of its plans to procure 22 Gripen E/F new generation fighters, a deal that was first announced in November 2011 (see *Vayu VI/2011*). Key factors are the fixed-price of SFr 3.1 billion (\$3.2 billion) with deliveries to be made between mid-2018 and 2021, to be preceded by an interim arrangement to lease 8 Gripen Cs and 3 Gripen Ds made available by Sweden at annual cost of SFr 44 million. Integral to the arrangement will be the Swedish Government's order for 40-60 Gripen E/Fs, also to be delivered from 2018, making this a potential acquisition of 82 Gripen E/F new generation combat aircraft.



Swedish Gripen D photographed from Swiss F/A-18 Hornet over the Alps

Still, the bilateral pact must go through parliamentary debate in Sweden and possible future referendum in Switzerland. The Swedish parliament is expected to review the proposal, which the Government insists "is necessary for the nation's defence capability, but also positive for Swedish jobs, exports and research and development". The partnership between Switzerland and Sweden was officially signed at Meiringen on 29 June 2012 by Swedish Defence minister Karin Enstorm and Federal Councillor Ueli Maurer which is essentially a statement of intent, to be supplemented by the framework agreement.

Typhoons for Oman

Oman is "likely" to order 12 Eurofighter Typhoon combat aircraft, according to BAE Systems. "The Royal Air Force of Oman is currently reviewing the Group's commercial response for 12 Typhoon Tranche 3 aircraft, plus associated support and training facilities," the UK company stated in their half-year results statement on 2 August 2012. "Contract negotiations have commenced, with contract award possible in late 2012."

Other potential operators are Malaysia and Saudi Arabia. Curiously, BAE continues to support "the Indian Government and its evaluation process" even after selection of the Dassault Rafale for the IAF's MMRCAs early in the year.

EADS and BAE in talks for merger

On 13 September, during the ongoing ILA 2012 Airshow in Berlin, Europe's largest aerospace companies and mega defence contractors EADS and BAE Systems announced their intention to merge and create a \$48 billion group. EADS would control 60%, with a united board and management structure and thus be the main rival to Boeing, which would in turn reshape the global aerospace and defence industry.

Merging BAE Systems with EADS would be a significant boost to European leaders' ambitions for a more efficient defence industry. The European Union has long sought to foster more cross-national cooperation on defence projects in Europe to plug holes left by shrinking military budgets and to eliminate wasteful duplication of effort.

The combination of BAE Systems and the Franco-German dominated EADS to form the world's biggest aerospace company could be a big step towards achieving those goals. "We would welcome any reinforcement of the European defence industry and its competitiveness on the international stage," according to a European Union source.

The companies have combined sales of \$93 billion, with products ranging from Airbus commercial airliners to Typhoon fighters and nuclear-powered submarines. EU officials would not take an official position because of sensitivities around the proposed merger, which will need the approval of the EU's competition watchdog. NATO too declined comment, saying the proposed tie-up was a commercial issue.

The French and German governments have yet to make clear if they will back the merger which could yet run into political obstacles over concerns about protection for jobs, defence of national interests, and the impact on competitors. Under the proposed deal, special shares in BAE and EADS would be issued to each of the French, German and British governments to replace the British government's existing "golden share" in BAE and the stakeholder deal that maintains a Franco-German balance of power in EADS.

The British government has said it is working with BAE and EADS to ensure the merger serves the public interest, but senior British lawmakers say Prime Minister David Cameron backs the deal. Falling defence budgets mean that hardly any European government, even the biggest military spenders such as Britain, which currently has no aircraft carriers flying fast jets, can deploy a full range of military capabilities. That has led to increasing stress on European governments working together to share capabilities and plug gaps. Britain and France signed a far-reaching defence agreement in 2010.

VAYU SELF AD

First M-346 for Singapore

The first M-346 advanced jet trainer for the Republic of Singapore Air Force was unveiled at a ceremony on 7 August at Venegono Superiore, near Varese in Italy. To be handed over later this year, this is first of a 12-aircraft order signed in September 2010. The M-346s are to replace Douglas A/TA-45U Skyhawks at Cazaux air base in France, where the RSAF conducts its 'Fighter Wings' course.



Alenia Aermacchi and ST Aerospace are to provide logistical support under a 20-year contract signed in July 2011 and Boeing will supply full-mission simulators for the programme. The first RSAF pilots are under training at the Italian Air Force's advanced training school at Lecce air base, using its extensive ground-based training system. Israel is the second international customer for the M-346, with an order for 30 aircraft.

Indonesia limits Su-30 fleet

According to sources in Djakarta, "there will be no further Sukhoi fighters ordered from Russia", the Indonesians instead ordering upgraded ex-US Air Force Lockheed Martin F-16s and, in the longer term, aircraft jointly developed with South Korea through the K-FX programme. The Indonesian Air Force presently has 10 Su-30 and Su-27s, with six additional fighters to be obtained. Funds are instead being made available for refurbishment of some 15 C-130s and purchase of more Indonesia Aerospace CN-295 transports. Indonesia will receive 24 F-16s from the USA.

Indonesian Secretary General of Defence Ministry stated that, "Indonesia has also invested in South Korea's K-FX programme, which will produce (5th generation) fighters to replace aircraft like the F-5s and F-16s. We aim to buy enough K-FX fighters for three squadrons of 16-22 aircraft each. That will cover our long-term requirements."

Colombia orders Hermes UAVs

Elbit Systems has signed a multimillion-dollar contract for a mixed fleet of Hermes 900 and 450 unmanned air systems with Colombia. The contract, worth "tens of millions of dollars," includes ground stations and a variety of surveillance and communications payloads.

Super Tucanos for Indonesia

The *Tentara Nasional Indonesia-Angkatan Udara* (TNI-AU, Indonesian Air Force) has received its first four A-29 Super Tucano light attack and tactical training aircraft. The hand-over ceremony took place at Embraer's facility in Gavião Peixoto, São Paulo, Brazil, and aircraft due to be delivered to *Skadron Udara* 21 of Wing 2, based at Lanud Abdul Rachman Saleh, Malang in Java. These are from an initial batch of eight for the TNI-AU;



twelve Indonesian pilots have been converted on the aircraft in Brazil and a type simulator installed at Lanud Abdul Rachman Saleh. The TNI-AU had ordered a second batch of eight Super Tucanos as part of its equipment modernisation programme, all of which will be handed over in 2014. The Super Tucano is to replace the present force of Rockwell OV-10F Broncos as part of the Indonesian Defence Forces' equipment modernisation plan for the years 2009 to 2014.

FCAS contract awarded

The UK and French governments have contracted BAE Systems and Dassault Aviation to begin the demonstration programme preparation phase (DPPP) of the Future Combat Air System (FCAS) unmanned combat air vehicle, joint development of which was announced earlier in 2012, and which stems from the Anglo-French defence treaty signed in November 2010. The contract follows signing of an agreement between the British Minister for Defence Equipment and Support, Peter Luff and Laurent Collet-Billon of the *Direction Générale de l'Armement* (defence procurement agency).

Independently, BAE Systems and Dassault have been working on the Taranis and nEUROn UCAV technology demonstrators, which are likely to contribute to the FCAS. Rolls-Royce and Snecma will provide the engines for the demonstrators and also announced a collaboration on 30 July to research new engine technologies as part of the DPPP. Their joint venture, Rolls-Royce Snecma Ltd, had been awarded a contract by the UK Ministry of Defence to conduct studies into the next generation of combat engines for both France and Britain.

T/A-50 for the Philippines

The Philippines Department of National Defence has announced choice of the Korea Aerospace Industries T/A-50 to meet its requirements for a light attack aircraft. A total of 12 aircraft will be acquired, two of which will be delivered “as soon as possible” so that crew training can commence. This armed version of the T-50 Golden Eagle advanced trainer will be equipped with ELTA Systems EL/M-2032 fire control radar and has an internal General Dynamics M197 20mm cannon plus AIM-9 Sidewinder air-to-air missiles and AGM-65 Maverick air-to-surface missiles. The T/A-50 was selected by the Philippines in preference to the Aero Vodochody L-159, Alenia Aermacchi M-346 Master, AMX International AMX, BAE Systems Hawk and Yakovlev Yak-130.



Meanwhile, the Phil. Air Force is establishing a new base at Lumbia Airport in Cagayan de Oro City but will vacate one of its eight current bases, the Danilo Atienza Air Base in Cavite, near Manila, to make way for civil aviation that will transfer from Ninoy Aquino International Airport in Manila. This is intended to reduce congestion at Ninoy Aquino, which shares a runway with the Jesús Villamor Air Base at Pasay City.

First Lightning II for RAF

The first Lockheed Martin F-35B Lightning II was delivered to the UK Ministry of Defence on 19 July, at a ceremony at Lockheed Martin’s facility at Fort Worth, Texas, attended by the British Secretary of State for Defence, Philip Hammond and the US Undersecretary for Acquisition, Technology and Logistics, Frank Kendall.



At the event, Hammond said that the UK would order 48 F-35Bs to equip the strike force of the *Queen Elizabeth*-class aircraft carriers currently under construction. The number of additional F-35s to be acquired will be outlined in the Strategic Defence and Security Review (SDSR) planned for 2015. Philip Hammond also announced that a fourth F-35 would be ordered in 2013, the first production standard version destined for training.

Meanwhile, on 10 August, the first Lockheed Martin F-35A Lightning II for the *Koninklijke Luchtmacht* (Royal Netherlands Air Force) made its maiden flight at Naval Air Station Fort Worth Joint Reserve Base, Texas. After being handed over to the Netherlands, it would join the multinational initial operational test and evaluation fleet at Eglin AFB, Florida.

Israeli-Italian deal for G550 CAEWs and M-346s

In a strategic government-to-government deal between Italy and Israel, the latter will receive 30 Alenia Aermacchi M-346 Master advanced trainers, while Italy will procure two Gulfstream G550 Conformal Airborne Early Warning (CAEW) aircraft. The M-346 was selected in February, when a preliminary agreement for the purchase was signed. Initial deliveries will be in mid-2014 and the M-346 will replace the Douglas T/A-4 Skyhawk with Israel’s Air and Space Force in the advanced and fighter lead-in training role.



A contract for the two G550 CAEWs for Italy was signed in Israel on 19 July. Both will be delivered to the *Aeronautica Militare* (Italian Air Force) along with ground and logistical support packages worth \$ 750 million. G550 CAEWs are to be produced from green airframes by Israel Aerospace Industries, with avionics supplied by ELTA Systems, including a solid state dual-band active electronically scanned array four dimensional radar and IFF for 360° detection, classification and tracking of airborne and surface targets; a communications suite from ELTA and SELEX-Elsag; 360° electronic support measures; a self-protection system, plus a mission computer system.

Turkey prepares for F-35s

The THK is preparing for introduction of the Lockheed Martin F-35 *Müsterek Taarruz Uçağı* (MTU, Joint Strike Fighter) and the first unit to receive the fighter will be 172 Filo of the 7th *Ana Jet Üssü* (AJÜ, Main Jet Base) in Erhac, Malatya.

In preparation of its first F-35s, the Turkish Air Force [*Türk Hava Kuvvetleri* (THK)] is systematically phasing out the present force of three F-4ETMs Phantom squadrons. The THK will have two frontline units (111 and 171 Filos) and one weapons and tactics (132 Filo) squadron left. In addition, 173 Filo also has 15 RF-4ETM reconnaissance Phantoms, which were due to receive electro-optical and synthetic aperture radar imagery pods from Israel under the Turkish Aerial Reconnaissance Programme (TARP).

Preparation of the infrastructure is under way and 171 Filo will transfer its F-4E 2020s to 111 Filo of the last AJÜ in Eskişehir, as the second F-35 operator within the THK. Nos. 111 and 112 Filos of the 1st AJ will be the next two F-35 units, as an earlier decision to operate a handful of F-35s with the 132 Filo 'Hancers' (Dagger) tactics and weapons unit has been shelved.

40,000 hrs surpassed by German Navy Do228s

According to the *Havariekommando* (Civil Emergency Command) at Cuxhaven, the German Navy's four Dornier 228-212s had flown 40,063 hours since entering service in 1991. Most flight time was accumulated by crews of *Marinefliegergeschwader 3* (Navy Air Wing) 'Graf Zeppelin' at NAS Nordholz, who accumulated 29,687 hours patrolling the German North and Baltic Sea coastlines. Another 10,376



hours were accumulated in the transport role. One of the Do 212-212LMs completed a mid-life upgrade at RUAG's facility at Oberpfaffenhofen in 2011, which included new avionics, engines, five-blade propellers and a glass cockpit. Two Do228-212LTs have meanwhile been sold on the civil market and will be replaced in service by a Do 228NG later this year.

CN235 MPAs for Turkey

Four Airbus Military CN235M-100 Maritime Patrol Aircraft have been delivered to the Turkish Navy. The aircraft were ordered under the *Meltem II* programme and the first 'green' airframe arrived in Ankara for equipment with mission systems, including the Thales Airborne Maritime Situation and Control System. Turkish aircrew were trained on the new platform as part of the contract. The fourth aircraft was recently handed over to the Turkish Navy during a ceremony at the Tusas Aerospace Industry facility in Ankara.

Russian Tu-22Ms in long range exercises

In recent exercises, the *Dalnaya Aviatsiya* (DA, or Long Range Aviation) flew four Tupolev Tu-22M bombers over the Sea of Japan, resulting in the Japan Air Self Defence Force scrambling F-15J Eagle fighters from Chitose air base on Hokkaido to intercept and escort them. The DA confirmed this claim and stated that two pairs of Tupolev Tu-95Ms bombers had also flown from Ukrainka airfield in the Amur region and Yelizovo in Petropavlovsk-Kamchatsky, on missions lasting 20 and 13 hours respectively, with mid-air refueling from Ilyushin Il-78 tankers. US Air Force F-15C Eagles later flew parallel to the Russian bombers near the Alaskan coast and Aleutian Islands.

On 17 July, pairs of Tu-22M also flew over the Baltic and Black Seas, operating from "air bases in the Nizhny Novgorod and Kaluga regions", with missions lasting for four and six hours respectively, the bombers being escorted for some part of the way by Russian Sukhoi Su-27 fighters. These Tu-22Ms were also intercepted and escorted over the Baltic by Polish Air Force F-16Cs, which are currently manning the NATO Baltic Air Policing detachment at Šiauliai in Lithuania.

Brazil's F-X2 postponed – again

Brazil's long awaited clearance for 36 new multi-role combat aircraft under the F-X2 requirement has been postponed (again), this time for six months. The *Força Aérea Brasileira* (Brazilian Air Force) has requested the three competing manufacturers to confirm validity of their bids, this extension being the fourth six-month delay to the project.

The Dassault Rafale, Boeing F/A-18E/F Super Hornet and Saab Gripen NG are short listed by the FAB. The Rafale has been considered the preferred F-X2 fighter for several years, with reports appearing in the Brazilian media in early 2010 suggesting the type had been selected. It is understood that Brazilian officials have recently held talks with Indian counterparts following the Rafale's selection for the IAF's Medium Multi-Role Combat Aircraft competition. The Indian CAS, Air Chief Marshal NAK Browne made an official visit to Brazil in August 2012.

IFSEC

Grob G120TPs for Indonesia

The first Grob G120TP basic trainer for the *Tentara Nasional Indonesia-Angkatan Udara* (Indonesian Air Force) was rolled out at the company's factory at Tussenhausen-Matties in Germany in late June. Indonesia is scheduled to receive six aircraft later this year and the balance by third quarter of next year. Indonesia's order for 18 G120TPs was announced in September 2011, to be used for primary training, with Indonesian pilots progressing onto the Korea Aerospace Industries KT-1 Woong-Bee.

The trainer is equipped with the Esterline CMC Electronics Cockpit 4000 and new Martin Baker Mk.17 ejector-seats. Grob is reportedly in final negotiations with two other nations about G120TP sales and has on-going campaigns in 23 countries, including several in South Asia.

PC-21s for Qatar

24 Pilatus PC-21s will be delivered to the Qatar Emiri Air Force by 2015, the aircraft flying part of a comprehensive training system including ground-based equipment to equip a new Flying Academy for the air force. Logistical support and a maintenance package are also included in the deal, which was signed in Doha on 30 July.

The PC-21 was selected as the new basic and advanced for the air force after evaluation in both Switzerland and Qatar. The initial examples will be handed over in mid-2014 and training will commence one year later. The new flight academy will allow the Qatar Emiri Air Force to train its own pilots for the first time, progressing from the PC-21 to the Dassault Alpha Jet, six of which have been in service since 1980. Qatar is also expected to seek a new advanced/lead-in fighter trainer.

Iraqi F-16 deliveries

The Iraqi Air Force has requested the US to expedite delivery of 18 Lockheed Martin F-16C/D Block 52s ordered under an initial Foreign Military Sales (FMS) deal. Iraq was due to receive its first F-16s in late 2013, but this has been delayed until early 2014. Lockheed Martin received a \$835 million production contract for 12 F-16Cs and six F-16Ds on 5 December 2011, with work due to be completed by the end of May 2018. Iraq is seeking to acquire a total of 36 F-16 Block 52s via FMS.

Fennecs for the Philippines

Four Eurocopter AS550 Fennecs are to be delivered to the Philippines in 2012, which have already been built and were originally destined for another country. The present force of MD520MGs are undergoing a service life extension programme and in recent years have been heavily utilised for combating insurgents in the country. Other helicopters due to be delivered to the Philippines by the end of the year include 21 refurbished Bell UH-1H Iroquois and two to four attack helicopters.



The AS550 Fennec

First RMAF EC725s

The Royal Malaysian Air Force (RMAF) will receive its first two new Eurocopter EC725 Caracal helicopters by January 2013. Malaysia had ordered 12 EC725s on 20 April 2010, to undertake transport and search and rescue duties, to replace the ageing Sikorsky S-61A-4 Nuris currently in service. Deliveries will continue through 2013, with the last on order due to be delivered in January 2014. A simulator has also been ordered, which will be housed at Subang, where the majority of the fleet will be based.

RSAF F110 engines

The Royal Saudi Air Force (RSAF) has ordered 193 F110-GE-129E engines to power 84 new twin-engine Boeing F-15SA aircraft, thus becoming the largest operator of F110 engines other than the US government. This follows earlier RSAF orders for 156 engines to power 71 re-engined F-15S aircraft, with deliveries



to start in 2013. In selecting the GE engine, the RSAF cited "the F110's high performance, safety and reliability and the successful operation" of their current F110-powered F-15 fleet. "More" than 3,000 F110 engines have been ordered worldwide since initial selection by the USAF in 1984, making it the best-selling engine for Lockheed Martin F-16C/D fighters.

US Navy contracts for SLAM ER and Harpoon Missiles

Boeing has received a firm-fixed-price contract from US Naval Air Systems Command for the production of some 90 Harpoon Block II missiles and associated hardware for the US and four foreign militaries. Harpoon Block II missiles feature autonomous, all-weather, over-the-horizon capability and can execute missions against sea and land targets, including coastal defence sites, surface-to-air missile sites, exposed aircraft, port or industrial facilities, and ships in port. More than 600 ships, 180 submarines, 12 different types of aircraft and land-based launch vehicles carry Harpoon missiles. SLAM ER, a derivative of Harpoon, is an air-dropped surgical strike weapon against high-value land targets or ships at sea or in port.



US Army contracts for guided MLRS rockets

Lockheed Martin has received a \$353.2 million US Army follow-on contract for the seventh production lot of Guided Multiple Launch Rocket System (GMLRS) Unitary rockets. Designed for destroying targets at ranges up to 70 kilometers, GMLRS is an all-weather, rapidly deployable, long-range rocket that delivers precision strike beyond the range of most conventional weapons. GMLRS Unitary rockets



have achieved a combat-reliability rate of 98 percent “and have established a reputation for affordability.” Each GMLRS rocket is packaged in an MLRS launch pod and fired from Lockheed Martin HIMARS or M270 family of launchers. The longer-range GMLRS+ rocket, with a range of more than 120 kilometers, is being developed and tested by Lockheed Martin.

Over 900 Sikorsky H-60 helicopters for US Army and Navy

The US Army and Navy have signed a massive \$8.5 billion contract with Sikorsky Aircraft to buy a baseline quantity of 653 Black Hawk and Seahawk helicopters through December 2017. “The five-year contract will yield significant savings for the US Government compared with purchasing the same quantity



across five separate annual agreements”. The five-year agreement also allows the Army and Navy to order as many as 263 more aircraft within the same contractual terms. If exercised, the optional purchases could push the contract value as high as \$11.7 billion. Actual production quantities will be determined year-by-year over the life of the programme based on funding allocations set by Congress and Pentagon acquisition priorities.

ASSTA 3.0 Tornados for Luftwaffe

Cassidian has delivered the first two Tornado’s upgraded to the new ASSTA 3.0 (Avionics System Software Tornado Ada) capability standard, to the German Air Force. After several months of retrofitting, certification and acceptance by Cassidian and by the Bundeswehr Technical Centre 61 in Manching, the aircraft have been returned to Fighter Bomber Wing 33 in Büchel. Besides integration of the network-centric data communication system MIDS (Multifunctional Information Distribution System / Link 16), the ASSTA 3.0 standard includes a state-of-the-art radio device, a digital video and data recorder (DVDR), and the integrated Laser Joint Direct Attack Munition (LJDAM), which can be guided to its target by means of satellite navigation or by laser.

Raytheon's WiPAK on French Navy Rafales

Raytheon has demonstrated a wireless method of integrating its combat-proven Enhanced Paveway II precision-guided bomb on the French Navy Rafale. Named WiPAK, the avionics kit enables integration of Paveway on a variety of aircraft without any modifications to aircraft wiring or changes to the flight and stores management software. During the test, an Enhanced Paveway II GBU-49 was dropped from the Rafale at the Biscarrosse test range in south-western France. The weapon system met all requirements during the demonstration and impacted the target well within the requirements. WiPAK consists of a small wireless transmitter, located in the aircraft cockpit coupled with a pilot interface, and a small receiver affixed to the Paveway weapon.



The WiPAK allows the use of Raytheon's Enhanced Paveway II family of weapons on aircraft previously unable to carry such precision smart weapons.

France orders Diehl naval ammunition

Diehl Defence has received an order from France to develop and qualify modern naval ammunition, which constitutes a refinement of the 76 mm naval ammunition employed worldwide. The new ammunition has insensitive explosives and is scheduled for deployment in the Oto Melara Super Rapido L-62 naval guns of the new frigates FREMM and HORIZON from 2015. The 76 mm ammunition is capable of engaging both air and sea targets as well as coastal targets.



AW159 Wildcat for UK MoD

Delivery of the new AgustaWestland AW159 Wildcat multi-role helicopter to the UK Ministry of Defence (MoD), was marked at a ceremony during the Farnborough International Airshow, in presence of the Secretary of State for Defence, Philip



Hammond. Wildcat IOC with the British Army is scheduled for 2014 and the Royal Navy in 2015. The British Army's AW159 Wildcat will perform a wide range of tasks on the battlefield including reconnaissance, command and control, transportation of troops and materiel, with provision for force protection. The Royal Navy variant will provide anti-surface warfare and force protection capability, operating in support of amphibious operations. There is a high degree of commonality between British Army and Royal Navy helicopters that enables aircraft to switch roles when required.

Maritime patrol aircraft for Turkey

Thales has completed delivery of initial standard maritime patrol aircraft under the *Meltem II* programme for Turkey, with four aircraft entering service between February and June 2012. Pierre Eric Pommellet, Executive Chairman of Thales *Systèmes Aéroportés*, officially handed over the aircraft during a ceremony at the Tusas Aerospace Industry (TAI) facility in Ankara. Thales is prime contractor for the *Meltem II* programme, which involves delivery of six maritime patrol aircraft for the Turkish Navy and three maritime surveillance aircraft for the Turkish Coast Guard, the aircraft being modified CASA CN-235s. The programme also includes the provision of 10 additional maritime patrol systems for integration on ATR 72 aircraft in service with the Turkish Navy. Seven of these have already been delivered to the SSM. The 19 mission systems are based on Thales's AMASCOS solution (Airborne Maritime Situation & Control System).

Boeing marks 50 years of Chinooks

As Boeing marks the 50th anniversary of delivering the first H-47 Chinook military helicopter, the company is nearing completion of a \$130 million renovation of its production line near Philadelphia that will help it meet global demand for the latest model, the CH-47F. Boeing has delivered more than 1,200 Chinooks to 18 operators around the world since delivering the very first to the US Army on 16 August 1962. More than 800 remain in operation, conducting combat, cargo transport and humanitarian relief missions. The production line updates will enable Boeing to continue to affordably increase Chinook



production rates. Boeing is scheduled to deliver nearly 60 Chinooks this year and has submitted a multiyear, firm fixed-price proposal to the Department of Defence to provide 155 CH-47Fs to the US Army with deliveries beginning in 2015.

[Vayu visited the Philadelphia plant in July : article in next issue]

Second production P-8A Poseidon for US Navy

Boeing have delivered the second production P-8A Poseidon aircraft to the US Navy, one of 13 low rate initial production (LRIP) maritime patrol aircraft that Boeing is building for the Navy as part of two contracts awarded in 2011. Navy pilots flew the P-8A from Seattle to Naval Air Station Jacksonville, where the first LRIP P-8A is being used for aircrew training.



Three P-8As currently are undergoing mission systems installation and checkout in Seattle and three are in final assembly in Renton, Washington. In order to efficiently design and build P-8A aircraft for the Navy and P-8I aircraft for India, the Boeing-led team is using a first-in-industry, in-line production process that draws on the company's Next-Generation 737 production system. All aircraft modifications are made in sequence during fabrication and assembly.

(US and Indian Navy P-8s are in near simultaneous production at Renton, detailed article in next Vayu).

HC-144A Ocean Sentry for US Coast Guard

The US Coast Guard has taken delivery of its 14th HC-144A Ocean Sentry maritime patrol aircraft from EADS North America. The Ocean Sentry is based on the Airbus Military CN235 tactical airlifter, more than 250 of which are currently in operation by 27 countries. The Coast Guard plans for a fleet of 36 Ocean Sentries, the latest aircraft delivery being last of three HC-144As delivered under a base contract awarded to EADS North America in August 2010.



Boeing F-15E Radar Modernisation Programme

The US Air Force has cleared the Boeing F-15E Radar Modernisation Programme (RMP) with approval to begin Low Rate Initial Production 2 (LRIP 2) of 10 APG-82(V)1 Active Electronically Scanned Array (AESA) radar systems. The RMP APG-82(V)1 AESA radar will replace the F-15E strike fighter's current APG-70 Mechanically Scanned Array radar. The AESA provides improved radar reliability, maintainability and performance, as well as reduced support costs. "When integrated into the F-15E weapons system, the AESA radar will significantly improve detection and tracking of enemy targets".

Raytheon's new Rolling Airframe Missile

The US Navy has awarded the Raytheon Company a \$51.7 million contract for low rate initial production of the Rolling Airframe Missile Block 2, which includes options, and would bring the cumulative value of this contract to more than \$105 million. RAM Block 2 features enhanced kinematics, an evolved radio frequency receiver, a new rocket motor, and an upgraded control and autopilot system. The contract award follows a series of key milestones, including successful guided flight tests for RAM Block 2.

RAM is a supersonic, lightweight, quick reaction, fire-and-forget missile providing defence against anti-ship cruise missiles, helicopter and airborne threats and hostile surface craft. For more than 35 years, the US and Germany have worked together developing and maintaining RAM. Development, production work and funding are shared between Raytheon and RAMSYS.

Raytheon Evolved SeaSparrow 2,000th missile

The Raytheon Company has delivered the 2,000th Evolved SeaSparrow Missile to the NATO SeaSparrow



Consortium. Deployed by the US Navy and 11 international fleets, ESSM defends the battlespace by delivering ship self-defence firepower against high-G manoeuvring anti-ship cruise missiles, as well as surface and low-velocity air threats. As a tail-controlled missile, ESSM uses recent enhancements to its guidance system to take advantage of improved seeker sensitivity, increased propulsion and greater weapon accuracy. Combined, these features result in ESSM arriving at the intercept point with more speed and agility to counter the threat.

Airbus Military in agreements with Portugal

Airbus Military has signed a cooperation agreement with the Ministry of Economy and various Portuguese industrial companies in fulfillment of the commitments arising from the sale of a fleet of twelve C295 aircraft for the Portuguese Air Force. With a value of several hundred million euros, these agreements will boost the Portuguese aerospace industry and strengthen the commitment of Airbus Military to Portugal. Assembly and production of the central fuselage of the C295 will remain with OGMA, and technical publications and development of an improved MITS will be subcontracted to EMPORDEF-TI. GMV Portugal will develop an integrated modular avionics demonstrator and provide training courses for the Brazilian Air Force.

MC-130J Commando II delivered

Lockheed Martin has delivered an MC-130J Commando II to the 522nd Special Operations Squadron USAF at Cannon, AFB, NM. The Commando II is used for missions such as in-flight refueling, infiltration/exfiltration, and aerial delivery and resupply of special operations forces.



Saab fire control and radar systems ordered

Saab has received an order for naval fire control and radar systems, amounting to SEK 450 million which involves business areas Security and Defence Solutions and Electronic Defence Systems. The fire control system and radar systems will be integrated with a third party combat management system. Development and deliveries will take place 2012-2017. “The defence and security industry’s nature is such that information regarding customers and products sometimes is subject to confidentiality agreements between Saab and its customers. For this reason further information about this order will not be announced”.

Order for Saab RBS15 Mk3

Saab has received an order from its German partner Diehl BGT for the surface-to-surface missile RBS15 Mk3. The order value is SEK 168 million and includes options with a total value of SEK 83 million. Deliveries will take place during the period 2014 to 2016. “The order for RBS15 Mk3 is important for us in the long-term cooperation with our partner Diehl and for the continued development of the system,” says Tomas Samuelsson, Senior Vice President and Head of Business Area Dynamics. “From a broader perspective, it is yet another evidence of our ability to deliver on Saab’s long-term strategy to increase sales outside Sweden.”



First flight for US Army Airship

Northrop Grumman Corporation and Hybrid Air Vehicles Limited have carried out first flight of the US Army’s Long Endurance Multi-Intelligence Vehicle (LEMV) at historic Lakehurst, New Jersey, the birthplace of the nation’s storied military airship past. This major milestone represents commencement of the flight test programme, and “demonstrates that Northrop Grumman and its industry partners have successfully developed the world’s largest, most-persistent, lighter-than-air optionally piloted aircraft”.



C212s for Vietnam Marine Police

Airbus Military has delivered the first of three C212-400 maritime patrol aircraft ordered by the Vietnam Marine Police. The aircraft, manufactured in Seville, Spain was handed over at Gia Lam (Hanoi) at the end of a 10-day ferry flight from Skavsta, Sweden following installation of its mission system.

The flight, staged through Kosice, Slovakia; Sitia, Greece; Luxor, Egypt; Riyadh, Saudi Arabia; Muscat, Oman; Ahmedabad and Kolkata, India and Chiang Mai, Thailand en route to Hanoi.



US Army Apache fleet surpasses 3.5 million flight hours

The US Army AH-64 Apache helicopter fleet surpassed 3.5 million flight hours in June 2012 as Apache crews flew combat missions in Afghanistan, participated in exercises in South Korea and trained with the new AH-64D Apache Block III.



Apaches began operating in 1984. The newest and most advanced Apache, the AH-64D Apache Block III, features composite main rotor blades, a composite stabilator, 701D engines with an enhanced digital electronic control unit, and an improved drive system that enhances the rotorcraft's performance.

15 UH-60M Helicopters for Sweden

Sikorsky Aircraft is to deliver the final two of 15 UH-60M Black Hawk helicopters to the US Army for further transfer to the Swedish Defence Material Administration (FMV). All 15 aircraft will have been delivered in just 16 months, a record acquisition pace for a squadron-sized fleet of Black Hawk



helicopters procured via the US Government's Foreign Military Sales programme. The accelerated deliveries are arriving in time for the Swedish Armed Forces to deploy three aircraft to Afghanistan in 2013 in support of Sweden's commitment to the International Security Assistance Force (ISAF).

Once in Afghanistan, Sweden will operate the UH-60M aircraft for medical evacuation, utility, and search and rescue missions. Sikorsky is delivering Sweden's aircraft to the US Army equipped with an advanced flight control system to reduce pilot workload, full night vision device capability for night operations, and a state-of-the-art communications suite.

First GE90-powered B777 with Thai Airways

Thai Airways International Public Company Limited held a special ceremony to mark entry of its first GE90-115B-powered Boeing 777-300ER aircraft leased from BOC Aviation. Thai operates five leased Boeing 777-300ERs, and this new Boeing 777 300ER is one of eight that are being leased from BOC Aviation. In addition to these leased aircraft, Thai has six GE90-115B-powered Boeing 777-300ER aircraft on order and will, in total, operate 19 GE90-powered Boeing 777-300ER aircraft. At 115,000 pounds of thrust, the GE90-115B engine includes such performance-enhancing features as three-dimensional aerodynamic (3-D aero) compressor and wide-chord, swept composite fan blades for greater efficiency.



First Bell 407GX for Africa

National Airways Corporation, a Bell Helicopter independent representative, has delivered the first Bell 407GX in Africa, the helicopter to be operated by a private customer in a corporate capacity. Based on the Bell 407, the 407GX is the only helicopter equipped with the Garmin G1000HTM integrated glass flight deck, making it the most advanced light, single-engine rotorcraft on the market. The glass flight deck provides pilots essential flight information for greater situational awareness, making the 407GX an ideal aircraft for flying in challenging, diverse environments, including arid deserts and mountainous terrain of Africa.

AW139s for Maryland Police

The Maryland State Police Aviation Command has executed options under their current contract for three additional AW139 medium twin helicopters. These aircraft will be used for emergency medical, search and rescue, law enforcement and homeland security missions. This order follows an initial contract for six AW139s placed in 2010.



Russian Technologies and Irkut MC-21 contract

Russian Technologies State Corporation through its subsidiary, specialised leasing company Aviation Capital Services LLC and JSC IRKUT Corporation, as part of JSC United Aircraft Corporation have signed a contract on 35 MC-21 short/mid-range airliners. The contract entails the MC-21 to be powered by PD-14 engines of the United Engine Corporation. First deliveries of MC-21 aircraft to customers are scheduled in 2017.



Alexey Fedorov, president of JSC IRKUT Corporation, and Michael L Kdobe, general director of Denel Aviation, signed a cooperation agreement for joint activities to promote IRKUT's products in South African countries, such as the MC-21 airliner, trainer aircraft, establishing an MRO centre on the basis of Denel Aviation and further development of industrial cooperation. The

long-term agreement underlines the interaction between the Russian Federation and the Republic of South Africa within the BRICS organisation.

Alexey Fedorov has also signed a number of agreements with the president of Zodiac Aerospace Group in expansion of their cooperation for the development of MC-21 in the areas of interiors and primary power distributions systems. This cooperation with Zodiac Aerospace provides the MC-21 with "the most advanced cabin interiors and airborne systems."

CHC Helicopter to procure AW139s

CHC Helicopter will acquire 10 AW139 medium twin helicopters over the next three years, to perform offshore transport missions in support of the oil and gas industry. This order will bring the total of AW139 helicopters operated and managed by this operator to 44, reinforcing CHC Helicopter as the largest AW139 user worldwide. CHC Helicopter's AW139s are deployed across the company's worldwide operations, which span some 30 countries. In addition to offshore transport tasks, CHC Helicopter is also using the AW139 for search-and-rescue and emergency medical service missions.

Bombardier CSeries for "new customer"

"A new customer", which remains unidentified at this time, has placed a conditional order for five CS100 and 10 CS300 jetliners, valued at approximately \$1.02 billion "Bombardier's CSeries aircraft provide a distinct economic advantage compared to any aircraft in their class, and we are thrilled to welcome the twelfth CSeries aircraft customer to the programme," said Mike Arcamone, President, Bombardier Commercial Aircraft. "The CS100 and CS300 airliners combine unmatched field performance along with transcontinental range, creating opportunities for new business models; what's more, they will be contributing to more sustainable aviation with their reduced environmental footprints." The CSeries aircraft is scheduled to enter service in late 2013.



New SSJ100 order from Interjet

SuperJet International (SJI), a joint venture between Alenia Aermacchi and Sukhoi Holding, announced that its launch western customer Interjet, has converted its five Sukhoi Superjet 100 (SSJ100) options into firm orders. In January 2011, SuperJet



International had signed a contract with Interjet for the purchase of 15 SSJ100 plus five options. All SSJ100 aircraft will be in the 93-seat configuration. Interjet's first SSJ100 will arrive in Venice (Italy) at SuperJet International's Headquarters in August 2012.

500th AW139 for Weststar Aviation Services

AgustaWestland delivered its 500th AW139 to Weststar Aviation Services of Malaysia during a ceremony held at the Farnborough International Airshow. The aircraft was accepted by Tan Sri Syed Azman Syed Ibrahim, Group Managing Director



of Weststar from Bruno Spagnolini, CEO, AgustaWestland. The 500th delivery comes just one year after AgustaWestland delivered the 400th helicopter.

Russia to deploy AW139s for Special Security Duties

AgustaWestland and Exclases Holdings Ltd. have confirmed that three AW139 helicopters will be operated in Russia for special security missions. These aircraft, which will be operated by a government agency "to enhance security", are scheduled to enter operational service in 2013. This marks entrance of the AW139 into the Russian parapublic helicopter market, expanding on the rapid success of this model across the nation where it has been chosen for VIP/corporate transport, passenger transport and utility missions. A civil AW139 assembly line in Tomilino, near Moscow, has just started operations, the plant run by HeliVert, a Joint Venture company established by Russian Helicopters and AgustaWestland.

Aircelle and Rolls-Royce in Trent 900 operating agreement

Rolls-Royce and Aircelle will be offering Trent 900 engine nacelles on British Airways' A380s, marking a long-term global care package commitment by these two original equipment manufacturers (OEMs) on a key component of the Airbus jetliner. This contract involves a 25-year coverage period beginning in 2013, during which Aircelle will provide complete support on the nacelles supplied for the Rolls-Royce Trent 900s that power British Airways' fleet of 12 A380s. Aircelle will ensure the availability of key Trent 900 nacelle components, including thrust reverser, fan cowls, air inlet and exhaust system, which are to be located at the airline's London Heathrow Airport technical base, "enabling optimised aircraft dispatch and operation through a quick engine change (QEC) capability."



Eric Schulz, Rolls-Royce's President, Large Engine Programmes (right), with Vincent Mascré, Chairman and Chief Executive Officer of Aircelle (left)

Aeromexico orders LEAP-1B engines

Mexico's flag carrier, Aeromexico intends to purchase 90 LEAP-1B engines to power 90 Boeing 737 MAX8 and MAX 9 airliners, valued at \$2.25 billion at list price. Aeromexico is a long-time CFM customer and took delivery of its first CFM56-7B-powered Next-Generation 737 in 2003. Currently, the airline operates a fleet of more than 40 CFM56-powered 737-700 and 737-800s with some 10 additional aircraft to be delivered.



The LEAP-1B, which is the result of an exhaustive six-year collaboration effort with Boeing, is the exclusive powerplant for the new 737 variant, with the engine optimised for the airplane. The 737 MAX continues a 30-year relationship between CFM and Boeing: CFM engines have been the sole powerplant for all 737 aircraft sold since 1981.

Tenth production SSJ100 aircraft

Sukhoi Civil Aircraft (SCAC) delivered its tenth production Sukhoi Superjet 100 (MSN 95017), the ninth to enter into service with Aeroflot. On completion of technical acceptance procedures, SCAC and Aeroflot signed the Act of Delivery & Acceptance for this aircraft at Ulyanovsk in the end of July 2012. The aircraft has been named after the outstanding Soviet pilot Vasily Borisov with tail number RA-89009.



45 Bombardier Q400s for WestJet

Bombardier Aerospace have announced that the conditional order placed by WestJet, an Alberta partnership on 28 June 2012, has been converted to a firm purchase agreement for up



to 45 Q400 NextGen airliners. The transaction includes 20 firm-ordered Q400 NextGen aircraft and options on an additional 25 aircraft. Based on the Q400 NextGen aircraft list price, the firm order is valued at approximately \$683 million and could increase to approximately \$1.59 billion if the 25 options are converted to firm orders.

UTAir selects CFM56-5B engines for A321s

UTAir Aviation (UTAir) of Russia has selected CFM International's CFM56-5B engine to power its new fleet of 20 Airbus A321 aircraft. To support its new fleet, UTAir also signed a long-term Rate per Flight Hour (RPFH) agreement for 40 CFM56-5B engines ordered. Under the terms of the multi-year comprehensive maintenance programme customised to UTAir's specific requirements, CFM will guarantee the maintenance cost on a dollar per engine flight hour basis. UTAir has been a CFM customer since 2007 and currently operate a fleet of CFM56-powered Boeing Next-Generation 737 aircraft. The new A321s, which will be configured for 220 passengers, will be used on domestic and international tourist routes. All of UTAir's A321 aircraft will be powered by the CFM56-5B Performance Improvement Package engine, which has been the production configuration since October 2011.



Philippine Airlines contracts for Airbus airliners

Philippine Airlines (PAL) has placed a firm order with Airbus for 34 A321s, 10 A321neo and 10 A330-300s, being purchased under a major fleet modernisation programme, with deliveries starting in 2013. The single aisle A321 aircraft are being purchased to enhance the airline's product offerings on domestic and regional routes, as well as to support alliances with its partner airlines. The widebody A330s will be operated on higher demand regional routes and longer range services to the Middle East and Australia. PAL will announce engine selections for all the aircraft at a later date.



China assembly line completes 100th A320 Family aircraft

On 31 August 2012, visiting German Chancellor Angela Merkel and Chinese Premier Wen Jiabao presided over an event at Tianjin to celebrate completion of the 100th A320 Family aircraft assembled at the Airbus A320 Family Final Assembly



Line China (FALC), which is a joint venture between Airbus and its Chinese partners. Earlier, a framework agreement was signed by Airbus, Tianjin Free Trade Zone (TJFTZ) and the Aviation Industry Corporation of China (AVIC), the two parties of the Chinese consortium that hold 49% stake in the FALC

joint venture, "concerning the shared intention to continue the cooperation on the project beyond the current business plan, which is due to expire in 2016."

The FALC is the third A320 Family final assembly line in the world after the ones in Toulouse, France and Hamburg, Germany and the first Airbus aircraft final assembly line outside Europe. In July this year, Airbus has announced its decision to establish an A320 Family final assembly line in the United States.

Eurolot order 6 more Bombardier Q400 NextGen aircraft

Bombardier Aerospace have announced that Warsaw-based Eurolot has converted options on six Q400 NextGen airliners to a firm order that will increase its fleet to 14 Q400 NextGen aircraft. Eurolot's firm order for eight Q400 NextGen airliners



with 12 options was announced on 9 March 2012, with delivery of the first aircraft on 17 May 2012. Bombardier has booked firm orders for 460 Q400 and Q400 NextGen turboprops and delivered aircraft are in service with more than 40 operators in 33 countries, on six continents.

OPTROLEAD Sagem and Thales' optronics joint venture

Sagem (Safran group) and Thales have announced creation of OPTROLEAD, an equally-owned joint venture for optronics, which follows the original MoU signed on 20 December 2011. OPTROLEAD will be responsible for the sale of future optronic systems, especially for defence applications. The new company is staking a position in several major programmes, including optronic payload for the planned upgrade of the French Navy's Atlantique 2 (ATL2) maritime patrol aircraft, the imaging system for the future French-British MALE (medium-altitude, long-endurance) drone, modular optronic systems for army combat vehicles and optronics for future helicopters.

X-47B First US Navy Flight

Northrop Grumman's X-47B made its first flight from the US Navy's main flight test centre at NAS Patuxent River, Maryland on 29 July 2012. The US Navy will use these test aircraft to demonstrate aircraft carrier landings and autonomous air-to-air refueling: operations that require precise and predictable flight characteristics. The Navy will support these tests using manned aircraft to make substantial progress in verifying the software. Other tests including taxiing on the flight deck, will be controlled remotely by an operator using a hand-held joystick. The USN's VX-23 squadron, assigned to testing experimental strike aircraft has been designated for the task.



The UCAS-D programme will assess technology for the USN's unmanned carrier-launched airborne surveillance and strike (UCLASS) programme. Major companies will compete for the UCLASS deal, including Boeing, with an undisclosed system, General Atomics Aeronautical Systems with the Sea Avenger and Lockheed Martin's Sea Ghost, while Northrop will offer a modified X-47.

H80 turboprop engine derivatives

GE Aviation is launching two derivative engines of its recently certified H80 engine, being the H75 and H85 turboprop engines. The H75 engine will be rated at 750 shaft horsepower (shp) for takeoff and maximum continuous operation and the H85 engine will be rated at 850 shp. Like the H80, the H75 and H85 engines will be aimed at the agricultural, commuter, utility and business turboprop aircraft segments. Engine type certifications from the European Aviation Safety Agency and the US Federal Aviation Administration are anticipated in early 2013. The H80 engine will feature an extended service life of 3,600 flight-hours or 6,600 cycles between overhauls to provide the option of a single or dual-acting governor, allowing customers flexibility in propeller selection.

'Passive radar' from Cassidian

Cassidian has developed what is referred to as 'passive radar', which can locate even difficult-to-detect flying objects such as stealth aircraft and itself is practically undetectable. In contrast to conventional radar, passive radar does not emit any radiation, but instead analyses radiation reflections from other emitters, such as radio and television stations, to detect objects.

With its passive radar, Cassidian is focussing on requirements of civil and military airspace control which until now could not sufficiently be met using active emitting radar. In civil application, passive radar makes cost-effective air traffic control possible without any additional emissions and without making demands on transmission frequencies in short supply. In military applications, the system enables large-area surveillance using networked receivers, while offering the decisive operational advantage that passive radar cannot be located by hostile forces. Great advantage of the new technology is its increased detection capacity in areas of radar shadow such as mountainous terrain and its capability to locate extremely slow and low flying objects.



ITT Exelis, EADS and Cassidian co-operation on EW

ITT Exelis, EADS North America and Cassidian will work together to provide enhanced electronic warfare solutions, particularly in the area of aircraft survivability equipment. In a MoU signed at the Farnborough Air Show, the three companies agreed to combine their respective capabilities for targeted global opportunities. One of their first joint projects is expected to be a missile approach warning solution for the US Air National Guard.

Eurocopter's X3 hybrid helicopter

Eurocopter has completed its seven-week X3 demonstration tour of the United States, enabling a full range of civil and military operators to witness and experience the revolutionary flight characteristics of this high-speed, long-range hybrid helicopter.



The X3 returned in August 2012 to its home base at the Istres Flight Test Centre in southern France. During its US tour, the X3 made appearances in four states from Texas to Virginia, logging more than 55 hours performed by the Eurocopter test crew, “along with opportunities for 47 guest pilots to take the controls for a first-hand appreciation of this aircraft’s excellent flight qualities, maneuverability and outstanding acceleration/ deceleration capabilities”.

TM800 for future Eurocopter X4

Turbomeca have announced a contract with Eurocopter to power the X4 new generation 5-6 tonne helicopter with the TM800 turbo-shaft engine. The future helicopter will be equipped with, the TM800 a turbo-shaft in the 1,100 shp (800 kW) category, benefiting from technological advances arising from Turbomeca’s R&T strategy. The TM800 incorporates results of several upstream research projects, including some technologies validated by the Tech 800 demonstrator and also takes advantage of operational experience feedback from the full Turbomeca engine range. The engine development and the certification plan are “in line with the entry into service of the initial version of the helicopter in 2017”.

Front section for A350 XWB at Toulouse

Airbus has delivered the front fuselage for the first flyable A350 XWB (MSN1) to the Final Assembly Line (FAL) in Toulouse (France). The impressive 21 metre long section is



already equipped with its systems and was flown in from Airbus’ site in Saint-Nazaire (France) in an Airbus Beluga transport aircraft. The A350 XWB front fuselage section will be mounted in the giant assembly jig ready to be joined with the centre and aft fuselage sections over the summer. Before they arrive at the FAL, the aircraft sections are equipped and pre-assembled at Airbus sites in the United Kingdom, Spain, France and Germany, all these major sections then transported to the FAL by Beluga aircraft.

Elbit’s new radar for active protection systems (APS)

Elbit Systems Ltd. have launched the VWS radar, a new, continuous wave (CW) radar, specifically designed for Active Protection Systems (APS). The system provides soft/hard protection and can be easily installed onboard any light or heavy armoured vehicle, as well as various stationary applications. The VWS radar is a cost-effective radar system, able to detect, classify and automatically track Anti Tank Rockets (ATR) as well as Anti Tank Guided Missiles (ATGM), providing 360° coverage and enabling continuous search of any potential threats.

Atlas develops advanced torpedo technology

Atlas Elektronik has substantially increased the reach of its torpedoes. With a test-firing in March 2012, the heavyweight torpedo SeaHake mod4 ER (Extended Range) achieved a range of over 140 kilometres. SeaHake mod 4 is the latest advancement of the DM 2 A4 heavyweight torpedo, which is in service with the German Navy as well as other navies in Europe and Asia. By fully exploiting the system’s unique propulsion and battery technology, it became possible to surpass the maximum ranges usual for modern heavyweight torpedoes in the global market by considerably more than 50%.



Sagem contract for Mica IR seekers

Sagem has signed a contract with MBDA to supply some 200 infrared seekers for Mica air-to-air missiles. Developed and produced by Sagem, the Mica IR seeker is a key to the missile's operational effectiveness, which also functions as a sensor providing tactical information to the flight crew, because of its high sensitivity, powerful imaging algorithms, bispectral imagery, automatic acquisition of all targets, ability to lock-on before or after firing, discrimination between targets and countermeasures. This latest contract consolidates the longstanding partnership between missile manufacturer MBDA and Sagem for infrared guided missiles. Sagem has already produced more than 30,000 seekers for the company's Magic, Mistral and VL Mica (Vertical Launch) missiles.

Lockheed Martin/Raytheon Electronic Attack Solution

A joint Lockheed Martin and Raytheon Company team has demonstrated its potential electronic attack solution for the US Navy's Surface Electronic Warfare Improvement Programme (SEWIP) during the multinational Rim of the Pacific (RIMPAC) maritime exercise near Hawaii.



The team's potential electronic attack solution went to sea aboard Lockheed Martin's mobile Integrated Common Electronic Warfare System test bed to demonstrate proposed improvements to the fleet's capability to electronically attack anti-ship missiles. SEWIP is an evolutionary development of block upgrades to the AN/SLQ-32 electronic warfare system installed on all US aircraft carriers, cruisers, destroyers and other warships to improve anti-ship missile defence, counter targeting and counter surveillance activities.

MBDA Germany Missile threat Simulation

MBDA Germany has supplied a missile threat simulation tool to the German Federal Office of Defence Technology and Procurement (BWB). This system enables the simulation of all types of missiles, particularly ballistic missiles and cruise

missiles, with physical correctness and in the greatest possible detail from launch to impact. Using this technology, technical propositions regarding threats can be organised, narrowed down and formulated with greater precision. Threats to nations or to troops on deployment from proliferating theatre ballistic, short-range and medium-range missiles (TBMs) can thus be analysed. Additionally, the data makes possible analysis of the performance capability of air defence systems. The knowledge gained thereby can be used in the development of modern air defence systems and the threat simulation helps to continually expand and update the air defence target catalogue.

Boeing X-48C Blended Wing Body Research Aircraft

A modified Boeing Blended Wing Body research aircraft, designated the X-48C, flew for the first time on 7 August 2012, at NASA's Dryden Flight Research Centre at Edwards Air Force Base in California and climbed to an altitude of 5,500 feet before landing 9 minutes later. The X-48C is a scale model of a heavy-lift, subsonic vehicle without the conventional tube-and-wing airplane design, in favour of a triangular aircraft that effectively merges the vehicle's wing and body. Boeing and NASA believe the BWB concept offers the potential over the long-term of significantly greater fuel efficiency and reduced noise.



With a 21-foot wingspan, the 200kg aircraft is an 8.5 percent scale model of a heavy-lift, subsonic airplane with a 240-foot wingspan that possibly could be developed in the next 15 to 20 years for military applications such as aerial refueling and cargo missions. The X-48C has an estimated top speed of about 140 miles per hour, with a maximum altitude of 10,000 feet. The X-48C project team consists of Boeing, NASA, Cranfield Aerospace and the US Air Force Research Laboratory.

F-35 airborne weapons separation milestone

The F-35 Lightning II accomplished a significant test milestone on 8 August 2012, when the aircraft successfully released a weapon in flight. BF-3, a short take-off and vertical landing F-35 variant, executed an inert 1,000-pound GBU-32 Joint Direct Attack Munition (JDAM) separation weapon over water in an Atlantic test range while traveling at 400 knots at an altitude of 4,200 feet. The release was the first time for any version of the



F-35 to conduct an airborne weapon separation, as well as the first from an internal weapons bay for a fighter aircraft designed for the US Marine Corps, the United Kingdom and Italy.

The milestone marks the start of validating the F-35's capability to employ precision weapons and allow pilots to engage the enemy on the ground and in the air, the aerial weapons separation test checking for proper release of the weapon from its carriage system and trajectory away from the aircraft. This is the culmination of a significant number of prerequisite tests, including ground fit checks, ground pit drops and aerial captive carriage and environment flights to ensure the system is working properly before expanding the test envelope in the air.

Airbus Military reconfirms A400M production output for 2013

Airbus Military has reconfirmed that it will deliver the first four new generation A400M airlifters to customers in 2013 as planned, following solutions to the recent engine issue.

Recently, there had been an engine issue on MSN6, the first production representative development aircraft. Tests had to be suspended after 160 hours of F&R flying because of the repeated detection of metallic chips in the oil system of one of the engines.



Airbus Military has supported the engine manufacturer Europrop International (EPI) in its investigations of the root cause and fixes. Consequently, the MSN6 engines as well as all series production engines have been sent back to EPI for replacement of this cover plate. As a consequence, first delivery to the French Air Force (MSN7) will now be in the second quarter

of 2013. There is a slight impact on the delivery of the second French aircraft (MSN8) while MSN9 (the first Turkish aircraft) and MSN10 (the third for France) will remain on schedule with delivery before the end of 2013. Other deliveries in 2014 and beyond continue as planned.

Textron development of Standoff Precision Guided Munitions

Textron Defence has entered into a cooperative research and development agreement (CRADA) with the US Special Operations Command (USSOCOM) Programme Executive Office (PEO) Fixed Wing for development of standoff precision guided munition capability. Initial activities will focus on Textron Defence Systems' Guided Clean Area Weapon (G-CLAW), a cost-effective, lightweight, guided precision unitary weapon providing anti-personnel and anti-material capabilities, as well as features for low collateral damage and hazardous unexploded ordnance (UXO) prevention.

Under the CRADA, the organisations intend to integrate the G-CLAW into PEO Fixed Wing's common launch tube dispenser and complete the required testing to secure flight and weapons safety certifications. From there, Textron Defence Systems and USSOCOM will conduct inert and live-fire demonstrations of precision unitary munition delivery from a tactical carrier aircraft such as the MC-130W Dragon Spear. Integration activities will culminate in an end-to-end, live-fire demonstration.

MBDA Germany centre for air defence systems

MBDA Germany has opened a new simulation and integration centre for air defence systems at its Schrobenhausen site. During the opening ceremonies, the MEADS launcher was demonstrated in front of guests from the political domain, the German Ministry of Defence, the German Federal Office for Defence Technology and Procurement (BWB) and the German Air Force. The programme is currently preparing for the first test firing against a real target. This is scheduled to take place at the White Sands Missile Range in New Mexico, USA at the end of the year. The test firing will utilise the command post, the Multifunction/Fire Control Radar (MFCR) and the launcher. The MEADS development programme will conclude in 2014. The development results are to be used in developing a future air defence architecture.



MBDA's Viper Strike munition

MBDA Incorporated's GBU-44/E Viper Strike munition launched from a Cessna Caravan test aircraft scored direct hits against high speed vehicles in a recent two-day test at White Sands Missile Range in New Mexico. Viper Strike has been used in combat by both manned and unmanned aircraft, and will deploy next on the US Marine Corps' KC-130J Harvest HAWK aircraft. Viper Strike is launched from a common launch tube that can be carried either internally or externally from the host aircraft, helicopter or UAV.



Viper Strike is a glide munition capable of precisely hitting targets from extended stand off ranges using GPS-aided navigation and an end-game, semi-active laser seeker.

SELEX Galileo Vixen 500E AESA Radar

Following completion of Operational Test & Evaluation (OT&E) flight trials in the United States, the SELEX Galileo Vixen 500E active electronically scanned array (AESA) Air Intercept Radar and Mission Management System (MMS) have entered service with US Customs and Border Protection (CBP) on their Cessna Citation C-550 jet. This new radar provides an enhanced capability in US border protection as part of the wider US Department of Homeland Security's mission and builds on the success of the Seaspray 7500 AESA surveillance radars currently in service with the US Coast Guard.

The Vixen 500E radar is a compact, easy to install solution and forms part of the large family of scaleable SELEX Galileo

AESA Radars ranging from the small PicoSAR surveillance radar to the larger Vixen 1000E wide field of regard radar and also the Raven ES-05 Fire Control radar selected for the Gripen NG aircraft.



Northrop Grumman, AgustaWestland team up for USAF and USN programmes

Northrop Grumman and AgustaWestland have signed a comprehensive teaming agreement to respond to anticipated requests for both the new US Air Force Combat Rescue Helicopter and the US Navy's recently announced programme to develop a new 'Marine One' presidential helicopter. A US built helicopter based on the AW101 platform will be offered by Northrop Grumman to meet these requirements. The agreement pairs Northrop Grumman's management and systems integration expertise with AgustaWestland's rotorcraft manufacturing and helicopter design and development.



Four EC725 SAR for Royal Thai Air Force

A contract has been signed between Eurocopter and the Royal Thai Air Force for supply of four EC725 helicopters, configured for search and rescue missions. Deliveries of the EC725 will be in 2015. The twin-engine EC725/EC225 rotary-wing aircraft family features high-performance navigation and mission systems, including a digital four-axis autopilot. Eurocopter already is a helicopter supplier in Thailand for military and law enforcement, having been selected for acquisitions by the Royal Thai Army and Royal Thai Police.



ILA 2012: The German Air Show

ILA 2012 was officially inaugurated by German Chancellor Angela Merkel on 11 September 2012, cutting the ribbon in presence of the Polish Deputy Prime Minister (Poland was partner country as India was in 2008). The Chancellor was on-hand when Lufthansa's Chief Executive Christoph Franz and Matthias Platzeck, Minister President of Brandenburg, officially christened the airline's first Boeing 747-8 (D-ABYA) after the Federal State 'Brandenburg', which surrounds the capital city and is site (Schoenefeld) for the new (but much delayed) future airport of Berlin.

Lufthansa has inaugurated services with its new 747-8, Delhi being the second city (after Washington DC), to be served by the new 'jumbo', reflecting the enormous importance of *Destination India* for the German carrier.

There were three distinct groups of visitors from India at ILA 2012. The most prominent were those from DRDO, this organisation hosting perhaps the largest chalet at the Show and with a very large stand opposite in Hall 1, with models of various programmes showcased. Several models of Tejas LCAs were at centre stage, but as at the Singapore Air Show, no obvious attempt was made by ADA to promote the virtues of this new generation light fighter with great export potential. It is learnt that the German Air Force itself might be "interested" in evaluating the two-seat operational conversion trainer version as a possible lead-in fighter trainer (LIFT).

At ILA 2008, when India was partner country, the government had sent six HAL Dhruv ALHs to Berlin and these performed spectacularly (*Sarang*s) before proceeding to the Farnborough Air Show in UK. Four years on, there was no hint of the ALH at Berlin, not even in model form. This is indeed regrettable as again the ALH has good potential for export sales, including for special missions with forces in Europe looking for helicopters of this size and capability.

The second group of Indian visitors at ILA 2012 were from the Department of Defence Production, led by the Secretary, along with the Chairman HAL and other senior officials.

The third group were from the private industry, with 20 companies taking part and "exploring opportunities for partnerships, joint ventures and technical tie-ups."

Full coverage of the Show in Vayu's next Issue.



On static display at Schoenefeld : the Lufthansa Boeing 747-8 just christened as 'Brandenburg' a short while earlier.



Dr Krishnadas Nair of SIATI and colleagues outside the DRDO chalet.



Eurofighter Typhoon of the Luftwaffe's JG74 which had just taken part at the 'Red Flag' exercises in the USA – with amazing success.

Also in Berlin : “the Future by Airbus”

Vision of Smarter Skies



Aspectacular 4D projection light show transformed Berlin’s Humboldt-Box into a moving and pulsating canvas to demonstrate the benefits of smarter flight in the future. The show, which launches the *Future by Airbus* Smarter Skies vision of air travel in 2050 and beyond, illustrates in stunning perspective how smarter aircraft operations could cut travel times, reduce emissions and lead to fewer delays.

“Our light show unveils the significant benefits of combining smarter aircraft, smarter technology and smarter skies in 2050”, says Charles Champion, Executive Vice President Engineering at Airbus. “Our Smarter Skies vision is one where highly intelligent aircraft would be able to organise themselves and select the most efficient and environmentally friendly routes, making the best use of daily weather and atmospheric conditions. It is also one where aircraft might copy the best aspects of nature and fly like flocks of birds allowing them to travel more efficiently and lower their energy use.”

Beginning with a single paper aeroplane launched from the balcony of the Humboldt-Box in Berlin, a maze of 3D blocks depicts the barriers and obstacles created by current national air space boundaries. A map of the world scattered with pin points and bright pulsing lines of light highlights the world’s busiest routes. The show then takes passengers forward in time to 2050

to demonstrate a world of flight where obstacles are removed, passenger travelling times are shortened, and where fuel use and emissions are reduced. The show closes with a fleet of Airbus concept planes flying in formation.

Charles Champion elaborates: “Our research for the *Future by Airbus* programme has shown that air passengers expect to fly more in the future, but they want to do so with fewer delays, less noise and more sustainably. The aviation industry has already committed to some of the toughest targets of any industry by pledging to cut aircraft emissions by 50% by 2050. Our Concept Plane has illustrated

how aircraft design could contribute. Our Smarter Skies campaign, brought to life by this light display, demonstrates the future benefits that smart aircraft operations could bring if we work together as an industry to make them happen”.

The *Future by Airbus* Smarter Skies vision consists of five concepts which could be implemented across all stages of an aircraft’s operation. It includes aircraft launched into a continuous ‘eco-climb’, flying in formation using ‘express skyways’, ‘low noise’ glided approaches, low emission landing and ground operations and airports that grow their own alternative energy sources.



Vayu Exclusive from Zhukovsky

Russian Air

The Russian Air Force celebrated its centennial on 12 August 2012, with an action-packed three-day airshow at the Ramenskoye airfield in Zhukovsky near Moscow. More than one hundred aircraft were on static display and in the air. The centennial programme exemplified the ongoing build-up of Russian military aviation which is adding 180 new and upgraded aircraft this year with another 200 planned for induction in 2013.

The flying displays lasted for eight hours each day (August 10, 11 and 12), involving air force and industry

Still, stars of the show undoubtedly were second prototype of the PAK-FA (Russian acronym for Future Complex of Frontal Aviation, Sukhoi's designation T-50) fifth generation fighter aircraft prototype Side 52, the Su-35 development prototype Side 901 and the MiG-29M2 prototype on its public debut. The Russian Air Force display team from Torzhok, the Berkuty (*Golden Eagles*) publicly performed for the first time with their Mi-28Ns, which have replaced their older Mi-24s. Show debutants also included an Ilyushin Il-80 "flying combat post".

At his press conference on 12 August, Bondarev said: "Those who came to the [Ramenskoye] aerodrome saw [historic] airplanes like those with which we started, and also those multirole, supersonic, all-weather missile-carrying aircraft that we operate now and are receiving from indigenous manufacturers... it takes an aviation professional to appreciate the power of Tu-160s and Tu-95s passing over this aerodrome to consider what potential these bombers have. Besides, the next generation T-50 and Su-35 fighters are carrying out aerobatics - as a pilot myself, I am proud that we have the world's best



Formation '100' flown by 5 Su-27SM3, 8 Su-25SM and 8 MiG-29SMT aircraft

aircraft, sports aviation, the DOSAAF organisation supporting the Armed Forces and historic aircraft from local and foreign collections. Foreign participants included Italy's *Frecce Tricolori* (on the MB.339), Poland's *Red-White Sparks* (on the TS.11 Iskra) and Finland's *Night Hawks* (on the Hawk Mk.51) display teams. Appropriately, it was the RAF *Red Arrows*, which dramatically opened the air display programme on the opening day, arriving over the aerodrome in Zhukovsky in tight nine-ship formation. France's *Armee De l'Air* brought two Rafale fighters to Zhukovsky.

The recently appointed commander of the Russian AF, Gen. Victor Bondarev referred to the aerial displays as "grandiose". He was happy to note that even on 11 August, when the sunny weather suddenly turned into heavy rain and even hailstorm, the service and the industry demonstrated a complete range of aircraft types in service and development prototypes: "the Air Force and test pilots once again proved their skills to fly in all-weather". He was also happy that 69 foreign delegations had arrived in Moscow to congratulate the Russian Air Force and participate in the 'Common Skies' military conference.

performing aerobatic teams, flying here along with foreign counterparts from the UK, Poland, Finland and Italy. We will maintain these links and develop them as new aircraft types come into service such as the Yak-130".

"After sufficient number of Yak-130s are delivered to flight schools, the Russian Air Force will procure additional 18 aircraft for the display team," Bondarev stated.

The Russian Air Force has emerged "strong after the hardest time ever" during last years of the previous century. During his press conference, Victor Bondarev

Force turns '100'

turned to Gen. Piotr Deinekin, seated next to him: "Piotr Stepanovich Deinekin was the [Russian Air Force] commander from 1991 to 1997. You know how difficult this time was. But they [Deinekin and his team] managed, saved our Air Force from disintegration during that time, when they [meaning "bad guys"] could have clipped our wings entirely... it is only due to their courage, heroism and power in making decisions and staying our course, the Air Force is today demonstrating achievements, it makes us happy, and all in our great Motherland. The Air Force is [not only making us happy but] also able to

military aviation is "an area of science and manufacture where Russia is on par with other leading nations - and even ahead of them in some technologies. Now, we are back in high gear, strategic bombers are on regular aerial patrols. Modernisation of the airfield infrastructure, foundation of new air force bases and multipurpose aviation groupings goes on. Special attention is being paid to creation of perspective aviation complexes for the Long Range Aviation (Strategic Air Command), tactical and army aviation, widespread use of precision guidance munitions, electronic warfare equipment,

"everything will be delivered as promised", he said. Specifically, the air force will get over a thousand new helicopters, over six hundred airplanes, and a number of air defence and radio electronic systems".

This manner of assurance is important in view of Prime Minister Dmitry Medvedev's recent call for "postponement" in deliveries of "some military items on order" so as to "reduce burden on the Russian budget and for financial lease mechanisms instead of direct purchase to serve the same purpose".

In 2012, the Russian Air Force expects to receive over one hundred combat and

successfully defend her [the Motherland]. The air force is back [on the rise], and able to defend the skies over our great country".

The General's words echoed Vladimir Putin's speech earlier made on 11 August at Ramenskoye, who had also noted that the air force had survived "difficult times" in the 1990s and beginning of the new century, "when airplanes were grounded for long times". At the same time, Putin said that "on many occasions" it certainly was the [Russian] aviation whose actions "determined the outcome in turning points of our history", and noted that

unmanned aerial vehicles and means of reconnaissance".

General Victor Bondarev said "the President shares our satisfaction over recent achievements...always shows his interest in the air force and the ways of improving it. On 11 August we had another opportunity to talk about our current state and problems and the ways to overcome these. The President assured me that the air force will continue getting new aircraft. He has approved our procurement plans and assured me that the air force will get everything that is included in the State Armament Programme 2010-2020

transport helicopters, along with over sixty "new and upgraded" aircraft. Bondarev also noted that next year the number of aircraft to be delivered would exceed 200, compared to "175-180" in 2012. Percentage of modern systems (such as the Su-35, MiG-29SMT, MiG-35, T-50 and Yak-130) in the next ten years will increase to 80%, while air defence units will rearm with the S-400 and Pantsir S1 SAM systems. A complete set of the S-400 system's main elements - including observation and fire control radars - were on static display at Zhokovsky, a sign that Russia is ready to export this new air defence system.



Russian Helicopters celebrates 100 years of the Russian Air Force

Russian Helicopters, part of the state defence holding company Oboronprom also took part in celebrations for the 100th anniversary of the Russian Air Force. The three-day celebration began on 10 August in the St Petersburg suburb of Gatchina, the site of the Air Force's first-ever military airfield. The action then moved to Zhukovsky, which hosts the annual MAKS Air & Space Salon. The event attracted more than 200,000 visitors, with displays by the Air Force and DOSAAF (the armed forces voluntary association).



The *Golden Eagles* aerobatics team performed a display with the Ka-52 Alligator and Mi-28N Night Hunter models manufactured by Russian Helicopters, and there also were demonstration flights of the Mi-26, Mi-8, Ansat-U, Mi-35 and Mi-2.

Helicopters have a long and distinguished history of service in the Soviet and Russian Air Forces, and have demonstrated their operational versatility as a workhorse carrying out everything from supply and logistics to attack missions. The first rotary-wing aircraft – the A-4 designed by V.A. Kuznetsov – entered the Red Army in 1934. During the Second World War, a squadron of A-7-3a gyroplanes designed by Nikolai Kamov fought during the siege of Smolensk; the squadron's engineer was Mikhail Mil, subsequently the renowned designer of helicopters.

Today, the Russian Defence Ministry remains one of the largest and most important clients of Russian Helicopters, with more than 1,000 helicopters slated for delivery to the Air Force in the next decade. In the past few years, the Company has delivered models including the Mi-28N, the Mi-8, Mi-26, Mi-35 and Ansat-U. The Ka-52 has also completed testing and is starting to enter service.



Next generation fighters

On the PAK-FA fifth generation fighter, Bondarev said that flight testing was proceeding “within the agreed timeframe and in accordance with decisions made earlier”. Results of the testing done so far – including 120 test missions flown – “by and large correspond to the specification that we put forward to this aircraft”. Three prototypes are in flight test, “and we expect three more to join them in a short time”. For the full testing programme, a total of 14 prototypes will be produced, Bondarev said, with first T-50s moved to air force bases for evaluation in 2013, to be followed by production examples in 2015, he added. Procurement plans within the State Armament Programme 2011-2020 call for acquisition of 250 Su-34s, Su-35s and T-50s, according to Bondarev.

In turn, Sukhoi issued their statement on 8 August that testing of “a unique onboard radiolocation system (read radar) fitted with active phased array antenna” (active electronically scanned array or AESA) had been installed in the PAK-FA, on one of the three prototypes built so far. Sukhoi has reported “considerable progress” from the start of ground testing and in-flight, adding that even the early testing immediately brought “stable results” and that the performance already demonstrated “corresponded to the existing level of best aviation systems available elsewhere”. The manufacturer also stated that further development of radar capabilities has been “confirmed” and added that checks on PAK-FA’s “optical channels” had commenced as well.

Tikhomirov’s NIIP had earlier revealed a full scale prototype of the new radar intended for the PAK-FA at MAKS 2009. This new radar uses locally produced components based on “nanohetero structures”, employing “advanced technologies of electronic control over the radar beam”. The radar is built on modular principles and with commonality in mind, wide use in modernisation programmes on in-service aircraft and anti-aircraft defence systems. The technologies employed in the new radar permit an increase in target detection ranges, and enable simultaneous operations in both air-to-air and air-to-surface modes including recognition and classification

of detected targets. These technologies also permit engagement of several targets simultaneously, using precision guidance munitions. The radar has integrated capabilities for secure communications and electronic countermeasures.

Earlier, during Farnborough 2012, UAC's President Mikhail Pogosyan had indicated that a fourth PAK-FA prototype would commence flights "shortly", but added that Russia would continue to produce 4th generation combat jets alongside the PAK-FA, for export as also to offer customers the choice of relatively inexpensive aircraft as compared with highly-priced "next-gen's". Meantime, the Su-35 prototypes have accumulated over 650 test flights. Sukhoi will deliver an initial batch of six Su-35s to the Russian Air Force by end of this year and launch series production in 2013. Development examples are currently undergoing weapons firing trials. The Su-35 currently uses the RLPK-35 Irbis system that includes a very powerful passive scanned array, but in future this aircraft too will be fitted with an AESA developed as a derivative of the PAK-FA's radar.



*General Victor Bondarev,
Russian Air Force Commander*

Meantime, Russia is working on "sixth-generation aircraft", but these are likely to be unmanned and with "built-in artificial intelligence". Bondarev said that development of "strategic UAVs" continues rapidly, but owing to its nature "this work is not being revealed".

The Russian Air Force is also interested in development and procurement of the PAKDA (Russian acronym for Future Aviation Complex for Long Range Aviation) to supplement and partially replace the Tu-160 and Tu-95MS strategic bombers. "The defence ministry is drawing up a complete range of requirements for



Anti-missile flares ejected by Su-27s



Cover Story T-50 formates with Mig-29M2



An-124-100 Ruslan, 224th Air Detachment



Mixed formation of Su-27s, Su-34s and MiG-29s arriving from Ryazan AFB.



Four Su-24Ms in flypast



"Flag of Russian Federation", Su-25BMs

the PAKDA, and after these are firmed up, the industry will be able to configure technical shape of this aircraft”.

Flight-tests of the PAKDA will begin in 2022, according to the Long-Range Aviation commander Gen. Anatoly Zhikharev. Preliminary design has been completed - and accepted - and the industry is now commencing full-scale R&D work on this aircraft. First phase of modernisation and upgrade on the fleet of in-service Tupolev bombers will result in extension of their lifetimes, up to 30 years in the case of the Tu-160. Then ten of these swing-wing supersonic aircraft will be subjected to second phase of modernisation, starting from 2016. “This will turn it into a completely different aircraft, with new systems and avionics”, Zhikharev stated.

Presently, the Russian Air Force has 12 “main bases” and 9 “army aviation bases”, plus two stations outside of the national border: Kant in Tajikistan and Erebuni in Armenia. On the airbase network, Bondarev said the air force would operate from seven “main bases”, while other bases in the network would be used “on rotation” principle by various units. In future a unified aerodrome network will be created in Russia so that every such class of base would be able to handle “any aircraft type without need in additional equipment”.

Over the past four years the average flying hours per year for junior pilots of Fighter Aviation has been “rising steadily”, now up to 85 hours, compared to merely 10-12 hours ten years ago. “Now we have all means to conduct combat training at a high pace, from availability of jet-fuel and funds for aircraft repair and servicing, to new aircraft coming off production lines”, the commander stated. According to the *Red Star* newspaper, official publication of the Russian MoD, all the Tu-160 commanders will have annual flight time above 100 flight hours, and Tu-95 crew members over 200, while certain Tu-22M3 commanders will even manage to log more than 300 flight hours per year!

Photos and text by Vladimir Karnozov

UAC



Dassault's Rafale carried out a spectacular display



Shape of the future : Yak-130



Tu-22M3 thunders over the crowds



Backbone of the Russian long range strategic bomber fleet is the Tu-160



M-55 takes to the skies

T-50 (PAKFA) prototype takes off



Italy's Freccie Tricolori aerobatic team



RAF Hawks over Zhukovsky

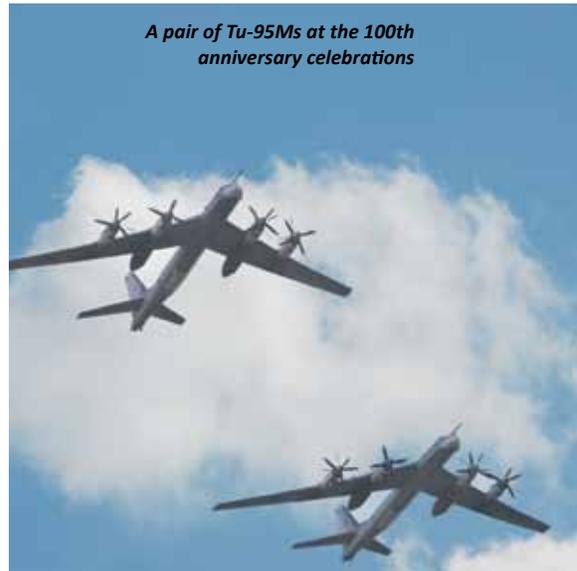




T-50 (PAKFA) and MiG-29 fly in tandem



Four Su-27s



A pair of Tu-95Ms at the 100th anniversary celebrations



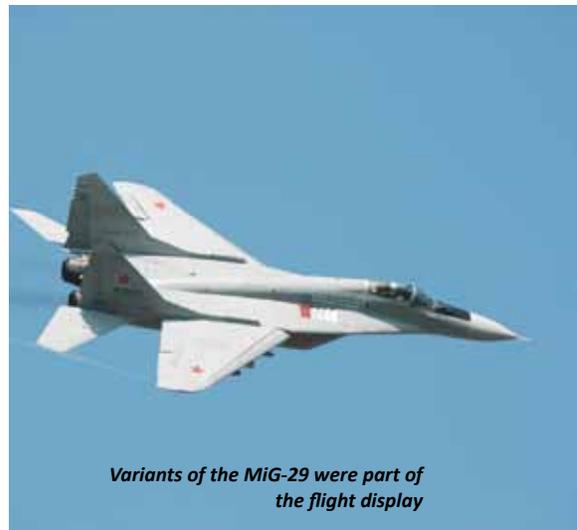
Russian Air Force 'Swifts'



The Beriev A50 AWACS



Su-34 flies low over the air base



Variants of the MiG-29 were part of the flight display

New vistas

50 years of Indo-Russian cooperation in aviation

India and Russia (also earlier the Soviet Union) have had strong ties in the area of military aviation co-operation since the mid-1960s. Hindustan Aeronautics Limited (HAL) has been a long-standing partner with UAC and its subsidiaries. The cooperation between the two countries has recently intensified as new projects gather momentum. Following the Indo-Russian cooperation on the Su-30MKI programme, which continues, the countries have started joint development of two new major programmes : the Fifth Generation

Fighter Aircraft (FGFA) and the Multirole Transport Aircraft (MTA).

The Sukhoi Holding Company, as part of Russia's United Aircraft Corporation (UAC) and HAL have joined efforts and resources to create an advanced new generation combat aircraft for the two Air Forces.

The Fifth Generation Fighter Aircraft will incorporate leading edge, state-of-the-art technologies, and have 'stealth' characteristics. The FGFA will be powered by new generation engines

Two Sukhoi T-50 prototypes fly in formation.

giving it supersonic cruise and high manoeuvring capability, with integrated systems embedded with elements of artificial intelligence, and equipped with advanced weaponry.

Russia and India are financing the programme equally, both countries having



A model of the proposed Indo-Russian Multirole Transport Aircraft.

agreed upon their requirements for the FGFA. They have also determined scale of work for each activity, including those systems and equipment which are to be developed in India.

Sukhoi and HAL have now begun to work on second stage of the design, after which both sides will begin detailed engineering and development work. A joint team of Indian and Russian design engineers are presently defining requirements for certain systems, with engineering personnel from HAL currently in Russia working on the FGFA project in conjunction with the Sukhoi Design Bureau.

The FGFA being developed by Russia and India will benefit from the expertise and technologies evolved during development of the T-50 prototypes. In order to meet the futuristic operational and technological

programme to be economically effective,” states Mikhail Pogosyan, UAC President. “But later on, as we will develop this aircraft further, then maybe there will be more (sales).”

The cooperation between Russia and India is not limited to just combat aviation. The two countries are also working on another programme, the Multirole Transport Aircraft (MTA), which will serve with both the Indian and Russian Air Forces and later be offered for export to other countries.

This aircraft is being developed in accordance with an inter-governmental agreement signed between Russia and India in September 2012, which established that the project would be a 50:50 venture between the countries. Russia is represented by its arms export agency Rosoboronexport and JSC UAC-

the partnership with India on the PAK-FA/FGFA combat aircraft, the MTA initiative has received strong support from the Russian Government. It is expected that more than 200 aircraft will be manufactured: 100 MTAs delivered to the Russian Air Force, 45 to the Indian Air Force and about 60 MTAs exported to other countries.

MTA production will both be in India and in Russia and it is planned that first flight will be in 2017 with series production launched in 2019. The MTA is envisaged as offering a payload capacity of up to 20 tonnes, the aircraft fitted with a glass cockpit, FADEC and fly-by-wire systems. The MTA will have a maximum flight speed of 800 km/h and range of 2500 km.

These programmes give Russia and India a “solid foundation to further



requirements of the Indian Air Force, it is also planned to incorporate advanced Indian and international technology systems in the FGFA.

It is expected that Russia’s Defence Ministry will soon approve series production of Sukhoi’s next-generation PAK FA/T-50 fighter, with the first pre-series examples to be delivered to the Russian Air Force in 2013. Some 250 of this new fighter type are likely to be procured by Russia, while India has indicated a requirement for about 200 such aircraft.

Earlier, UAC had forecast sales of the PAK FA at 600 aircraft, including exports to third countries. “We stick to the previous target – it’s quite enough for this

Transport Aircraft, and India by Hindustan Aeronautics Limited.

In order to “manage” the project, a joint enterprise Multirole Transport Aircraft Limited was created, which holding company, will be responsible for development, production and after sales support of the MTA. On 28 May 2012, Hindustan Aeronautics Limited and United Aircraft Corporation-Transport Aircraft signed a General Contract to stipulate the preliminary design stage works and scope of work for each side.

“We have made a lot of effort recently to boost this programme and make it move quicker than over the previous several years. We have prepared a really solid foundation,” said Pogosyan. As with

develop cooperation and perhaps bring them towards the sphere of civil aviation, where engineers from India with their unique competences can broaden the field of cooperation into the future”.

The Russian aircraft industry is meanwhile also working on two commercial aerospace programmes, each of which will play a pivotal role in UAC’s future development : the Sukhoi Superjet regional aircraft and Irkut’s narrow body MC-21. The Sukhoi Superjet 100 has just cleared its first year of revenue operations with launch user Armavia, and also with Aeroflot. 12 aircraft have been delivered to operators till this time (see *Vayu* Issue III/2012).

Vayu briefing in Moscow

Man's Curiosity on Mars

The Nasa Mission



This artist's concept features NASA's Mars Science Laboratory Curiosity rover, a mobile robot for investigating Mars' past or present ability to sustain microbial life.

NASA's most advanced Mars rover *Curiosity* is now roving on surface of the Red Planet. The one-ton rover, hanging by ropes from a rocket backpack, touched down onto Mars on 6 August 2012 culminating

a 36-week flight and to begin a two-year investigation. The Mars Science Laboratory (MSL) spacecraft that carried *Curiosity* succeeded in every fantastic step of the most complex landing ever attempted on Mars, including the final

severing of the bridle cords and flyaway manoeuvre of the rocket backpack.

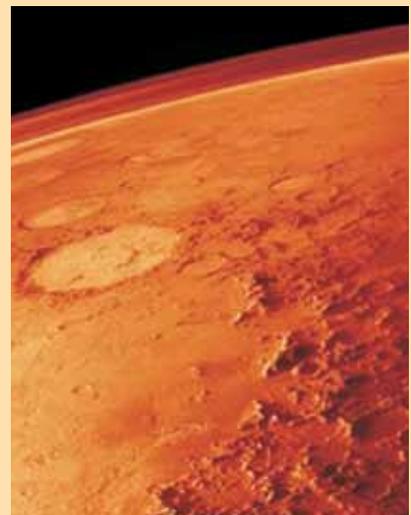
"Today, the wheels of *Curiosity* have begun to blaze the trail for human footprints on Mars. *Curiosity*, the most sophisticated rover ever built, is now

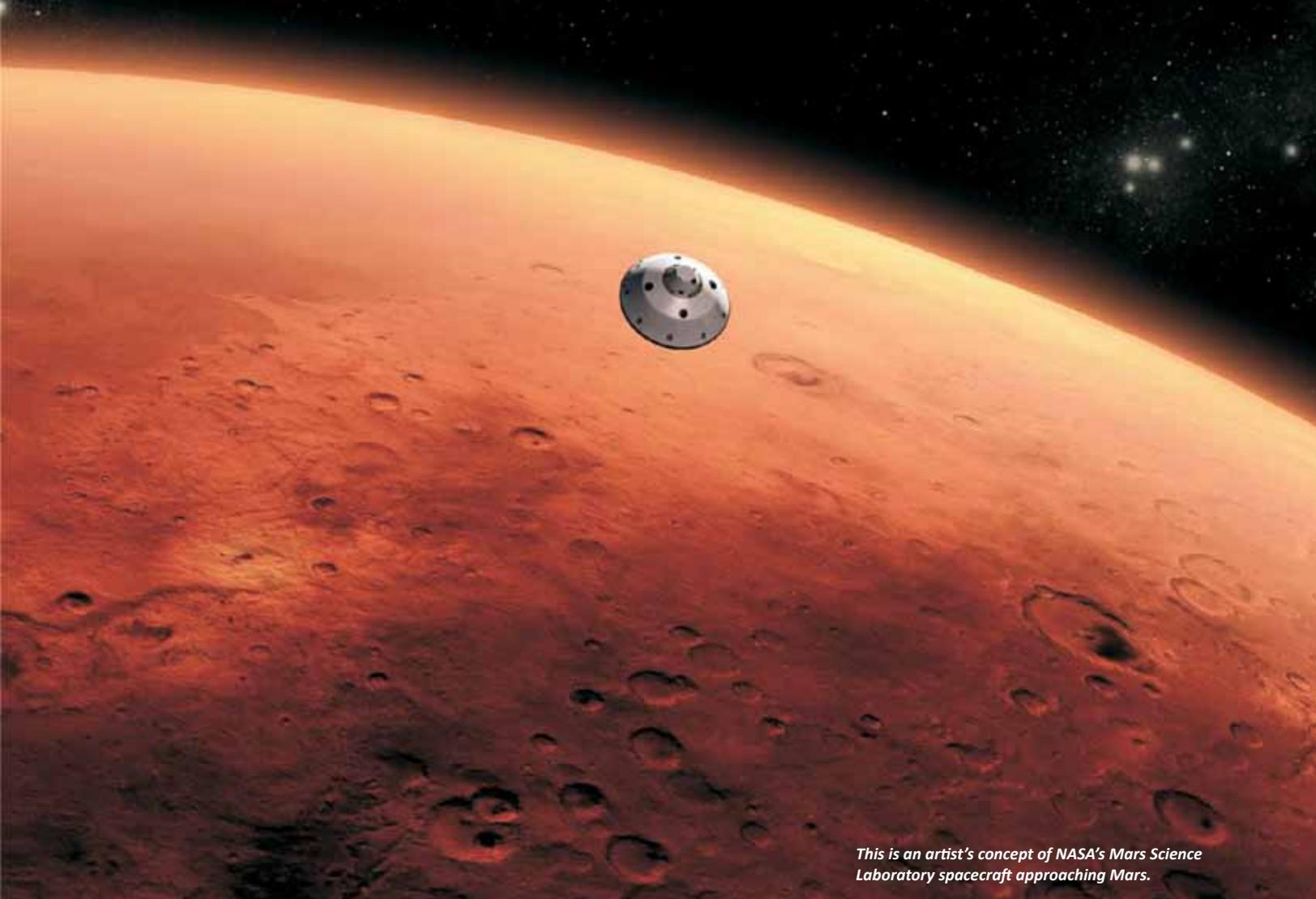
India to launch Mars mission in 2013

India plans to launch its own space probe that will orbit Mars, Prime Minister Manmohan Singh confirmed on 15 August after press reports that the mission was scheduled to begin late next year. The project would mark another step in the country's ambitious space programme, which placed a probe on the moon three years ago and envisages its first manned mission in 2016.

"Our spaceship will go near Mars and collect important scientific information," Dr. Singh said in his annual Independence Day address, heralding the plan as "a huge step for us in the area of science and technology". The Indian Space Research Organisation (ISRO) is expected to launch the unmanned orbiter as early as November next year. According to an ISRO official, the cost of the mission has been estimated at four to five billion rupees (\$70-90 million).

In September 2009, India's *Chandrayaan-1* lunar probe "discovered" water on the moon, boosting the country's credibility among more experienced space-faring nations. But the space programme suffered a setback in December 2010 when a satellite launch vehicle blew up and fell into the Bay of Bengal after veering from its intended flight path. The United States, Russia, Europe, Japan and China have all sent missions to the planet Mars.





This is an artist's concept of NASA's Mars Science Laboratory spacecraft approaching Mars.

on the surface of the Red Planet, where it will seek to answer age-old questions about whether life ever existed on Mars -- or if the planet can sustain life in the future," exclaimed NASA Administrator Charles Bolden. "This is an amazing achievement, made possible by a team of scientists and engineers from around the world and led by the extraordinary men and women of NASA and our Jet Propulsion Laboratory. President Obama has laid out a bold vision for sending humans to Mars in the mid-2030s, and today's landing marks a significant step toward achieving this goal."

Curiosity had landed near the foot of a mountain three miles tall and 96 miles in diameter inside Gale Crater. During a nearly two-year prime mission, the rover will investigate whether the region ever offered conditions favorable for microbial life.

"The Seven Minutes of Terror has turned into the Seven Minutes of Triumph," said NASA Associate Administrator for Science John Grunsfeld. "My immense joy in the success of this mission is matched

only by overwhelming pride I feel for the women and men of the mission's team."

Curiosity carries 10 science instruments with a total mass 15 times as large as the science payloads on the Mars rovers *Spirit* and *Opportunity*. Some of the tools are the first of their kind on Mars, such as a laser-firing instrument for checking elemental composition of rocks from a distance. The rover will use a drill and scoop at the end of

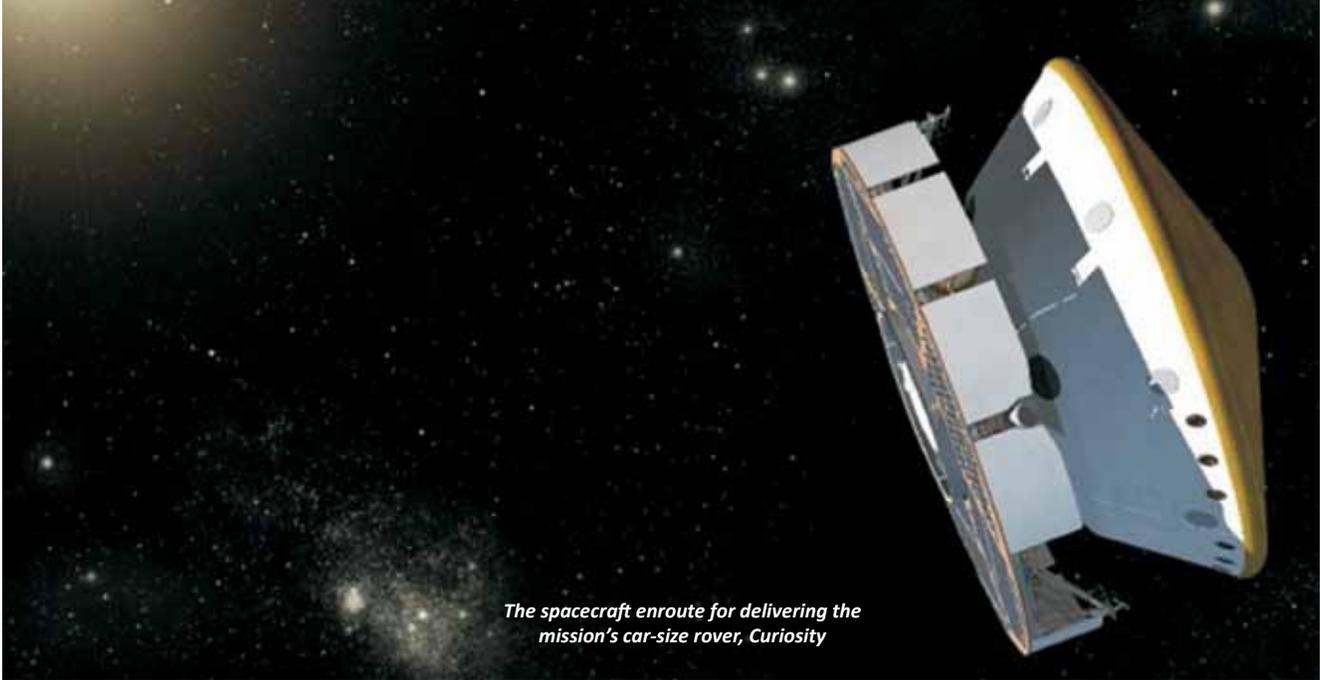


its robotic arm to gather soil and powdered samples of rock interiors, then sieve and parcel out these samples into analytical laboratory instruments inside the rover.

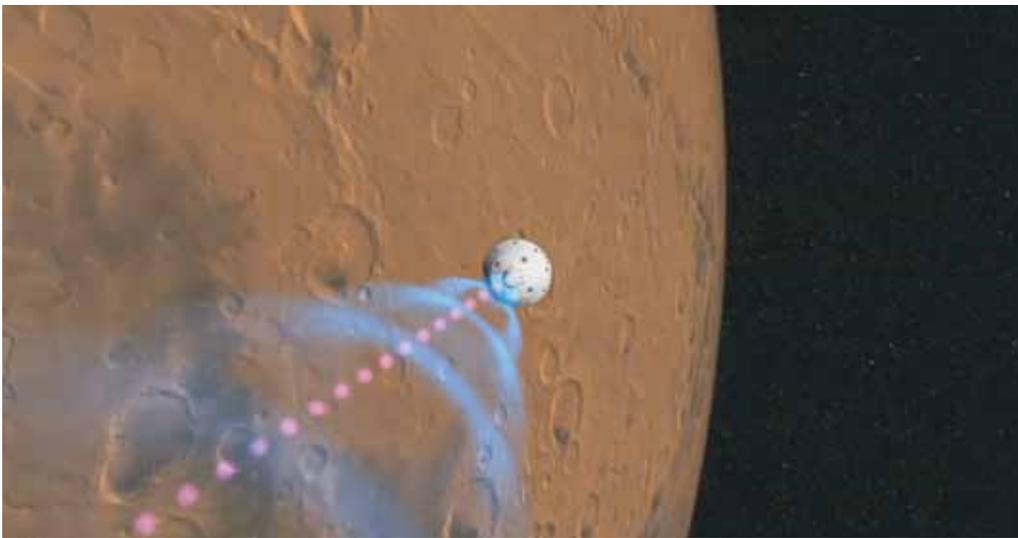
The mission is managed by JPL for NASA's Science Mission Directorate in Washington. The rover was designed, developed and assembled at JPL.

(all information and photos: NASA)

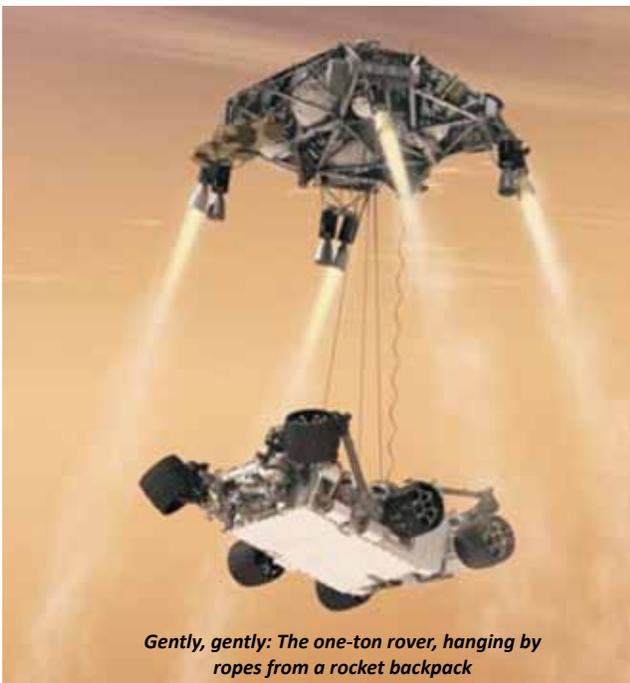
Curiosity's environment: this is one of the first images taken by NASA's Curiosity rover, which landed on Mars on the morning of 6 August 2012. It was taken through a fisheye wide-angle lens on the left "eye" of a stereo pair of Hazard-Avoidance cameras on the left-rear side of the rover. The image is one-half of full resolution. The clear dust cover that protected the camera during landing has been sprung open. Part of the spring that released the dust cover can be seen at the bottom right, near the rover's wheel. On the top left, part of the rover's power supply is visible. Some dust appears on the lens even with the dust cover off. The cameras are looking directly into the sun, so the top of the image is saturated. Looking straight into the sun does not harm the cameras.



The spacecraft enroute for delivering the mission's car-size rover, Curiosity



This artist's depiction depicts how NASA's Curiosity rover communicated with Earth during landing. As the rover descended to the surface of Mars, it sent out two different types of data: basic radio-frequency tones that went directly to Earth (pink dashes) and more complex UHF radio data (blue circles) that required relaying by orbiters. NASA's Odyssey orbiter picked up the UHF signal and relayed it immediately back to Earth, while NASA's Mars Reconnaissance Orbiter recorded the UHF data and played it back to Earth at a later time. Image credit: NASA/JPL-Caltech



Gently, gently: The one-ton rover, hanging by ropes from a rocket backpack

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Pushpinder Singh Chopra
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'Birds in Paradise'



This former Air Ceylon DC-3 acquired by the SLAF in 1975 and served till 1986.

The Sri Lanka Air Force Museum at Ratmalana

SLAF Ratmalana – home to No. 2 (Heavy Transport) Squadron and No. 8 (Light Transport) Squadron

On the main road from Galle going north, just some kilometres short of the capital was a signboard painted 'Colombo Airport'. Turning off, the side road led to the Sri Lanka Air Base Ratmalana, currently housing two transport squadrons of the Sri Lanka Air Force but also, in a 17-acre enclave, the little known but amazingly maintained SLAF Museum.



The RCyAF's first trainer, the de Havilland Canada DHC-1 Chipmunk entered service in 1950. It was phased out in 1985 but a few examples are preserved in airworthy condition.



Insignia of the Royal Ceylon Air Force which became the SLAF on 22 May 1972

A little bit of history : In 1934 the State Council of Ceylon (as it then was) made a decision to construct an aerodrome within reach of the capital city of Colombo



The SLAF acquired a total of 9 SIAI Marchetti SF 260 TPs beginning in 1985. The last of these was retired in 2001.



This MiG-17F saw combat beginning in 1971 and is preserved in pristine condition.

and decided on Ratmalana as the best site. On 27 November 1935 a De Havilland Puss Moth flown by Tyndalle Bisco, chief flying instructor of the Madras Flying Club, was the first aircraft to land at the new airport.

During the Second World War it was used as a Royal Air Force base, with No 30 Squadron flying Hawker Hurricanes from there against Japanese Navy aircraft. After the war, Ratmalana airport was the country's main air terminal, with Douglas DC-3 Dakota and Lockheed Constellations of Air Ceylon operating from here. In the 1950s, BOAC flew Canadair Argonauts from Ratmalana to London and in August 1952, 3 months after the inaugural service of a passenger jet aircraft, BOAC began its Comet services between Colombo and London.

After inauguration of the Bandaranaike International Airport in the 1960s, which is located some 35 kilometres north of Colombo, Ratmalana has been used for domestic air services, business aircraft operations, flying club activities but mostly by SLAF air transport squadrons.



The Kamov Ka-26 was operated by the SLAF between 1971 and 1978.



Six de Havilland DH.104 Dove aircraft were inducted to the Royal Ceylon Air Force (RCyAF) in 1955, and served as part of No. 2 (Transport) Squadron.

The SLAF Museum at Ratmalana is spread over 17 acres of lush gardens and flowering trees within which there are several hangars housing aircraft, aero engines, ground vehicles, photo galleries, an Avro simulator, a mini theatre, a cafeteria and a souvenir shop. In other words, a wonderfully planned and exquisitely maintained tribute to the Sri Lanka Air



The SLAF currently operates a small number of MiG-27MLs but since end of the Tamil insurgency has reduced demands on the fast-jet forces, this pristine Flogger is on display at the museum along with an array of external stores.

Force which marked its 60th anniversary in March 2011.

The Museum was first established in 1993 as the ‘Aircraft Preservation and Storage Unit’ at Air Force Base Ratmalana with the intention of preserving history of aviation in Sri Lanka in general and history of the Sri Lanka Air Force in particular. Located as it is within an operational air base, it adds to the museum’s real life appeal.

Air Chief Marshal WDMRJ Goonetilleke, then Commander of the Sri Lanka Air Force, initiated a special project in 2008 with the intention of modernising the museum and the new title was adopted.

There are some 50 aircraft on display, ranging from the very first DHC Chipmunk trainer, Airspeed Oxford light transport and Boulton Paul Balliol advanced trainer to contemporary types such as the MiG-27ML and IAI Kfir fighters. Imaginatively mounted are Siai Marchetti SF 260s, which trainer aircraft was usefully employed for light attack during the 1990s, a very friendly DC-3 Dakota display with steps inviting visitors to go through the cabin and then a miscellany of helicopters ranging from the Westland



This Beechcraft E18S was formerly a civilian aircraft before being acquired in 1981 by the SLAF.



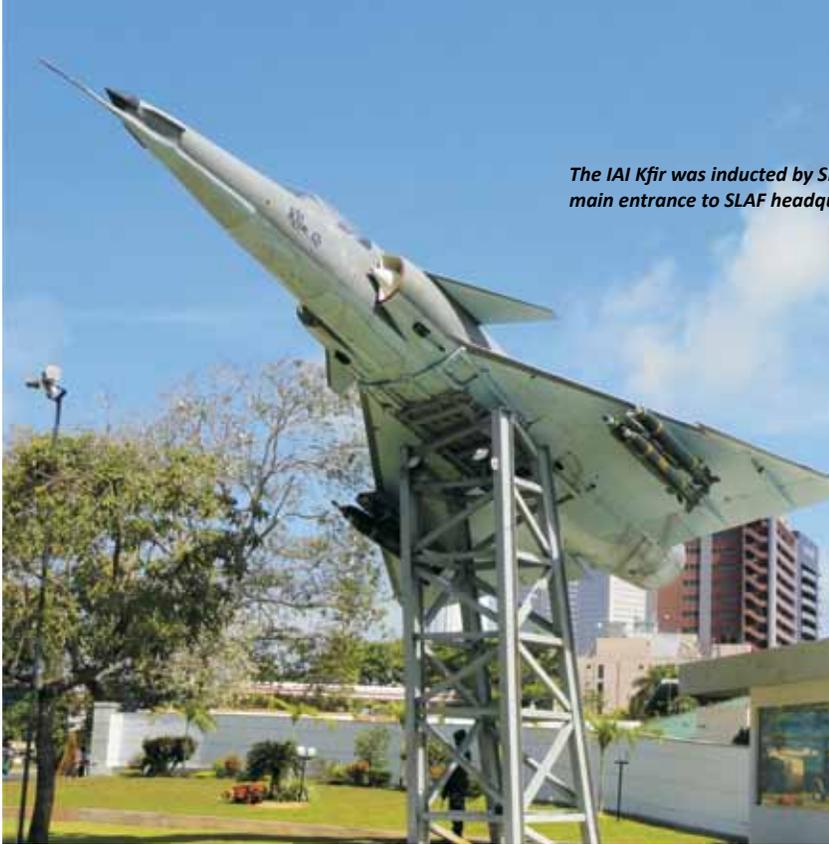
The RCyAF purchased 12 Boulton Paul Balliols in 1951 as an intermediate trainer. This example is preserved in near-flyable condition.



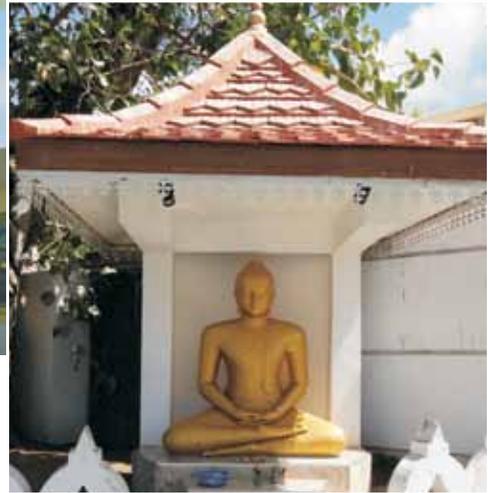
Mil Mi-24s entered SLAF service in 1995, with a total of 26 Mi-24 and Mi-35s acquired. These were extensively employed during the insurgency, as part of No. 9 (Attack Helicopter) Squadron.



The Shenyang FT-5 (JJ-5) was developed as trainer for the PLAAF in 1968. SLAF inducted two FT-5s in 1990 and handed them over to the museum in 2009.



The IAI Kfir was inducted by SLAF by 1996 and an example is displayed outside the main entrance to SLAF headquarters in downtown Colombo, near Beira Lake



The revered Golden Buddha, outside the main entrance of SLAF headquarters in Colombo.



Wreckage of the LTTE Zlin Z 143 light aircraft shot down by SLAF anti-aircraft gunners near Katunayake Air Force Base.



An IAI Kfir C.2 mockup

SLAF air defences during a suicide attack against the SLAF's No.10 Fighter Squadron flying IAI-KFirs. Appropriately, mounted as a gate guardian outside SLAF headquarters in the heart of Colombo is a Kfir, which flanks the entrance, with a statue of the Buddha on the other side.

Considering that the Museum is part of an operational air base, security was obvious but not unobtrusive and SLAF personnel most helpful and friendly with the *Vayu* visitors from India. The deputy head of the Museum was a serving Squadron Leader (Technical) Monindika who had attended a course earlier with the Indian Air Force at Bangalore.

The only reference at the Museum to the Indian Air Force is given on a board in the photo gallery thus :

"4th June 1987 – The Indian airdrop created a huge furore in Sri Lanka. Separating the facts from the rhetoric, the Indian Air Force deliberately violated Sri Lankan airspace. For the SLAF, this act became a subject of considerable discussion within their high command.

Quoted herewith is a section of SLAF's Annual Report of 1987, 'The infamous violation of our airspace and dropping of food supplies over Jaffna by the Indian Air Force would not have taken place in that manner, if we had an air interception and air defence capability'.

Angad Singh

S-51 Dragonfly to the Kamov Ka-26, Dauphin SA-365C, Bell 412 and Mi-24, the latter extensively employed during the last years of the conflict in northern and eastern Sri Lanka.

At the Museum's edge is an unusual Sri Lanka Air Force war victory memorial : the propped up wreckage of a LTTE 'Sky Tigers' Zlin Z143, shot down by

25 Years Back

From Vayu Aerospace Review Issue V/1987

HAL's stress on D & D

In a positive statement made at Bangalore on 23 August, Air Marshal MSD Wollen (retd.)

Chairman of HAL said that the industry's focus must shift to design and development activities and those responsible for aircraft design would have to anticipate future trends.

HAL had a unique opportunity at this point of time with the country needing fighter aircraft and helicopters of its own and HAL as the foremost aeronautical complex in South East Asia, was the only agency that could conceivably "deliver the goods".

Air Marshal Wollen admitted that for more than 15 years there had been little design activity. Production of aircraft had mostly been under licence from foreign companies.

A ten-year design perspective plan has been prepared, not only aimed at improving performance of the existing fighters in the Indian Air Force, including aeroengines, but concentration is on de-novo designs such as the Light Combat Aircraft (LCA) and the Advanced Light Helicopter (ALH).

French involvement in LCA definition

It has been reported that Dassault Breguet are to assist in developing India's Light Combat Aircraft (LCA) and, according to HAL, Dassault's consultancy has been sought to "speed up LCA project definition".

The project has been delayed owing to problems in finalising the definitive design. The Dassault consultancy includes active participation by Indian engineers connected with the project. The dead-line for completion of project definition is reportedly set for September 1987.

US assistance on LCA

In July 1987, a four-member team of Ministry of Defence R&D officials including the SA to RM Dr VS Arunachalam, visited the USA to discuss critical matters concerned with the Light Combat Aircraft (LCA) project. A number of important agreements were reached, the most visible being approval by the US for purchase of the IBM 3090 computer system for CAD work on the Light Combat Aircraft project. Along with approval for the hardware, permission has been given to acquire the CAD software for aerodynamics plus work associated with combat aircraft development.

The first breakthrough came in 1985 with the US agreeing to supply data for the F.404 engines which were subsequently contracted for to serve as the interim engine for LCA.

In addition to the computer, the Indian team has reportedly been cleared for discussions on US-origin avionics for the LCA, possibly involving entire systems or components and sub-systems, Wide-Angle Head-Up Displays, special tubes, computer chips, auxiliary technologies like ejection seats, data distribution systems and generators form part of this list. The result will be as one official put it, the LCA will now be a 1990s plane when it rolls out in 1990 instead of a 1980s aircraft".

HAL's ALH programme

The Advanced Light Helicopter (ALH) programme is at the detailed design phase and an engineering mock up has been completed,

according to the HAL Chairman Air Marshal MSD Wollen. Being designed in collaboration with MBB of West Germany, about 250 design engineers from HAL have been involved on the ALH programme whose prototype is to fly by mid-1989, with series production to commence from 1992.

The ALH, powered by two Turbomeca TM 333B turbo-shaft engines, will incorporate an advanced composite rotor system, have good survivability features and be produced in a number of variants, including an anti-tank version, a naval version and transport version (10 passengers).

HAL's Dornier 228 Programme

During his presentation of HAL's current activities at Bangalore, the Chairman Air Marshal MSD Wollen stoutly supported the Dornier 228 Light Transport Aircraft programme which is presently under manufacture at HAL's Kanpur Division.

"The Dornier 228 is a good aircraft and we will try and make every part of it top class. We stand by the plane we make and the decision to select this aircraft to serve a wide range of agencies." The Chairman said that HAL "expects to sell the HAL-built Dornier 228 in India and abroad."

Pawan Hans status

Pawan Hans, his corporation set up by the Government of India with the objective of replacing foreign operators engaged in the oil sector, has managed to achieve its target within nine months of the receipt of its first helicopter.

The Corporation, has ordered 27 Dauphin and 21 Westland W930 helicopters.

GE Engines ordered

The Government of India will purchase 11 General Electric F. 404 engines for the Light Combat Aircraft (LCA). Meanwhile, India is building gas turbines under license from the General Electric Corporation, the LM-2500 gas turbines being for the five destroyers now under construction at the Mazagon Docks in Bombay.

INS Viraat arrives

The Indian Navy's second aircraft carrier, the INS *Viraat* (R-22), formerly the Royal Navy's HMS *Hermes*, arrived at its home port, the Indian naval base at Bombay, on 22 August 1987.

INS *Viraat* had been ceremoniously visited by the Prime Minister Rajiv Gandhi, the Defence Minister KC Pant and other dignitaries the previous day, when the aircraft carrier was some 100km off Bombay in the Arabian Sea. The visitors witnessed naval exercises for nearly an hour, with Sea Harriers being launched off the carrier's skiramp, Westland Commandos inducting marines and vehicles on the carrier's deck and Seakings carrying out depth charge attacks on simulated under surface targets.

Chief of Naval Staff Admiral RH Tahiliani stated that acquisition of the second aircraft carrier, "a great moment for us in white uniform", marked "the beginning of a true blue water capability", with an ability to control specified areas of the sea to forestall intrusions, a task "best performed by aircraft carriers".

Nigerian basic trainers

The Nigerian Air Force has reportedly short-listed three aircraft to fulfil its new basic trainer requirement these being the EMB-312 Tucano, the Pilatus PC-7 and the RFB Fan-trainer.

It has also been reported that Nigeria was negotiating purchase of 24 HAL HTT-34s to replace the Bulldogs in the ab initio phase, but a contract for these has yet to be confirmed.

Thank God !

Has the God Particle been found? Scientists working at the European Organisation for Nuclear Research, or CERN, on the Swiss-French border, claim they have gathered enough evidence to show that the long-sought 'God Particle', answering key questions about the creation of the universe, almost certainly does exist. CERN's atom smasher, the \$10 billion Large Hadron Collider, has been creating high-energy collisions of protons to help the scientists understand the creation of the universe billions of years ago, which many theorise occurred because of a massive explosion known as the 'Big Bang'.



An alternative seaplane ?

It is learnt that Jal Hans, the seaplane subsidiary of Pawan Hans have issued a world tender for amphibian aircraft, both single and twin-engined. Could one imagine the venerable T-6 Harvard basic trainer in this role ? Here, early morning anglers are treated to the spectacle of T-6 Harvard aircraft from 'The Flying Lions Aerobatic Team' water-skiing across the Klipdrift Dam near Johannesburg, South Africa.



Skip the in-flight movie

A low-cost Vietnamese airline, *VietJetAir*, decided to forgo the on-screen entertainment in favor of a bikini fashion show on a flight to inaugurate its service from Ho Chi



Minh City (former Saigon) to the coastal town of Nha Trang earlier in August. Shortly after news of this publicity event spread, the airline was fined \$950 by the country's Civil Aviation Administration for organising 'an unapproved show'.

Fare is fair

The front end of this derelict transport aircraft below serves as an entrance to a cave that once was the headquarters of former Chinese Communist military leader Lin Biao. Located in the mountains on the outskirts of Beijing, the cave has been turned into a 'Military Bar' using old military ordnance like sandbags, helmets, artillery shells and landmines as furniture. Lin Biao used the cave as his military headquarters in 1968 shortly before his aircraft crashed in Mongolia following what appeared to be a failed coup to oust Chairman Mao Zedong.



Curiouser and curiouser

NASA's Curiosity rover landed on Mars on 6 August 2012. Early pictures show no signs of ESPN, beer, naughty magazines etc – making it very clear that men are NOT from Mars! (joke doing rounds on the internet).



(cartoon by Gianfranco Uber)

A Simple Riddle

Can readers answer all seven of the following questions with the same word?

- ★ The word has seven letters....
- ★ Preceded God...
- ★ Greater than God...
- ★ More Evil than the devil...
- ★ All poor people have it...
- ★ Wealthy people need it...
- ★ If you eat it, you will die.

Did you figure it out ? Only 5% of Stanford University graduates figured it out !

If you got it, send the answers to 'Tale Spin' c/o *Vayu Aerospace & Defence Review*.

Otherwise, wait for the next Issue !

(Contributed by Lalit Mehra)

Afterburner

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Produced in partnership with Hindustan Aeronautics Ltd, the Hawk Advanced Jet Trainer complimented by a suite of ground based synthetic training aids has made a step change in Indian Air Force fast jet training. With high levels of reliability and serviceability the Hawk Training System is proving to be both a cost effective and highly productive solution; one which provides India with high quality front line pilots as well as high technology employment for the Indian aerospace workforce.

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