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Aerospace & Defence Review

V/2013

The IAF's 81st Anniversary

Interview with the CAS

The Challenge of Indigenisation

Air Combat Philosophy

Dassault's Deadly Storm

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The IAF's latest aircraft acquisition, Boeing C-17 Globemaster III comes into land (photo courtesy Boeing).

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A strategic milestone

Technical accomplishments aside, the true significance of the reactor on board India's first Indian nuclear submarine achieving criticality is strategic. INS *Arihant* marks the first step towards completing the third component of the triad of air, mobile land-based and sea-based deterrent forces envisaged in India's nuclear doctrine. The advantage of nuclear submarines over conventional ones is their ability to remain under water for long without refuelling, and thus to travel long distances. It will, however, be a long haul from here on towards making this sea-based naval nuclear asset fully operational. Having validated the performance of the primary power pack, it has to be proven that the propulsion system can indeed be driven by nuclear power. The subsequent sea trials, which would involve complex speed, pitch and rolling manoeuvres, will test the ability of the reactor to withstand high acceleration loads and the fast response needed for rapid power ramp-up. These issues have posed serious nuclear fuel, material and engineering challenges, not hitherto encountered in land-based reactor systems. The Department of Atomic Energy and the Defence Research and Development Organisation deserve credit for successfully overcoming these. The full fleet, according to reports, will include seven such boats over a decade. This calls for enhanced submarine building and reactor fabrication capacity. More important perhaps would be preparing the operating personnel psychologically for long endurance inside an underwater cocoon.

Considering that most submarine accidents have involved nuclear submarines — most of them Russian — safety assumes great importance. Especially since there seems to have been substantial Russian assistance in the design of both the boat as well as the power pack. From a safety perspective, there is a larger issue that needs to be addressed. The entire strategic sector has remained out of purview of the Atomic Energy Regulatory Board and the safety overview system in place for strategic nuclear systems has never been discussed in public. The issue obviously gets more complicated for sea-based nuclear assets. Moreover, the DRDO and the Indian Navy, under whom the nuclear submarines will operate, have limited expertise in nuclear-related matters. In terms of technology, India has now clearly demonstrated that it has the requisite expertise to launch a parallel stream of enriched-uranium based Pressurised Water Reactors (PWRs). The land-based prototype 80 MWt PWR reactor at Kalpakkam is expected to serve as a platform for the proposed chain of 900 MWe PWR power reactors in the country, whose design is stated to have been completed. But that would call for a substantial increase in uranium enrichment capacity as well.

From : The Hindu

A Terrible Tragedy

In its worst-ever peace-time incident, the Indian Navy has lost one of its frontline submarines involving on-board explosions that have resulted in the tragic death of 18 naval personnel comprising three officers and 15 sailors. INS *Sindhurakshak*, a Russian-made *Kilo*-class diesel-electric submarine which sank soon after the explosions while docked at the Mumbai naval base, had only four months ago returned from Russia where it underwent a major refit-cum-upgrade involving the integration of land-attack missiles and other advanced equipment at a cost of $156 million, which, incidentally, exceeded its original cost of an estimated $118 million.

The incident is indeed horrific as it is shocking. It is for the first time that the Navy has lost a submarine and that too in peace time while docked in home waters. The incident raises several questions relating to technical and human error and even sabotage. As of now there is considerable speculation on what went wrong and it would be premature to arrive at a conclusion. A specially constituted Board of Inquiry is expected to determine the causative factors. As of now it is widely believed that the explosions were triggered by either a buildup of hydrogen generated during recharging of the batteries or mishandling while arming the on-board weapon systems.

Incidentally, three years ago in February 2010, this very submarine was the scene of a smaller explosion that led to the death of one sailor and the wounding of two others while its batteries were being recharged at the Visakhapatnam naval base. Needless to say, the Indian Navy can ill afford such incidents and must identify the reasons that led to this terrible incident which has resulted in a tragic loss of lives, the loss of an expensive and potent weapon system, the further depletion of an already limited submarine fleet and a loss of image to a professional Navy. Furthermore, it certainly does not auger well for a country that projects itself as a major power in a very complicated region where some powerful adversaries are at play.

From : The Tribune, New Delhi

Break the Iron Triangle

India's defence story somehow gives an impression of two steps forward, one step back and then one sideways. Thus we have seen, in a period of a few weeks, the first indigenous aircraft carrier being launched — the INS *Vikrant* 2.0, the reactor of the country's first nuclear submarine going critical, and then the worst naval peacetime accident in decades with the INS *Sindhurakshak* exploding at its berth.

The positive view is to perceive in all this evidence that the country is slowly moving forward at the strategic maritime level. The new carrier is small, its indigenous component largely hull and steel slabs. However, it's a major step towards ending the present trap of being fleeced by foreign vendors — such as the billion-dollar *Admiral Gorshkov* boondoggle.

There is nothing indigenous about the nuclear submarine INS *Arihant*. What matters is its existence: it helps plug a gaping hole in the country's nuclear deterrence. Only a nuclear capability that swims with the fishes can be sure to survive a sneak attack against India's nuclear arsenal. This bit of military hardware is really a testimony to diplomacy — New Delhi persuading the likes of a Russia or a France to officially hand over ultra-sensitive technology. Money helps, but is never enough by itself.

BAE SYSTEM

Such incidents of triumph and tragedy deflect attention from the much deeper problems afflicting the Indian defence system. The Indian Navy is arguably the most forward-looking of the three services. Something about blue waters makes Admirals more prone to seeking strategic horizons. India's maritime indigenisation programme is further ahead than any other service. Roughly 80% of the navy's hulls are made in India and over half its engines.

The imported component, unfortunately, soars when one gets into the nitty-gritty bits and pieces like missiles, radars and sonars, and things that go 'boom'. That's still much better than what the army and the air force have done. The last, the most technologically advanced service, is particularly laden with equipment made everywhere except India.

Defence indigenisation is one of those hackneyed topics that receives so much lip service that articles on the topic should carry a Rolling Stones symbol. Defence minister AK Antony is only the latest in a long line of 'raksha mantris' who have declared their full support for Indian weapons, announced quotas and various other incentives — and then gone to sleep on the subject. What is needed is a 20-year plan to slowly but surely build up the capacities to make arms at home. Rightly, the craft of weapon-making is upheld as the ultimate test of a nation's technological capacity — and strategic muscle. Southern California, for example, is littered with small precision engineering firms that contribute one bit of knowhow to a fighter or warship.

If manufacturing components is tough, it pales in comparison to systems integration — the putting of all these components and technologies together into a working and lethal whole. In India nothing of this sort exists. The public sector defence firms are little more than assembly plants, their indigenisation accomplishments are little more than screwdriver work on imported CKD kits. Hindustan Aeronautics Limited (HAL) calls itself the "most diversified" aeronautics company in the world!

The phrase 'Jack of all trades, master of none' comes to mind. The truth is HAL and its sister organisation the Defence Research and Development Organisation have a more self-serving interest in claiming they can build everything and seeking to corner every defence contract from Lehberry juice-making to the Akash missile. They seek to keep out the Indian private sector which, for them, is the real enemy.

This is the true cancer in the Indian defence production system: the iron triangle that exists among the defence ministry's bureaucracy, the defence PSUs and a coterie of arms exporters and their agents. The real test of defence indigenisation will be when a carrier is equipped with an India-made anti-missile system, the software running the fifth generation fighter is being tapped out in Bangalore, and the night-vision equipment on our tanks has optics ground in India.

A sensible indigenisation policy will have to be about incubating long-term capacities. This may mean policies that seem perverse and contraindicated. Competition may have to be curbed at times, with the odd single-vendor contract. Foreign direct investment may have to be increased so Indian firms can learn overseas processes and technologies. India should also begin selling arms to earn the necessary capital, experience and corporate muscle to make arms at home. The point here is that this is not about inserting three pages on building more highways in the Five-Year Plan, this is about creating a military-industrial-technological culture from scratch.

That is the real Indian defence problem and the real Indian defence tragedy is that finding a solution has not even begun.

Chanakya : in Hindustan Times

A Costly Defence

The RBI stepped up its defence of the rupee by sharply tightening liquidity and pushing up interest rates. The measures might be effective in preventing further rupee depreciation, but they could also hurt hopes of reviving investment and growth. One of the significant steps taken by the RBI has been to restrict the amount banks can borrow from it to 20 per cent lower than the current level. It will conduct open market operations, selling bonds to further reduce liquidity in the market. Call rates have responded by going up, above the corridor of the repo and reverse repo.

The biggest question confronting the banking sector is whether this will merely flush out what the RBI believes is speculative capital affecting the rupee or hurt domestic bank lending, already suffering from the impact of declining investment and growth. Will it mean an increase in the lending rates of banks at a time when the economy can ill afford it? And if it does, what was the need to do it? While companies that recklessly undertook unhedged foreign currency exposure will benefit from actions preventing further depreciation, firms that were sensible and did not borrow in dollars will now have to face higher costs. The already slipping growth in employment will take longer to revive.

If interest rates had been raised in an open and transparent manner, after discussing the inflation and growth expectations of the economy and then raising the repo rate, the issue would merely have been one of disagreement with the stance of monetary policy. Today, the question is not merely one of monetary tightening, but also the manner in which it has been done. It comes with the pretence of not raising rates, but only tightening liquidity. Whether you raise the price of money directly or through changing the quantity, the net effect is the same, as seen in the call money market today. Further, the RBI has undermined the transmission mechanism of monetary policy that it has itself built in a fragile environment. First, by using instruments other than the repo rate, the RBI has undermined its own instrument. Second, it has attacked the 100 basis point corridor that it had carefully created, where the call rate remains between the repo and reverse repo rates. On the one hand, the finance minister is asking banks to cut lending rates, and on the other, the RBI is raising the costs of funds by tightening liquidity. Any effort to revive growth will undoubtedly suffer.

From : The Indian Express

Rafael

Perspective

Time for a Hard Look

Over the past few months, a raging controversy has gathered steam involving the Indian Air Force and Hindustan Aeronautics Limited (HAL), with the Ministry of Defence (MoD) being a mute spectator. The genesis of the case is the grounding, in 2009, of the HAL HPT-32 trainer aircraft that was being used by the IAF for basic training of its pilots, owing to repeated accidents and HAL's inability to arrive at solutions.

At that time, the then Chief of Air Staff stated that the HPT-32 aircraft fleet had experienced 108 engine failures and mishaps resulting in 23 fatalities. A fatal accident involving two experienced flying instructors broke the proverbial camel's back, leading to final grounding of the aircraft. It also left the IAF without a basic trainer aircraft, which is a critical tool in laying the foundation on which is based the future mental and operational potential of any military pilot.

To fill this vital void, the MoD cleared acquisition of 181 basic trainer aircraft in 2009 with immediate import of 75 aircraft and the remaining 106 to be made up by the proposed indigenous HAL design, the HTT-40. Consequently an order was

Sikorsky

placed for the purchase of 75 Pilatus PC-7 Mk.II from Switzerland through import and the initial batch of Pilatus trainers has since been received. After a gap of over four years, the IAF will be settling down to an established training pattern for at least part of the trainees whose number will progressively grow as the number of trainer aircraft increases.

In the interim, the IAF will be compelled to resort to an ad hoc training system, which will have a negative opportunity cost attached to it, in terms of a weaker training foundation. This, though unquantifiable, will no doubt reflect on both operational capability and safety record of the IAF in the times to come.

As reported, the IAF is keen that the MoD exercises the option clause in the Pilatus contract to procure another 38 aircraft with the shortfall of the remaining 70-odd trainers also to be made through later purchases of this aircraft. If this proposal is accepted by the MOD, it will sound the death knell of HAL's HTT-40 project.

As warfare and technology have evolved, they have continued to develop organisational models for not just their armed forces, but also found the right balance for interfacing with the complex aerospace business.

Expectedly, HAL is unhappy with this development. The spark, which seems to have ignited this open fight, is a purported letter by the Air Chief to the Defence Minister in support of the IAF's proposal, including the supposed cost benefits of importing the aircraft. Those against closing of the HAL project are not only questioning the cost benefit argument, but casting indirect aspersions on the very integrity of the IAF by hints of import preference and undue favoritism.

That the current spat is being played out in the public domain is unfortunate since both the organisations come directly under the defence ministry. It is not this writer's case to wade into the details of the arguments on either side of the present controversy, but to look at the larger picture of why the perennial love-hate relationship between IAF and HAL never seems to die. The debate on whose view should prevail is by no means new.

The IAF is often accused both by HAL and the Defence Research and Development Organisation of changing staff requirements mid-stream, of being pro-import and against self-reliance in their choice of platforms and systems. The IAF's grouse is that HAL and DRDO are given first lien on meeting their requirements based on inflated claims and then failing to meet these commitments of performance, time frames and costs.

Parameters of the debate may differ but they are of little consequence until the national security establishment is able to define its priorities. The fundamental question that arises is whether our defence research and development and production are there to serve the needs of the armed forces or is it that the armed forces must play second fiddle to sustain a military industrial complex that is bureaucratically driven with an archaic mindset out of tune with the technological and commercial realities of today ?

If we look at some of the industrialised countries that run very successful aerospace industries and who are the benefactors of obtaining our contracts, it is evident that their countries have arrived at a unique model for managing this dilemma. As warfare and technology have evolved, they have continued to develop organisational models for not just their armed forces, but also found the right balance for interfacing with the complex aerospace business in a way that serves the needs of the armed forces and also the commercial and strategic interests of the industry and the national economy itself.

Today HAL is one of the largest aerospace companies in Asia with the IAF as its captive customer.

Unfortunately, we, in India, have steadfastly refused to review the organisational model of the MoD, which remains frozen in time. We are hence witness to inter service rivalry that results in wasteful duplications and a military-industrial complex that is only accountable to its bureaucratic masters and not to the ultimate users. The MoD becomes the arbiter in disputes like the present one and with no professionals within it to guide it, every thing comes down to personalities and ad hocism. Since there is neither an aerospace vision nor strategy, we are condemned to continuing imports and licence manufacture. This can then be blamed on the IAF !

Today HAL is one of the largest aerospace companies in Asia with the IAF as its captive customer. It is no exaggeration to say that the IAF and HAL are locked in an embrace from which neither can disengage without delivering a mortal blow to the other. But rather than promoting cohesiveness and mutual support and add the Air Officer-in-Charge Maintenance to the HAL's board along with the Deputy Chief of Air Staff, one finds that even the Deputy Chief of the Air Staff has been taken off the board and relegated to the position of a 'permanent invitee'.

No aerospace company in the world today attempts to cover every aerospace activity as does HAL. The last known was probably the erstwhile Soviet Union where some of their aircraft factories were reduced to making domestic goods! Also no aerospace company in the world attempts to be totally self-reliant because technologies needed are diverse and need cross linkages to be dynamic, efficient and economical.

The time has now come for the government to take a hard look at how our entire aerospace industry is being organised and managed. It should devise a national aeronautics policy that caters to the requirements of all the stakeholders duly harmonised where necessary and put in place an aeronautics commission along with a dedicated department of aeronautics and supporting institutional bodies. These should be tasked with strategising and achieving the scientific, technological and industrial goals in furtherance of this policy. A proposal to this effect was first mooted by the Aeronautical Society of India under the presidentship of Dr APJ Abdul Kalam and later modified and submitted to the government in 2004. This writer recalls being part of the initiative. It would be worth opening this for serious debate and implementation.

In the meantime, is it too much to hope for the MoD and HAL to focus on the bigger challenges facing the military-industrial complex and not grudge the IAF having its small way in getting a basic trainer of it's choice? In the larger interest of the future combat potential and safety of our pilots, is this not the morally upright decision for our Defence Minister to take ?

Air Marshal Brijesh D Jayal (Retd)

Saab

OPINION

Speculation is not the answer

Just before midnight on 13 August, two explosions rocked the IN submarine INS *Sindhurakshak* and a huge ball of fire escaping from the conning tower hatch, the only hatch that is left open in the harbour, lit the night sky. Briefly thereafter, the submarine sank alongside. The 18 crew members who formed the duty watch were missing. Since the flames came out of the conning tower hatch nobody in these areas would have survived. There might have been a possibility of survivors had any of the sailors been in the aftermost compartments, but normally, in harbour nobody goes to the aft compartments except on periodic rounds. The nature of the incident, the loss of the submarine and the tragic loss of lives of those 18 ill-fated crew members makes it vital for the Navy to find the exact cause of the accident.

It is very easy in such incidents to jump to conclusions and air pet theories. Sabotage, problems with the modifications, hydrogen explosion or a handling accident that set off the chain of events are some of the theories being floated—the most tempting of these being the sabotage theory because that makes the incident an open-and-shut case. We should not fall for or be distracted by pet theories. To find the truth, the Navy needs to determine for itself not only the cause of this incident but also put in place procedures and precautions that would ensure such incidents never reoccur. Sailors and naval officers must also be assured that we can determine the fault lines and set them right so that they have the confidence to continue to work in the potentially dangerous environment that exists on board any submarine.

From available information, the submarine was being prepared for an operational deployment and was expected to sail early in the morning. The entire crew was scheduled to arrive on board at about 0300 hrs to prepare the submarine for sea. The full outfit of 18 weapons in this type of submarine consists of a mixture of missiles, oxygen torpedoes and electric torpedoes. Of these, six are stowed in the tubes and 12 on racks in the torpedo compartment. Normally, weapons kept on the racks are not 'armed'. This means mechanisms and devices that are required to detonate the high explosives in the warheads are not placed in them, thus rendering them safe.

Taking into consideration that only two explosions were heard, that would mean the remaining 16 warheads, each containing approximately 250 kg of HE, did not explode. This indicates that the inherent stability and safety of the warhead's design played a vital role in mitigating collateral damage.

Initial assessment

Going by where the flames came out, the explosion originated in the torpedo room, and not from the tubes. Of the two explosions, the first one, or the 'trigger,' could not have been a warhead explosion (which, given the design, could have happened only had there been a tremendous shock to the unarmed weapons). Considering that heat and flame intensity would have been much higher after a second explosion, and that it did not cause a further 16 explosions, the second too could not have been a warhead explosion. Therefore, *prima facie* the trigger explosion appears to be from the weapon fuel i.e. either oxygen from the torpedo or the booster of the missile. Anyhow what is important is that apparently damaging explosions were caused just from the trigger source and the adjacent weapon. Other weapons do not appear to have contributed to the damage. The Board of Inquiry, I am sure, will concentrate on these issues.

Normally an investigation would have recourse to various materials, log books and eyewitness accounts. In this incident, the spread of the flames from the forward compartments to the control would have incinerated everything. Reconstructing the events that led to the accident would be difficult, to say the least. Therefore the board will have to depend on advanced forensics to help it analyse the incident. Essentially this would entail chemical analysis of various materials to see if we can determine the nature of fuel that caused the burn. A lot of valuable evidence will lie in the debris of the fore ends. Much of this will be diluted by the sea water and most of it will be lost in the pumping out that will have to be done to bring the submarine to the surface. The Board of Inquiry will need to take advice from experts in forensic chemical and accident investigation to chalk out a course of action to collect samples before it is too late.

Damage control

The damage control design basis of the submarines provides for survival and maintenance of sufficient reserve of buoyancy when the pressure hull is breached and one compartment is fully flooded and two adjacent ballast tanks are destroyed. When this happens, the submarine is trimmed for neutral buoyancy. The submarine puts on a diving trim by flooding various tanks only when at sea, so as to avoid having to flood the tanks with dirty water in the harbour. Therefore, *Sindhurakshak* would have been 100 tonnes lighter than its normal diving trim. Despite this the submarine sank alongside. Nobody can provide a design basis that would allow flotation under conditions that existed on the *Sindhurakshak* on that fateful night.

What is worrying is that had the accident occurred when the submarine was out at sea, the death toll would have been devastating and there would have been no chance of salvaging any part of it. The Navy does not have any submarine rescue capability. The Deep Submergence Rescue Vehicle programme has not borne results even 13 years after the *Kursk* incident. There was much hot air after the Russian disaster but we still do not have the capability.

The Chief of Naval Staff has said we should hope for the best and prepare for the worst. It is high time that we equip ourselves for the worst and also teach ourselves to ensure that we have the best.

Vice-Admiral (retd) K N Sushil

(The writer, who retired as Flag Officer Commanding-in-Chief of the Southern Naval Command, was a submariner who served on Foxtrot and Shishumar-class submarines. He was Flag Officer Submarines and ACNS (Subs) before becoming Inspector General, Nuclear Safety in the Navy).

Elettonica

New INS Vikrant launched

To enter service in 2018

The launched hull of INS Vikrant

On 12 August 2013, Cochin Shipyard Limited (CSL) launched India's first indigenous aircraft carrier (IAC-1) in a landmark event for the $5 billion project. Following naval tradition, the warship has been named INS *Vikrant* ('Courageous') and the 37,500 tonne carrier will proceed for trials in 2016, to be operational by 2018. The aircraft carrier carries the name of India's first aircraft carrier, the British *Majestic*-class carrier formerly HMS *Hercules,*

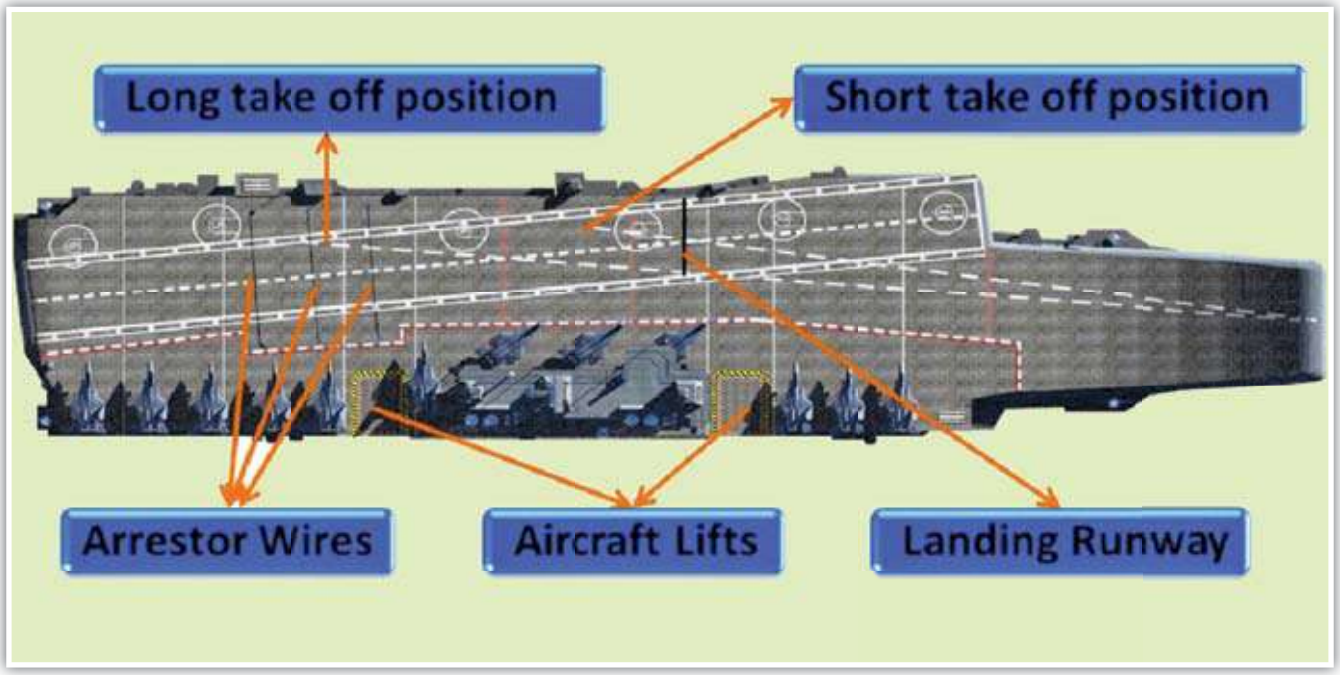
Mrs Elizabeth Antony after launch of the INS Vikrant, together with Defence Minister AK Antony and Chief of Naval Staff, Admiral DK Joshi.

which was commissioned into the Indian Navy as INS *Vikrant* (R11) in March 1961. INS *Vikrant* (R11) later played a key role in the blockade of East Pakistan during the December 1971 war.

Defence Minister AK Antony called this occasion "a remarkable milestone" and added that it "marks just the first step in a long journey but at the same time an important one." His wife, Elizabeth Antony, formally launched the ship by placing a garland of flowers on the hull. The launch marks India's entry into a select club of just four other nations – USA, UK, France and Russia – that possess the capability to design, build and operate aircraft carriers with fixed-wing aircraft.

For the record the new INS *Vikrant* is 260 metres long and 60 metres wide, with a pronounced 14° ski-jump at the bow to facilitate STOBAR (short take-off but arrested recovery) operations of fixed-wing fighters. It is designed for a top speed in excess of 28 knots and can remain at sea for extended periods and has a crew of 1600 sailors and officers.

The INS Vikrant being towed out during the launch ceremony

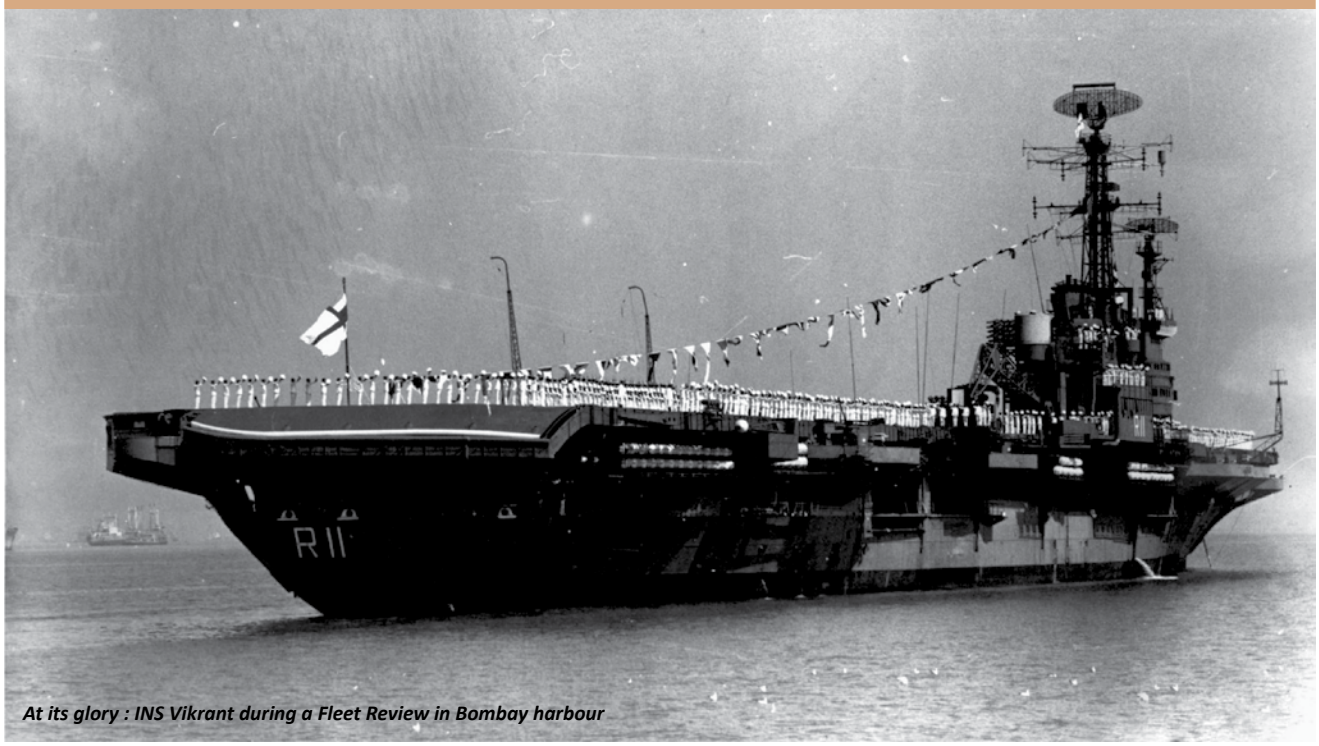


Top-view drawing of the deck of INS Vikrant, showing the STOBAR layout with two take off positions and three arrestor cables

The *Vikrant* is dead – long live the *Vikrant* !

It was a bitter-sweet time for the Indian Navy, the original INS *Vikrant* and the peoples of India. Despite great efforts to keep India's first aircraft carrier intact, albeit as a floating museum, in the end a bitter dispute between the Maharashtra Government and the Indian Navy sounded the 'last post' for the INS *Vikrant*. According to the MoD, final orders for disposing (read break up at the yards) of the ship were signed by Minister of State for Defence Jitendra Singh in June 2013.

Not that all efforts were not made to retain the Indian Museum Ship *Vikrant* which was a major tourist attraction during the years it was open to the public. The aircraft carrier became a Museum in 2000 but this was temporary and after a decade of limited public access, the floating museum was finally closed in 2010. The Navy expressed concern about the deteriorating state of the carrier's hull which needed some Rs 22 crores for repairs. The Government of Maharashtra suggested co-use of the carrier a the floating heliport, siting the ship off Oyster Rock near the Gateway of India. The Navy opposed this as it would be very close to its helicopter base INS *Shikra*, in Colaba, which is an extremely sensitive location. Maharashtra Chief Secretary JK Banthia informed then Defence Secretary Shashikant Sharma that the Navy's financial support was needed. The impasse over the site could not be resolved and the shortlisted private companies pulled out of the project in January 2012.



At its glory : INS Vikrant during a Fleet Review in Bombay harbour

However, Project 71 (the INS *Vikrant* programme) is two years behind schedule owing to problems in sourcing specialised steel from Russia, delays with crucial equipment and even a road accident in which vital diesel generators were damaged. However, the mammoth project has encouraged key indigenous capabilities that will hold the Navy and domestic industry in good stead over the coming years of intensive modernisation and acquisition.

The structure of the ship–the hull and superstructure–will be 90 per cent indigenous, while a large proportion of the on-board machinery, such as diesel generators and air conditioning systems, are domestically built as well. The four GE LM2500 gas turbines and associated shafting are one of the few foreign components powering the ship. Crucially, the warship-grade steel used in *Vikrant's* construction was developed indigenously through collaboration with DRDO's DMRL (Defence Metallurgical Research Laboratory) and SAIL (Steel Authority of India Limited). Prior to Project 71, this specialised grade of metal had to be sourced from abroad, often leading to supply issues and construction delays. Henceforth, all indigenous warships will be built using Indian steel.

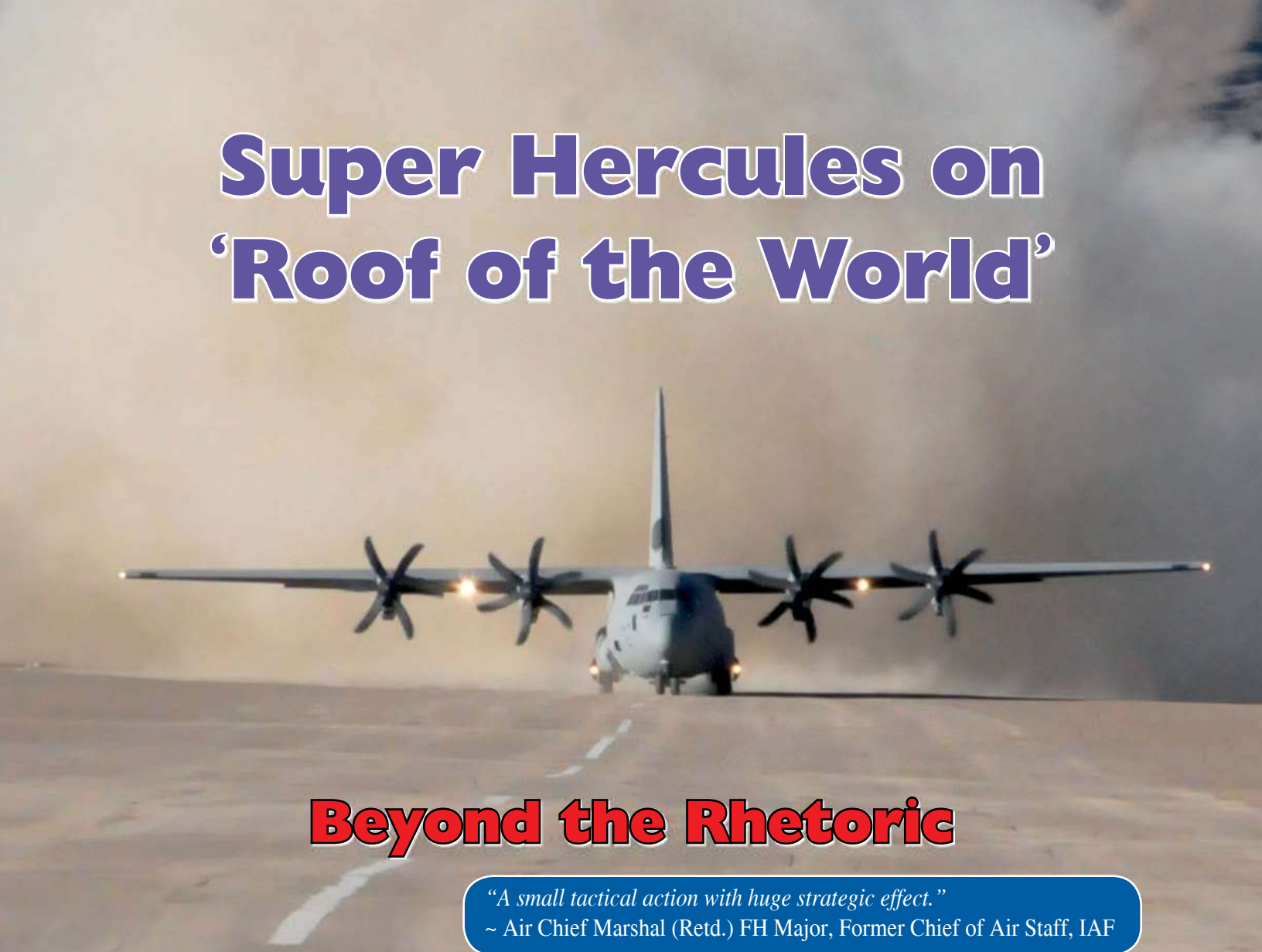
However, it is important to note that most of *Vikrant's* offensive capability will be imported, most notably the AK-630 CIWS, the entire aviation complex (essentially identical to the Russian system aboard INS *Vikramaditya*) and of course, its complement of MiG-29K fighters. In addition to MiG-29Ks, *Vikrant* will also embark Kamov Ka-31 AEW helicopters, Sea Kings, Chetaks and Dhruvs.

Following the launch, the aircraft carrier will enter CSL's larger 'repair dock' where the remainder of underwater work will be concluded, along with the integration of the ship's superstructure and sponsons. Once complete, INS *Vikrant* will undergo extensive trials in 2016 before being inducted into the Navy by 2018.

Angad Singh

Rolls-Royce

Super Hercules on 'Roof of the World'



Beyond the Rhetoric

"A small tactical action with huge strategic effect."
~ Air Chief Marshal (Retd.) FH Major, Former Chief of Air Staff, IAF

On 20 August 2013, the IAF landed its recently inducted C-130J Super Hercules aircraft on the airstrip at Daulat Beg Oldi (DBO), one of India's vital Advanced Landing Grounds (ALG) on the border with China. Historically, at any given time, the IAF has had, in its inventory, an aircraft capable of airlanding troops and cargo at DBO – at first it was the Packet, then the An-32 and now, the C-130J. The landing of the Super Hercules, in that regard is just an event in the long-term calendar of the IAF – a matter of routine! Notwithstanding the routineness of the event, an ecstasy of sorts permeated the domestic atmosphere following the landing and gave it a very special aura.

The Euphoria

The electronic media broadcast the landing of the aircraft, raising a massive cloud of dust as it touched down and rolled to a halt. This was reported as the highest ever landing by a C-130 since the commissioning of the aircraft nearly half a century ago – an aviation (world) record of sorts! The print media too splashed pictures of the aircraft declaring that the IAF has bettered its own record of high altitude operations. The dust that the aircraft raised on landing, symbolised the mood of the moment – the media went berserk: "Angry Birds," said a caption; "India flexes muscles with Super Hercules landing," screamed a heading and "India taunts China, lands Super Hercules near LAC," read another. The animated panel discussions on the television projected India's readiness to "take on" China.

The first successful landing of this special operations aircraft in the rarefied atmosphere at 16,600 feet in the Himalayas caused a nationwide euphoria comparable only to the feelings aired at the time of the aircraft's acquisition last year. In fact, the expectations had begun soaring even before the first C-130J entered Indian airspace. The public mood then had conveyed a feeling of immediate attainment of a capability to "undertake Entebbe-type raids;" in this instance, it is the perceived capability to "respond to Chinese provocations at the borders."

The implications

India's push to undertake operations using the C-130J from this remote airfield despite occasional Chinese admonition for creating infrastructure in the border areas, Ladakh in particular, has conveyed India's resolve to conduct operations within its borders even in the face of external pressures. It is an assertion of India's right to maintain and use its existing infrastructure regardless of this being in the sensitive border areas.

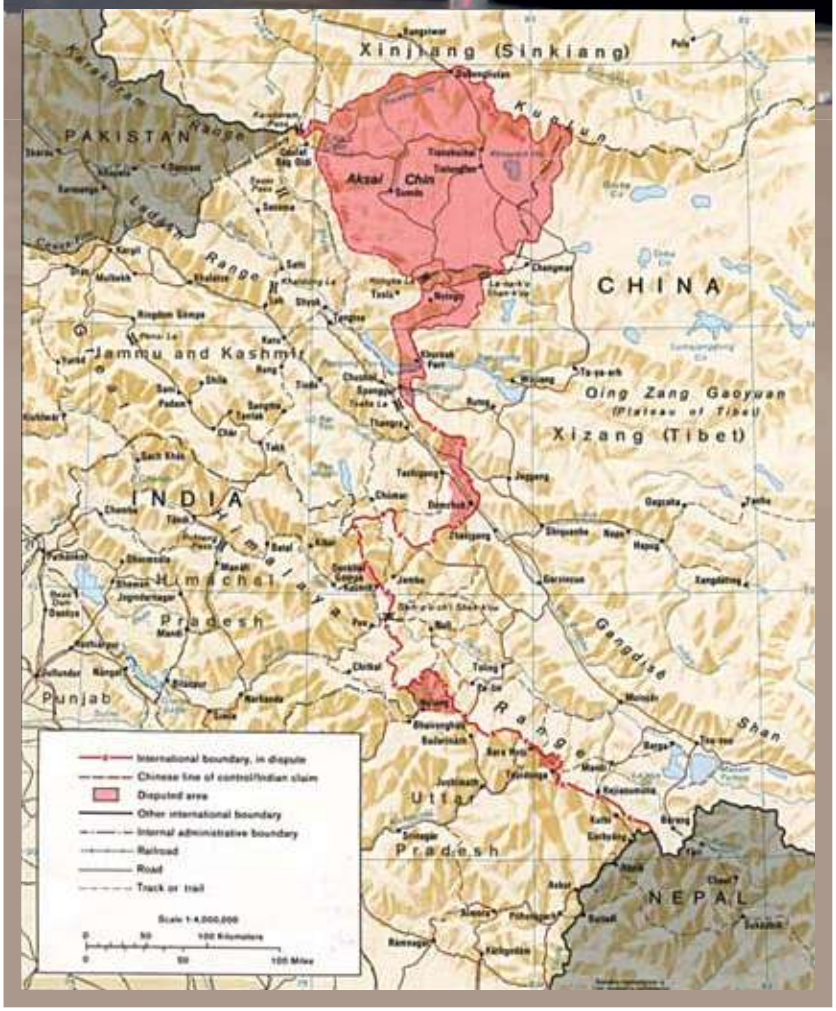
The exuberant public (and media) response to such events is not uncommon

or unusual; it is a natural expression of elation on what people perceive as a momentous achievement. That said, these are also the occasions to introspect: a few facts about DBO and the C-130J aircraft, coupled with some antecedents will explain the charged atmosphere and help getting down to reality.

DBO, the C-130J and the Antecedents

Wedged between the eastern edge of the Siachen glacier and the un-demarcated Line of Actual Control (LAC) with China, and located just south of the 18,290-foot Karakoram pass connecting India with Xinjiang in China at an altitude of 16,614 feet, DBO is one of India's forward posts in north-eastern Ladakh, barely eight kilometres from the LAC. Its proximity to the border and the existence of an ALG (the highest landing strip in the world) at DBO gives India a tactical advantage, as the nearest Chinese airstrip is located 200 km to its east at Qazil Jilga. India, realising the strategic importance of maintaining this post, created an airstrip (of compacted earth) in the early 1960s. The IAF's workhorse of those days, C-119 Fairchild Packet, did not have the power to operate in those high altitudes. So, to overcome the problem, HAL Bangalore in collaboration with Steward Davis developed a Jet Pack to assist with extra boost for take off – an innovation that enabled the IAF to undertake airlift in the mountainous terrain during the war with China (1962), and after.

China-India Border: Western Sector



Map sourced from Wikipedia

Inducted in the IAF in 2011, Lockheed Martin's C-130J Super Hercules is the world's most advanced tactical airlifter used mostly as a Special Operations aircraft. Designed and developed with mission flexibility in mind – combat delivery, aerial refuelling, special operations, disaster relief and humanitarian missions – the C-130J has a unique mix of agility and performance to consistently operate at a very high pitch, efficiently and reliably. With its great range and flexibility for geographical reach, the C-130J enables the IAF rapid tactical access to the remotest parts of the country. This tactical transport aircraft has proven itself in the harshest operating conditions possible. The Russian-origin twin-engine An-32 aircraft, inducted in the IAF in the mid 1980s, is less capable – its capacity of four tonnes (in the plains) goes down considerably when it operates in the high Himalayas. The ability to airlift reduces to a trickle as the day progresses and the temperature rises, operations are called off beyond a certain time/ temperature. At first, poor visibility owing to fog, mist, haze and low clouds and then, as the day progresses, high temperature hampers airlift operations in the region. Thus a small window of opportunity is available in the mountains to undertake flying, rendering airlift to DBO by An-32 a symbolic gesture.

The C-130J, with its four turbo-prop engines can airlift 20 tonnes in the plains. Thus use of a Super Hercules as against an An-32 aircraft, *ceteris paribus*, multiplies the airlift capacity by a factor of five – simple arithmetic ! This improved capacity throws open many possibilities: airlift of heavier artillery/weapon systems and larger quantities of all supplies in every single sortie. It also implies that in a given window of opportunity, the Hercules will be able to deliver more cargo that an An-32 and many corollaries can be arrived at to exploit this increased capability.

The enhanced capacity to supply the troops of the Indian Army and the Indo-Tibetan Border Police (ITBP) stationed in the DBO area in itself is not the reason for the elation. The widespread exhilaration is linked with India's setbacks in the war with China (1962) and more recently, its muted response because of the perceived incapacity to respond to repeated border incursions by China. The ability to land the C-130J with load at DBO translates into a much-improved capability to respond

An-32 landing at DBO

to incursions in the future; hence the atmosphere of celebration.

Points to Ponder

Although landing of the C-130J at DBO is a milestone in India's military capability build-up, it is not the time to celebrate, and certainly not the time for the military to lower the guard. Here are some points to ponder:

Consolidation: A few landings on a dirt-strip may be an operational necessity; but routine operations from unprepared surface will mandate excessive maintenance and will be detrimental to the service life of any aircraft (even if it is a C-130J). Therefore, considering the strategic importance of DBO, the first logical step would be to devote thought, energy, action and resources to improving the infrastructure at DBO for near full-scale operations. With an improved capacity to airlift, this should be achievable with fewer tears.

Seeing the Big Picture: Viewed in a larger perspective this landing at DBO is just the confirmation of a capability to airlift 'X' tonnes to an ALG at 16,000-plus feet. Working with this statistic as the starting point, the effort could now be to ensure physical reach to all possible landing grounds with similar geographical features. A step further would be to discover/create ALGs at even higher altitudes (and/or closer to the border) and to explore the feasibility of airlifting supplies to them. Creation/up-gradation of ALGs in the region will give a boost to overall preparedness. We may or may not land at all those ALGs routinely but such experimentation will offer multiple options for operational planning when a situation arises.

Scenarios: What if DBO is unavailable owing to any reasons – natural or otherwise? How effective would paradrops be? Building scenarios based on ground realities and planning accordingly would help consolidate the capability.

Judicious use of capability: Tonnes of barbed wire were airlifted even as the troops deprived of occupational clothing and equipment, were fighting the Chinese at the borders in 1962. It is unfair to judge that airlift without knowing the real reasons for it. However, prudence suggests that airlift of winter clothing and arms/ammunition rather than barbed wire would have enabled the troops to offer stiffer resistance. A five-fold increase in the airlift capacity per sortie is a quantum leap, which needs to be judiciously exploited so that every kilogram of cargo airlifted enhances the overall preparedness.

Integrating the Border Areas: Activating air bridges in the border areas would result in improved national integration in peacetime. During natural calamities, emergencies and war, such established air bridges would be a big boon.

Rhetoric does not pay: While on one hand rhetoric boosts the morale (read ego) of the people, on the other hand it needles a shrewd adversary to go into a balancing/countering act, thereby diminishing the relative advantage that might have accrued because of an effort of this nature. The landing of C-130Js, like the earlier ones of Packets (1961) and An-32s (2008) at DBO would not have gone unnoticed by the Chinese in any case, but the attached rhetoric in this instance, which in a few cases amounted to sabre-rattling, might needle China to cite this landing as a provocation and exploit the situation to increase the nagging incursions.

The way forward

The incrementally increasing Chinese incursions in recent months had projected India as a soft state and had raised doubts about the capability of the armed forces to deal with such issues. The C-130J landing at DBO, though a small blip on the strategic screen has projected significant improvement in India's airlift capability in the region. It has brought about a much-needed change in the perception of the people – an *increased* confidence in the ability to counter a belligerent neighbour.

A deliberate and determined, but quiet and unassuming approach to building and consolidating airlift capability with a focus on the future needs of the border areas will go a long way in strengthening our position militarily; a better preparedness

to deal with disasters would be a spin-off. There is a need to handle our strategic achievements astutely.

Group Captain Ashok K Chordia

(Senior Fellow at the Centre for Air Power Studies)

Note: The opinion expressed in this paper is the author's own and does not convey the views of the Centre for Air Power Studies or any organisation.

From the Cockpit: the DBO landing

At the Boeing C-17 induction ceremony on 2 September, *Vayu* got some exclusive details about the C-130J operation in and out of the Daulat Beg Oldi ALG.

First, it is important to note that Lockheed Martin, manufacturer of the C-130J, has published a performance table for the C-130J, detailing its capabilities at various operating altitudes with a range of payloads. However, this table only covers operations up to 13,300ft – that being the elevation of El Alto International Airport in La Paz, Bolivia – site of Lockheed's high altitude flight-testing of the C-130J. Since there is no available data for operations above this altitude, the personnel at No. 77 Squadron had to extrapolate data from Lockheed tables and make calculations and corrections over the course of about three months to make sure that the flight into and out of DBO would proceed as planned.

The landing and takeoff roll distances at DBO remain closely guarded information, given that the aircraft had performed outside the manufacturer's openly available specifications. However, it is known that the compacted-earth airstrip at DBO is approximately 7000 feet long, so it is obvious that the C-130J was operating within that limit. Also, in stark contrast to Russian aircraft that are highly sensitive to FOD (foreign object damage), the C-130J plowed through the dust and dirt at DBO and required nothing more than a compressor wash of its Rolls-Royce AE 2100 engines upon its return.

The airstrip at DBO is apparently quite narrow – barely wider than the track of the C-130J's main landing gear – and there were numerous obstructions on either side of the strip that had to be removed lest they damage the aircraft. With preparations at the site complete, the stage was set for the Air Force to demonstrate the new reach of its tactical transport arm.

In order to ensure that the operation would be more than a hollow 'chest-thumping' exercise, the Air Force loaded the aircraft with extra fuel to simulate a useful payload. Needless to say, the *Veiled Vipers* did a fantastic job of demonstrating IAF airlift capability and pushing the envelope within which these extremely-capable aircraft can be safely operated.

Skylords at Hindan

The IAF's first C-17 Globemaster III Squadron is formed

Vayu has recorded and written on the C-17 Globemaster III for the Indian Air Force continuously, following the type's first displays during the 2009 Aero India Show at Yelahanka, its evaluation trials in India including at Leh, the symbolic final assembly of the first C-17 for the IAF ('India I') on 31 July 2012 at Long Beach California, now till the formal induction at Hindan, on the outskirts of Delhi on 2 September 2013. The *Vayu* editorial team was there to cover the event on-the-spot.

The first three Boeing C-17 Globemaster IIIs of the Indian Air Force were formally inducted into service at Air Force Station Hindan on 2 September 2013 by Defence Minister AK Antony in presence of MoS for Defence Jitendra Singh, CAS Air Chief Marshal NAK Browne, VCAS Air Marshal Arup Raha, AOC-in-C WAC Air Marshal SS Soman, the US Ambassador to India Ms Nancy Powell, Lt Gen Sam Angelella and other senior officers of the USAF, senior executives of the Boeing Company and, of course, personnel of the Indian Air Force and special invitees.

Carrying tail numbers CB-8001, 8002 and 8003, these are the first of ten C-17s ordered by the Indian Air Force to equip the newly raised No.81 Squadron whose appellation is 'Skylords' and whose motto is *Saksham, Balam, Sarvatram*, which is sanskrit for 'Capable, Powerful, Omnipresent'. The squadron crest and flying patch of this, the IAF's youngest formation, have been designed by the unit and are proudly worn on their overalls.

Commanded by Gp Capt BS Reddy, formerly flying Il-76s with No.44 Squadron and a CAT-A QFI with the Aircrew Examining Board, the C-17s of No.81 Squadron will bestow major strategic airlift capability to the Indian Air Force. 'Stractical' is the special word coined for their unique ability to operate from austere airstrips in forward locations, to high altitude airfields in the Himalayas, and long distance to air bases thousands of kilometers distant, carrying heavy loads of over 70 tonnes with aplomb.

Wg Cdr TR Ravi, Flt Cdr No.81 Squadron.

The Commanding Officer and his Flight Commander, Wg Cdr TR Ravi, along with another 28 pilots, 10 engineers, 15 loadmasters and 84 technicians were given conversion training on the C-17 and its systems by the United States Air Force at various bases in the United States. The pilots went to Altus Air Force Base in Oklahoma, the host unit being the

MWO MS Chauhan, senior load master

97th Air Mobility Wing, assigned to the Nineteenth Air Force of the Air Education and Training Command, whose mission is to provide C-17 Globemaster III initial and advanced training. The IAF aircrew were attached with the 58th Airlift Squadron, tasked with conversion on the C-17 Globemaster III.

The IAF technicians spent time with the USAF's 437th Aircraft Maintenance Squadron at Charleston, South Carolina for comprehensive training following their initial attachment with the 373rd Training Squadron 'Detachment 5'. Training included maintenance management, flight line supervision, jet engine maintenance, avionics systems, electronic countermeasures, aircraft structures and general aircraft mechanical tasks. The USAF spokesman stated that the IAF technicians were getting "the best training and mentoring from the best maintenance personnel and instructors in the US Air Force".

A defining moment at Hindan

Describing the induction of C-17 Globemaster IIIs in the Indian Air Force as a 'defining moment', Defence Minister Antony in his address at Hindan said

'Skylords' of No.81 Squadron

Defence Minister AK Antony hands over the symbolic golden key to Gp Capt BS Reddy, CO No. 81 Squadron during the induction ceremony (Photo : Angad Singh)

that, "with this, the IAF has taken a giant stride towards its goal of acquiring multi-spectrum strategic capabilities, essential to safeguard India's growing areas of interest". The government had expedited the process of procuring ten C-17 Globemaster IIIs from the United States under the Foreign Military Sales (FMS) programme because "the rapidly evolving geopolitical environment around us calls for a robust national security architecture".

Continuing, Antony stated that "traditional challenges to our national security have evolved into complex multi-dimensional threats. A long-term comprehensive capability enhancement approach by and for our Armed Forces is the need of the hour. On its part, the government remains fully committed to this responsibility".

In his address, Air Chief Marshal NAK Browne referred to the "realistic appraisal of the geopolitical environment which brings forth a complex security paradigm. Located in a geo-strategically important region, our nation faces multi-faceted challenges to its security. India's unique topography which makes our operational environment extremely challenging. Our area of operation is characterised by a diverse terrain, high altitude air bases and a constantly changing weather pattern. This imposes tough conditions on our combat crews and impinges on successful conduct of operations. Thus, the dynamic contours of modern battlespace in such an ever evolving environment calls for a potent and modern air force with full spectrum capabilities. On its part, the IAF has its tasks well cut out to maintain very high levels of operational preparedness and to retain an ever vigilant posture".

The Defence Minister and Chief of Air Staff

The CAS continued, "fully conscious of our nation's aspirations and the immense trust that it reposes in the IAF, we have embarked on a modernisation programme with an aim to acquire key capabilities necessary to address the emerging national security challenges. A comprehensive assessment of future scenarios and identification of key aerospace capabilities required in the 21st century has resulted in the formulation of a detailed modernisation roadmap with new acquisitions, upgrades and training reviews".

"Being fundamental to the conduct of all military operations, airlift operations also play an indispensable role in aid of civil authorities and sustaining remote reaches of our vast land and ocean territory. The versatility demonstrated by the recently inducted C-130J Hercules in 'Op Rahat', while flying in fuel supplies to Uttarakhand as also, the first time landing of the C-130J at DBO at a height of 16,600 ft. asl, is an excellent example of IAF's professional competence and commitment of not only rising upto the important nation-building task of providing disaster relief support but also to sustain our troops guarding our frontiers. This is an abiding commitment. And I can think of no better platform than the C-17 Globemaster III which has been specifically selected to provide a major boost to our strategic airlift capability. Designed to rapidly despatch a payload of 70 tonnes across a range of 4200 kms, the C-17 fleet will provide tremendous flexibility in terms of operational response options in any future campaign. The long range, heavy lift capability will allow commanders to induct troops, squadrons, re-locate forces as well as rapidly shift forces between theatres".

Inside the cavernous cargo hold of the Globemaster III

"While the existing fleet of Il-76s, An-32s, Avro 748s and Dornier 228s have rendered yeomen service and will continue into the future to form the mainstay of our tactical airlift capability, the induction of ten C-17 aircraft in the 12th Plan period promises to be a 'game changer' on how we conduct air transport operations. This will prove to be a key enabler in transporting men and material to austere locations during hostilities especially in the forward bases and ALGs in the North and NE Sector".

"As India charts its path towards sustained growth and lasting security, our spheres of interest correspondingly

Ground support equipment with the Globemaster III

Flight deck of the C-17, with sister aircraft visible outside

continue to expand. I can visualise that the enhanced reach and versatility of the C-17 fleet will bolster our ability to assist our neighbours and our friends in the Indian Ocean Region, as also our expanded interests globally".

"Having received the first three aircraft on schedule, 81 Squadron prepares itself to induct the remaining seven aircraft as part of an accelerated delivery programme. The tenth Globemaster is planned to reach Hindan by end of next year itself. As part of the project, a total of 30 pilots, 10 engineers, 15 loadmasters and 84 technicians have been trained in USA. The Squadron will operate from a state-of-the-art squadron complex which will be ready by next year, and will be supported by a comprehensive infrastructure upgrade at Hindan, all of which forms a part of this project".

Why 81?

For the record : No.81 Squadron personnel with the RM, RRM and CAS at Hindan on 2 September 2013 (Photo : IAF PRO).

No. 81 begins a new Squadron series of the IAF which has hitherto maintained some logical sequence in numbering, with no particular bias on whether the unit flew fighters, bombers, transport aircraft or reconnaissance types. Thus, in the earlier years of the IAF, No.10 had fighters, No.11 and 12 were transport squadrons : then onto the 'twenties', 'thirties' 'forties' and 'fifties': as examples No.24 had fighters, No.25 had transports, No.32 had fighters, No.33 transports, No.44 had transports, No.45 fighters, No. 51 had fighters, No.59 was a transport squadron. The next were century series but Nos. 101, 102, 103, 106 squadrons were initially equipped with reconnaissance types. The 200s began with Nos. 220 and continued till 224, but were all fighter squadrons.

Over the last decades, several transport squadrons were number plated, including the battle-honoured No.19 (Ladakh in 1962, Sri Lanka in 1987-89) and No.42 which with Il-14s, were tried and tested till phasing out. These were not resurrected when the IAF began to receive new transport and special mission aircraft such as the Il-78MKI, A-50 AWACS and C-130J Super Hercules which formed equipment of Nos. 78, 50 and 77 Squadrons respectively.

The selection of '81' as squadron number for the new C-17 Globemaster III strategic airlift aircraft, has puzzled many observers but it was the Air Chief who provided a clue during the induction ceremony at Hindan when he commented that in celebrating the beginning of a new chapter in the IAF's history was raising of No.81 Squadron in the 81st year of the IAF's existence!

The Indian Air Force's latest aircraft type, the Boeing C-17 Globemaster III at IAF Hindan (photo : Angad Singh)

Boeing C-17 Globemaster III inducted into IAF

The first three Boeing C-17 Globemaster IIIs of the Indian Air Force were formally inducted into service at Air Force Station Hindan on 2 September 2013 by Defence Minister AK Antony. Carrying tail numbers CB 8001, 8002 and 8003, these are the first of ten C-17s ordered by the Indian Air Force to equip the newly raised No.81 Squadron whose appellation is 'Skylords' and whose motto is *Saksham, Balam, Sarvatram*, which is Sanskrit for 'Capable, Powerful, Omnipresent'.

The third Boeing C-17 Globemaster III airlifter (tail number CB-8003) for the Indian Air Force

In his address, the CAS stated that the "C-17 fleet will provide tremendous flexibility in terms of operational response options in any future campaign, designed to rapidly despatch a payload of 70 tonnes across a range of 4200 kms. This long range, heavy lift capability will allow commanders to induct troops, squadrons to re-locate forces as well as rapidly shift forces between theatres. The induction of ten C-17 aircraft in the 12th Plan period promises to be a 'game changer' on how we conduct air transport operations" (see story *Skylords at Hindan* in this issue).

Order for second batch of C-130Js "imminent"

The Government of India is close to confirming orders for a second batch of Lockheed Martin C-130J Super Hercules for the IAF, which will supplement the earlier six aircraft presently in service with No 77 Squadron at Hindan. The second C-130J squadron will reportedly be based at Panagarh in West Bengal, which is the location of the proposed Army Mountain Strike Corps, which was cleared for raising by the CCS on 17 July 2013 (see *Vayu Issue IV/2013*).

According to reliable sources in New Delhi, the contract should be signed before the end of 2013, and "certainly within the financial year". In addition, the Government of India will be progressing contracts with the USA, under the Foreign Military Sales (FMS) Programme, for 22 Boeing Apache attack helicopters, 15 Boeing Chinook heavy lift helicopters and 145 M-777 ultra light 155 mm howitzers, the latter considered as intrinsic for the Mountain Strike Corps.

C-130J of No.77 Squadron at Hindan (photo : Angad Singh)

Joint study group visits HAL

In the course of a detailed review of the aeronautical sector of the country, a joint study group headed by Air Marshal M Matheswaran, Dy Chief of the Integrated Defence Staff (PP & FS) visited HAL in the latter half of July. The study group had discussions with the HAL management at its corporate office, following which they visited various HAL facilities at Bangalore including the ARDC, CMD, Helicopter and Aerospace Divisions.

Air Marshal M Matheswaran, who is an experimental test pilot, seen at Aero India 2011, after flight in the Gripen.

Air Marshal Matheswaran later addressed and interacted with senior executives of HAL and DRDO.

HAL signs MoU with Transparency International India

HAL has signed a Memorandum of Understanding (MoU) with Transparency International India (TII) for adoption of an Integrity Pact (IP). The MoU was signed by Dr. RK Tyagi and Justice Kamleshwar Nath, Chairman, TII at a function in New Delhi. HAL has so far signed this 'Integrity Pact' with 115 vendors (85 foreign and 30 Indian). 'Integrity Pact' is a tool developed to ensure that all activities and transactions between companies or Government departments and their suppliers are handled in fair and transparent manner. TII will support HAL by providing advice and resources to implement the Integrity Pact programme successfully. For the record, HAL is the first Defence PSU to sign such an MoU with TII.

HAL Chairman, Dr. R. K. Tyagi (left) and Justice Kamleshwar Nath, Chairman, TII signing an MoU on Integrity Pact (IP).

HAL ALHs for Ecuador sold "below cost"

An audit report has revealed that HAL had supplied seven Advanced Light Helicopters to the government of Ecuador in 2008, at a cost of Rs 204 crore, which was "Rs 52 crore below the manufacturing cost". In its counter point, HAL has stated that this was a calculated attempt to win the contract and thereafter, gain from after sales service and support. The first five ALHs were supplied to Ecuador in March 2009, following the Aero India 2009 show.

HAL continues development of HTT-40

Defence Minister AK Antony has stated that the basic trainer aircraft (BTA) project being undertaken by HAL "is still on" and that the Indian Air Force has not sought further supplies of the Swiss-origin Pilatus PC-7 Mk.II trainers. His statement clarified many doubts in the public domain on the continuation of the HTT-40 development by HAL in wake of reports of that the IAF wanted to exercise the option for another 38 PC-7s which would in effect make further work on the HAL trainer infructuous. In fact, the PIB (Defence Wing) had issued a detailed clarification on the subject following reports in the media where 'facts have been misrepresented'. It is understood that IAF officers have recently interacted with HAL on the requirements for 106 more basic training aircraft to supplement the 75 PC-7s already contracted for with Pilatus.

Meanwhile in their media release, HAL formally clarified that the matter is before the competent authorities and there are no comments to offer on this subject in particular. "HAL continues to whole heartedly support the progress of Indian Air Force and highly values its relationship with IAF."

Latest launch of Agni 5 ICBM

On 15 September 2013, the Agni 5, India's long range inter continental ballistic missile and designed to deliver nuclear warhead with high precision, was successfully launched at 0850 hrs from DRDO's Launch Complex at Wheeler's Island, and impacted on its target "with expected precision". The missile is powered by three stage solid rocket motors and followed its entire trajectory in textbook manner, dropping the three stages at predefined points in the ocean. Various ships with radars and electro-optical systems, stationed at midrange and at the target point, tracked the ICBM in real time. "All systems and subsystems of the missile, including the launch system, navigation system, control systems, rocket motors, the re-entry package, etc. performed well. The Navigation systems, very high accuracy Ring Laser Gyro based Inertial Navigation System (RINS) and the most modern and accurate Micro Navigation System (MINS) ensured the missile reaching the target point within few meters of accuracy", according to the spokesman.

Ariane 5 orbits key satellite payloads including INSAT-3D

On 26 July, the 70th flight of Arianespace's heavy-lift Ariane 5 launcher orbited Europe's largest ever telecommunications satellite, Alphasat and India's latest meteorological spacecraft, INSAT-3D, on the third Ariane 5 mission of 2013. Some five minutes after Alphasat's deployment, Ariane 5 completed its mission with the successful separation of INSAT-3D, which will provide enhanced meteorological observation and monitoring of land/ocean surfaces. The satellite carries a six-channel imager

and 19-channel sounder, as well as a data relay transponder for satellite-aided search and rescue operations.

INSAT-3D is adapted from India's I-2K spacecraft bus and was developed by the nation's Indian Space Research Organisation (ISRO) space agency with its ISRO Space Applications Centre. India's INSAT-3D is the 16th ISRO spacecraft the company has orbited – a partnership that dates back to the third Ariane 1 flight in 1981 – while Alphasat is the eighth payload launched by Arianespace for Inmarsat.

India's first defence satellite GSAT-7 launched

India's first exclusive defence satellite GSAT-7 was successfully launched by European space consortium Arianespace's Ariane 5 rocket from the Kourou spaceport in French Guiana on 29 August, giving a major boost to the country's maritime security. The Indian Navy would be the user of the multi-band home-built communication spacecraft, expected to be operational by the end of September 2013.

The Rs.185 crore GSAT-7, the country's first dedicated spacecraft for defence applications, was launched with and the event telecast live. After a flight of almost 34 minutes, the satellite was injected into a geosynchronous transfer orbit (GTO), completing the launch mission. From 31 August to 4 September, ISRO performed three orbit-raising operations to place the satellite into a geostationary orbit at 36,000 km above the equator. By 14 September, GSAT-7 was positioned in its orbital slot of 74º east longitude and subsequently the satellite's communication transponders switched on. The frequency bands of GSAT-7 will help space-based marine communications with coverage over the Indian landmass as well as surrounding seas.

According to a senior space scientist, the Navy has thus far faced limitations from line of sight and ionospheric effects, among others, as far as space-based communications are concerned. It was therefore essential to have an integrated platform for the Navy's exclusive use. Earlier, satellite communication on ships was through Britain's Inmarsat, a major provider of global mobile satellite communications services.

GRSE launches offshore patrol vessel for Mauritius

On 2 August, an Offshore Patrol Vessel (OPV) for the Republic of Mauritius was launched from Kolkata-based DPSU, Garden Reach Shipbuilders & Engineers Ltd (GRSE), first export order for a warship being built in India. The CGS *Barracuda* was launched by Senior Chief Executive PMO, Government of Mauritius, Mrs K O Fong Weng-Pooran in presence of the Mauritian High Commissioner. Others present included Deputy Chief of the Naval Staff, Vice Admiral Pradeep K Chatterjee and others from the Ministries of Defence, External Affairs and West Bengal administration.

The OPV measures 74.10 m in length and is 11.40 m wide, has a maximum speed of 20 knots and an approximate displacement of 1,300 tonnes. The OPV will undertake various tasks including anti-piracy, search and rescue, anti-smuggling, surveillance and anti-poaching operations. It can also undertake logistics support including transportation of dry cargo, fuel oil, fresh food, pollution response and external fire fighting, transportation of small detachment of troops and embarks a helicopter on deck without hangar.

Indian Navy Boeing P-8I at INS 'Utkrosh', Port Blair

A Boeing P-8I long range Maritime Reconnaissance/Anti-submarine Warfare (LRMR/ASW) aircraft of INAS 312 made its maiden landing at INS Utkrosh airfield in Port Blair on 6 August 2013.

Piloted by the Squadron Commander (designate), Cdr HS Jhajj, the aircraft under call sign 'IN 321' was welcomed to the islands by Commander-in-Chief, Andaman & Nicobar Command, Air Marshal PK Roy, at an event that was attended by senior officers of the Unified Command. The aircraft is the first of eight P-8Is being procured under a contract signed in 2009 and is based at INS *Rajali,* Arakkonam.

P-8I at INS Utkrosh

The P-8I is the Indian Navy variant of the P-8A 'Poseidon' that Boeing has developed for the US Navy. The aircraft is equipped with an array of sensors for maritime reconnaissance, anti-submarine operations and electronic intelligence missions, and is fully integrated with state-of-the-art sensors plus highly potent anti-surface and anti-submarine weapons.

Nuclear reactor activated on INS *Arihant*

Contributing to the country's quest for a nuclear weapon triad, the uranium-fueled 83 MW pressurised light-water reactor aboard the indigenous nuclear submarine INS *Arihant* went critical on 9 August 2013, a step forward towards its operational deployment by the Navy, currently planned for 2014. The Indian Navy's nuclear submarine will have the ability to stay submerged for long durations, facilitating undetected patrols as well as a viable 'second strike' nuclear retaliation capability. "The vessel's endurance is limited only by crew fatigue and consumable stores. By contrast, conventional diesel-electric submarines have to surface at regular intervals to charge their batteries."

The DRDO has reportedly developed a medium-range nuclear missile B-05 'Sagarika' (also known as the K-15) for deployment on the *Arihant* with its last developmental trial held on 27 January off the coast of Vishakhapatnam (see *Vayu* II/2013).

Northrop Grumman MK54 torpedo nose arrays for Indian Navy

Northrop Grumman has been awarded a contract for the production of acoustic nose arrays for the MK54 lightweight torpedo, under the foreign military sales (FMS) programme with a number of completed MK54 torpedoes earmarked for the Indian and Royal Australian Navy. The initial scope of the contract is for 428 nose arrays with a potential for as many as 3,000 over the life of the agreement. The $45.9 million firm-fixed-price, cost-plus contract includes options that, if exercised, would bring the cumulative value of the contract to $294.3 million.

IAC-1 launched as INS *Vikrant*

On 12 August 2013, Defence Minister AK Antony launched India's first indigenous aircraft carrier in Cochin. Named as INS *Vikrant* and with this induction, India has joined a 'select club' of countries capable of designing and building an aircraft carrier of this size and capability. INS *Vikrant*, with an ability to embark 36 aircraft, would go for extensive trials in 2016 before being inducted into the Navy by the end of 2018.

Some 90% of INS *Vikrant's* hull has been built indigenously with DRDO and SAIL (Steel Authority of India Ltd) supplying specialised shipbuilding steel. The flight deck of INS *Vikrant* will have the capacity to hold 19 aircraft and the hangar will have room for 17 more (*see story in this issue*).

Inshore Patrol Vessel ICGS *Rajveer* commissioned

The Indian Coast Guard Ship *Rajveer*, 7th in the series of eight IPVs designed and built by GRSE, was commissioned on 10 August 2013 at Visakhapatnam by RK Mathur, Defence Secretary in the presence of Vice Admiral Anurag G Thapliyal, DG Indian Coast Guard, Inspector General SP Sharma, PTM, TM, Commander Coast Guard Region (East) and other senior officials of the Central and State Governments.

The IPV is equipped with advanced navigation and communication equipment, propelled to a maximum speed of 31.5 kt by three MTU 4000 series diesel engines producing 2720 kW each, coupled with three 71S2 Rolls-Royce Kamewa waterjets. At economical cruising speed of 14 kt, it has an endurance of 1500 nautical miles. The ship includes an Integrated Bridge System (IBS), Integrated Machinery Control System (IMCS), and an indigenously built 30 mm Gun Mount with Fire Control System. The ship is designed to carry one Rigid Inflatable Boat and two Gemini craft for search and rescue, law enforcement and maritime patrol.

Rolls-Royce launches 'India Open' innovation pilot programme

Rolls-Royce has launched its 'India Open Innovation' programme (IOiN-RR) which is designed to help identify buy or license technologies or techniques outside Rolls-Royce's traditional areas of operation that are new and potentially beneficial to Rolls-Royce. IOiN-RR will also provide Indian organisations with the opportunity to leverage their solutions globally.

The challenges will focus on three critical areas, which are test and measurement, repair, inspection and servicing technologies and novel designs and manufacture of large components and tools.

RTAF Gripens stage via Port Blair

Three Saab JAS 39 Gripen C fighters and a Swedish Air Force C-130 in support were diverted to Port Blair in the Andaman Islands on the night of 3 September 2013. The Gripens were on a delivery flight to Surat Thani, base of the Royal Thai Air Force's Wing 7 when one of the aircraft was struck by lighting, prompting the precautionary landing at Port Blair. There were no injuries reported and the aircraft departed on 4 September, having stayed overnight.

These aircraft are the last of an order for 6 Gripen C fighters placed by Thailand in 2010, which was itself a follow-on to a previous contract for 6 Gripen C/Ds placed in 2007. The first six

Gripens were delivered in February 2011 and a second batch of three fighters reached Thailand in April 2013. The aircraft are operated by the 701st Fighter Squadron 'Sharks' at Surat Thani, alongside Saab 340 Erieye AEW aircraft in the air defence role.

Vice Adm. Shekhar Sinha flies MiG-29K

Vice Admiral Shekhar Sinha, FOC-in-C Western Naval Command (and 'Grey Eagle' of Indian Naval Aviation) notched another milestone in his professional career by taking off and landing a MiG-29K from deck of the INS *Vikramaditya* (former *Admiral Gorshkov*) in the Barents Sea on 6 September. In the second cockpit was the Chief Test Pilot of RAC MiG Mikhail Belyaev. The INS *Vikramaditya* is planned to be commissioned in the Indian Navy 'in the very near future'.

U-2s operated from Indian bases

Declassified documents in Washington DC have confirmed that the US obtained permission from the government of India to operate its high-flying U-2 recconaissance aircraft from Indian bases in the months after the 1962 frontier war between India and China. The U-2s flew several sorties over the India-China border, taking off from a base in Thailand, before switching to an unused World War II-era airfield in Charbatia, near Bhubaneshwar on the Bay of Bengal.

Border Defence Co-operation Agreement with China

Even as China and India are presently working to have a new Border Defence Cooperation Agreement (BDCA), in place, the government of India has reportedly conveyed to China that it will not be possible to 'freeze' the infrastructure construction and forces at existing levels along the LAC. The existing levels of roads, railways and airfields, all critical for building up defences, are "lopsided in favour of China." The Indian Army, the Indian Air Force and the Ministry of Defence have advised against agreeing to a halt on construction of new roads, airports or railway lines along the 4,057-km-long Line of Actual Control (LAC).

Both sides have exchanged drafts of what they opine should form part of the new agreement. It is expected to be inked when Prime Minister Manmohan Singh visits China sometime in October this year. The last meeting on the matter was conducted on 20 August between Indian Foreign Secretary Sujata Singh and Chinese Vice-Foreign Minister Liu Zhenmin.

India is concerned with China's rapid expansion of forces in the area during the past decade, with as many as 27 airfields in Tibet and Xinjiang. The government of India has recently undertaken to build a network of border roads, upgrade advanced landing grounds, raise a Mountain Strike Corps and base Sukhoi Su-30MKIs in the north-east.

China has two dedicated Military Area Commands at Lanzhou and Chengdu, both allocated two group armies, each comprising between 75,000-100,000 troops equipped with tanks, mobile missile launchers, artillery and helicopters.

US Army Chief visits India

The US Army Chief of Staff General Raymond T Odierno visited India at the end of July and met with his counterpart, Indian Chief of Army Staff, General Bikram Singh. He later visited the Indian Army's Northern Command, responsible for the borders with Pakistan and China, and interacted with the staff and commanders there including these of the Srinagar-based 15 Corps and Nagrota-based 16 Corps. General Odierno was briefed on counter-insurgency operations, particularly in Jammu and Kashmir.

General Odierno with Indian Army Chief General Bikram Singh

Reportedly impressed by the Indian military's successful counter-insurgency operations, he said: "The US would like to learn from the Indian experience as how to fight militants in a tough environment and difficult terrain as in Afghanistan." The General expressed interest in conducting joint US-India exercises in Kashmir. Indian and US troops have earlier held joint exercises in the mountainous Ladakh region in 2003 and the renewed interest in Kashmir may has a reason. "The basis of our continued relationship will be the sharing of information about what they face on a day-to-day basis with Pakistan as well as with China." There is speculation on the message that the General is conveying to Pakistan by speaking about the possibility of joint India-US military exercises in Kashmir.

Exercise *Panchjanya*

The 15-day Exercise 'Panchjanya', an integrated exercise at theatre level, was recently held in the Doaba region of the Punjab where more than 15,000 troops and integrated combat elements of 11 Corps participated, under the aegis of Headquarters Western Command.

The exercise was conceptualised by Western Command focusing on rapid mobilisation and speedy multiple offensives, deep into 'enemy territory', in which all the three Corps of the Western Command operated together in an integrated manner. "The exercise concentrated on new and efficient ways of fighting in a synergised battlefield."

The exercise involved participation of all arms, combat and support elements including artillery guns, rockets, missiles,

Special forces being inducted by Mi-17V5

armoured tanks and helicopters. Special emphasis was on the functional integration of the Army with the Indian Air Force in a network-enabled environment. The Indian Air Force deployed fighter aircraft, Unmanned Aerial Vehicles (UAVs) and attack helicopters in support of their Army counterparts.

Armoured forces use pontoon bridges to cross a canal

Indo-Mongolian Exercise *Nomadic Elephant*

The ninth Indo-Mongolian combined training and exercise, 'Nomadic Elephant - 2013', was held at the Special Forces Training Centre, Khujir Bulan in Mongolia in mid-June2013. Besides promoting military relations between India and Mongolia, the objective was to conduct combined operations with emphasis on counter-insurgency and counter-terrorism operations in mountainous terrains and forested areas, for enhancement of inter-operability between the Mongolian Armed Forces and the Indian Army during peacekeeping operations under UN mandate.

Soldiers of the Mongolian and Indian Army conduct joint patrols while training in Counter Terrorist Drills during Ex Nomadic Elephant

The Indian contingent participating in the exercise consisted of a specially selected and trained platoon from the Sikh Light Infantry, the Special Forces and a team of observers. The Mongolian Armed Forces were represented by 50 officers and other ranks of their special task battalion.

The Indian contingent acquitted itself commendably, the 'Warriors Medal' later ceremonially presented by the Mongolian Armed Forces to the participants from India.

Army Chief visits Jammu & Kashmir

General Bikram Singh, Chief of the Army Staff (COAS) visited the Kashmir Valley in mid-July 2013, interacting with troops deployed in the forward areas of Baramulla and Kupwara

The COAS meeting senior officers in Srinagar

General Bikram Singh on arrival at Corps Headquarters in Srinagar

Sectors. The Army Chief was accompanied by Lt Gen Sanjiv Chachra, GOC-in-C Northern Command and Lt Gen Gurmit Singh, Commanding 15 Corps, and was briefed on the prevailing security scenario in the Kashmir Valley.

"On the second day of his visit to J&K, the Army Chief interacted with officers and troops located in forward areas and complimented them for the state of vigilance, preparedness to face challenges and high morale."

General Bikram Singh was appreciative of the initiatives undertaken by Northern Command and 15 Corps in particular, which have resulted in "a peaceful environment in the Valley."

Indo-French Joint Army Exercise *Shakti 2013*

The joint exercise *Shakti 2013* between the Indian and the French Armies took place 9-20 September 2013 at Grenoble in the French Alps, being the second joint military exercise between the two countries. The participating troops, some 60 soldiers, were drawn from 5th Battalion Kumaon Regiment, while the French troops were from their 27th Mountain Infantry Brigade. Objective of the exercise was to conduct platoon-level joint Counter Insurgency operations in high altitude mountainous terrain under the UN Charter.

Indian troops regularlyundergo extensive training on advanced mountaineering techniques at the High Altitude Warfare School at Sonamarg in Kashmir, in addition to tactical drills involving close cordon and house intervention. The twelve-day exercise was conducted in multiple modules in order to achieve complete integration between the two contingents, at every stage. The vast experience and expertise gained by the Indian troops in high altitude areas like Siachen Glacier and in Counter Insurgency operations held special importance for the French Army. "Conduct of the joint exercise would therefore set the stage for greater defence cooperation between the two nations, thus contributing to enhanced military ties in the years ahead according to a spokesman."

Indian troops in France, 2013.

NEXTER ADD

Orders for Saab self-protection system for ALH

Saab has received orders from Hindustan Aeronautics Limited for serial production of an integrated electronic warfare self-protection system for installation on the Indian Army and Air Force Advanced Light Helicopters, with a total value of some SEK 216 million (USD 33 million). Deliveries are scheduled to commence in 2014. Development and production of the IDAS system will take place at Saab in Centurion, South Africa (Saab Grintek Defence).

Saab's Integrated Defensive Aids Suite (IDAS) "protects crew and aircraft and enhances the survivability in sophisticated, diverse and dense threat environments, the system providing timely warning against different types of threats including radar, laser and missile approach warning and automatically deploying the appropriate countermeasures.

These orders follow initial serial production orders received in 2008. "With these orders we continue to build on our very successful partnership with HAL. The fact that HAL and the Armed Forces have continued to show faith in the IDAS system is a testimony of the effectiveness and reliability of the solution," says Lars-Olof Lindgren, Head of Market Area Saab India.

First Hawk for Indian Navy

The Indian Navy has received the first of 17 Hawk AJTs on order. The Hawks for the Indian Navy form part of a contract for 57 aircraft signed in 2010 of which 40 are for the Indian Air Force, this country becoming the largest operator of Hawk with 123 aircraft ordered to date, of which over 70 have been delivered to the Indian Air Force.

The Hawk will supplant the current HAL Kiran Mk.IIs of INAS 551 to provide advance jet training for Naval pilots to progress to frontline aircraft, the Hawk effectively integrating air and ground based elements for efficient and cost-effective training of pilots.

The Indian Navy Hawk was officially handed over to Vice Admiral Pradeep Chatterjee, DCNS by Dr RK Tyagi, Chairman HAL at a function in Bangalore. As Guy Griffiths, BAE System's Group Managing Director International said, "The introduction of the Hawk to a new user is a momentous occasion, and further testimony to the aircraft's global success. This marks another significant milestone in our longstanding partnership with HAL which has established a track record operating a world-class Hawk production capability. We are committed to strengthening our relationship with HAL and exploring long-term sustainable business opportunities, globally." He added, "we have also submitted our response to HAL's Request for Proposal for a potential order to supply products and services for the manufacture of 20 additional Hawk aircraft to the IAF, and are now looking forward to partnering with HAL in providing the Indian Air Force's display team this fantastic aircraft."

Prithvi II missile conducts successful user mission

On 12 August, a missile unit of the Strategic Forces Command (SFC) successfully launched from the test range at Chandipur, off the Odisha Coast, an indigenously developed surface-to-surface Prithvi II missile with a strike range of around 350 km,. Equipped with advanced high-accuracy navigation and manoeuvring systems, the missile "achieved all targeting and technical parameters set out for this launch". DRDO radar stations, electro-optical tracking systems and telemetry units located along the coast of Odisha, tracked the missile trajectory and downrange teams aboard a ship deployed near the designated impact point in the Bay of Bengal monitored the terminal events and splashdown of the missile.

Inducted into India's Strategic Forces Command in 2003, the Prithvi II missile, the first missile developed by DRDO in the IGMDP (Integrated Guided Missile Development Programme), is now a proven weapon. Carried on a mobile transporter erector launcher (TEL) vehicle, the missile is designed for rapid manoeuvrability and high operational flexibility on the battlefield.

Prithvi-II missile being launched from Chandipur Range (photo: SFC)

Appointments

Lt Gen Anil Chait PVSM VM appointed as CISC, IDS

Lieutenant General Anil Chait PVSM VM has taken over as Chief of Integrated Defence Staff to the Chairman Chiefs of Staff Committee (CISC). In his career spanning over 39 years, the General Officer has held various Command, Staff and Instructional appointments. Lieutenant General Chait was associated with the Special Action Group ('Black Cats') of the National Security Guard and was awarded the Vishisht Seva Medal. He has served with an infantry division as Colonel General Staff on the Line of Control during *Operation Parakram*. The General Officer has had staff assignments in the Military Secretary's Branch as a Colonel and the Perspective Planning Directorate as a Brigadier dealing with formulation of National and Military Security Strategy & Policy. He commanded an Armoured Regiment, an Independent Armoured Brigade and an Infantry Division on the Western border.

He has attended the US Army War College where he was awarded the 'Medal of Excellence'. As General Officer Commanding of a Strike Corps, he has been responsible for the study on the restructuring of the Strike Corps, making it into a 'transformational trailblazer' for FORCE-2025. The General Officer has been Commandant of the Army War College and set up a study centre for domain specialisation and transformed the college into "a centre of excellence." Prior to his current appointment, Lt Gen Chait was GOC-in-C Central Command and led from the front during the Rescue Operations in Uttarakhand in June 2013. Earlier, Gen Chait had successfully organised the 4th Edition of the Military World Games.

Air Marshal DS Khajuria SC takes over as Air Officer-in-Charge Maintenance

Air Marshal DS Khajuria SC took over as Air Officer-in-charge Maintenance at Air Headquarters on 1 July 2013. Commissioned in the Aeronautical Engineering (Mechanical) branch on 25 July 1977, he is a graduate engineer in Mechanical Engineering with Post Graduation in Defence Studies. His prior appointments include Director General (Systems) at Air Headquarters, Senior Maintenance Staff Officer, Director of Training at Air Headquarters, Chief Technical Training Officer, Command Engineering Officer, Air Force Examiner at the Aircrew Examination Board and Chief Engineering Officer of an operational unit. He has had the rare distinction of commanding two Base Repair Depots.

Air Marshal Khajuria was posted on a diplomatic assignment as Deputy Air Attaché at the Embassy of India in Moscow. He also represented the Indian Air Force during the Seventh Scientific Expedition to the Antarctica. As a Cat 'A' Flight Engineer he has more than 3000 hrs of flying to his credit. The Air Marshal is recipient of the Shaurya Chakra for "extraordinary act of bravery and courage." As a sportsman he has represented the IAF in Inter-Services Hockey Championships.

Rear Admiral Srinivas Kanugo VSM is first ACNS (Air Material)

The Indian Navy has created a new position, Assistant Chief of Naval Staff (Air Material) to which has been appointed Rear Admiral Srinivas Kanugo as the first Flag Officer at the Integrated Headquarters MoD (Navy) on 17 July 2013.

The post has been created as the single point of responsibility for all matters related to aviation technical management of the burgeoning air arm of the Indian Navy. The ACNS (AM) will be responsible for planning and co-ordination of newly inducted air equipment and systems, repair and overhaul of all existing aircraft, aero engines and associated equipment and systems as well as provisioning of air stores.

The Navy now operates over 200 aircraft with over 20 different types including fighters, fixed wing maritime reconnaissance aircraft, helicopters and UAVs, making the creation of this position an important step in meeting the growing challenges of future maintenance, repair and overhaul, with the Naval air arm on the threshold of a massive increase in numbers and capability.

Commissioned on 1 August 1981, Rear Admiral Kanugo is an air electrical engineer who has held numerous appointments on ships and at air establishments during his 32 years of commissioned service in the Navy. An alumnus of JNTU College of Engineering, in Anantapur, Admiral Kanugo did his Masters degree from Institute of Armament Technology at Pune. He has held numerous prestigious appointments such as Director, Naval Institute of Aeronautical Technology at Kochi; Chief Controller, Naval Aeronautical Quality Assurance Service; Commodore Superintendent, Naval Aircraft Yard (Kochi), Chief Staff Officer (Technical), Headquarters Naval Aviation and Principal Director, Directorate of Naval Air Materiel at IHQ MoD (Navy).

QuEST Global Manufacturing Pvt Ltd and Saab AB in joint venture

QuEST Global Manufacturing Pvt Ltd and Saab AB have inaugurated their new facility dedicated to the manufacture and supply of aerostructure assemblies for the commercial aerospace market. Aerostructures Assemblies India Private Limited ("AAIPL") is a joint venture between QuEST Global Manufacturing and Saab AB with each company holding 74% and 26% stake respectively. AAI currently has 23 employees and will be looking to scale up over the coming months.

Aerostructures Assemblies India Private Limited (AAIPL) is located at Belgaum, in Karnataka, where QuEST Global has developed a fully operational Special Economic Zone, which also houses QuEST Global Manufacturing. The new entity is established with a vision to develop a robust aerospace business with AAIPL focused on build-to-print assemblies for emerging markets and to harness growing defence offset opportunities in the country.

Appointment of seven DRDO Director Generals

The DRDO has appointed seven Director Generals for seven different clusters, including Dr. K. Tamil Mani, Distinguished Scientist who is Director General for Aeronautical Systems (Aero) and Mr SS Sundaram, appointed as Director General - Electronics & Communication Systems (ECS). Both the Director Generals are based in Bangalore. Besides these, Mr S Sundaresh, Chief Controller R&D (PC & SI), is Director General for Armament & Combat Engineering Systems (ACE), Dr. VG Sekaran is Director General for Missiles and Strategic Systems (MSS), Dr. V Bhujanga Rao is Director General, Naval Systems & Materials (NS&M), Dr. KD Nayak is Director General for Micro Electronic Devices & Computational Systems (MED & CoS) and Dr. Manas K Mandal is Director General-Life Sciences (LS).

Dr. K. Tamil Mani

Mr SS Sundaram

Dennis Swanson appointed Boeing Vice President in India

Boeing has appointed Dennis Swanson as vice president for Boeing Defence, Space & Security (BDS) in India. To be based in New Delhi, he will "focus on strengthening relationships with customers, ensuring customer satisfaction and establishing new in-country partnerships". Pratyush Kumar, President of Boeing India said, "We're proud of the enduring relationship our company has forged with India over the past 70 years. Swanson's assignment demonstrates our commitment to a lasting relationship with the Indian government and with the growing number of in-country Boeing partners and suppliers."

Arrow Aircraft is Beechcraft's Sales Distributor in India

On 12 September 2013, Beechcraft Corporation announced the appointment of Arrow Aircraft Sales and Charters Private Limited (Arrow) for promoting Beechcraft range of aircraft in India. Arrow was founded in 2009 and has quickly developed into a significant provider of business aviation services, including sales, charters and operation management. The company serves its customers from its headquarters in New Dehli, as well as offices in Mumbai, Kolkata and Sharjah in the UAE. Immediately planned is a King Air 250 regional demonstrator tour in September. As Sanjeev Choudhary, *Arrow* senior vice president said, "We have showcased this superb aircraft to our customers as we fly it throughout India from 16-23 September. This will really bring to life the capabilities of the King Air and underline why it is well suited to the Indian market."

Super Hercules at Daulat Beg Oldi

On 20 August 2013, the IAF first landed a C-130J Super Hercules of No. 77 Squadron at Daulat Beg Oldi in north eastern Ladakh, the world's highest airstrip. The airstrip, at an altitude of 16,614 feet, was in disuse for several decades until it was reactivated by the IAF in 2008 after a gap of 43 years, with an An-32 landing. The tactical transport aircraft and medium-lift helicopters operating to Daulat Beg Oldi have limited load-carrying capabilities as compared with the C-130J Super Hercules, which can transport up to 20 tonnes of men and material in one sortie which gives the IAF a six-fold increase in deployment capabilities. Only 8 kilometres from the Line of Actual Control with China in this sector, Daulat Beg Oldi is a vital forward base for support of the ground forces in this sector **(*see story in this Issue*).**

Flying Doctors take off in India with Pilatus PC-12

The Pilatus PC-12, one of the most popular turbine-powered aircraft in the market is now being used by Medanta - The Medicity for its air ambulance services launched in June 2013. The Pilatus PC-12 is a "perfect air ambulance aircraft, bringing the finest care to the farthest corners so that anyone who lives works or travels in remote and rural areas can enjoy the best of healthcare" says the company.

Medanta - The Medicity launched its dedicated air ambulance service and is now the first hospital in India to have a hospital-based air ambulance at its disposal. The project is the result of work by Dr. Naresh Trehan, Chairman and Director of the hospital, who wanted to introduce a fully equipped flying intensive care unit to India in order to overcome the combined challenges of distance, time and specialised patient care. A team of medical practitioners, women's health doctors, registered nurses, allied health professionals, pilots and administrators, who aim at providing medical evacuation from the remotest of areas to metro hospitals would be available on-board. The specialised team of 40 doctors from different specialties would be ready to provide on board medical support. The air ambulance is equipped with the state-of-art life saving equipment back up and specialised medical teams of Medanta – The Medicity.

Three Pilatus PC-12 NG aircraft have been customised to function as ICU units on board to give real-time critical care to patients while they are being evacuated to a hospital after a medical emergency, such as a heart attack or multiple bullet wounds.

"Continue the Exceptional Work"

C-17 Globemaster III on the tarmac at Hindan AFS (photo: Angad Singh)

Vayu's exclusive interview with Air Chief Marshal NAK Browne, Chief of Air Staff IAF

VAYU : We recall your very first interview with the *Vayu Aerospace Review* soon after taking over as the CAS in 2011. You had articulated on the IAF's Vision as transforming into one which is "modern, flexible and capable of tackling threats across the entire spectrum of conflict." How satisfied are you on the progress made in such transformation of the IAF during your stewardship of the IAF?

CAS: At the very outset, let me tell you that I am extremely pleased with the progress made by our team in the last two years in so far as IAF's transformation plan is concerned. On 2 September this year, we inducted the C-17 Globemaster III which will add an important strategic dimension to our airlift capability. In addition, we have inducted and operationalised the C-130J Super Hercules, Mi-17 V5 as well as the Pilatus PC-7 Mk.II Basic Trainer Aircraft (BTA). We are also satisfied with the progress of the MMCRA project which is presently in the crucial CNC stage. We are also actively engaged with all stakeholders involved with the LCA and FGFA D&D programmes to ensure their steady progress. I am confident that these new acquisitions along with the ongoing upgrades on Mirage, MiG-29 as well as Il-76 and An-32 will add tremendous

The CAS makes his point

value to our operational capabilities. Another equally important issue for us is our comprehensive infrastructure upgrade plan which focuses on creating modern operational and technical facilities. These are essential to absorb the new capabilities more efficiently.

I am also of the firm belief that our air warriors are the real enablers of this transformation process. I am extremely proud of their professionalcontributions day in and day out. The outstanding performance of these fine men and women during various exercises and particularly during 'Op Rahat' re-affirms my faith that we are capable of reaching greater heights in the future.

VAYU : We are at the beginning of the IAF's long term perspective plan, which extends over 15 years (2012-2027) when obsolescent aircraft, equipment

Mirage 2000H taking off at Gwalior (photo: Angad Singh)

Elta

and weapon systems will be phased out and replaced with modern equivalents. The main focus has naturally been on combat aircraft and weapon systems. In light of the often declared objectives of achieving 40 combat squadron strength by 2027, can you give an indication on the force structure planned and to which extent will these include indigenous types such as the LCA and AMCA?

CAS: As you are aware, the LTPP is a result of an elaborate assessment of capabilities envisaged in order to meet the emerging challenges of the 21st century. By 2027, IAF envisages a total of 39 combat squadrons in its inventory. These would include a mix of the upgraded Mirage 2000, Jaguar and MiG-29 aircraft as well as new acquisitions like the Su-30 MKI, Rafale (MMRCA), FGFA, two squadrons of LCA Mk.I and four squadrons of LCA Mk.II.We are confident that these assets will afford us a potent combat capability enabling us to deliver a rapid response to our future contingencies. As far as the Advanced Medium Combat Aircraft (AMCA) is concerned, the project is still at the conceptual stage and will take some time.

VAYU : Selection of the Rafale was announced in January 2012 and various committees have since been engaged in discussions, without a clear picture emerging as to when this will be completed. Considering urgency of the case, is some 'fast tracking' possible in order to conclude the contract within the financial year 2013-14?

CAS: The scale and complexity of the MMRCA project is unparalleled and therefore, the processes involved are also quite comprehensive.The CNC is examining various aspects of the project and trying to close all issues related to license production of the Rafale aircraft in India. Concurrently, Dassault Aviation as the OEM and HAL as the Lead Production Agency are also putting together a joint contract, which has been finalised between them in July 2013 and that is presently under vetting within HAL.I am confident that all efforts are being made by the CNC to conclude the contract negotiations at the earliest. We are hopeful that we will be able to further process the case for soliciting CCS approval within the current financial year.

VAYU : It has been stated that the first FGFA will be received in India by 2015 for flight testing and trials followed by two more in 2017-18 with series production commencing in 2022. Is this schedule being maintained? Will all FGFAs for the IAF be single-seaters?

CAS: Currently, negotiations are underway for signing the contract for the R&D Phase of the FGFA programme. The timelines for flight testing, trials and series production would be finalised only after the contract for this phase is signed. And yes, all FGFAs contracted for by the IAF would be single-seater aircraft.

Sukhoi T-50 showing advanced design features to good effect (photo: Dmitry Zherdin)

Rafale C seen loaded with guided bombs and SRAAMs

VAYU : Unmanned aerial vehicle (UAVs) are presently being deployed by Indian Armed Forces for reconnaissance and surveillance, while the United States have long utilised armed drones with deadly effect in the Af-Pak theatre. Is the IAF planning use of combat UAVs for similar employment in the near future?

CAS: In my opinion, Remotely Piloted Vehicles (RPAs) have certainly gained prominence by virtue of the unique operational advantages they afford especially in post war counter insurgency scenarios. Yes, we are aware of their operational potential and are also expanding our inventory as we do envisage a larger role for them in the

Textron Bell

Tejas LCA prototype conducting flight display at Aero India 2013 (photo: Angad Singh)

future. The use of RPAs in combat role however, would depend on the future operational requirements of the IAF and hence, the issue needs to be examined accordingly.

VAYU: When releasing the book on '50 years of MiG-21s in India' in April 2013, you announced that the 'type' would continue in front line service with the IAF till 2019, even though the then RRM had (in 2011) said that these would be phased out by 2017. Is this extension an inevitable result of the continuing delays in LCA clearance for service?

CAS: Our transformation plan adopts a three pronged approach which besides inducting new assets and upgrading combat worthy assets also includes exploitation of combat worthy legacy systems. I have alreadydiscussed the new inductions as well as the upcoming upgrades. It is essential that IAF maintains an ever vigilant posture with requisite combat assets, therefore, my foremost priority is to ensure that our combat potential is always sustained. Towards this,the MiG-21 aircraft are planned to be exploited as they have adequate residual service life available. And to address any other apprehensions, let me assure you that every MiG-21 which gets airborne is fully airworthy with sufficient residual flying hours and calendar life left.

Su-30MKI at Aero India 2013 (photo: Angad Singh)

MiG-21M coming in to land (photo: Simon Watson)

VAYU: Concerning the Integrated Air Command and Control System which will network all sensors and platforms to meet the long term objective of operating in a network centric environment, what capability enhancements have been achieved over the past few years?

CAS: The IAF's focus on net centricity for improvedbattle space awareness has ledto the conceptualisation of IACCS. This system is designed to integrate all the sensors with the shooters in a comprehensive command and control system and the system is fully functional.

VAYU: In context of attack helicopters, the Defence Minister has often mooted "perfect" synergy between the Army and Air Force. The Air Force is yet to receive the Apaches; the Army has just formed its first Rudra armed helicopter squadron and expects that all future attack helicopters will be part of Army Aviation. Is there some dichotomy in the above situation?

CAS: IAF is of the firm opinion that helicopters, as is the case with other advanced airborne platforms, are capable

MBDA

File photo of IAI Heron UAV in flight

of undertaking a wide variety of roles and hence, should not be restricted to one particular task. Attack helicopters inducted into IAF are tasked not merely as pure anti-tank platforms but also perform multiple IAF specific tasks which include radar busting, UAV interception, combat SAR etc. The IA has projected the need to have its own attack helicopters and the MoD has given its decision based on a process of detailed deliberations and discussions.

VAYU : The incredible manner in which the IAF responded in wake of the 'Himalayan Tsunami' in Uttarakhand during June 2013 will surely go down in history as amongst its 'finest hours.' We trust that the gallantry and devotion displayed by aircrew will be appropriately recognised!

CAS: As I look back at the events on the night of 16-17 June, I feel proud in the way we responded within few hours of the initial reports and mobilised our rescue and relief operations in Uttarakhand. We had set up eight large scale flying detachments at Jolly-Grant, Gauchar, Pithoragarh, Dharasu, Joshimath, Rampur, Bageshwar and Shimla and in a very short time frame marshalled 45 helicopters of eight different types to operate from all these helipads.

'Op Rahat' went on to become the largest heli-borne humanitarian airlift operation in aviation history. We flew 3544 sorties, air lifting 801 tonnes of relief supplies and 23,905 personnel. Despite losing five of our valiant air warriors on one such important rescue mission, IAF resolved to keep the 'rotors turning' till we pulled out the last survivor. And our brave men and women deployed in these operations strived hard towards executing this mission. The biggest recognition for IAF is the re-affirmation of the nation's faith in our capabilities and commitment and we are grateful to our countrymen for their support.

VAYU : On the vital matter of flying training: with receipt of Pilatus PC-7 Mk.IIs, the long interrupted basic training Phase I is underway but with continued delays in clearing the HJT-36 IJT (for Phase II) even as HJT-16 Kirans are on verge of retirement, can it be envisaged that fledgling pilots spend more time at Phase I and move directly to the Hawk advanced jet trainer thereafter?

Mi-35 at Exercise Iron Fist 2013 (photo: Angad Singh)

Mi-17V5 at Exercise Iron Fist 2013 (photo: Angad Singh)

CAS: Though the IAF remains fully committed to development of an indigenous Intermediate Jet Trainer, the inordinate delay in HAL's IJT project has placed additional strain on the existing fleet of Kirans. We are optimistic that IJT deliveries will start by 2015 with the Initial Operational Clearance expected to be cleared by December 2013. While the Kiran fleet would be utilised till 2017, the number of Kiran Mk.I/IA aircraft would reduce substantially by 2015. Hence, any further delay in IJT induction beyond 2015 would certainly have an adverse affect on our Stage II (F) training.

Boeing

VAYU :In February 2013, IAF showcased its prowess during exercise 'Iron Fist' at Pokhran and followed this up with the extended exercise 'Live Wire'. Can you share with us an overall assessment of these exercises in the scenario of a two-front war?


Mi-26 heavy lift helicopter conducting relief operations during Operation Rahat

CAS: If I were to sum up our performance in both these exercises, I would rate them as "Exceptional". Exercise 'Iron Fist', conducted in February 2013 was to showcase the combat prowess of IAF by fire power demonstration through day, dusk and night in a net centric environment. On the other hand, Exercise 'Livewire' was conducted from 18 March to 4 April 2013 with a two-fold aim. Firstly, to "exercise entire IAF in its ability to undertake effective operations in response to likely future threats and operational contingencies" and secondly, to "exercise IAF's latest acquisitions, in terms of newly operationalised AD elements and weapon systems, effectively and in a network centric environment so as to validate their concept of operations, refine SOPs and understand their strengths as well as limitations for effective exploitation".

We have successfully achieved all the aims and objectives that we had set for these exercises and all observations are being comprehensively addressed.

VAYU : The Chinese Air Force is fast building up into becoming a modern aerospace power. The PLAAF is augmented by China's 2nd Artillery Corps. We assume the IAF has factored in this threat in its contingency planning. Kindly comment.

CAS: The capabilities of both PLAAF and China's 2nd Artillery Corps are well known to us. Each country has its own plans to orchestrate it's military operations in a synergistic manner. Our capability build up is not specific to any adversary but is based on an analysis of the overall capability requirements to tackle challenges to national security in India's area of interest. IAF analyses its threat perception at regular intervals and accordingly updates its plans factoring in all the envisaged threats and contingencies.

VAYU : You are regarded as the inspiration behind the unique approach on the 'Avro 748' replacement programme. Since "rear loading capability" and "pressurization" is part of the specification, will this not preclude a number of otherwise capable aircraft types?

CAS: The Air Staff Qualitative Requirements (ASQRs) have been formulated based on RFI responses and detailed deliberations at Air HQ. We think that these are adequately broad based to ensure a multi-vendor response. Rear loading capability and pressurisation are standard features in any modern medium transport aircraft so this should come as no surprise to anyone. Even the Avro aircraft has pressurisation.


HAL HJT-36 at Aero India 2011


MiG-29B taking off (photo: Simon Watson)

Dassault

HAL-built Avro 748 at Yelahanka AFS (photo: Angad Singh)

VAYU : Statistics reveal that the spiralling costs of fuel are gnawing into the Air Force budget in an alarming manner. A recent report has it that fuel costs alone were over Rs 4000 crores in 2012-13, which is a major drain of the total annual budget. Much of this is to do with 'fuel guzzling' aircraft types with the IAF. Will future procurements consider this critical aspect as intrinsic with 'life cycle costs'?

CAS: The cost of fuel contributes significantly towards the life cycle cost of an aircraft and is relevant especially for aircraft where the operating costs because of fuel are high. It is exactly for this reason that the concept of determining the lowest bidder is made on the basis of the Total Cost of Acquisition (TCA). This model was evolved by the MoD after detailed studies and first introduced in the MMRCA RFP. Thereafter, it was decided by MoD that all aircraft and helicopter cases will be processed on the TCA model. As a matter of fact, the first case based on the LCC concept was the procurement of the Basic Trainer Aircraft (BTA) which has been successfully concluded on the TCA model.

VAYU : Your message please for the air warriors and the nation on eve of the 81st anniversary of the Indian Air Force!

CAS: My message to our air warriors would be to continue doing the exceptional work they have been doing all along as this has helped the IAF make significant progress. As an eighty year old service, we inherit a rich legacy and all our actions therefore, must reflect the pride and ownership in being a part of this great organisation. I am aware of the transformational challenges which we face as also the commendable efforts being put in by all the men and women in the field towards addressing them. Time and again, the IAF has come to the assistance of our countrymen in the hour of need and we need to remain prepared for this sacred responsibility at all times.

My best wishes to all air warriors and their families on occasion of the 81st anniversary.


Air Chief Marshal NAK Browne at Hindan AFS (photo: Angad Singh)

Lockheed Martin

Air Commodore Jasjit Singh on

The Challenge

ADA-designed, HAL-built Tejas Light Combat Aircraft at Aero India 2013 (photo : Angad Singh)

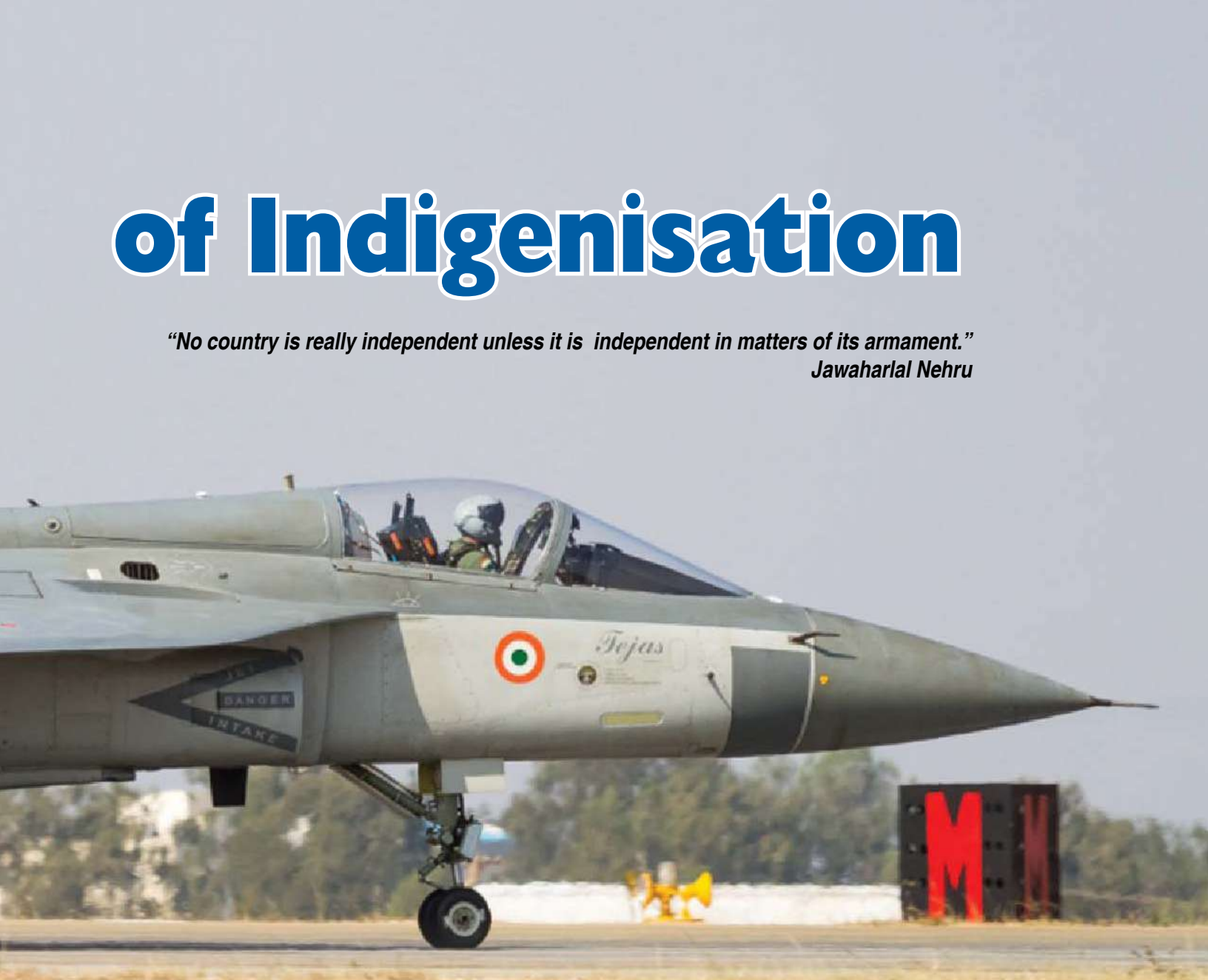
The Case of the Aircraft Industry*

It appears curious and inexplicable to most students of national security and defence that in spite of an aircraft industry that has expanded enormously since 1939 when it was set up, India has been forced to import almost all types of complete aircraft from foreign sources. A small degree of self-reliance was achieved by licensed manufacture of some of the aircraft. But the high-technology systems and components for these also were imported. At one level, this can be explained by the reality that the country was deindustrialised during the two centuries before independence. The Industrial Revolution had started in England three centuries before India's independence. As industrialisation grew and expanded geographically to Europe and North America, muscle power gave way to machine power for economic productivity.

Growth and advances of technology, especially in its military application, as the natural consequence of the industrialisation of England and Europe, also provided significant military advantage over the local and regional regimes and became the source of capability to establish empires in the rest of the world. The colonial powers of Europe did not set up any industry in the countries they ruled, and focussed on military technological

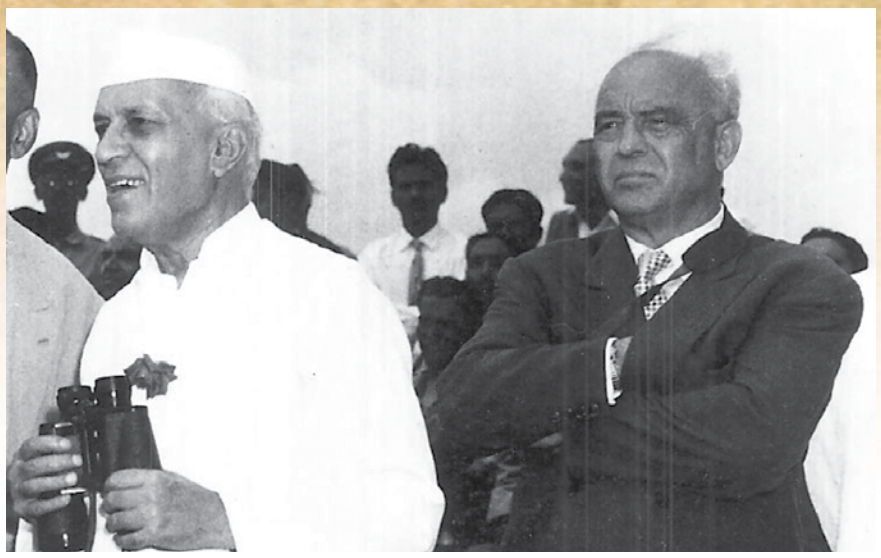
# of Indigenisation

"No country is really independent unless it is independent in matters of its armament."
Jawaharlal Nehru



superiority and further advancement of their own industries with resources and raw materials from the colonised countries. Japan, however, did create numerous industries in Manchuria when it invaded China. China had also grown with massive transfer of military and civil industries, lock, stock and barrel by Stalin's Soviet Union in early 1950.

While some "sunset industries" like textiles had been transferred to India by the British (after British labour costs began to rise), India's industrialisation really began after independence. In fact, there was serious difference of opinions among the leaders of the Indian National Congress which had spearheaded the struggle for independence, on whether India should adopt a village-based cottage industry or try an invest in heavy industries



The inspiration and the muse : Jawaharlal Nehru and Kurt Tank watch the HF-24 in flight in 1961. An ecstatic Nehru exclaimed that the aircraft was like "a gazelle of the air."

After test flight of the HF-24 Mk.IT tandem seating trainer at HAL, Bangalore

like steel, cement and power generation, etc. Perhaps both strategies could have been followed if financial resource and techno-economic aid had been forthcoming. Nehru's vision of modern industrialised India with village-based development appears to have provided the mixed economy which over the years has succeeded in moving the country toward substantive socio-economic development. From our perspective of indigenisation of military weapons, especially aircraft and their peripherals, we have lagged behind perhaps due to the Indian mind emphasising on "cutting edge" technology. But the Indian mind also tends to focus much more on the theoretical rather than the practical application of that theoretical knowledge: for example, there is great emphasis on political science and very little on international relations, etc.

We need to constantly keep in mind the reality of the centuries of deindustrialisation which had the country way behind the developed countries and even behind China, which got significant infusion of industrialisation. Hence, India has had to condense into decades, its industrial technological revolution, which the developed world achieved in centuries with the added' benefit of resources from the colonised countries. Contrary to conventional wisdom, India did/does not possess any significant natural resources. Its only asset for two centuries has been its human resource which was fully exploited by the British in areas ranging from transportation of labour to work in plantations as far as the Caribbean, Fiji, South Africa, Kenya, Myanmar (then Burma), Malaya, etc., though the greatest exploitation was of Indian soldiers in the Imperial Wars. The raw materials produced by the country like cotton, iron ore, etc., were exported to run textile mills in England. Hence, we need to judge our ability/inability to achieve self-reliance in armaments keeping in view the handicaps that our history placed on us in the past when the developed industrial countries enjoyed the benefit of unlimited access to resources.

It is also true that HAL (now Hindustan Aeronautics Limited) has manufactured many hundreds of combat aircraft, and overhauled thousands of aero-engines for combat and transport aircraft. But, more important, after independence, it started on the ideal vector which would rely on three parallel processes: (i) indigenous design and development even if it required collaboration with foreign expertise; (ii) licensed production of weapons and equipment in the country, presumably including every sub-system and component down to the nuts and bolts; (iii) direct import of urgent and high-technology aircraft and systems to meet operational requirements, with licensed manufacture to complete the full complement of aircraft required. When looked at closely, the last process mostly has become another aspect of the second process, that is licensed assembly and production for an aircraft/system designed abroad in which HAL was not, and could not have been, a party. When the government proudly announced, every time a contract was signed, that this would be accompanied with TOT (Transfer of Technology), what it really meant was that production technology would be available.

The all-Indian HF-24 Mk.IT could well have admirably served as a lead in fighter trainer during the decades that the IAF was yearning for an advanced jet trainer.

HAL-built Avro (HS) 748 medium transport aircraft, now sought to be replaced by a modern type, and one which the IAF would like built by a JV between an international OEM and Indian private sector partner. (photo : Angad Singh)

HAL-built Dornier 228 light transport aircraft which is used by the IAF for logistic air support, air staff transportation and multi-engine conversion training. The Indian Navy and Coast Guard operate large numbers of the Do 228 for maritime reconnaissance, coastal patrol and information warfare tasks. (photo : Angad Singh)

Designed & developed by HAL with technology support from the erstwhile MBB of Germany, the Dhruv advanced light helicopter (ALH) is now in series production and serving with the Indian Army, Air Force, Navy and Coast Guard.(photo : Army Aviation)

The official terminology in the Ministry of Defence was a choice between "buy" and "make," the former without any licensed manufacture and the latter, including manufacture under licence. A typical example is that HAL manufactured around 600 MiG-21 variants. But when

The Chinese, of course, do things differently. For example, they purchased the Sukhoi Su-27 air superiority fighter from Russia in early 1990 under a contract that specified 24 aircraft outright imported and the balance to be assembled and manufactured in China. It acquired the

HAL-built MiG-21bis in afterburner takeoff. In this eminently successful and long term relationship with the Russian (nee Soviet) aviation industry, nearly 600 MiG-21 variants were built by HAL between 1966 and 1987.

125 MiG-21bis aircraft were subject of major upgradation to 'Bison' standards.

HAL designed the "combat flaps" to enhance the air combat capability of the aircraft, it could not introduce that in the fleet. Similarly, when it was finally decided to upgrade the MiG-21, the Russians had to be involved in the process and paid for their labour though they were not really needed.

Su-30MK after that on similar terms and realised that the platform was the same as that of the two-seat Su-27 trainer. It copied most of the systems of the Su-30 and cancelled the Su-27 contract and began to manufacture it modified to the Su-30 standard, and called it the J-11. The Russians were livid; but they needed the hard currency and exports to China, especially of the high-powered jet engines which China (like India) is unable to produce indigenously.

Looking back at the triple process of building indigenous capacity while meeting the operational demands of the Indian Air Force (IAF), the third process, viz., outright buy, especially high-technology aircraft and systems, has continued. The second process of relying on licensed production actually received a boost after the Sino-Indian War of 1962 when the IAF was authorised to expand from 25 squadrons to 64 squadrons. The Soviet Union did not demand hard currency payments which it would have been unable to spend given the complete ban by the West on economic and trade relations with it. For an India perennially short of hard currency, trade with the Soviet Union on rupee payment appeared as a boon in spite of the rupee-rouble exchange being pegged on a basket of Western currencies, thus, significantly costlier to India than its face value. But Soviet aircraft and systems rapidly increased in technological quality and served the IAF's (and the other two armed forces') operational purposes.

Moscow soon began to offer even long-term credit at very low interest rates to ensure that the rupees it earned in this trade would sustain for a long time to enable it to use them to purchase consumer items like medicines, rice, tea, hosiery, textiles, etc. from India. HAL set up additional plants for the licensed manufacture of Soviet designed aircraft (at Nasik in Maharashtra) and engines (at Koraput in Orissa) at two opposite ends of the country. Incidentally, Koraput is not even connected by rail (or an airfield anywhere close by) and all engines manufactured and overhauled at this factory had to be moved on hired trucks thousands of kilometres away from Nasik IAF air bases across the country. This inevitably led to increased costs and inefficiency, with an impact also on aircraft serviceability in the operational squadrons. The direct negative result of this process was that licensed manufacture of Soviet aircraft and arms became the dominant part of the three parallel processes we identified above. Above all, successive governments became complacent.

HAL is currently producing the Sukhoi Su-30MKI at its Nasik facility, with its AL-31FP engines being assembled at Koraput. Some 270 numbers of this 'air dominance' fighter will serve with IAF for the next three decades, including those imported as fly aways.

There is no doubt that the efforts to diversify the sources of supply had become a way to achieving a lower level of self-reliance since it reduced the dependence on anyone country. But in the ultimate analysis, this had long ago settled down to two-odd countries: the Soviet Union and two European manufacturers (the UK and France) of aircraft and associated weapons and equipment. On the other hand, piecemeal acquisitions (like that of the Jaguar) only led to cost escalations and we denied ourselves economies of scale. But none of them was converted into joint ventures and nor was design data transfer part of the licensed manufacture contracts. So we could not even modify the aircraft we were manufacturing in the country.

The major casualty of this complacency was the first of the three processes identified above: indigenous design and development. It is pretty obvious that indigenous design and development is the foundation on which overall indigenisation for self-reliance can be built. The other two processes could at best serve as an interim step till a country reached self-reliance in design and development capability. Hence, India's march toward indigenisation is at best a one-legged effort and it will be a very long time before Indian pilots would be able to fly a modern Indian designed combat aircraft. I recognise that many people would angrily question the above conclusions at the very start of this study. I can hear loud noises about the Light Combat Aircraft (LCA). But this actually proves the central point being made.

The LCA was conceived in 1979-80 as an incremental approach to design and development of a low cost fighter for battlefield support to the land forces to replace the MiG-21 beginning 1985-86 and building 450 aircraft as the "workhorse of the IAF" as Mr Arun Singh, the Minister of State (MoS), Defence, used to say. Three key deficits of the otherwise excellent MiG-21 (which shot down two F-104 Starftghters of the Pakistan Air Force in the 1971 War in low-level air combat) were sought to be removed in the process of designing the new aircraft. The first, repositioning of the air intake (no longer required to be so critically managed as that in the MiG-21 which was to operate at Mach-2 at 22-km altitude) to the side intakes to hopefully make the aircraft less susceptible to bird strikes which accounted for total loss of the aircraft in nearly a quarter of our flying accidents. The second was to install a better modern air interception radar with a head-up display in the nose now freed from the imperatives of the nose intake. Third, there would be space for a cockpit air-conditioning system as compared to the existing MiG-21 which instead has a cockpit heating system needed above 14/20km altitude. The bulk of our flying was being done at low level and the Air Force was expected to engage the enemy in air combat at very low altitudes and penetrate hostile air space at tree-top level. The MiG-21 cockpit temperatures in the north Indian summer would normally reach over 70 degrees Celsius within two minutes after take-off. Pilots would, on an average, lose as much as 3.5 kg weight in a 40-minutes low-level sortie (I proved it once in 1975) !

Third, the MiG-21 then was flying with 475 kg of ballast weight split into small pieces in most of the front fuselage to maintain the critical centre of gravity of a partially unstable aircraft design. The aircraft had a limited range and payload (like most Soviet aircraft of the 3rd generation in keeping with their defensive orientation) and their low cost allowed large numbers to be deployed defensively.

Hence, the penetration range of the aircraft in a ground attack role, or its time for air combat was limited. Utilising 475 kg for internal fuel would have dramatically enhanced its range as compared to the MiG-21.

Unfortunately, the decade of the 1980s was spent on one side in hyping the standard of preparation and Air Staff Requirements (ASR) to make it the dream of a fighter pilot! But someone forgot to increase the weight to accommodate everything that would make it a 21st century combat aircraft at par with the best in the world. On the other side, a vicious tussle raged as to who would head the new national project in or outside HAL? Ultimately, the proverbial Indian compromise was adopted and an ad-hoc organisation (more of it later) called the Aeronautics Development Agency (ADA) was set up as a registered society (to make financial management easier) but under the Defence Research and Development Organisation (DRDO) by milking HAL of designers and engineers. The critical point is that three decades after the design of the first and so far the only HAL designed multi-role combat aircraft, the HF-24 Marut, was commenced, the LCA finally started to move ahead with design feasibility that the IAF had major difficulties with. During those three decades, aviation technology had advanced exponentially and our early designers who formed part of the HF-24 design team, led by a German group under Dr. Kurt Tank, had retired. In the absence of institutional memory, the mistakes committed during the HF-24 were repeated in the LCA. In short, in 2013, the LCA has yet to reach its Initial Operational Capability (IOC) although the IAF has placed orders for 40 aircraft to demonstrate its commitment to the programme. And with a new engine, the GE 414, the aircraft would have to undergo significantly extensive development processes.

What lessons can be drawn from the above sketch? Some of the ones relevant to our present study can be briefly outlined as follows:

- Design and development form the critical foundation of indigenisation and self-reliance.
- The Design Division of HAL set up after independence has been emasculated over the decades. So much so, that the country is importing a basic trainer for *ab-initio* training from abroad after a lapse of four years.
- The final marginalisation of HAL's design and development capability was achieved by establishing the ADA under DRDO management, increasing the stakeholders and decision-authorities in the government and sidelining the IAF.
- The combat force level of the IAF is facing an unplanned 24 percent drop. It has happened when both our potential adversaries have pursued a massive modemisation of their air forces.
- What was true at the time of independence is true today. The Indian Air Force is the primary stakeholder in the aircraft and systems that it acquires and employs in defence of the country and its air warriors keep ready for the worst in peace and war.
- The Indian Air Force is expected to increase its force level to 42 combat squadrons by 2022 and possibly 49 squadrons by 2030 or so.

Pair of HAL HJT-16 Kiran Mk.IIs of the IAF's Surya Kiran formation aerobatic team at Aero India 2011.


HAL-assembled BAE Systems Hawk Mk.132 advanced jet trainer. (photo : Angad Singh)

If this is so, should not the IAF play greater role in the critical area in the processes of design, development and acquisition of the tools with which it has to function even at short notice perhaps against immense odds and yet win the wars of the nations? If the answer is yes, then the question is, how can that be achieved within the norms and parameters of Indian democracy?

Indian Navy Model The most simple and efficiently workable approach to indigenise design and development up to, and partly including, the manufacture of aircraft and weapons systems besides their integration with the platforms is to adopt the model that the Indian Navy has followed since independence. It needs understanding that this policy was inherited from the British since the Admiralty had directly controlled warship design and construction to meet their operational requirements over the centuries. Hence, the Naval HQ now has a Directorate of Naval Design under the Chief of Naval Staff (CNS) and also the Controller of Warship Construction which allows it

to direct the construction also. Most of the dockyards constructing and refitting warships are headed by naval officers. The third element is the WESEE (Weapons and Electronic System Engineering Establishment) notionally under the Ministry of Defence though managed under the Chief of Materiel in Naval HQ in close cooperation with the Scientific Adviser to the Defence Minister. It has highly qualified technical experts from the Navy and the scientific community on its strength. The Indian Navy's advanced capabilities in information warfare, cyber capabilities and warfare, etc. are all due to the enormous design and development work being carried out in WESEE. One possible reason for its success is that the electrical and electronic branch officers have very few vacancies at the top ranks; and WESEE provides professional challenges and satisfaction, besides the potential for employment in the corporate sector in later years. The IAF used to rely on a similar institution called the Directorate of Technical Development and Production (DTD&P). Two dedicated DRDO laboratories work in close cooperation with the Indian Navy beside a large number of qualified naval officers being assigned to a number of DRDO laboratories.

The key factor that emerges from a closer study of Indian naval warship design and construction strategy is that its four components outlined above function in deep harmony. The Ministry of Defence has been providing it full support for the past six decades. The success of the Indian Navy in indigenous design and development has been well recognised. The INS *Delhi,* a 7,000-odd ton destroyer which many in the international community interpreted to be a cruiser, was an instant success, when it was launched in 1997, and other *Delhi*-class ships have, if anything, surpassed its performance and capability. Many of the critical systems like guided missiles are still imported and integrated into Indian naval warships. It may be recalled that the Defence Minister, Shri A.K. Anthony had stated a couple of years ago that the Indian Navy from now on will not be importing any warships. The Chief of Naval Staff had recently stated that out of 44 warships under construction, 22 are being constructed in India. This indeed is a remarkable achievement, unparalleled by any other component of armed forces in India.

It is an example worth emulating by the IAF if it has to push for indigenisation of its aircraft and their support services without having to pay the price of depleted combat force levels and/or poor serviceability and sustainability of its aircraft due to poor product and spares support of even imported aircraft and those manufactured under licence. And the Ministry of Defence should support such a redirection. It needs to be clarified that the British relied totally on their private industry to design and develop aircraft of all varieties. At the government level, it was the Ministry of Supplies that dealt with the industry and placed orders on the industry on behalf of the Royal Air Force, with the UK Defence Ministry acting as the key organisation which also included the top hierarchy of the Air Force, what with a Minister of State heading the branch. When India became independent, the Ministry of Supplies was the agency to approve demands and approve acquisition.

But the Industrial Resolution of 1957 brought all defence activities and aircraft acquisitions under the Ministry of Defence which also separated itself from the Air Force leadership once the IAF and other armed forces became subordinate Services. But this also created a lacuna in that transport aircraft, airliners and general aviation remained in a limbo. In due course, the airliners were brought under the Civil Aviation Ministry, and military transport aircraft under the responsibility of Ministry of Defence in keeping with the Industrial Policy resolution. General aviation has remained in a limbo even now. The extensive review of the higher defence organisation triggered by the Kargil War provided only a weak, partial solution by changing the nomenclature without any reforms or reorganisation as such in terms-of creating an integrated Ministry of Defence. But that is a vast and different issue that need not be dealt with here although the organisation of the defence establishment and the place of the IAF in it are crucial issues that affect indigenisation.

HAL-designed HJT-36 intermediate jet trainer which is to supplant the Kiran in IAF service.

The IAF's fleet of MiG-29s is being upgraded to the UPG standard, the first 6 aircraft in Russia and the balance by the IAF at its base repair depot (BRD) at Nasik.

HAL-built Jaguar Maritime which are being upgraded to Darin III standards.

Design and Development Integral to IAF

The second option would be a variation of the Indian Navy's example to suit existing realities and the IAF's specific needs. Air Chief Mshl P.C. Lal had reorganised the Air Headquarters (HQ) in January after he took over as Chief of the Air Staff. If pursued as the directorate responsible for new projects, it had the organisational potential to become equal to the Naval HQ's Directorate of Naval Design. In essence, it separated many distinctly different issues under separate directorates. For example, -instead of the all-embracing Policy and Plans Directorate, he separated administrative plans from aircraft and weapons acquisition plans. What is of interest to our present study is that a Directorate of Projects was created under the Deputy Chief of the Air Staff. As the name suggests, this was to become the embryo for managing projects for the Air Force. Alongwith it, the Directorates of Systems Analyses to improve decision making, and of Air Staff Publications to produce the requisite literature were also established. The close coordination of the Directorate of Projects with the Directorate of Technical Development and Production (DTD&P), and the Scientific Adviser to the Chief of the Air Staff would have been the natural way forward. Unfortunately, this did not happen. So

Production of the Tejas LCA at HAL's Bangalore Complex has been protracted and is subject of major reviews by the Ministry of Defence.

much so, that when the Air Force decided to integrate and create a new weapons aiming and navigation system of the newly acquired Jaguar in 1979, the task was undertaken by an ad-hoc group of IAF personnel (with a test pilot as the key person) who created the Darin system that made the IAF Jaguars far superior to the British and French aircraft. The process is now producing the Darin III, the third development in the series.

Similarly, Air HQ has taken the initiative to indigenise as many line items as possible for the MiG-29 and the process is proving to be enormously successful. Our purpose in identifying these efforts and earlier organisations is to highlight the need and potential of establishing design and development of aircraft as an IAF responsibility with adequate interface with HAL management. Incidentally the old system of appointing Air Force officers as Chairman and General Managers is hardly conducive to the larger issue of indigenisation as the history of the past six decades shows.

As noted earlier, the ADA was established in the mid-1980s as an ad-hoc ad interim organisation with a specific task to design and develop the LCA with manpower seconded from HAL but with the organisation delinked from HAL as an independent registered society. Rationally, its original task has been long finished though the weakness in design (like the airframe being much heavier than the design stipulation) has not led to its performance meeting the ASR against which the LCA was finally approved for design and development. Since it was done under the initiative of the DRDO, the head of DRDO continues to be the Chairman of the society and, thus, the head of the ADA. DRDO designed the aircraft, but had to go to HAL for producing the product. In spite of excellent cooperation between the ADA (read DRDO) and HAL, there have been serious problems in productionising the design. Historically (and I can cite many examples), this was to be expected and logically ADA should have been merged with the HAL design bureau once the technology demonstrator was ready.

In fact, ADA failed to even start a follow-on design project in the early 1990s which could have begun to mature by now. I had argued in favour of doing so at the LCA progress review attended by the then Defence Minister, Shri Sharad Pawar, in late 1991. This may be fairly accurately ascribed to its one-shot task and goal of designing the LCA and it had no stake in becoming the design and development hub for all or at least some of the IAF aircraft needs. Nor did DRDO, the controlling authority of the ADA, appear to have looked at it from that perspective. It had made progress in many areas of design and development of aircraft; and a great deal of the research work had been outsourced to nearly 300 academic institutions. There is no reason why it could not have undertaken at least the design and development of a primary trainer which, it was clear at that time, the IAF would require badly after the HPT-32 had been in service for around 15 years.

The best course in the interest of the country even at this stage is to bring the ADA under the Air HQ as its design and development capability. DRDO can then concentrate on strategic systems like long-range highly accurate ballistic missiles (hence, usable with conventional warheads), manoeuvrable reentry warhead/vehicle (which has been operationalised by the US, Russia and China already), and Ballistic Missile Defence (BMO) (especially with boost-phase interception), which may have a long gestation period, and withdraw from areas like design of an odd aircraft. In order to optimise the output of the ADA, probably on Air Marshal at the top (possibly a second Deputy Chief of the Air Staff) may have to be nominated for this role; and this, in the era of the A.V. Singh Committee implementation when the Air Force is looking for suitable jobs for the authorised strength of Air Marshals would serve the dual purpose of taking on key tasks within the existing force level. There are many highly capable technical officers and test pilots in service who could usefully take on the responsibilities of managing the ADA. The other alternatives would be substantive expansion of the ADA to undertake all design and development tasks in the aviation sector or at least take on the responsibility for future IAF needs rather than continuing the ad-hoc programmes. In addition, some coordinating mechanism has to be evolved between the ADA and HAL so that design-to-production synergy can be built up. In conclusion, one can assert that the best course of action is to follow the known experience of the Indian Navy and bring the ADA under the IAF to form the critical design and development agency for future aircraft and systems. If, for some reasons, the ADA cannot be brought under the IAF which is the primary stakeholder for military aircraft, then logically, the ADA could be merged with HAL. Leaving the ADA as an interim ad-hoc institution for decades in such a critical area would be a gross mistake.

Research and Development

Two issues demand serious attention. The first is that a Research and Development (R&D) laboratory is required to be established in the Air Force to undertake a variety of tasks like new weapons and system integration, etc. It is worth noting that the US Air Force (USAF) has a number of its own laboratories for R&D for new capabilities in the aerospace domain. And they compete with each

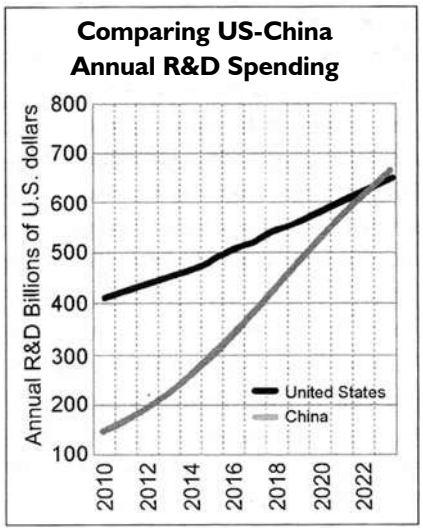
Share of Global R & D Spending			
	2010	2011	2012
US	32.80%	32.0%	31.1%
Asia	34.3%	35.5%	36.7%
Japan	11.8%	11.4%	11.2%
China	12.0%	13.1%	14.2%
India	2.6%	2.8%	2.9%
Europe	24.8%	24.5%	24.1%
Rest of the World	3.0%	3.1%	3.2%

Source : "2012 Global R&D Funding Forecast", Battelle R&D Magazine, December 2011.

other to ensure that the USAF remains the world leader in aerospace technology. One has only to look at their programmes to understand how and why the US is far ahead of even highly industrialised Western countries, and the USAF remains the preeminent air force in the world.

Aircraft design and development is deeply linked to the R&D expenditure in the aerospace sector specifically and national R&D investment in general. Hence, looking beyond the aircraft industry and design and development issues in enhancing indigenisation, the second major issue that deserves attention is that Indian expenditure on R&D is pathetically low for a country that is already at the cusp of being a major power. Over the past three decades, the total R&D as a percentage of national Gross Domestic Product (GDP) has not exceeded 0.8 percent; and out of this, nearly 0.7 percent is spent in the government agencies like DRDO and Department of Science of Technology in its laboratories. There is a serious risk if we do not take remedial measures; industrial production, already on the decline, may further go down in the coming years and the great Indian dream may come to nought. In that case, there could be serious domestic violence adding to the problems of economic growth.

According to *Battelle R&D Magazine,* global R&D spending was expected to grow by about 5.2 percent to more than $1.4 trillion in 2012. Most of the global funding growth is being driven by the Asian countries, which were expected to increase nearly 9 percent in 2012. The share of global spending on R&D explains clearly how some countries like Japan and China have advanced so much (see Table 1 for details). While the US, spending almost a third of the global R&D expenditure, is obvious as the largest spender, this also has to be seen in the context of the United States' economy and, more important, the advances in technology that have been funded for over a century. At the same time, the major driving force for US R&D funding at such high levels is that the country clearly wants to stay ahead in technology compared to any other country though some day, another country may close the technological gap. But only a large country like China may be a real challenge some day as a peer.



As may be seen from Table 1, India is one of the very low spenders on R&D. China has been spending an average of 13 percent of the global expenditure on R&D and the results are clear in terms of the technological advances supporting economic growth in an interactive process. China spends nearly 13 percent of the global R&D expenditure whereas India accounts for a mere 2.8 percent or so, during the three years under review in spite of the fact that its average annual GDP growth for the first decade of this century was in the order of 8.4 percent! This may well be the reason why the industrial growth (as a percentage of GDP) has been slowing down in recent years since it obviously depends heavily upon licensed production (as in the case of the aircraft industry) rather than innovation through research and development even if it is only a case of reverse engineering, like China does in many cases. At the rate China is investing in R&D (besides US offshore R&D operations in China), it is likely to surpass US R&D spending by 2023 (See Fig 1).

Note: China's double digit growth in R&D spending is expected to match and surpass that of the US by about 2023, if several forecasting criteria are maintained. This forecast is based on Chinese R&D continuing at an average 11.5 percent per year and US R&D growth averaging about 4.0 percent per year for the next 13 years. Present US R&D annual growth is only about 2.1 percent but has been more than 6 percent over the past six years. China's R&D growth over the past 15 years has consistently exceeded 10 percent.

What is perhaps more relevant is that China's rate of growth of R&D spending has far exceeded its national GDP growth rates over the past two decades or so. In 2011, China's Ministry of Finance had announced its allocation of$125 million to promote the application of China's R&D results into the commercial sector with the aim of accelerating the transfer of science and technology achievements into production and promoting corporate technology innovation-steps crucial to competitive industrial production growth. Secondly, unlike India, where nearly 0.6 percent of the GDP on R&D is from government funding, and the balance amounting to only 0.2 percent of the GDP is spent by the business/private sector, in China's case, the reverse is the norm, the general impression of state run institutions being the norm notwithstanding.

The post-1991 growth in India's economy has been remarkable and averages around 8.4 percent for the first decade of the new century. The service sector has shown the highest growth rate among the three segments of industrial production, agriculture and service sector. With the economic meltdown since 2008, it was inevitable that Indian economic growth would also slow down although it has remained one of the two major countries (China and India) with a fairly high economic growth. Even industrial growth has been fairly high. This is no doubt due to Foreign Direct Investment (FDI) which has brought with it the knowledge and means of industrial *production* and not necessarily any meaningful investments in R&D for future growth in India. A RAND study had looked at the composition of national gross expenditure on R&D in different countries over a period of ten years average from 1995 to 2005 (see Table 2). The expenditure has also been depicted in sectorwise distribution.

What strikes one is that India is the only country among those examined where the industry's contribution to R&D is significantly lower than that of the government. Obviously, the reforms have not touched the core activity for future industrialisation and stares at the reader as the weakness in the industrial revolution that India must pursue if it has to sustain its growth rate over the coming decades. It is regrettable that the industry's

contribution and investment on R&D has remained poor.

Such low investment in national R&D by the industrial sector runs contrary to the expectation that the private sector should/would get involved in the aerospace industry. The government needs to look into this fundamental lopsided weakness.

As may be seen, in the United States, which stands as a model of technology driven economic development, the private industry's investment in national R&D is over six times that by the government. In India, a handful of industries like the pharmaceutical industry have invested substantially in R&D after 2000 and their growth has been remarkable as a consequence of this approach. It appears that the early successes of some of the government initiatives in nurturing new biotech companies are responsible for this change in the scenario. But, this has not happened in the other sectors. This stands as a powerful reason for the IAF to get involved in R&D in the aerospace sector like the US Air Force relying on a number of laboratories under it often in competitive programmes between the laboratories such as the hyper velocity vehicles for the future as part of the USAF programme of Prompt Global Strike [as distinct from the Defence Advanced Research Projects Agency (DARPA) which undertakes R&D for the Department of Defence].

In conclusion, one has to reemphasise that design and development is the critical foundation of the aircraft industry and, hence, every step taken toward self-reliance through indigenisation must give it the greatest emphasis. This is where India has been remiss. The Indian Air Force has the greatest and most crucial stake in this process and possesses the capabilities to undertake the tasks with minimal reorientation. The ADA should be brought under Air HQ to begin moving toward the Indian Navy model of design, development and manufacture. This model has proved its value over six decades and

National Gross Expenditure in R&D (GERD) (Average from 1995 to 2005 as a percentage of GDP				
	USA	CHINA	INDIA	
GERD	2.6	1.0	0.8	Gross Expenditure in R&D
GOVERD	0.3	0.3	0.6	Government Expenditure in R&D
BERD	1.9	0.6	0.2	Business Expenditure in R&D
OTHERS	0.4	0.1	0.0	

Source : RAND Report, *China and India, 2025 (Santa Monica : RAND, 2011)*

INS Satpura (lead), is one of the Navy's Shivalik-class stealth frigates designed by the Directorate of Naval Design and built by Mazagaon Dockyards.

The Indigenous Aircraft Carrier-1 to be commissioned as INS Vikrant, was launched at Cochin on 12 August 2013.

now stands at the cusp of self reliance in meeting the future needs of the Indian Navy, even designing and building India's first aircraft carrier at the Cochin Shipyard. The nuclear submarine, no doubt, took quite some time as should have been expected; but the sea trials of the INS *Arihant* are scheduled in the near future. The earlier the government agrees to transfer the ADA to the IAF, the earlier we would put our aircraft industry on a sound footing for the future and move away from ad-hoc experimentation which had led us into the present cul de sac.

The second aspect of design and development is that designers are unique in their education but more so in their conceptual abilities. Hence, they deserve to be handled and utilised differently. The Soviet Union, in fact, went all out to do so: its aircraft were known by the names of their designers and the designers occupied the place of the head of the aircraft manufacturing facilities of that enterprise. We have tended to marginalise not only design and development but also our designers. Scientists from institutions like the National Aerospace Laboratories (NAL) in India would perhaps be the best heads of the Design Division of HAL or even as Chairman, HAL. Curiously, Dr. Valluri, who headed NAL and Raj Mahendra who for a long time had headed HAL's design bureau Dr. Valluri and who was keen to involve, were finally sidelined when the ADA was established; and so was (later) Air Mshl P Ramachandran, an outstanding test pilot, operational fighter pilot and one of the finest officers that the IAF had, who was the key person in developing the Darin weapon aiming and navigation system for the Jaguar in the early 1980s. Personalities matter when national programmes are to be carried out. But we made another mistake: waiting for the LCA and not seeking an alternate operational aircraft for the IAF which simply led to unplanned decline of the combat force level, seriously jeopardising national security.

Looking ahead, the offsets clause offers a unique opportunity to find foreign investments as well as the relevant technology from the prime manufacturers, provided we handle it correctly. The first issue is that offsets must not be seen as a source of FDI only. They must be viewed as the route to enhance the technological capacity of the country and, hence, expedite the ongoing industrial revolution. Second, all the aircraft and syste91s that we have bought or are likely to buy (which are not joint ventures) have already been designed. Hence, little design technologies can be accessed as such. But all such aircraft have a life of 30-40 years during which they will require technological upgrades almost every decade.

The offsets should be geared to undertake such tasks and, hence, enable design and development in R&D establishments, preferably in the private sector, with collaboration with the prime manufacturer which should employ increasing numbers of Indian scientists and designers to work on the system engineering and upgrades. This process should create the requisite design and development capabilities in India in less than one generation besides supporting the larger national techno-economic base. It may look impossible but the steps like those of the Chinese Finance Ministry referred to above should become the norm. Above all, we need to enhance the investment in national R&D efforts, especially in the private sector, facilitated by the government but not directed by it.

✻ *This is lead chapter in the book* ***'Indian Air Force : The Case for Indigenisation',*** *published in 2013 by the Centre for Air Power Studies, New Delhi, edited by Air Commodore Jasjit Singh, AVSM, VrC, VM*

The Eagle at Rest

In salutation to Air Commodore Jasjit Singh, India's Warrior-Scholar

Air Commodore Jasjit Singh was so many things to so many people. In the late 1970s, he inspired the metamorphosis of *Vayuyan* into evolving as the *Vayu Aerospace Review* and remained a distinguished member of its Editorial panel till his sad passing away on 4 August 2013 after a brief illness.

But work remained his passion : Jasjit was simultaneously working on multiple programmes including those with the *Society for Aerospace Studies*, writing the lead article for *Vayu*'s special Indian Air Force Issue, preparing for the Seminar 'Endgame Afghanistan 2014' in late September 2013 and finalising topics and speakers for the annual Seminar on 'Energising India's Aerospace Industry' in mid-October 2013. All this over and above, of course, his onerous responsibility as Director General *Centre for Air Power Studies* which he founded in 2001 and which, under his dynamic leadership, soon became India's leading strategic institution, focusing not only on the evolving role and transformation of the Indian Air Force and India's aerospace industry but also on the broad band spectrum of national security issues.

Jasjit Singh was commissioned into the Indian Air Force on 1 April 1956 [Service No.5100 F(P)], was a fighter pilot who flew offensive air support missions in Mystere IVAs with No.3 Squadron during the December 1971 war and was awarded the *Vir Chakra* for gallantry (his elder brother Charanjit Singh and brother-in-law Major General Ram Singh were also decorated for gallantry, making them the most decorated family in the country).

Jasjit Singh thereafter commanded No.17 Squadron with MiG-21Ms and later served as Director Operations at Air Headquarters. In the early' 80s, he was seconded to the *Institute for Defence Studies and Analyses* (IDSA) then at Sapru House under the redoubtable K Subrahmanyam from whom he took over as Director in 1987. The rest is history.

Pilot Officer Jasjit Singh receiving the Sword of Honour from Air Commodore Arjan Singh

The family with most gallantry awards in India seen with General (later Field Marshal) Sam Maneckshaw after the 1971 war. Left to right are Major General Ram Singh, who received the PVSM for his command of 'Foxtrot' Sector (later 16 Infantry Division), Wg Cdr Charanjit Singh, who carried out numerous strategic reconnaissance missions in Canberra PR 57s with No.106 Squadrons and Sqn Ldr Jasjit Singh who flew numerous ground attack missions on Mystere IVAs with No. 3 Squadron

Jasjit Singh was Director IDSA for a record 14 years, till 2001. He thereafter founded the Centre for Air Power Studies (CAPS).

As articulated by Commodore C Uday Bhaskar (who was Deputy Director IDSA from 1996-2004), *Jasjit Singh led the IDSA and nurtured a large number of researchers and analysts who now constitute the Indian strategic and security studies community. During his IDSA tenure, Jasjit Singh made a major contribution to Indian thinking apropos the nuclear issue, modernisation of the military, reviewing the defence budget, air power and naval issues, internal security challenges, the end of the Cold War, and more. A prolific writer, his articles and books, singly authored and edited, are numerous.*

The IDSA, under K. Subrahmanyam and Jasjit Singh, made a significant contribution to the shaping of India's nuclear discourse at a time when the country was ostracised and under severe international sanctions. The Sapru House, where the IDSA became then located, was the venue of intense deliberations and analysis; academics and media personnel were regular visitors.

The US-led war for Kuwait in early 1991 saw Jasjit meticulously following the military operations and providing some of the most rigorous battlefield analyses derived from visual imagery — a first for Indian print-media. India's nuclear tests of May 1998 and the Kargil War of 1999 again had Jasjit Singh publishing two definitive edited volumes in a relatively short period — and they still remain the more authoritative books on the subjects.

Post the IDSA tenure, Jasjit was editorial advisor for defence and strategic affairs for The Indian Express, and then moved on to found the Centre for Air Power Studies (CAPS) in 2001, which was the first of the three service think-tanks [the other two being the Centre for Land Warfare Studies (CLAWS) and the National Maritime Foundation (NMF)]. Under Jasjit Singh's rigorous stewardship, CAPS notched up an enviable track-record and has published almost 70 volumes/monographs in the last decade, of which a third have been either authored or edited by Air Commodore Singh. One of the books he laboured over was the biography of the Marshal of the Indian Air Force, Arjan Singh, 'The Icon' (many images and paintings were contributed by Pushpindar Singh of The Society for Aerospace Studies).

Jasjit's most significant contribution was in the abiding chink of India's national security—the management of higher defence. In early 1998, when the NDA government assumed charge, a task force led by the late KC Pant was set up to review policy challenges and recommend long overdue structural changes. As the

Air Commodore Jasjit Singh receiving the Padma Bhushan, the country's second highest civilian award, in 2006 from then President APJ Abdul Kalam for his contribution to shaping national strategic thinking.

At Air Commodore Jasjit Singh's last (the 7th) International Conference on 'Energising Indian Aerospace Industry' on 19-20 September 2012 : (left to right) Mr T Suvarnaraju, Director, Design & Development HAL; Air Commodore Jasjit Singh AVSM VrC VM Director General, CAPS; Air Marshal RK Sharma AVSM VM, Deputy Chief of the Air Staff; Mr Satish K Kaura, Co-Chairman, CII National Defence Council and Mr Gurpal Singh, Principal Advisor & Head, Defence, Aerospace & Security, Confederation of Indian Industry.

member-secretary, Jasjit Singh laboured for months and produced a comprehensive document that sensitised the political establishment as to what had to be done to remedy the situation.

The Kargil War followed, and subsequently the NDA government initiated some more committees and task forces but regrettably, there has been no tangible change to the existing national security lattice right down to UPA 2. In my last few interactions with Jasjit, he spoke passionately about the many areas that still needed to be addressed by him as an analyst and fretted that he did not have enough time. This, despite working diligently for as much as 16 hours every day.

Awarded the Padma Bhushan in 2006, Air Commodore Jasjit Singh served the country as soldier, scholar and institution-builder, and surmounted many challenges – both personal and professional – with commendable commitment and stoicism.

While Air Commodore Jasjit Singh's distinguished stewardship of IDSA and CAPS are monuments of the intellectual heights scaled by him as a fighter pilot, his colleagues in the Service, those junior to him and his peers, will always remember him also for his impressive personality - a tall,sprightly figure always standing out in his smart Air Force uniform, bearing an impeccable aura of someone born to be a great martial persona. He was soft-spoken to a fault and carried his innate quality of leadership softly on his shoulders, inspiring and motivating everyone around him with his personal example.

Air Commodore Jasjit Singh's articles regularly appeared in the *Vayu Aerospace Review* and recent ones included those on 'The Future of Air Power' with air dominance remaining a critical factor through the continuously changing nature of warfare in the 20th century, 'Quixotic Situations', reflecting on certain crucial elements which actually require transformation of the mind in the government, air force and political leadership. His opinion was that capabilities of aerospace power could only be increased if the human element was capable of exploiting it to maximum advantage. In his seminal 'Bolts from the Blue', he articulated on air power in the foreign policy of nations while 'The Right Stuff ' was on flying training imperatives of the IAF, a subject of great contemporary relevance.

Air Commodore Jasjit Singh's article on 'The Challenge of Indigenisation: The Case of the Aircraft Industry' – lead in the book personally presented by him to *The Society for Aerospace Studies* – is reproduced in this special issue of the *Vayu* as tribute to this great air warrior and brilliant strategist. ***Rest in Peace.***

Single or two-seat fighters ?

The matter that has bewitched the IAF for decades

Twin-seat Su-30MKI taking off from an airbase in Rajasthan (photo : Simon Watson)

Angad Singh reviews the evolution of two-seat fighters from the mid-20th century till the paradigm shift of recent times where single-seat, multi-role fighters prevail in almost all contemporary air forces worldwide; the odd 'plane out is the Su-30MKI destined to serve in large numbers with the IAF.

The neatest argument in favour of two pilots (or more accurately one pilot and one RIO/WSO) is for reducing individual workload and therefore improving total combat effectiveness. Through the 1960s and 1970s, where combat aircraft were required to possess capabilities that strained available technology to the limit, air forces around the world recognised the value of sharing the workload of what was rapidly becoming a very complex task – operating combat aircraft !

Evolution

Typical mid-20th century air forces employed single-role combat aircraft – dedicated types for air superiority, ground attack/CAS, interception and so on. With these relatively straightforward roles, pilot workload was manageable. Until the 1960s almost all combat aircraft had a crew requirement of a single pilot, save for bombers and some of the larger ground-attack types. The 1960s signalled a shift in aircraft design, with most aircraft being optimised for two or more roles. The American F-4 Phantom II, for example, was designed to fulfil the roles of interceptor, fighter and fighter-bomber. The powerful but complex AN/APQ-72 radar that guided multiple AIM-7 Sparrow missiles necessitated a second crewman (radar intercept officer – RIO) to monitor and target radar contacts and conduct missile launches, so that the pilot could devote attention to flying and evading enemy fire. In the fighter-bomber role the RIO was also responsible to air-to-ground targeting and firing. Over 4000 F-4s

Formation of twin-seat USAF QF-4E Phantom IIs

were operated by the USAF, USN and USMC, making two-crew operations all but standard in the USA for the duration of the F-4's service, as well as in other customer nations that operated the aircraft (UK, Germany, Israel, Turkey and Japan among others).

The Soviet Union, however, continued with a large number of single-pilot designs – this being explained by Soviet pilots' relative lack of autonomy compared to their Western counterparts and the fact that Soviet aircraft remained optimised for single roles decades after Western air forces began supplanting their fleets. Soviet aircrews remained heavily reliant on controlled intercepts from powerful ground-based tracking stations, and therefore complex avionics requiring additional crewmembers were not considered a priority. Aircraft developed during this time include the Sukhoi Su-15 (interceptor), Su-17 (ground-attack), Mikoyan-Gurevich MiG-23 (interceptor/tactical fighter), MiG-25 (interceptor/reconnaissance), and MiG-27 (ground-attack).

The 1970s and 1980, brought about a global shift in radar, avionics, nav-attack and other aircraft systems and consequently aircrew requirements. Most combat aircraft designed during this time reflect the changing nature of

Formation of two single-seat F-15C Eagles

Indian Air Force MiG-23MF air defence fighter (photo : Simon Watson)

tactical and strategic imperatives. Wars like the Vietnam conflict and Korea were no longer the norm, while the maturity and efficacy of ICBMs forced a change to the strategic landscape as well. The large air forces (read: Soviet and US) focused on single-role aircraft, while many European nations partnered on a number of programmes intended to reduce development costs and fleet sizes but with a focus on what were at the time considered key roles – interception and nuclear strike. Depending on the role and available avionics, these European designs featured single member aircrew (eg: SEPECAT Jaguar for tactical and nuclear strike) or two pilots (eg: Panavia Tornado for interception/strike/SEAD).

However, on other side of the Atlantic and behind the Iron Curtain, 'super power' air forces (and budgets) led to extremely high-performance aircraft optimised for their respective roles. The F-15 and F-16 were developed as single-seat air superiority fighters, designed with an unrelenting focus on air-to-air engagements. For close air support and ground attack, the Fairchild-Republic A-10 Thunderbolt II was built, also crewed by a single pilot. These developments were mirrored in the Soviet Union, with development of the Su-27, MiG-29 and Su-25, all three of which were single-role aircraft designed for a single crewmember. A notable exception was the MiG-31 'Foxhound' interceptor, successor to the famed MiG-25 'Foxbat'. The 'Foxhound' featured a very powerful radar and in keeping with the trend for powerful radar-equipped contemporary interceptors, was designed around two crewmembers (the older MiG-25 was more reliant on GCI than autonomous interception). In the late 1980s, when the USAF modified the air-superiority F-15 Eagle into the tactical strike F-15E Strike Eagle interdictor, they were compelled to do much the same with a second crewmember (WSO – weapon systems officer) seen as necessary to operate the additional air-to-ground avionics.

Twin-seat MiG-31 interceptor in flight


Single-seat MiG-29B of Indian Air Force at Jamnagar (photo : Simon Watson)

Paradigm Shift

The next paradigm shift came in the 1990s with the widespread adoption of modern semiconductor technology. Enormous leaps in computing power made a high degree of automation possible in the field of military aviation. A dedicated crewmember to operate radar or designate targets was made redundant, those tasks being accomplished accurately, swiftly and reliably by on-board computers.

This is reflected in contemporary 4th and 5th generation fighter designs – all of which are – without exception – single-pilot aircraft, despite being highly versatile multirole aircraft. The key to limiting crew size is available technology (for automation) and the quality of the man-machine interface (MMI). Simplifying and streamlining the MMI in sync with the exponential growth in technology has allowed for a single pilot to conduct a number of tasks in the air without compromising situational awareness, combat efficiency or safety. In addition, the increasing use of precision-guided 'smart' weapons, especially long-range standoff munitions, have vastly increased survivability of combat aircraft, regardless of crew size.

New generation Typhoon (single seater) is replacing the earlier generation Tornado (twin-seat)

Single-seat Rafale-M with air-to-ground PGMs seen after launch from the aircraft carrier Charles de Gaulle

Why is the IAF an outlier ?

The US armed forces (USAF, USN, USMC) have continued into the 21st century with a mix of single and multi-role aircraft. The F-16, originally designed as a single-seat air superiority day fighter, has evolved into a tremendously successful all-weather multirole fighter but retaining its single-seat configuration. The single-seat F-15C, despite the existence of its F-15E strike-optimised sibling, is also capable of deploying a limited set of air-to-ground ordnance. The US Navy's F/A-18C/D Hornet (and later F/A-18E/F Super Hornet) were designed from the outset as multirole aircraft, as reflected by the 'F/A' (fighter-attack) designation, but with a single pilot seen as sufficiently combat effective even in the 1980s. The US Marine Corps, which also operates the F/A-18C/D Hornet, relies heavily on single-seat combat aircraft, with the AV-8B Harrier II being optimised for air-to-ground missions with secondary anti-air capability – this while being a complex VTOL aircraft !

Its two-seat cockpit configuration seen to good effect, an Su-30MKI of the Indian Air Force (photo: Simon Watson)

This focus on multirole aircraft, either as modifications to former single-role aircraft or as clean-sheet designs, allowed single-role aircraft fleets such as the A-10, A-6, S-3 and EA-6B to be dramatically downsized or eliminated altogether, leading to significant cost savings in acquisitions, maintenance and human resources.

This trend was mirrored in Western Europe, where most nations have all but done away with single-role combat aircraft in the face of shrinking budgets and declining threats. All 4th generation types developed in Europe through the 1990s – Dassault Rafale, Eurofighter Typhoon and Saab JAS 39 Gripen – are multirole, single-seat designs, albeit with twin-seat operational trainers that are fully combat-capable. As relatively new clean-sheet designs, these aircraft all share similar levels of sensor fusion, automation and benefit from modern approaches to MMI.

During the twilight years of the Soviet Union and continuing into the first decades of the new Russia, its air power has continued to rely on the Su-27 'Flanker' family for the bulk of its 4th generation fighter needs. The Su-27 was designed in the 1970s with the intent to outperform the F-15 Eagle, the benchmark for air superiority fighters at the time. Initial specifications were quite ambitious, calling for long range, high agility, Mach 2+ speed, and heavy armament, along with the ability to use short, semi-prepared airstrips. The resulting aircraft featured a favourable thrust-to-weight ratio and low wing loading as well as enormous internal volume for fuel. Coupled with the N001 'Myech' radar and BVR missiles, these made the Su-27 an excellent air-to-air platform.

Russia has elected to focus the bulk of future development on basic design of the Su-27, adapting the Soviet-era single-seat air superiority fighter into a formidable multirole combat aircraft, the Su-35 of today. Yet the single-pilot configuration has remained inviolable. Along with significant airframe changes to increase the MTOW (and hence payload/range), Sukhoi overhauled the avionics suite and took the opportunity to significantly upgrade the MMI. The new system has two digital computers that collect and process information from various onboard sensors and present relevant information to the pilot through two primary and three secondary multi-function displays (MFDs) in the glass cockpit. The introduction of an AESA radar, OLS-30 (IRST/TV/LR) detection suite and powerful 3D thrust-vectoring Saturn 117S engines have resulted in a contemporary and formidably modernised 'Flanker'.

However, going back to the early 1990s, the Sukhoi Design Bureau also introduced the Su-30 family of multirole fighters based on the Su-27UB twin-seat operational trainer. The rear seat was retained, ostensibly to manage the increased workload, and along with 2D thrust-vectoring Saturn AL-31F engines and a pair of optional canard foreplanes, the type was a commercial success, with the bulk of deliveries made to overseas customers, including China, Algeria, Indonesia, Malaysia, Venezuela and Vietnam. India undertook a deeper collaboration with Russia, utilising the basic Su-30K airframe and tailoring a custom-designed avionics suite including indigenous systems around it, resulting in the Su-30MKI. Unusually, despite Sukhoi itself marketing the Su-30 family as multirole fighters, with the second seat (and associated aerodynamic penalties) seen as a trade off for increased capabilities, the Indian Air Force has always characterised the Su-30MKI as an 'air dominance' (read: air superiority) fighter, which begs the question – why bother with a second crewmember in a single-role aircraft?

While the opaque nature of the Chinese defence establishment means that it is difficult to ascertain the roles and capabilities of Chinese combat aircraft, some inescapable conclusions can be drawn from simple observation. The bulk of China's 4th generation air power centres on the Shenyang J-11, an unlicensed copy of the Su-27 (with a number of modifications). These are complemented by indigenous Chengdu J-10 and JF-17 fighters, along with the purportedly domestic J-15 naval fighter (strikingly similar to the Su-33), making clear the Chinese preference for single-seat multirole fighters to form the backbone of their air combat arm.

The Chinese PLA Air Force is inducting large numbers of single-seat J-10 multirole fighters

The light-multirole JF-17 has already entered operational service with the Pakistan Air Force

The future is nigh, and it's single (or no) seats !

There is only one currently operational fifth-generation fighter in the world, and unusually, it is a single-seat *single-role* type – the Lockheed Martin F-22 Raptor. Designed to replace the F-15 Eagle, it has inherited that aircraft's role in the USAF order of battle. However, a lengthy development period meant that single-role aircraft were no longer in vogue by the time the Raptor entered service. However, by virtue of its design, the Raptor lends itself well to electronic warfare and signals intelligence roles, and has been quickly adapted to deliver a limited range of air-to-ground ordnance. Despite production and funding issues, there is no reason why continued development of the F-22 should

US Navy F/A-18E with gravity bombs launches from aircraft carrier

Pilots enter the single-seat Gripen multi-role fighter

not result in an outstanding multirole aircraft, whilst still retaining the single pilot.

Other stealth fighter programmes, with the benefit of hindsight, are designed from the start as multirole types and, exactly like the previous generation of combat aircraft, have no requirement for more than one pilot. The multinational F-35 Joint Strike Fighter, Chinese J-20 and J-31 stealth fighters and Russian PAK-FA are not only single-seat aircraft but also have no twin-seat variants on the horizon.

Initial details regarding the joint Indo-Russian FGFA (Fifth Generation Fighter Aircraft) that is to be based on the Sukhoi PAK-FA 5th generation prototype indicated that India appeared set to be the outlier once again, mandating a second seat in the FGFA but sanity (or pragmatism) appears to have prevailed, with the Indian Air Force quietly acquiescing to a single-seat design in the face of strenuous opposition from Russia.

With the future of the FGFA seemingly resolved, it is assumed that the indigenous AMCA (Advanced Medium Combat Aircraft) will also be a single seater, and that the Indian Air Force will finally abandon its inexplicable attachment to twin-seat combat aircraft.

Postscript : on the eve of Paris 2013, the Saab CEO revealed that the Swedes are working on a version of the Gripen E which could be unmanned ! The emergence of increasingly sophisticated air defenses is driving military planners around the world to explore greater use of unmanned aircraft to mitigate risk to personnel. The US is boosting funds for development of unmanned combat aircraft, with France and the UK cooperating on an attack drone project and even China has displayed a prototype of this concept.

Angad Singh

Two pilots of Squadron Leader rank with one Su-30MKI (photo: Simon Watson)

On air combat philosophy

Pair of Su-30MKIs of the IAF (photo: Simon Watson)

Air Commodore Parvez Khokar (retd), formerly Director National Flight Test Centre and having over 5000 hours on 62 different aircraft types including virtually all Soviet-origin fighters ranging from the bisonic MiG-21 to the trisonic MiG-25R, writes that the historical perspective on aircrew requirements for combat aircraft must be viewed in context of the combat philosophy of the manufacturer's nation.

Air Forces belonging to the NATO alliance virtually functioned in an autonomous mode, with aircrew trained accordingly with their better airborne radars, avionics and sensors and aircraft having more endurance. On the other hand, Soviet state-controlled aircraft companies were the only suppliers to the Warsaw Pact nations and thus Soviet control over their their philosophies was very stringent. A trust deficit between the State and its citizens always existed, and this was reflected in the operational doctrines of these Air Forces, with more focus given to long range ground radars and constant ground-based control of combat aircraft, even final orders for release of weapons. The IAF initially adopted this approach as well, until it was realised that the potential of the weapon system could be exploited manifold, if autonomy were exercised in the air. The metamorphosis of the MiG-21F to the MiG-21 Bison is a classic case study and all this essentially because of the IAF's air combat philosophy.

The next phase of development that saw a quantum jump in radar, sensor and weapons development in the West meant that the work load of the single Pilot-Operator become untenable for successful

MiG-21 Bison (photo: Simon Watson)

Mirage 2000H taking off from Gwalior (photo: Angad Singh)

engagements. The F-4 Phantom and the F-14 Tomcat, both manned by a crew of two, became mainstay of the US Air Forces and these two aircraft, during their service lives did more operational sorties than the F-15 and F-16 combined.

Traditionally, two-seat fighters evolved from being as operational conversion trainers, since their primary role was to train pilots. Some limited armament was introduced at a later stage, the main reason not being economy of effort or expense, but to keep the weight and flying qualities as close to that of the fighter, without major design changes. Remember, an extra cockpit, with all its paraphernalia had to somehow be fitted in. Also the trainer was always 'an afterthought'. Stringent economic measures to control expenses also influenced retention of the single seater. After all the most expensive and most difficult commodity to replace will always be the 'man', in the Man-Machine interface.

So why have 4th and 5th generation fighter aircraft essentially been single seaters ? Has the technology become simpler ? No, technologically the world is far more advanced and so the major reasons for reverting to single seat fighters are :

- Sensor fusion, which allows major interfaces and co-operation between related sensors, which in turn are coupled to the weapon systems. Selection of one automatically triggers off a host of sensors that complement each other. For example, if a radar is being slewed to follow a target and the target is fast manoeuvring its escape path out of the radar beam, a Helmet Mounted Display can follow him at more acute angles with the missile sensor also slewing along with the head. As a result the weapon can be fired at erstwhile unimaginable angles abeam of the fighter.
- Cost of two-seaters with all systems is obviously more than that of a single seater.
- Cost of two crew means double the costs of training, manning and overheads.
- Maintenance costs are increased
- In case of a mishap, two crew members need to be replaced instead of one.

So why does the Indian Air Force continue to forge ahead with two-crew fighters, such as the Su-30 ?

The reasons can be summarised as follows :

- The philosophy of fighter engagements with long range, long endurance aircraft, like the Su-30MKI, can best be exploited with the aircraft remaining airborne for extended periods of time, so as to engage targets at extreme ranges or to ensure a quicker response by airborne patrols. This justifies the induction of mid-air refuelers, regarded as 'force multipliers'. Why have these around if you need to land in a shorter duration of time ? Also to accrue optimum benefit while taking off from high altitude airfields/very hot temperature conditions, the aircraft can be fully armed and refuelled in the air.
- The second cockpit in the Su-30 is not a weapon operator's platform but is a fully configured cockpit from where the aircraft can be flown through its complete envelope. A major factor ignored by the uninitiated is that of aircrew fatigue. It is most telling and can severely compromise the success of a mission. As the IAF envisages using this aircraft at long ranges/ stay on station longer, without any degradation in operational capability, the usage of a two-pilot crew is justified.
- As to why the Russians do not want a two-seater PAK-FA – perhaps because their rigid philosophy of supremacy of ground control has not been altered an iota since the Cold War. It's still too early to conclude whether India will only go in for the single seat 5th generation aircraft. It may still turn out to be a optimum mix of the two, as is in the case of the selected 4th generation aircraft.

Single-seat Mirage 2000H (photo : Angad Singh)

The Rising–and Rising Cost of Air Operations

Powered by two massive Ivchenko AI-20M turboprops of 4,195 shp each, an An-32 comes in to land at Gwalior with its long concrete runways. The An-32 is essentially an An-26 with more powerful engines and larger propellers for augmenting performance from 'hot and high' airfields in the mountainous terrain of north and north-east India (photo: Angad Singh)

Any enterprise functions on the basic principle of inflow and outflow. An air force is no different. The government provides an influx of funds, i.e. the defence budget, and the air force is expected to perform its duties within its means, within its budget. A look at the burgeoning bills of the Indian Air Force shows that the force's spending seems to be well above others which are making almost desperate attempts to reduce operational costs. One wonders if the Indian Air Force could well be forced to cut operational costs.

Fuel Costs

An important portion of the IAF's budget is the exorbitant amount spent on fuel. An *Economic Times* report estimates that the Air Force spent an astounding Rs. 4090 crore just on fuel during 2012-13. Much of this can be attributed to fuel–guzzling fighters and transport aircraft types. A twin engine Su-30MKI consumes approximately 7.5 tonnes of fuel an hour. For a fleet of 150 aircraft that each fly an approximate 200 hours a year, the cost of keeping India's Su-30MKIs aloft will amount to Rs. 1100 crores annually! In the pipeline are additional batches of Su-30MKIs which will take the total on order to 272, to equip fourteen and a half squadrons, which will constitute nearly 50% of the IAF's current order of battle. The Air Force's intention of not wanting to purchase too many varieties of aircraft as a rationalisation measure is perfectly logical, but with cost of each Su-30MKI having reportedly ballooned to over $100 million apiece from the initial $35 million, it negates any savings that might have been attained with continuation of an existing production line, while adding the burden of staggering fuel consumption. Add to this the highly fuel inefficient and ageing An-32 tactical transport, and it is understandable why the Air Force is burdened with such a massive fuel bill. The An-32s are meanwhile being upgraded and the IAF will continue to operate these for several

The Sukhoi Su-30MKI is powered by a pair of Saturn AL-31FP afterburning turbofans developing 12,500 kg thrust each (photo: Simon Watson)

more decades, with consequential continuing high fuel costs.

Of course, to expect the IAF to curtail flying in order to cut costs would be foolish. What could be a viable alternative is the selection and induction of decidedly more fuel efficient aircraft and not augment the already existing fleet with more of the gas guzzling variety.

The most vital element of spending for an air force would be the procurement of new hardware, specifically combat aircraft. The MMRCA odyssey which began some ten years ago is now in its final lap, but it is instructive to recall the words of the Indian-origin, US-based defence and strategic analyst Ashley Tellis, "The Indian Air Force intended to obtain 'the least expensive, mature, combat proven fighter that would be a bridge to obtaining more advanced stealth aircraft in the future." At the end of an intensive and detailed technical evaluation, the IAF shortlisted the Eurofighter Typhoon and Dassault's Rafale, finally picking the latter in 2012. The Rafale was reportedly the second most expensive fighter among the six types. As is the case with defence deals, with rising prices and renegotiations, the fighter is pegged at over $100 million apiece. Negotiations are stalled at the transfer of technology terms and offset clauses that the Ministry of Defence has been insistent upon. Without technology transfer and keeping in mind the capabilities of India's aerospace industry, the cost of this deal, some say, could balloon to well over a staggering $30 billion, while providing little benefit to the local aerospace industry. In addition, the Rafale, a twin engine fighter, is set to add to the IAF's growing fleet of twin engine combat aircraft like the Su-30MKI, the MiG-29 and the soon to be inducted FGFA. The financial connotation of inducting more twin engine fighters, in context of fuel burnt , must certainly also be borne in mind.

The life cycle cost (LCC) of an aircraft encompasses its acquisition cost, the fixed and variable operating costs and any residual costs that may arise. This involves the cost of maintenance, spares, fuel costs, repairs and upgrades. A key point of consideration in the MMRCA competition was the life cycle costs of the aircraft being purchased. The Ministry of Defence went along with their L1 policy of selecting the lowest bidder, and hence the Rafale was picked over the Eurofighter Typhoon. A 2012 study published by IHS *Jane's* on cost per flight hour of the six MMRCA contenders reveals that the Saab Gripen was the least expensive aircraft to operate as compared to the F/A-18 E/F, the Rafale, the Eurofighter Typhoon, the MiG-35 and the F-16 Block 50. At an estimated $4,700 an hour, the cost per flight hour of the Gripen is about one quarter that of the Typhoon/ Rafale, which is an estimated $16,500.

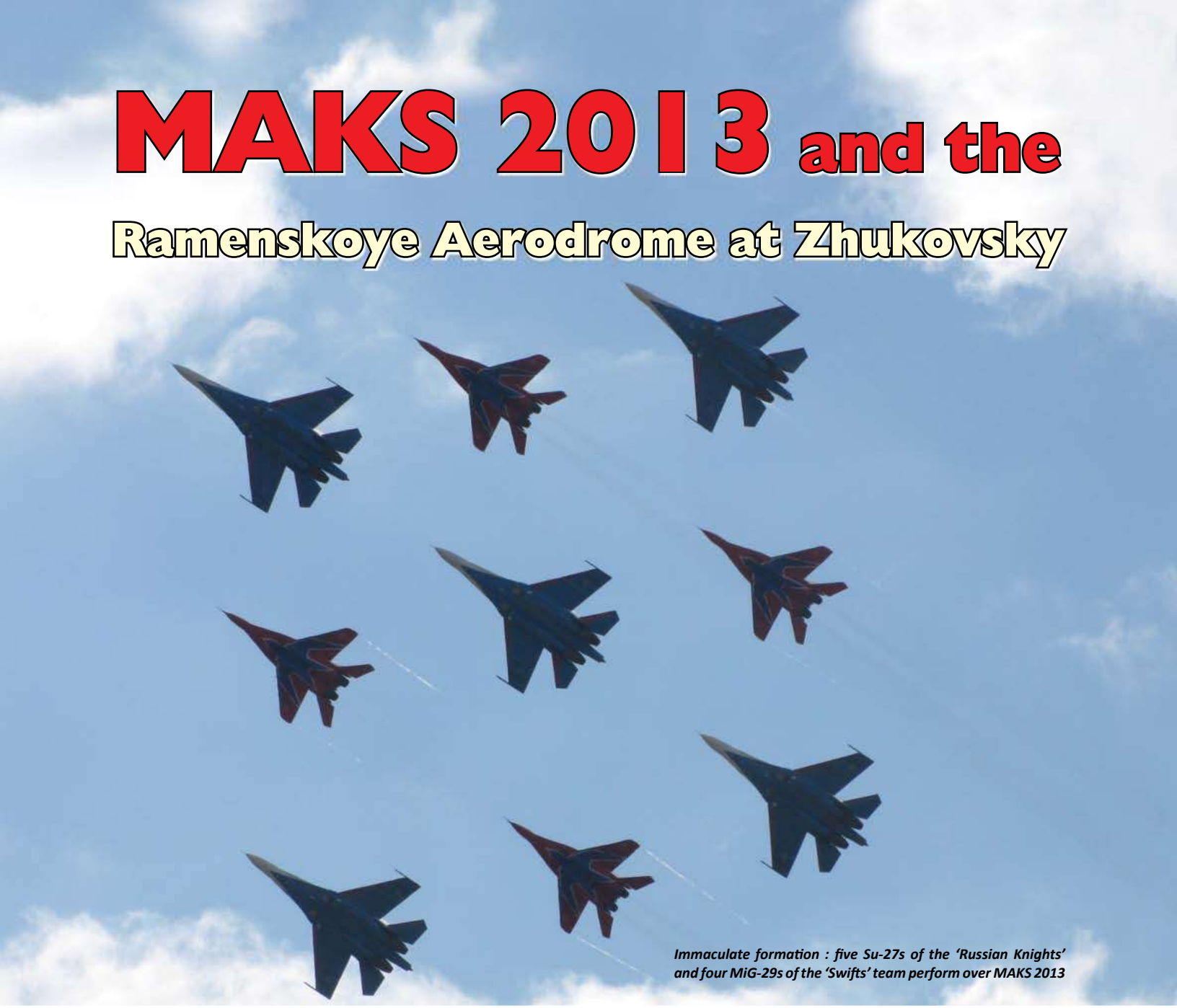
Two Snecma M88 afterburning turbofans of 7,680 kg thrust each power the Dassault Rafale (photo: Angad Singh)

Turning off the fuel tap and being parsimonious is definitely not the answer to the spiralling costs of having a first class Air Force. That would rather lead to a substandard, underequipped and mediocre air arm, one detrimental to national security. Instead, a wise path to tread on would be smart decision making, resulting in smarter investments.

Vijay Matheswaran

The Gripen C is powered by a single Volvo RM12 (GE F404) producing 8,200 kg thrust with afterburner (photo: Peter Gronemann)

MAKS 2013 and the Ramenskoye Aerodrome at Zhukovsky



Immaculate formation : five Su-27s of the 'Russian Knights' and four MiG-29s of the 'Swifts' team perform over MAKS 2013

The enigmatic town of Zhukovsky, some 35 km southeast of Moscow has been the epicentre of Russian aviation through the last half century, the town named after Nikolai Zhukovsky, a renowned scientist, considered the father of Russian aviation. All key aviation research centres in Russia are located at Zhukovsky.

Zhukovsky has a massive and unique airfield, capable of testing every type of aircraft developed in Russia. The airfield, known as Ramenskoye, has three concrete runways, one of which is the longest in Europe, 120 meters wide, 5.4 km in length and has no weight limitations. It was on this runway that the Antonov An-225 'Mriya' achieved a successful take-off and landing while 'piggy-backing" the Buran orbiter at a total weight of 600 metric tons. The airfield boasts an aerial flight test zone of 40,000 sq. km.

The main industrial enterprises at Zhukovsky include the Central Aerohydrodynamic Institute, the Gromov Flight Research Institute, the Experimental Engineering Plant, the Scientific-Research Institutes of Instrument Engineering and Aviation Equipment, as well as test centres of most prominent Russian aviation research-and-design bureaux. Besides, there are aviation colleges and technical institutes.

The Central Aerohydrodynamics Institute (TsAGI) is a major research and test complex involved in both basic and applied aerodynamic research, which has helped design and test every major Soviet fighter, airliner, and spacecraft. TsAGI has more than fifty aerodynamic test facilities, including a supersonic wind tunnel for speeds up to Mach 1.7; a 24 meter subsonic wind tunnel; a 4,600 cubic meter thermal testing chamber that simultaneously checks temperature, pressure, and speed; and a 13.5 meter diameter, 30 meter long vacuum chamber for thermal strength testing.

RAC MiG have their own advanced flight-experimental base at Zhukovsky which provides facilities for flight and design tests of new generation aircraft. The MiG Test Pilot's School here

was established under direction of chief test pilot Grigory Sedov in the 1950s and has carried out flight test programmes of the entire range of Russian aircraft from civil airliners to reusable space systems.

During the mid-1980s, prototypes of new Soviet combat aircraft were tested at Ramenskoye Airfield and 'spied' upon by Western surveillance satellites which 'discovered' various new aircraft types which were promptly given 'Ram' (for Ramenskoye) designations. Thus Ram-K, assumed to be a fixed-wing interceptor, was eventually identified as the Sukhoi Su-27, the Ram-L, became known as the MiG-29, and the Ram-J or T-58, was the Su-25 ground-attack aircraft.

In an interesting aside, during the mid-1980s, when the Indian Air Force was seeking new generation fighters to counter Pakistan Air Force F-16s, the Soviets offered the MiG-23MF swing wing fighter which did not measure up to the IAF's requirement. When the then DCAS, Air Marshal CV Gole referred to the 'Ram-K' and 'Ram-L' whose blurred photographs were published in *Janes Defence Weekly*, the Soviets shrugged off their existence. Not too many years later, the Indian Air Force were in fact offered (and later received) both the MiG-29 and Su-30 (based on the Su-27).

Now, since the past 20 years, the Russian International Aviation and Space Show(MAKS), is held at the Ramenskoye Aerodrome at Zhukovsky, and the following is *Vayu*'s on-the-spot-report of MAKS 2013.

A Quintessentially Russian Air Show

Massive flag of the Russian Federation towed by Russian helicopters to herald start of the air display at MAKS 2013

The Show was quintessentially Russian although there were isolated western aircraft on static display, including the giant Airbus A380 and the Agusta Westland AW 101 VVIP helicopter. Visitors gawked at the rows of Russian-origin bombers and fighters of an earlier era, moving to the present, with Sukhoi Su-27 and MiG-29 variants vying for attention. They did not have to try very hard, with a mixed formation of the two types putting on an impeccable display with nine aircraft over Zhukovsky every afternoon !

As Alexander Mikheev, Deputy Director General of Rosoboronexport stated, "we are launching a large number of new Russian aircraft, airborne munitions and air defence systems to the international arms market. Of special importance is the fact that potential customers will be able to see these items live in Zhukovksy, and even to fly in some aircraft, for example the Yak-130 combat trainer, during familiarisation flights".

The Yak-130, painted in demonstrator colours, takes off at Zhukovsky

In his opinion, foreign delegations showed great interest in advance combat aircraft such as the Su-35, latest upgrades of the Su-30MK and MiG-29 as also the Ka-52 and Mi-28 combat helicopters, Mi-17 medium lift and the Mi-26T2 heavy lift helicopters. As for transport and maritime patrol aircraft, there was interest in the new Il-76MD-90A, An-148 and An-140-100 transports and the revived Be-200 amphibian aircraft.

According to Mr Victor Kobzev of Beriev, the Russian company intends to begins series production of the Be-200 jet amphibian (*see above*) with the first aircraft to be completed by end 2013. There are 12 firm orders for the Be-200, half of them for the Russian Ministry of Emergency Situationsand the balance for the Russian Ministry of Defence. The manufacturing will be carried out at a new site in Taganrog even as the Russian Navy has expressed interest in building up an amphibian aircraft force. Meanwhile, the Chinese Government has expressed strong interest in both the Be-200 and the much smaller Be-103.

Mil Mi-28N attack helicopter in dramatic display during MAKS 2013

Tor M2KM Missile System mounted on Tata Motors LPTA-series truck

The Russians have always wielded formidable air defence systems and at MAKS 2013 were displayed the S-400, Antey-2500, Buk-M2E, Tor-M2E, Pantsir-S1 and Igla-S.

There were scores of chalets but the mother of them all was that of United Aircraft Corporation (UAC), considering that the Corporation is formed by 16 companies including Sukhoi, Irkut, Ilyshin, Tupolev, RAC-MiG, Kazan, Myasischchev and Beriev among others. UAC President Mikhail A Pogosyan, who is well known in India as well, was at the front with visiting Russian President Vladimir Putin and Prime Minister Dmitry Medvedev and their delegations.

Model of the air-launched BrahMos supersonic cruise missile displayed at MAKS 2013

The new S-350E Almaz-Antey surface-to-air medium missiles

Entrance to the formidable United Aircraft Corporation Chalet at MAKS 2013

The Indo-Russian PMF-FGFA programme

Surely the cynosure of all eyes at MAKS 2013 was the Sukhoi T-50 fifth generation fighter aircraft, three prototype of which had flown to Zhukovsky from across the entire continent from Komsomolsk-on-Amur in the Far East. The three aircraft first taxied down in formation and then took off to perform their aerial display at end of the Show. The Indian and Russian Governments had agreed on a joint development and manufacture of what is now referred to as the perspective multi-functional fighter (PMF-FGFA) following Medvedev's visit to India in December 2010. The preliminary contract was thereafter signed by Hindustan Aeronautical Limited, Sukhoi Aviation Holding Company and Rosoboronexport, work share of each side agreed upon with systems and subsystems to be developed by India duly identified.

Three prototypes of the T-50 in formation at MAKS 2013

As reported two years earlier after MAKS 2011 (see*Vayu*V/2011 *'All eyes on the FGFA'*) when Esha Singh interviewed the PMF programme's Chief Test Pilot Sergey L Bogdan, it was announced that "the T-50 will provide the backbone not only of the Russian Air Force but also that of India's." At that time, it was reported that the Indian intention was to procure upto 214 of these futuristic fighters (166 single seaters and 48 twin-seaters) while Russia planned around 200, with first deliveries to the latter service planned for 2016-17.

However, much water has flowed down the Volga and Ganges since then and there seems to be some changes in requirement and configuration. In late 2012, it was reported that the Indian requirement was reduced to 144 aircraft, all single seaters. The recent news is that this figure to has been reduced to 116 aircraft, perhaps owing to a major increase in design & development costs which have also gone up from the original $ 8 billion to over $ 11 billion of which the Indian share would be $ 5.5 billion.

According to New Delhi sources the original contract also envisaged start of production in India during 2019-20 but this is likely to move right to 2022 onwards. The first three prototypes were to be received in India during 2014, 2017 and 2019 for extensive flight and development trials. It is understood that a high level HAL team, accompanied by senior officials of the MoD, visited Komsomolsk-on-Amur in mid-July 2013 to inspect the T-50 production facilities, although HAL designers have been working with their Sukhoi counterparts on PMF-FGFA specifications and systems since January 2012.

Meanwhile, Sukhoi has developed the Su-35 4++ generation super-maneuverable multirole fighter, which in effect becomes the sophisticated flying test bed for optimised advanced technologies

The Su-35S during its powerful performance over Zhukovsky

of the PMF-FGFA. This includes a new avionicssuite based on an information control system employing multiple processor computers and phased-array radar. According to the Russian spokesman, "the Su-35S together with PAK FA, 5thgeneration fighter, is going to determine the future air power of Russia."

$12 billion contracts signed at MAKS 2013

The last day at MAKS 2013 was nearly 'washed out' with low clouds and rainfall curtailing much movement around the static displays and exhibition halls, as also aircraft demonstrations in the skies. However, a pair of T-50 FGFAs, flown at low altitude redeemed some of the situation.

The 11th MAKS international aerospace show resulted in a record number of contracts, with deals worth hundreds of billions of rubles signed during three days of business sessions. Mikhail Pogosyan was satisfied; "we signed contracts to supply aircraft and agreements that will later take the shape of contracts for the supply of 173 aircraft, estimated value of approximate $9 billion and if we add our $3-billion contract with the Defense Ministry for aircraft maintenance services, the overall value of the contracts signed by the UAC will be around $12 billion."

Among the shining stars at MAKS 2013 was the Ka-62 multi role helicopter. Five Ka-62s were sold to Colombia and as Alexei Mikheyev, of Russian Helicopters said, " this is the first Russian helicopter built in cooperation with European partners. The engine is supplied by the French firm Turbomeca, part of the Safran Group, and the transmission is provided by Austrian company

The Chinese PLAAF sent their '1 August' formation aerobatic team equipped with the Chengdu J-10 multirole fighter at MAKS 2013. Performing intermittently, they were 'absent' during the first trade days but reappeared during the public days.

Like at an auto show, models show off the new Ka-62

Zoerkler, but all other main systems are Russian. The export future for the Ka-62 looks very promising." Over the five days of MAKS2013, there were some 300,000 visitors, mostly Russian.

Contracts and Agreements

On fourth day of the Show, Ilyushin Finance Co. (IFC) signed a number of agreements with the letters of intent to supply ten MS-21, ten TU-204SM and ten Q400 NextGen turboprop airliners with Russian airline Red Wings. IFC also signed a letter of intent to supply five Bombardiers CSeries CS300 to UTair-Ukraine with delivery to start in 2014-2015.

United Aircraft Corporation and the Russian Academy of Sciences signed a cooperation agreement which implies collaboration in various areas, in particular, concerning development of new energy sources, materials and smart designs, decrease in fuel consumption, and improvement of aircraft environmental performance.

Russian Helicopters and AgustaWestland signed a tentative agreement on the directions of the development of a joined programme for constructing a new helicopter with a take-off weight of 2.5 tonnes. The program will be executed on a parity basis.

Ilyushin Aviation Complex and Moscow Bank of Sberbank signed a partnership agreement which implies cooperation development in the areas of financial and consulting services, including crediting, security bonds, letters of credit, hedging exchange risks etc. The partnership agreement was concluded for a period of five years.

Showing off the Kh-31, a medium-range air-to-surface missile whose anti-radiation variant with passive seeker head has a range of about 110 km. According to recent reports, the KH-31P/PD anti-radar missile (NATO reporting name AS-17 'Krypton') is being considered to arm the IAF's Rafales should the US-origin AGM-88 HARM not be available.

Ilyushin displays new Il-76 variant

Ilyushin's recently revived Il-76 military and commercial transport was displayed at MAKS 2013, being the Il-76MD-90A2 variant, also known as the Il-476. The programme required Ilyushin to move production from Tashkent in Uzbekistan to the new Aviastar factory in Ulyanovsk in Russia. According to Vladimir Belyakov, deputy director general of marketing, Ilyushin has been working on this follow on variant after receiving a contract from Russia's trade ministry to build a new Il-76 with upgraded engines, a glass cockpit and improved landing gear and brakes.

The Russian defence ministry followed up by signing a contract for 39 of the new Il-76MD-90A2s. Ilyushin will deliver the first production aircraft to the Russian Air Force in 2014, and the company believes it can sell 150-200 Il-76MD-90A2s to domestic and export customers over the next 17 years. A follow-on deal from the Russian Air Force for an in-flight refuelling tanker version of the aircraft is anticipated.

Flypast : prototype of the Il-76MD-90A2 (Il-476) over Zhukovsky

PD-14 demonstrator engine

Russia's counterpart to the latest Western-origin turbofan engines for single-aisle aircraft from CFM International and Pratt & Whitney, was on public display for the first time at MAKS 2013 where Aviadvigatel unveiled the technology demonstrator of the PD-14, a proposed alternate powerplant for Irkut's MC-21 airliner.

The engine has a 1.9m (75in)-diameter inlet fan composed of 18 blades made from titanium alloy. The fan diameter provides a bypass ratio of 8.5:1, which is significantly larger compared with previous Russian engines, but still slightly below the 10:1 bypass ratio achieved by the CFM Leap-1A or the 12:1 ratio of Pratt & Whitney's PW1400G. The latter is the baseline engine selected by Irkut to power the MC-21 at its service entry in 2017, but the PD-14 is being considered as an indigenous option. Aviadvigatel believes that the PD-14 would also provide a new core that could be developed into an engine called the PD-18R, which would feature a fan-drive gear system similar to the PW1400G. Although the PD-14 display at MAKS revealed that Aviadvigatel has not yet adopted CFM's composite fan blade technology, the Russian manufacturer is catching up !

Russian Helicopters showcase their range at MAKS 2013

Russian Helicopters, a subsidiary of Oboronprom which is part of State Corporation Rostec, showcased a range of their helicopters, including the new combat trainer Mil Mi-28UB, based on the Mi-28NE Night Hunter combat helicopter manufactured by Rosvertol. The Mi-28UB performed its maiden flight on 9 August at Rosvertol's flight centre and its public presentation at MAKS was impressive.

The Mi-28UB has been tailored to Russian requirements, which specified a need to train military pilots for the Mi-28NE helicopters and at the same time perform all functions of an attack helicopter. The Mi-28UB is equipped with a dual control system to aid training, while retaining full attack capability. The dual hydro-mechanical flight control system allows the helicopter to be operated both from the pilot's cockpit and the flight instructor's cockpit, while area of the flight instructor's cockpit has been increased, with an expansion in the pilot canopy and change to the configuration of the energy-absorbing seats.

The 750th Mi-8AMT / Mi-171

Ulan-Ude Aviation Plant (UUAP), a Russian Helicopters company, has produced the 750th Mi-8AMT (export designation Mi-171), the landmark achieved on eve of MAKS 2013. The Mi-8AMTSh will enter service with the Russian Defence Ministry.

The first Mi-8AMT (Mi-171) was produced in 1991 and this type has been continuously updated. The contemporary Mi-8AMT is fitted with various additional equipment to expand its potential uses, including a spotlight with IR filter, a FLIR system and various winches, while additional fuel tanks can be added to increase the helicopter's range. Flight safety is provided by advanced in-cockpit piloting and navigational equipment and a system for emergency landings on water, while air-conditioning is installed for the comfort of passengers and crew.

The Ulan-Ude Aviation Plant has built more than 8,000 aircraft in its 70-year history and presently concentrates in production of the Mi-171 (Mi-8AMT) and Mi-171Sh helicopters.

The Ka-62 at MAKS 2013

The good looking Kamov Ka-62 is destined for success

There has been significant international interest in Russian Helicopters' new model, the medium multirole Ka-62, which will be produced at Progress Arsenyev Aviation Company in the Russian Far East. Russian Helicopters secured the first export contract for the Ka-62 in December 2012 with seven helicopters ordered by Brazil's Atlas Táxi Aéreo.

Prototype of the Ka-62 was on display at MAKS 2013. Along with passenger transport and rescue operations, it can be deployed in the oil and gas sector as well. A large cabin that can carry up to 15 people also makes the helicopter suited for corporate purposes. The Ka-62 has high cruise speed and low vibration levels, with high payload-range. Flight testing of the Ka-62 is planned to start in 2013, and Russian Helicopters expects to obtain certification in 2015-16.

Meanwhile, Turbomeca and Russian Helicopters announced their Memorandum of Understanding (MoU) to provide maintenance Level 1 and 2 activities on Turbomeca engines operated by the Russian helicopter operators. The engines covered are the Arrius 2G1 and the Ardiden 3G, powering the Ka-226T and the Ka-62 helicopters respectively. This maintenance centre is part of a global common support strategy aimed at providing a highest level of support to all operators flying with Turbomeca engines in accordance with "the best practices and standards."

The vast spectrum of Irkut Corporation

Irkut Corporation today provides a full spectrum of aircraft design, manufacture, sales and after-sale support for a wide range of military and civil aircraft. A market leader in Russian aircraft manufacturing and over the last few years, it has notched 15% share of Russian arms exports. The Ministry of Industry and Trade of the Russian Federation bestowed Irkut Corporation with the 'Best Exporter of the Year' award in the Aircraft Manufacturing category, four times from 2009 to 2012, and Irkut's revenues have more than trebled in a decade, with their order book currently standing at about $9 billion.

The Irkutsk Aviation Plant (IAP) is a subsidiary of Irkut Corporation and also its key production facility. In 2009,an active engineering centre named after A.S. Yakovlev specialising in the development of commercial, combat - trainer and light aircraft was formed within the structure of Irkut Corporation, the Centre based on the JSC Yakovlev Design Bureau. Irkut Corporation is part of the United Aircraft Corporation (UAC) which is responsible for the Su-30MK Multi-Role Fighter, developed by JSC Sukhoi Design Bureau and manufactured by the Irkutsk Aviation Plant.

Su-30MK fighter is the front line combat aircraft of the Indian, Algerian and Malaysian Air Forces. From 1996 to 2012, Irkut Corporation signed firm contracts with foreign customers for the supply of about 350 Su-30MK aircraft and aircraft kits. Over 250 of them have been delivered to the customers.

Preparations are afoot for "deep upgrade" of the Su-30MKI of the Indian Air Force, with Russian and Indian experts reviewing technical configuration of the upgraded 'Super 30' aircraft with onboard AESA radar. Integration of the BrahMos supersonic anti-ship missile with the Su-30MKI is being done in India.

Meanwhile, Irkut Corporation along with the Sukhoi Design Bureau has developed modifications of the Su-30SM for the Russian Air Force. In March and December 2012 two contracts for the delivery of 60 aircraft of the type to the Russian Ministry of Defence were signed and an initial batch delivered to the Russian Air Force. One of these aircraft conducted daily flying displays during MAKS 2013

The new generation Yak-130 Combat Trainer, developed by the Yakovlev Design Bureau, provides advanced training for pilots moving to 4+ and 5th generation combat aircraft and has been chosen for basic and advanced training of Russian Air Force pilots. After completion of flight trials in December 2009, the Yak-130 has been inducted into the Russian Air Force and in December 2011 the Russian Ministry of Defence and Irkut Corporation signed a contract to supply the Russian Air Force with 55 Yak-130s by 2015. 15 of these combat trainers had been delivered by the end of 2012 and furthermore, the Russian State armaments programme for 2011-2020 provides for the procurement of 65 Yak-130s in total. Export contracts for the Yak-130 aircraft have been secured, the first of which was fulfilled in 2011. Negotiations for more sales of the aircraft are underway.

Aeroflot will be first airline to operate the MC-21 on schedule services

An important International Industrial cooperation programme concerns manufacture of Airbus A320 components at the Irkutsk Aviation Plant and deliveries commenced in 2008.

The Irkut-developed MC-21 new generation airliner is a major project of the Russian civil aviation industry. The decree of the President of Russian Federation dated 6 June 2010 defines Irkut Corporation as "the unique executor of state orders for development and certification of the new airliner."

The MC-21 is being developed to provide airlines with a new generation narrow body airliner with powered costs and improved passenger comfort. Savings in direct operating costs are estimated at 7-9%, with fuel consumption economy per passenger at 12% and 24% in CO_2 emissions.

The cabin pressure corresponds to an altitude of 6000ft above sea level (while most existing aircraft offer pressurisation equivalent to about 8000ft) and features include an optional humidification system and significantly reduced cabin noise, among other innovations aimed at improving passenger comfort.

The MC-21 programme is proceeding on schedule and in 2012, the MC-21 moved from the design stage to the manufacturing of certain parts plus comprehensive load testing as well. Series production of the MC-21 will take place at the modernised Irkutsk Aviation Plant, with first deliveries scheduled to begin in 2017.

Contracts and agreements for deliveries of more than 250 MC-21 aircraft have been signed with Russian and foreign companies, the largest of these orders being received from the Russian Technologies State Corporation. Aeroflot, Russia's national carrier, will be the first operator of the MC-21 in commercial service.


The modern flight deck of the MC-21

Bombardier and Rostekhnologii sign agreements

Bombardier and Rostekhnologii ("Rostec"), a state corporation controlled by the Russian Federation, announced during MAKS 2013 that they had signed a series of preliminary agreements. These include a letter of intent (LOI) for the sale of 50 Q400 NextGen aircraft as well as a Market Development Agreement with Rostec and its aircraft leasing subsidiary, Avia Capital Services, that will provide an opportunity to place at least 50 additional Q400 NextGen aircraft in the region. The two firms also signed an MOU to validate the opportunity to set up a Q400 NextGen final assembly line in Russia. Should definitive agreements be reached, based on the list price of the Q400 NextGen airliner, an order for 100 Q400 NextGen aircraft would be valued at approximately $3.39 billion.

The establishment of a Q400 final assembly line in the Russian Federation, as outlined in the MOU, is a key commercial requirement of both the LOI and the Market Development Agreement. Under the MOU, Bombardier and Rostec will validate the opportunity to set up a Q400 NextGen final assembly line in Russia that would be managed by a joint venture between the two parties. This final assembly line would produce aircraft for Russian customers and would be incremental to Bombardier's current Q400 NextGen aircraft production operations in Toronto, Canada. Bombardier and Rostec are working towards definitive agreements to be concluded in 2014, subject to obtaining the required internal, governmental and third-party approvals.

There are currently more than 120 Bombardier commercial aircraft in-service in Russia and the Commonwealth of Independent States (CIS) and over the next 20 years, Bombardier forecasts a market demand of approximately 400 aircraft in the 20- to 99-seat market in the region.

AgustaWestland and UTair Agreement at MAKS 2013

AgustaWestland announced the signing of a Service Centre Agreement with UTair Aviation of Russia during an official ceremony held at MAKS 2013. Under the agreement, UTair will act as an authorised service station, providing a comprehensive range of support and maintenance services as well as an extensive spare parts inventory for AW139 twin engine helicopters in Russia. UTair is already a certified AW139 helicopter operator with ten aircraft currently in service to perform passenger, corporate and VVIP transport missions in Russia. Aircraft are deployed and operated from bases in Moscow, Saint Petersburg, Sochi and from additional bases in Siberia. The programme foresees qualification of approximately 60 pilots and 40 technicians to fly and maintain the AW139.

The AW139 is also being assembled and delivered by the HeliVert plant located in Tomilino, near Moscow. HeliVert is a Joint Venture company established by Russian Helicopters and AgustaWestland. The plant will have the capacity to assemble up to 20 helicopters per year. Production started in mid-2012 and is progressively increasing to meet the growing demand for the AW139 helicopters in Russian and CIS markets.

AgustaWestland and Russian Helicopters' 2.5-tonne helicopter

Russian Helicopters and AgustaWestland have signed a Heads of Agreement at the MAKS 2013 air show, defining the joint design and development programme for a new 2.5-tonne class single-engine helicopter. The agreement was signed by Daniele Romiti, CEO of AgustaWestland, and Russian Helicopters CEO Dmitry Petrov. The preliminary assessment of the helicopter's technical design and commercial opportunities is expected to be completed in the next few months. The programme, first announced by the partners in summer 2012, is intended to be shared on a 50/50 basis, with the new helicopter being designed for a wide range of applications in the global market.

Vysokotochnye Kompleksy and Safran agreement on thermal imagers

Vysokotochnye Kompleksy (High Precision Systems), a Rostec State Corporation company, and Safran signed a Memorandum of Understanding (MoU) confirming the confidence of NPO Vysokotochnye Kompleksy in the high-performance thermal imagers produced by Sagem (a Safran Group company) and secures further orders of thermal imagers later this year. The partnership between Safran and NPO Vysokotochnye Kompleksy reflects more than ten years of collaboration between two of their respective companies – Sagem and Instrument Design Bureau (KBP), leveraging their complementary skills and technologies. The imaging solutions offered by KBP and Sagem have led to a number of sales successes in both Russia and international markets, reflecting the strong potential of their partnership.

United Aircraft Corporation doubles revenue in six years, order book reaches €25 bn

United Aircraft Corporation (UAC) President Mikhail Pogosyan announced the Russian aviation conglomerate's order book had reached €25 billion as its growth programme accelerates. that UAC's order book stands at more than 740 aircraft, with about one third formed by civil aircraft orders.He also announced a €200 million investment into composite aircraft production facilities for the Sukhoi Superjet 100 and MC-21 civil aircraft programmes in UAC plants in Ulyanovsk and Kazan, east of Moscow.

His remarks come as commitments for the SSJ100 are continuing to grow following an announcement that Ilyushin Finance Co had ordered of twenty of the aircraft. Pogosyan highlighted UAC's growth of 20 per cent a year and vastly increased civil aircraft production rates. Compared to 2007, revenue has doubled to €4.5 billion and UAC is targeting revenues in excess of €7.5 billion by 2015. He also stated that UAC expects to be producing more than 200 aircraft a year by 2015.

UAC will continue to consolidate and streamline the companies brought together under its umbrella brand, with forthcoming consolidation seeing Tupolev and KAPO merging. In the military sector, along with the re-organisation within Sukhoi, NAZ Sokol and RAC-MiG will also be merging.

Pogosyan played up UAC's civil aviation performance, stating that "the first delivery of Mexico's Interjet order for 20 Sukhoi Superjet 100s is a significant milestone."

Airbus shows its latest products at MAKS

Airbus showcased its leadership with the largest passenger aircraft in service, the A380, at MAKS 2013. At the show Airbus was located in the EADS stand, where visitors were able to see models of the A320neo, A350 XWB as well as the C295. In parallel, the A380 (MSN4) performed daily flying displays and was present on static display alongside a C295 transporter of the Spanish Air Force.

Airbus and Aerolia celebrate 500th ship-set from Irkut Corporation

At MAKS 2013, Airbus and Aerolia celebrated delivery of the 500th ship-set of the nose landing gear bay for the A320 family, from Irkut Corporation. The event was attended by Christopher Buckley, Executive Vice-President Sales Europe, Asia, Africa and the Pacific, Oleg Demchenko, President of Irkut Corporation and Raphael Duflos, Aerolia Chief Procurement Officer. Airbus started its partnership with Irkut in 2004 by signing an agreement for components supply as part of the strategic industrial partnership for the A320 programme. Irkut received major work packages which included the supply of keel beam, flap track and the nose landing gear bay for the A320 family. The first ship-set of the nose landing gear bay was delivered first to Airbus in 2007 then to Aerolia from 2009 when the company took over production for Airbus of the nose landing gear bay. Since then, Irkut has been increasing the production rates of this component and is currently supplying 12 ship-sets per month.

Steady progress on Sukhoi's Superjet 100

On 22 August, the Aviation Register of the Interstate Aviation Committee (IAC AR) issued a Supplement to the Type Certificate for SSJ100-95LR aircraft – the Long Range variant of the Sukhoi Superjet 100 – upon successful completion of the certification test programme. IAC AR confirmed the SSJ100 LR's compliance with current aviation regulations, which certification will allow Russian airlines to operate the SSJ100 LR.

On 15 February, a Superjet 100 LR prototype performed its ferry flight across Russia from Komsomolsk-on-Amur to the Flight Test Centre in Zhukovsky to start the certification programme. The programme included testing for stability and control performance, high angle of attack and integrity limit conditions, buffeting and shimmy, testing of engines and automatic control equipment. As part of the testing programme, the SSJ100 LR test aircraft (MSN 95032) operated 115 flight hours on more than 60 flights.

The Sukhoi Superjet 100 LR variant differs from the basic version in several respects: it has a range of 4578 km and increased take-off weight up to 49.45 tonnes. The SSJ100 LR is equipped with a PowerJet SaM146 engine with 5% increased thrust compared to the basic SSJ100.

The first Sukhoi Superjet 100 LR delivery, to Russian airline Gazpromavia, is planned for the third quarter of 2013. The aircraft is configured with full-economy class seating for 90 passengers. Gazpromavia has ten SSJ100 LRs on order.

On 27 August, during the MAKS 2013 show at Zhukovsky, Sukhoi Civil Aircraft Company and Ilyushin Finance Company (IFC) signed two firm contracts for the delivery of 20 Sukhoi Superjet 100 aircraft. The first contract was for five SSJ100 LR aircraft in 103-seat configuration, with increased passenger capacity provided by means of slimmer seats installation. Deliveries of these aircraft are expected to commence at the end of 2015. The second contract was for fifteen SSJ100 aircraft, with first deliveries in 2015.

Also during MAKS 2013, a three-party delivery contract for six Superjet 100 aircraft was signed by Sukhoi, UTair Aviation and VEB-Leasing. The delivery of these aircraft is scheduled for 2014. According to the contract, VEB-Leasing will purchase the six aircraft (worth about $217.2 million at catalogue price) and will then lease them on to UTair Aviation.

Cassidian's defence and security solutions at MAKS 2013

Cassidian showcased its defence and security solutions at MAKS with the main focus on optronic solutions for military aviation and radar systems for border and infrastructure surveillance. Among Cassidian's exhibits at the EADS booth was the missile warning system MILDS AN/AAR-60 which fits the requirements for self-defence of helicopters and wide-body aircraft in order to counter the increasing threat of IR-guided missiles. It detects incoming missile threats and indicates the direction of arrival at maximum warning time.

The Advanced Laser Threat Alerting System (ALTAS) detects laser range finders, laser target designators and, with the additional beamrider channel of ALTAS-2QB, also detects solid state beamrider sources. ALTAS can be easily integrated into higher level electronic warfare suites using standard interfaces and permits easy installation and integration on all airborne military platforms.

Also showcased was the ARGOS-II Airborne Observation System that enables helicopters to pinpoint troop movements. Moving targets can be tracked reliably for fire control systems and precise target coordinates can be sent to other units. The robust observation equipment functions even in inclement weather and through day and night.

The SferiSense helicopter laser radar system is a laser-based, electro-optical suite that detects obstacles in the flight path such as very thin cables, even when they are difficult for the pilot to see. It also projects the image of the surrounding landscape onto the helmet visor.

SferiSense helicopter laser radar system

Special Event at MAKS 2013

Ceremonial launch of book 'History of Airplane'

At launch of the book at MAKS 2013, Pushpindar Singh of The Society for Aerospace Studies giving his talk on Indo-Russian co-operation in Military Aviation. Seated on the dais are Mr DS Subolev, and other dignitaries including Mr Subrahmanyan, Managing Director, (HAL MiG-Complex)

An important event at the MAKS 2013 International Aviation and Space Salon was the ceremonial release of the book 'History of Airplane' by the well known Russian author DA Sobolev, who has written innumerable books on the subject for decades.

This took place at the Congress Centre in Hall 'Zhukovsky' on 28 August hosted by Mr Sergey Baranov, Director General of Rusavia Ltd where present were senior officials of both the Russian and Indian aeronautical industries.

As Mr Baranov wrote in his Preface, "Russian Aviation Company Ltd (Russavia Ltd) which has been in business for more than 20 years, has also been involved in publication of aircraft books and on their designers, having cooperated with well known writers and historians specialising in aviation history".

The book by Mr DS Subolev is "the first fundamental monograph in Russia about the history of world aircraft construction. In the past, historians of our country when studying domestic aviation, often exaggerated its role in the global technological progress, on the contrary, the vast majority of books by foreign authors show conquest of the air ocean only as a contribution of inventors and scientists of the USA, England, Germany and France. Today the reader can count on a more objective overview of aviation development. Only this approach can present the true picture of evolution of aircraft, which is one of the symbols of modern technical progress".

Mr S Subrahmanyan with Mr Mohan Naagir (former Director Design & Development, HAL)

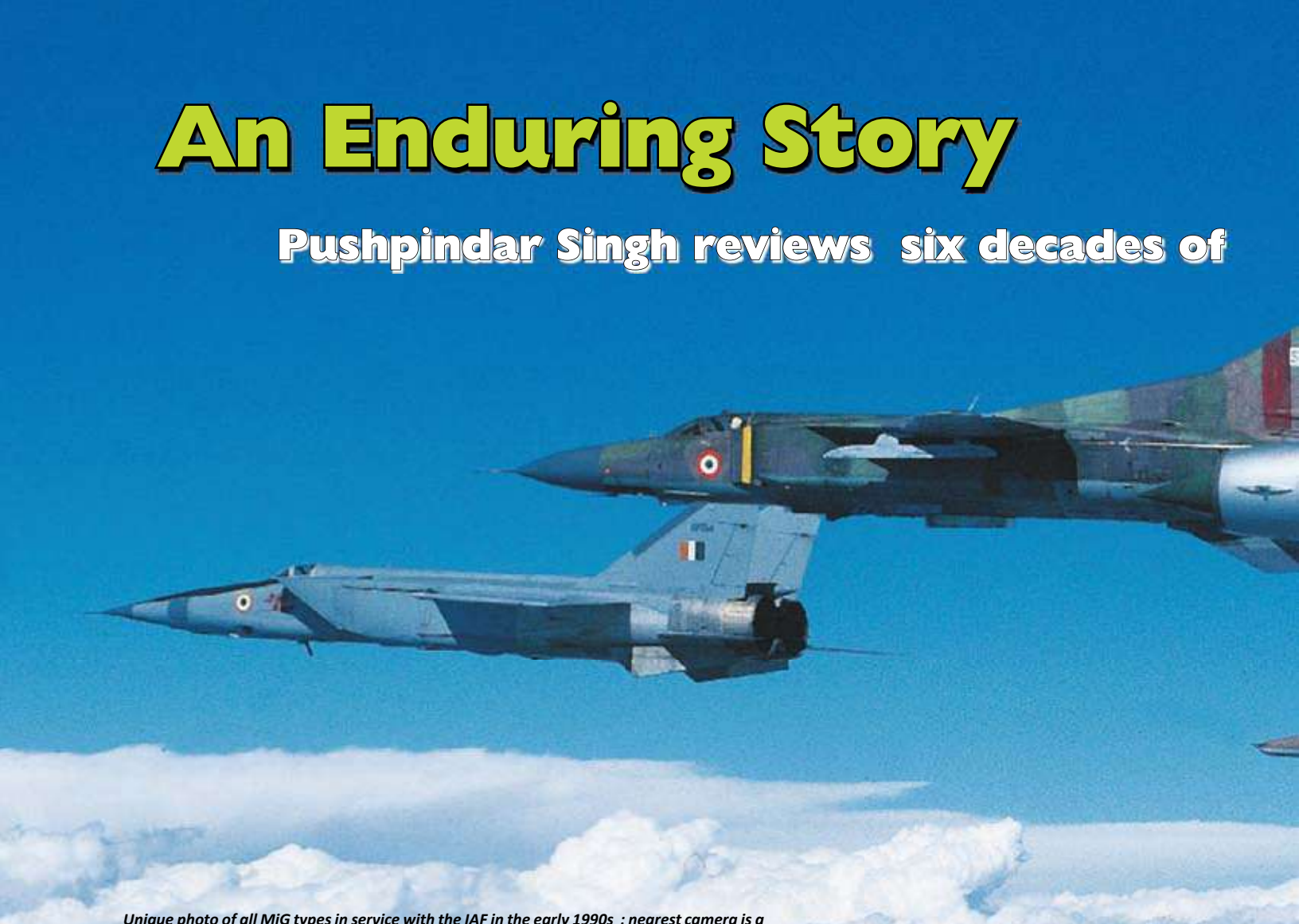
"The monograph in English was issued at the same time with the monograph in Russian. I am very pleased that our Indian friends and colleagues took an active part in this project. I am particularly grateful to the Chairman of Hindustan Aeronautics Limited (HAL) Dr RK Tyagi, who took the trouble to write the introduction to the book. The famous Indian writer and historian Pushpindar Singh took part in the work on the text, and the translation was carried out with the assistance of the Indo-Russian Aviation Limited (IRAL)".

Apart from well known Russian aviation personalities, including former senior Air Force Marshals and Director Generals of Industry, speakers included Mr S Subrahmanyan, Managing Director (HAL MiG-Complex) and Mr Pushpindar Singh who contributed the special section on 'Indo-Russian Co-Operation in Military Aviation'.

Irina Vladykina and Mr Sergey Baranov

An Enduring Story

Pushpindar Singh reviews six decades of



Unique photo of all MiG types in service with the IAF in the early 1990s : nearest camera is a MiG-21M and (in order beyond) MiG-23MF, MiG-25R, MiG-27ML and MiG-29B.

For well over half a century, Russian (earlier Soviet)–origin military aircraft have adorned Indian Air Force markings and from the mid-1970s, also those of Indian Naval Aviation aircraft. The statistics themselves tell of this grand story, that of the unrivaled co-operation in aviation, and much else, between these two major nations of the world. Some 33 different types of aircraft, including helicopters, totaling nearly 2500 in number, have served with distinction in India, both in war and peace, and of those, nearly half that number have been built under licence by Hindustan Aeronautics Limited in India.

These strong links are continuing well into the 21st century, with the Indian Government signing co-operation agreements with Russian aerospace companies to jointly design, develop and produce next generation aircraft types including the T-50 fifth generation fighter aircraft (FGFA) and multi-role transport aircraft (MTA) even as production of the Sukhoi Su-30MKI continues apace.

Although a handful of transport aircraft from the then Soviet Union had been received by the IAF in the mid 1950s, the year 1962 marked a watershed in the plans and procurement policy of the Government of India when the first combat aircraft of non-Western origin were selected and ordered for the Indian Air Force.

The paradigm change

Such decision to order combat aircraft from the Soviet Union represented a major policy change, departing the first time from the traditional (i.e., British and French) sources for meeting the requirements of the Indian Air Force. The compulsions behind the final decision to induct the MiG-21 supersonic tailed-delta fighters into IAF service were dictated largely by political but also economic and strategic considerations. Induction of the MiG-21 into IAF service and then to mass produce it under licence by HAL in-country was most fortuitous and it is, indeed, difficult to visualise the size and status of the Indian Air Force for over 50 years without its MiG-21 variants. The vital and far-reaching decision to simultaneously manufacture the MiG-21 under licence by Hindustan Aeronautics Limited (HAL) was also the means of acquiring such enhanced performance capability in meaningful quantity. Indeed, it was only the MiG-21 family of fighters that could be afforded in the quantum required to raise new fighter squadrons and reequip those flying obsolescent aircraft types.

On 29 August 1962, the Government of India entered into an agreement with the USSR Government for production in India of the MiG-21FL (Type 77),

Indo-Russian co-operation in military aviation

its powerplant (R-11 F2), forgings and casting, avionics and K-13 air-to-air missiles. The Government's decision was followed by the establishment of an entity named Aeronautics India Limited on 16 August 1963, a Company to produce the MiG-21 and the various components in India. Mr. Sucha Singh Khera a senior ICS Officer, later the Cabinet Secretary, was hand picked by Prime Minister Jawahar Lal Nehru to be AIL's Chairman.

Bestowing both quality and quantity

Even as work began to plan the factories, the main MiG-factory at Ojhar (near Nasik, 250 km. from Bombay) being allotted 3662 acres of land on the Bombay-Agra national highway, the Government of India took a policy decision to re-organise the entire Indian aviation industry and on 1 October 1964. Aeronautics India was merged with HAL and AMD (Kanpur) to form Hindustan Aeronautics Limited, thus keeping intact the acronym 'HAL'. The MiG-Complex of HAL was thus to consist of Divisions at Nasik, Koraput and Hyderabad, with Air Vice Marshal AS Rikhy as the first Managing Director, his place being taken many years later by other pioneers including Air Commodore CR Kurpad and then Gp. Capt. SC Keshu.

The aircraft factory at Ojhar had, literally, to be built from the grass roots, the personnel recruited to man it also to be trained for aircraft assembly and construction from scratch. The Department of Defence Production and Government of Maharashtra worked out detailed plans and, firstly, established the Aeronautics India Limited (AIL) office at the Old Distillery Building in Nasik Road not far from the railway station. Service personnel were seconded from the Indian Air Force, Air Commodore M. Bhaskaran being appointed as the first General Manager, a most fortuitous choice as he was not only professionally most competent, but a great human being and leader, inspiring the increasing numbers of fresh employees from varied backgrounds, into performing with great spirit and energy.

In association with the Department of Technical Education, the Maharashtra Government, AIL and the IAF, a Technical Training Centre was set up the first batch of 300 trainees joining in August 1963 itself, being all diploma holders from Industrial Training Institute (ITIs). The training course was for 18 months, the first batch "graduating" in the aeronautics cadre in March 1965 even as the second batch of 400 trainees had joined in January 1964.

The barren land at Ojhar was almost magically to be transformed into an aircraft building plant, with complexes of hangars and buildings and roads, runways, taxi tracks and aprons. Construction first began of the runway, taxi tracks and

Another unique photograph showing the last of the MiG-21s alongside first of the MiG-27s at the Nasik assembly line.

ATC tower. The first building was the flight hanger and then, in order, the final assembly, sub-assembly buildings, tool room complex, engineering block building and, manufacturing shop complex.

Simultaneously, the HAL Township at Ojhar was built for the officers and men, and for the large number of Russian specialists and advisors who were beginning to arrive. At the start, there was one Russian for every 4 Indians, reaching a peak of 400 Russians, including some families, who worked very hard but also demanded recreational facilities, a large swimming pool and the very popular Kino theatre, "the best in Nasik". Eventually, some 4000 quarters were constructed for the workers and their families as also the officers plus a large guest house to accommodate visitors. Foundation stone for the main administration building at HAL Ojhar was laid by Air Vice Marshal Ranjan Dutt, HAL's Managing Director, on 5 August 1966. In January 1975, the General Manager 'Jimmy' Bhandari unveiled a symbolic metal monument "In commemoration of 10 years of successful Indo-Soviet collaboration in the aircraft industry, 1965-75".

The first MiG-21s came in CKD form, four crates for each aircraft comprising forward and rear fuselage, engine and wings. Since the normal Bombay-Nasik railway line had a number of tunnels, too low for the massive crates, the special flat wagons were routed from Bombay via Surat, Bhusaval, Manmad to Sukene, offloaded and brought by IAF trailers to Ojhar. The first MiG-21s were assembled by Russians and test flown by Russian pilots before IAF pilots (Wing Commander 'Granny' Dhiman, Sqn. Ldrs. Brijesh Jayal and Inderjit Singh Sandhu were the pioneers) test flew the aircraft and accepted them for the Indian Air Force. Other senior IAF officers seconded to Ojhar were Sqn Ldrs B. Bose who combined his ATC duties with overall security of the complex, S.J. Gomes and Manjit Singh (in-charge of the missile development). From HAL Bangalore came D.S. Krishnamurthy as Factory Manager.

Inevitably the HAL Ojhar Employees Union was soon established, under the leadership of Geroge Fernandes, the founder of Bombay Labour Union and who, 35 years later, would visit the HAL Ojhar Division as India's Union Defence Minister !

When Jawaharlal Nehru, Prime Minister of India, first saw the barren land at Ojhar, he urged the officers seconded to the project to "Dream of India, transform this wasteland into a most modern factory, make it a reality." Under Air Commodore

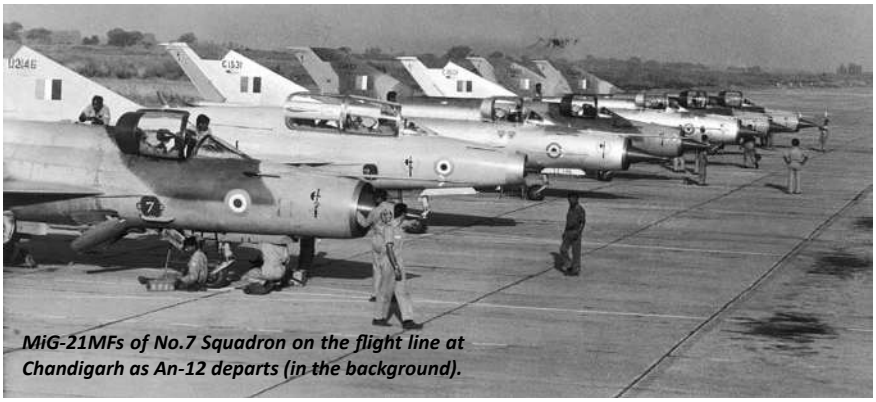
Elbit

Bhaskaran's sterling leadership, the company set upon its objective of flying the first aircraft from Ojhar by 1966. This was achieved, the first MiG-21FL in fact being delivered ahead of schedule on 16 October 1966.

Amongst the 200 Soviet 'advisors' was Geronin, who was a senior research scientist at the MiG-OKB at Moscow, followed by Rekshinsky, the First Chief Designer, and then E Lazbinov who was designated as Chief Designer and Technical Adviser to the General Manager of HAL Nasik. Russian test pilots, also seconded from Gorky (now Nizhny Novgorod), were responsible for test flying and clearing the MiG-21s first assembled and then built at Nasik. Every section had Russian specialists : flight testing, engine installation, machine shops, sheet metal work, welding, rubber and plastic, plus quality control. The Russians made themselves at home at Nasik and relationships with the HAL personnel were close and very friendly, not only at the manufacturing plant but socially with football matches, stage shows and picnics organised by the Ojhar community.

By 1966, there were over 2000 personnel at Ojhar, a tenth of them being Russians, but from 1970, their numbers began to taper down. When the follow on MiG-21M, (Type 96), and then MiG-21bis (Type 75) programmes were initiated, in 1973-74 and 1979-80 respectively, some more Russian specialists from Gorky were seconded and again when the MiG-27ML programme began in the mid 80s, they came from Irkutsk in Siberia.

The MiG-21 being considered as the 'backbone' of the Indian Air Force, the HAL factory at Ojhar was a strategic target, and air defences were accordingly set up. Prior to and during the December 1971 conflict in the sub-continent, two fully-armed MiG-21FLs remained on ORP readiness at Ojhar airfield around the clock even while air defence guns were positioned around the perimeter. On conclusion of this war, and in acknowledgment of the sterling performance of the HAL-built MiG-21FLs, Air Chief Marshal P.C. Lal, Chief of the Air Staff and former Chairman of HAL from 1966-69, specially visited the Nasik Division along with Air Marshal G.B. Singh, the Air Officer-in-Charge



MiG-21MFs of No.7 Squadron on the flight line at Chandigarh as An-12 departs (in the background).

Maintenance to laud the workers and share the nation's triumph.

In the early months of 1964, the Government of India (GOI) had revised the original schedules for the MiG-21's production in India, accepting that perhaps these they were too ambitious in terms of time and shortage of trained supervisory staff and skilled workmen. Even as the factories for manufacture of the MiG-21's airframe, engine and electronics were being constructed and in keeping with the Indian Air Force's anxiety to acquire supersonic intercept capability at the earliest, the GOI contracted for the direct supply of additional 'flyaway' aircraft from the USSR. Yeshwant Chavan, the then Defence Minister visited Moscow and on return announced that agreements had been reached with the Soviet Government for the supply of a further batch of MiG-21s "almost immediately" which with the surviving MiG-21Fs received under the 1962 agreement, would enable three IAF squadrons to be equipped with the type.

A further lot of MiG-21s were to follow in the form of CKD assemblies and the supply of jigs, tools, and other plant equipment for licence-manufacture of the MiG-21 in India would be accelerated. Plans were made for the assembly and progressive-manufacture in India of well over 400 MiG-21s although (in 1964) it was assessed as unlikely that MiG-21s with "substantial" Indian-manufactured components would be delivered much

Frontal view of MiG-21bis

Irkut

before 1969-70. As for costs, it was estimated that, at Rs. 40 lakhs per aircraft, (US$ 200,000) the HAL-built MiG-21 would eventually cost roughly 10 percent less than that imported from the USSR.

The Department of Defence Production announced in mid-1966 that the MiG-21 manufacturing programme was to proceed in four distinct stages culminating in the manufacture from raw materials. The airframes were to be produced at the new plant at Ojhar, the Tumansky R-11 turbojets at Koraput, Orissa, while the ancillary factory at Balanagar, Hyderabad, was to produce the AAMs and avionics. A batch of MiG-21s purchased from the USSR were test flown in Russia, dismantled, shipped to India and reassembled at Nasik under Russian supervision. The definitive version selected for import and manufacture was the MiG-21FL (*Forsazh Lokator*), designated Type 77, which differed, primarily in the airborne radar, the type R2L search and track system being fitted. Also received in late 1965 were a number of MiG-21U (*Uchebne*) tandem-seating trainers of the "Mongol-A" version and designated Type 66.

Assembly of the first MiG-21FL at Nasik began in November 1966, and by March 1967, the first 15 airframes had been assembled and delivered. The initial aircraft were of course, equipped with imported turbojets. The progressive stages in the manufacture of the MiG-21FL airframe were attained as per schedule, the first MiG-21FL produced from raw materials was handed over to the IAF at Nasik, its indigenous content being 60 per cent. The 'last' of 197 MiG-21FLs were delivered in March 1974 and there were followed by the MiG-21MF (Type 96) which retained the distinctive clipped-delta platform wings swept back approx. 57°, with slight anhedral from the roots and a sharply-swept tail plane. It differed externally from the MiG-21FL in having a large dorsal spine fairing along the fuselage top from canopy to fin while the cockpit canopy was sideways-hinged to starboard and surmounted by a small rearview mirror. Some 36 of this variant were imported to re-equip two IAF fighter squadrons and a licence agreement for the manufacture of 162 MiG-21Ms in quantity was signed in October 1969. The first MiG-21M of the assembly phase were delivered to the IAF in February-March 1973 and the raw material phase began in November 1975 continuing till September 1981, when the last raw material aircraft was delivered to the IAF. The Government of India had now been offered the far superior and "definitive" version, the MiG-21bis (Type 75). Following the earlier pattern, a batch of 70 aircraft were imported directly from the Soviet Union even as in August 1976, HAL signed an agreement for licence manufacture of 220 MiG-21bis, its R-25 powerplant and associated equipment, avionics and accessories at its various Divisions. The first Type 75 was delivered from the assembly phase in November 1978.

The last of MiG-21bis aircraft was delivered in March 1987. The first batch of Tumansky R-25 engines were received directly from the USSR, then being produced in progressive batches by March 1982, with a total of about 300 R-25-300 engines built by the engine division at Koraput.

The MiG-21bis was 'promoted' as a multi-role fighter and began to reequip some of the earlier MiG-21FL-equipped squadrons, a few flying the MiG-21M and one with the Sukhoi Su-7. At the peak, ten squadrons of the IAF were formed with the MiG-21bis.

Following the MiG-MAPO proposal to majorly upgrade the MiG-21bis (from 2nd to 4th generation, with the latest avionics, airborne radar and missile combination, the Indian Air Force finalised the programme in 1996 when the upgrade was signed. A total of 125 Mig-21bis aircraft were 'converted' to the 'Bison' standard to equip six squadrons. It is perhaps poetic justice that the IAF's oldest and most venerable fighter type has had the distinction assuring in new generation technologies, systems and weapons.

With nearly 1000 MiG-21s of various versions operated by the Indian Air Force for over 50 years, at the peak some 24 frontline fighter squadrons flew the type. In addition there were another three squadrons equivalent of MiG-21s with the MOFTU and OCU for advanced jet training and type conversion while experimental test pilots enhanced capabilities and evolved tactics at the ASTE and TACDE.

The MiG-21's prowess will be forever enshrined for its successes in December 1971 when its versatility was proven in war. In the western sector, MiG-21s notched aerial victories over F-104s and other enemy fighters while in the eastern sector, MiG-21s supported the Army's lightening advance with precision attacks on key strategic targets.

It is, indeed, difficult to visualise the size and status of the Indian Air Force for half a century without its MiG-21 variants which constituted, through till the 1990s, the service's combat backbone. It was this type that literally propelled the IAF into the supersonic era at a time when the transonic Hunter, Mystere IVA and Gnat were its fighter mainstay. The far-reaching decision to simultaneously manufacture the MiG-21 under licence by HAL in India was the means of acquiring such enhanced performance capability in meaningful quantity. It was essentially the MiG-21 family of fighters that could be afforded in the quantum required to raise new fighter squadrons and re-equip those flying obsolescent aircraft types. In summary, the MiG-21 gave the IAF both quality and quantity and today, five decades after the first IAF pilots converted onto the type, the MiG-21 still remains, in sheer numbers, the largest combat type with India's air arm.

Production of the MiG-21bis by India was to be supplemented at HAL, Nasik by the follow on MiG-27ML programme and for a few years, even as the last MiG-21s were being completed, the first batches of MiG-27s were being produced, this unique side-by-side structure continuing till March 1987, and from then onwards, the swing-wing tactical fighter occupied the HAL Nasik production lines exclusively for the next ten years with some 165 of this type built.

Supersonic strike Su-7s

The Sukhoi Su-7 was also operated by the Indian Air Force but its frontline service was relatively shorter. A highly swept wing fighter aircraft developed by the Soviet Union, the Su-7 became the first ground attack fighter aircraft with supersonic capabilities to achieve service status. In the mid-60s, even as the MiG-21 was being received in increasing numbers, the Indian Air Force sought a high performance offensive air support aircraft to replace the Mystere IVA and HF-24 Marut. The Indian Air Force evaluated

the Sukhoi Su-7 tactical fighter in the summer of 1967. This evaluation was followed rapidly by a contract for some 90 Su-7BMK fighters and Su-7U two-seat conversion trainers. The first aircraft arrived by ship at Bombay, assembled at Santa Cruz Airport and delivered to No. 26 Squadron which became the first squadron to operate the new type in March 1968.

Induction of the Su-7 in the IAF was extremely rapid and No. 101 Squadron followed in July 1968, with No. 221 Squadron converting to the Sukhoi in August. Two more batches of Su-7s were ordered, thus taking the total procurement to 140 aircraft, and enabling formation of 3 more squadrons (No.32, No.108 and the newly-raised No.222 being formed in September 1969). Thus, within 18 months, the IAF had raised six squadrons of supersonic attack aircraft, dramatically boosting its overall strike potential. The Su-7 force was earmarked for the roles of offensive air support, counter-air, short range interdiction and tactical reconnaissance. The Su-7 had impressive performance, with a maximum speed of 1056 mph at 40,000 feet and an initial climb rate of 29,900 ft/min.

The sub-continent was plunged into armed conflict on 3 December 1971 with Pakistan's pre-emptive air strike that evening. Thereafter, from the fourth morning until the cease-fire on 17 December, the six Su-7 squadrons became responsible for the bulk of attacks by day, flying nearly 1500 offensive sorties, ranging from counter-air to short-term interdiction, close air support and tactical reconnaissance.

For over a decade since that war, the Su-7 remained in the front-line force, a number of squadrons were re-equipped with the MiG-21M and MiG-23BN, while the last Su-7 formations (No.32 and No.222 Squadron) converted to MiG-27s in 1984-85.

The swing-wing era

Genesis of the MiG-23 family (NATO code Flogger, IAF name *Vijay*) in service with the Indian Air Force is traced to the late 1970s when the Tactical Air Strike Aircraft (TASA) requirement was to be met. The MiG Design Bureau had, in the mid-1960s, begun development work on a MiG-21 successor, with greater payload, range, firepower and new sensors

HAL-built MiG-27ML of the Indian Air Force (photo : Angad Singh)

but retaining the characteristic good airfield performance of the MiG-genre. A radical approach was to incorporate variable-geometry wings, such a 'swing-wing' concept having been adopted to compromise on the conflicting requirements of high-speed flight with good low-speed handling as also airfield landing performance. Sweepback of the wings in flight or on ground was to three notches at 16°, 45° or 72°.

The resultant MiG-23 was powered by a massive Tumansky R-29B turbojet and following some years of development and flight trials, was ordered into production in the late 1960s. The initial fighter was optimised for air defence, with first Soviet Air Regiments flying the MiG-23MF as the primary air-to-air tactical aircraft in Eastern Europe and the Soviet Far East, with Warsaw Pact air forces following shortly thereafter as also export of the type to various countries in North Africa and West Asia. The MiG-23MF had early-model beyond-visual-range plus close combat missiles, pylons for rocket pods and the reliable GSh-23 cannon in a belly pack. The MiG-23U was a tandem-seating operational conversion trainer but forward view of the pilot from the back seat was limited.

The MiG-23BN was a single-seat ground attack and interdiction version with sharply tapered nose, raised ejection seat, external armour plate but retaining the powerplant, variable-geometry intakes and armament features of the interceptor version. The MiG-27 was further development of the MiG-23BN, being optimised for the ground attack strike role, having the same tapered nose but including a small sloping window covering the laser range finder and marked target seeker. The ejection seat and canopy were raised to improve the pilot's view and a 6-barrel 23mm Gatling-type gun was installed underbelly. There were bomb racks under each side of the rear fuselage in addition to five pylons for external stores.

An Indian Air Force test pilot team, led by Wg Cdr Philip Rajkumar had test flown and evaluated the MiG-23BN at Lugovaya in April-May 1979 and as per the LTREP, the Cabinet Committee for Political Affairs (CCPA) thereafter cleared acquisition of 95 MiG-23BNs and 15 MiG-23U operational conversion trainers for the IAF in November 1979. Licence manufacture of the MiG-23BNs were to follow at HAL Nasik, subject to confirmation after operational experience on the type. (In the event, the MiG-27ML was selected for production in India).

IAF and HAL teams visited the Soviet Union in February 1980 for detailed discussions on the MiG-23BN and its variants, essentially to meet the IAF's TASA requirement, as distinct from the DPSA. The Government shortly thereafter formalised an agreement for the direct supply of MiG-23BNs and a follow-on licence for manufacture of the optimised MiG-27ML to replace the Sukhoi Su-7, HF-24 Marut and Ajeet with existing IAF offensive/close air support squadrons.

Eight pilots, nine engineering officers and 55 airmen of the IAF left for the Soviet Union on 1 September 1980 for conversion training on the MiG-23 variable-sweep fighters and their support systems. From Moscow, the team flew on to Frunze in Kyrgyzstan and then by train to Lugovaya in Kazakhstan to begin training, this being completed by end-December 1980. The pilots were given 15 hrs each on type and returned to India even as the first aircraft (in crates) were being unloaded at Bombay port on 10 December 1980. These were assembled, test flown by Soviet pilots before being handed over to the IAF on 20 January. First IAF unit

on the swing-wing fighters was No. 10 Squadron which was re-formed at Jodhpur on 1 January 1981.

True to tradition, the IAF wanted to display their latest acquisition at the forthcoming Republic Day Parade, just two weeks thereafter. There was feverish activity at Nasik and by 14 January the first MiG-23BN was assembled and test flown. Air Marshal CV Gole, the Deputy Chief, ordered that 3 MiG-23BNs be deployed to the north, first of the 'swingers' flying over the capital city on 24 January 1981 two days before the 'big show'. Batches of MiG-23BNs were thereafter flown to Jodhpur in March 1981. By August 1981, number of MiG-23BNs and MiG-23Us were available for No.10 Squadron to also begin conversion of No. 220, the next squadron with the new fighters.

As increasing numbers of MiG-23BNs were received from the Soviet Union, conversion training of pilots and maintenance personnel was conducted at Jodhpur. Over 2000 flying hours were logged by the initial batch of MiG-23 aircraft in the very first year. These added an additional measure of potency to the IAF offensive air support fleet, being able to carry nearly twice the ordnance, over twice the distance of its predecessors, but with far greater reserves of speed and agility.

Pilots praised the swing-wing fighter's handling qualities: transition of wing sweep to and from any of its three positions was smooth and uncomplicated, the aircraft relatively steady at low level and high speed. Take-off run was shorter than that of the preceding types and the undercarriage, somewhat complex in appearance, was actually an ingenious design, the large low-pressure tyres permitting operation from rough airstrips. The MiG-23BN retained the centre-line GSh-23 cannon, which had an effective, high rate of fire and six under-fuselage and wing glove hard points which could carry a variety of ordnance ranging from retarders to M-62 iron bombs and varying calibre air-to-ground rockets.

In January 1982, year of the IAF's Golden Jubilee, two formations of MiG-23BNs took part in the Republic Day flypast. The IAF's 50th Anniversary celebrations had got off to spectacular start when even as the magnificent two-hour parade down the grand avenue of Raj Path drew to a close, the crowd of over a million witnessed the fast, low flying jets that provided an awesome finale. The MiG-23s, after-burners on, flashed past, just 100 metres above the parade.

The 50 aircraft that took part then not only symbolised 50 years of the IAF in 1982 but vividly illustrated the composition of India's air arm which integrated aircraft of Western, Soviet and Indian design and more significantly, the fact that all these aircraft types were to be produced in India. The MiG-23BNs were soon thereafter part of the fire power display at Tilpat Range and were inspected by the visiting Soviet Defence Minister Marshal Ustinov who was reportedly most impressed by the professionalism he witnessed.

No. 221 Squadron replaced their Su-7s with MiG-23BN in March 1982 and No. 31 finally retired their HF-24 Maruts in March 1983, becoming the fourth and final unit with the MiG-23BNs.

Licence agreement for production of the dedicated MiG-27ML variable-geometry strike fighter by HAL at Nasik, together with its Tumansky R-29D engine at Koraput, was signed between the two Governments also in March 1982 and extensive upgrading of HAL's facilities became necessary to cater for the technologies involved in production of this new technology combat aircraft. The first batch of MiG-27Ms, produced from CKD kits, were delivered to No.222 Squadron (formerly with the Su-7) in the spring of 1985 and with production momentum building up, additional squadrons were earmarked for re-equipment with the type in the coming years. The MiG-27MLs replaced all the Ajeets with Nos. 2,9,18 and 22 Squadrons and thereafter, No.10 also converted on the type which supplanted its MiG-23BN with the MiG-27ML, total of 165 aircraft being built by HAL at its Nasik Division.

A two year programme of upgrades involving MiG-27s built in India was carried out during 2002-2004 and performed at HAL Nasik under the direction of Mr Mohan Nadgir. The upgrade was aimed at performance improvement in multi mission tasks, enhanced weapon carrying capability and survivability in hostile environment. Also, importantly, pilot comfort and efficiency was to be addressed to reduce workload and increase efficiency to better man-machine interface. Some 40 MiG-27ML of the IAF were upgraded and will continue in frontline service till the end of the decade.

Trisonic MiG-25s for strategic reconnaissance

The MiG-25 had been conceived in the late 1950s to provide defence against the trisonic USAF B-70 strategic bomber and reconnaissance aircraft. The latter project got cancelled but the MiG-25 project continued partly for its great potential as a high altitude interceptor/reconnaissance platform. The MiG-25 and its variants established several world records and remained one of the fastest combat aircraft in the world.

The Government of India felt the requirement of having strategic reconnaissance capability and the IAF required an ultra high altitude aircraft in its inventory to meet various commitments with the change in the security environment in the Indian subcontinent. The enigmatic MiG-25 was inducted in No.102 Squadron 'Trisonics', under the command of Wg Cdr AJ Singh at Air Force Station, Bareilly on 17 August 1981 with five MiG-25 Reconnaissance aircraft and two MiG-25U trainers. The first operational mission was flown in October 1987, and the 'Foxbat' first went on public display at the Indian Air Force Fire Power Demonstration at the Tilpat Range in March 1989.

The MiG-25R was equipped with a number of electromagnetic-spectrum sensors along with a larger and more capable side-looking airborne radar (SLAR). It is also fitted with two left-to-right rotating cameras of a focal length of 650mm and 1300mm that could be fitted in the three interchangeable camera bays located in the nose cone of the aircraft. On 24 October 1995, a two-seater MiG-25 flew "chasing the sun" to photograph the solar eclipse over India, assisting Indian scientists, attempt to measure the exact diameter of the sun.

During the summer of 1999, MiG-25Rs flew many innovative reconnaissance missions over the high Himalayas capturing on film the enemy locations and supply routes which gave the IAF much needed intelligence.

The MiG-25's, original calendar life was fifteen years but in 1995 it was

pushed by another ten years. The aircraft was finally phased out on 1 May 2006 at a special ceremony at the Air Force Station Bariely. Even though the MiG-25 still had many years of airframe life left, for logistic reasons the aircraft was taken out of service and all the aircraft airframes sent out to be preserved at various air bases and the Indian Air Force Museum at Palam.

The MiG-29B ('Fulcrum')

Although in the early 1980s, the Government of India was receiving batches of Anglo-French Jaguar strike fighters and limited numbers of French Mirage 2000 multi-role fighters, it was felt at the highest government levels, that the new, and hitherto unrevealed, MiG-29 be evaluated.

In an epoch-making move, the Soviets offered a still under-wraps, top-of-the-line air superiority fighter from the Mikoyan design bureau for the IAF. Rumours that such a type existed had been around for a few years, with satellite photographs showing hazy outlines of a new generation fighter under experimental trials in the Soviet Union (coded as Ram-K and Ram-L by NATO). When IAF test pilots were invited, in April 1984, to test fly the new MiG, history of a kind was created as not only were Air Cmde Prithi Singh and Wg Cdr Mike Mittal the first foreign pilots to fly this advanced fighter but prospects were that the IAF could receive the Soviet Union's most advanced fighter/weapons system even before any of the Warsaw Pact air forces would.

In 1986, the Indian Air Force selected the MiG-29, twin engine air superiority fighter to replace the MiG-21FL for air defence, and became the first international customer of the MiG-29. When the Indian Air Force placed an order for more than 50 MiG-29s in 1980 the aircraft was still in its initial development phase, and the aircraft thereafter underwent a series of modifications with the addition of new avionics, subs-systems, turbofan engines and airborne radars. The MiG-29 was inducted in the Indian Air Force with No.47 Squadron ('Black Archers') on 5 December 1987 at Lohegaon Air Base, Pune and this was followed by No.28 Squadron ('First Supersonics').

Amongst the first pilots to convert on the MiG-29 was Sqn Ldr Arup Raha (now Air Marshal and Vice Chief of Air Staff) who recollects the conversion months at Lugovaya thus : "in March 1987 the team returned to India and in April-May 1987, the 'Black Archers' moved to Poona for raising of the first MiG-29 squadron. Most of the Soviet-trained aircrew and technicians were sent to Ozhar where the aircraft had arrived in huge mother-crates for erection. Soon regular acceptance check sorties were being flown and the aircraft ferried to Poona. By mid-1987, regular flying activities commenced and the 'First Supersonics' also moved to Poona to form the second MiG-29 squadron. Formal induction of the MiG-29 into the IAF by the Prime Minister in September 1987 was a memorable occasion. The low level aerobatics display on the MiG-29 by Wg Cdr Harish Masand was an awesome performance, which heralded induction of the finest air superiority fighter in the sub-continent, boosting the confidence of the IAF to an unprecedented level."

Pair of MiG-29Bs of No.28 Squadron ('First Supersonics') over the Saurashtra Coast.

On 6 December 1987, the Indian Air Force formally inducted the new generation MiG-29 in presence of the Defence Minister KC Pant, Air Chief Marshal DA La Fontaine and the Soviet ambassador VN Rylcov at Lohegaon air base (Poona).

At an impressive ceremony, the MiG-29 flew along with the other earlier MiG-types (the MiG-21, 23, 25 and 27), in an unusual mixed type formation led by none other than Air Marshal SK 'Polly' Mehra, one of the pioneers of No.28 Squadron and then AOC-in-C South Western Air Command. After take-off, the Squadron Commander took his MiG-29 straight up into the "blue skies only to return in minutes to awe-inspiring feats of spinning and various manoeuveres".

The grand finale that morning was provided by an-all 'Baaz' formation patterned on the silhouette of a MiG-29 aircraft itself. By the time the awe-struck spectators stopped clapping, two formations of MiG-29 in starboard echelon appeared in front and did a final peel off, before landing, bringing the curtain down on a scintillating 45-minute show.

During the induction ceremony, Defence Minister KC Pant emphasised that acquisition of the MiG-29 was a major landmark in modernisation of the Indian Air Force. "The MiG-29 is a topnotch aircraft, which any airforce in the world would be proud to acquire and operate".

Pointing out that the military scenario was rapidly changing all over the world, Mr Pant said that it was important to acquire such aircraft and equipment as were likely to maintain our relative strength. He expressed grave concern at the unabated supply of very advanced weapons, aircraft and equipment to "a neighbouring country" on a very large scale in the recent past.

Addressing the aircrew of the latest induction, Air Chief Marshal DA La Fontaine said the MiG-29 'Baaz' marked a significant departure in design and quality from what air forces from other parts of the world possessed at present. "You are the pioneers. Fly hard and fly well. Make the maximum use of

the tremendous potentialities of the sophisticated machinery that has now been placed at your disposal," he said.

Some years later, a third Squadron, No.223 ('Tridents') was formed with a fresh batch of MiG-29s in November 1989. Eight additional MiG-29B, and two MiG-29UB were ordered in 1994 and delivered to the Indian Air Force in 1996 and thereafter, the MiG-29s have been operated extensively including for air superiority missions during the 1999 Kargil operations in Northern Kashmir.

Even as the three MiG-29 squadrons of the IAF have been honed for their exacting tasks, the type is being upgraded to take it to contemporary generation standards. According to a statement by Defence Minister AK Antony at Parliament on 23 November 2008, the Government of India signed a contract for up gradation of the Indian Air Force MiG-29 fleet with the Russian Aircraft Corporation - 'MiG' on 7 March 2008. The contract also envisages that major aircraft overhaul and retrofitting will extend their service life to 3,500 flight hours and 40 years. Thus, the Indian Air Force have leap frogged to get a fourth generation multirole combat aircraft, even if it is modestly referred to as the MiG-29UPG.

According to RAC-MiG "the new avionics package will greatly enhance the MiG-29's capabilities which at the moment is largely restricted to air-to-air roles. With the new systems, the MiG-29s will have an anti-land and sea capability". New equipment will include the multifunctional radar Zhuk-E, an advanced onboard computing complex, a new weapon control system, an optronic station based on space technologies and. a cockpit with colour multi functional displays. Weaponry includes a substantially expanded range of air-to-air missiles and guided missiles to destroy ground and sea surface targets with 'smart' aerial bombs.

The retrofitted MiG-29's avionics suite will also include a number of systems developed and produced by HAL and BEL, along with some enterprises from other countries including France and Israel. The first six MiG-29s have been upgraded-and flight-tested in Russia, while the overhaul and modification of the balance MiG-29s will be carried out in India at IAF Base Repair Depots with the equipment kits coming from RAC-MiG in Russia.

One of the first IAF MiG-29s to be upgraded in Russia.

That the generic MiG-29 will have a long innings in service in India has been confirmed by the Indian Navy's selection of the navalised version (MiG-29K) for service on board its aircraft carriers. In January 2010, India and Russia signed a deal under which the Indian Navy would acquire 29 additional MiG-29Ks, bringing the total number of MiG-29Ks on order to 45. The MiG-29K officially entered service with the Indian Navy in April 2013 but before this several Indian Naval pilots converted to the MiG-29 with the Indian Air Force at various air bases (more on the MiG-29K in the subsequent chapter).

The Sukhoi Su-30 MKI dominates Indian skies

After selecting the Sukhoi Su-30 new generation fighter in 1995 as the essential platform to meet the Indian Air Force's air dominance requirements in the new century, the Su-30MKI variant was jointly developed by Russia's Sukhoi Corporation and India's Hindustan Aeronautics (HAL). The MKI's airframe evolved from that of the Sukhoi Su-27 while most of the avionics were developed by India with some cooperation with other countries. The Su-30MKI incorporates state-of-the-art avionics developed by Russia, India and Israel and which includes display, navigation, targeting and electronic warfare systems.

The Su-30's thrust vectoring controls give it incredible agility and this has not only been displayed at international events (such as by the similar Su-35s at Paris Air Show in 2013) but during 'Red Flag' Exercises with the USAF in 2008. The Su-30MKI is reportedly more advanced than the basic Su-30MK, the Chinese Su-30MKK/MK2 and the Malaysian Su-30MKM "The Indian Air Force's Sukhoi Su-30MKI is a generation ahead of Su-30MKK/MK2 fighters given

Su-30MKI of No.20 Squadron over the desert

to China." stated a Russian official and Russia's Defense Ministry was impressed enough with the performance envelope of the variant to have ordered 30 Sukhoi Su-30SMs, a similar version of the Su-30MKI, for the Russian Air Force.

The Government of India had initially signed a US$1.462 billion deal with the Sukhoi Corporation on 30 November 1996 for the delivery of 40 (later another 10 were added) Su-30MKI aircraft, powered by AL-31FP turbofans. These 50 aircraft were manufactured by Sukhoi at Irkutsk (Russia) and delivered to the IAF as 'fly aways' to equip an initial two fighter squadrons (No. 20 and 24). More have followed and in 2013, there are some nine frontline IAF squadrons operating the Su-30MKI.

Going back to October 2000, a Memorandum of Understanding had been signed for licence production of 140 Su-30MKIs in India and in December 2000, the contract was formalised at Irkutsk, involving full technology transfer to Hindustan Aeronautics Ltd, with Su-30MKI production planned to be done in four phases, leading to 'raw material' production. The first Su-30MKIs from Nasik were to be delivered from 2004, with phased production continuing till 2017-18. However in November 2002, the delivery schedule was sought to be expedited with production to be completed by 2015.

An estimated 920 Al-31FP turbofans were simultaneously to be produced at HAL's Koraput Division, while the mainframe and other accessories were manufactured at HAL's Divisions in Nasik and Lucknow respectively. Final integration of the aircraft and its test flight are carried out at HAL's Nasik Division as has been the pattern followed over the decades, with MiG-21s and MiG-27s.

In 2007, a repeat order for 40 Su-30MKIs had been placed and in June 2010 the Indian Government's Cabinet Committee on Security cleared a follow on contract for another 42 Su-30MKIs which would go into service by 2018. In fact, on 24 December 2012, the Government of India had ordered assembly kits for these 42 Su-30MKIs, signing a deal during President Putin's visit to India which has now taken the IAF total order to 272 Su-30MKIs, a formidable number by any count.

Simultaneously even so, the IAF is planning to upgrade its Su-30MKI fighters with Russian Phazotron Zhuk-AE Active Electronically Scanned Array (AESA) radars which can track 30 aerial targets in the track-while-scan mode and engage six targets simultaneously in attack mode. This AESA radar has demonstrated significant capabilities, including ground-mapping modes. The Su-30 upgrade package, with an improved radar and reduced radar signature, is referred to as 'Super Sukhois'.

In 2008, Samtel-HAL Display Systems (SHDS), a joint venture between the Indian company Samtel Display Systems and HAL, had won a contract to develop and manufacture multi-function avionics displays for the MKI. A helmet mounted display, 'Topsight-I', based on technology from Thales and developed by SHDS would be integrated on the Su-30MKI in the next upgrade.

On 18 August 2010, Indian Defence Minister AK Antony stated the current estimated cost for the upgrade was Rs.10,920 crore (US$2 billion) with the aircraft likely to be upgraded in phases beginning in 2012. An upgrade of earliest 80 Su-30MKIs involves integrating them with BrahMos missiles.

Meanwhile, first test of the air-launched version of the BrahMos supersonic cruise missile, developed jointly by India and Russia, is planned to be conducted by December 2013. Two IAF Su-30MKI are being integrated with the aerial launcher and the BrahMos missiles integrated on the Su-30s will provide IAF with the capability to attack enemy targets from stand-off ranges of around 300km.

Tactical transport aircraft

In actual fact, the very first aircraft of Russian (Soviet) origin to serve with the Indian Air Force, was an Ilyushin Il-14 which was presented to Prime Minister Jawaharlal Nehru on 24 December 1955

The future : subject of Indo Russian joint design & development is the T-50/FGFA fifth generation fighter aircraft

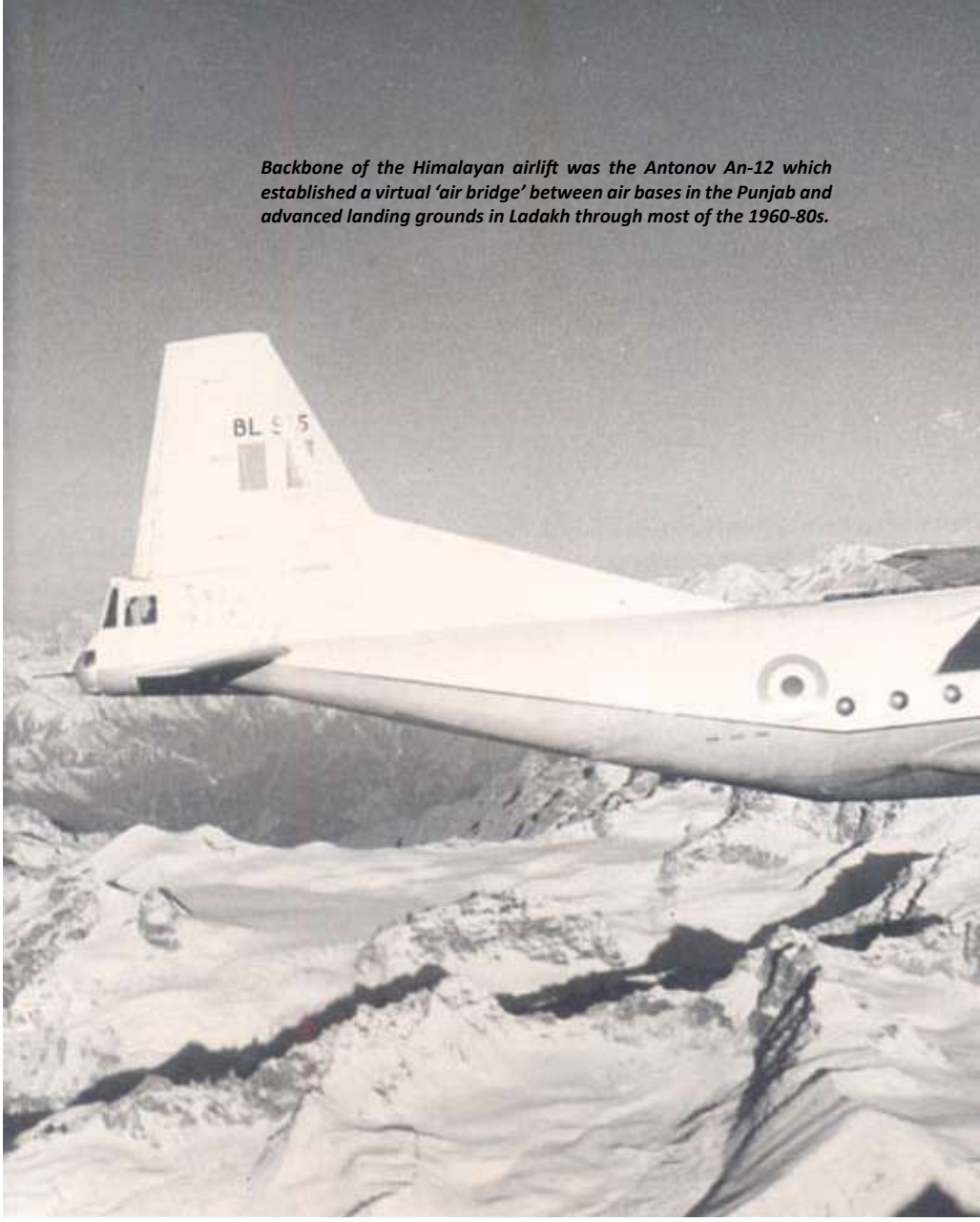
and this aircraft was to form part of the VIP Communications Squadron. A second Il-14 was presented a year later, also for the Communications Squadron. An Indian Air Force Il-14 was to establish the Lhasa air link, pioneering an air route from India to the capital of Tibet in 1956. Five years later an Indian mission visiting Moscow negotiated the purchase of further Il-14s and a batch of twenty four were obtained in May 1961 to equip the newly raised No. 42 Squadron. In an ironic twist of history, the Il-14s were soon under considerable pressure, flying troops and cargo in support of border posts on the frontiers with Tibet, the Il-14s ranging far and wide from Ladakh to Assam during the October-November 1962 frontier war with China.

Another aircraft type that wore IAF markings was the Tupolev Tu-124, similar in design and in overall appearance to the Tu-104 commercial airliner, but was 25 percent smaller and meant to meet Aeroflot's requirement for a regional airliner to replace the Ilyushin Il-14 on domestic routes. The Tu-124 was designed to carry 44 passengers in three separate cabins, and apart from the IAF, CSA Czechsolovakia Airlines and East Germany's Interflug operated this aircraft.

Three Tu-124s were completed in a VIP configuration in 1966 and inducted into Indian Air Force service in October 1966, with Air Headquarters Communications Squadron based at Palam, flying VVIPs to destinations all over India and overseas. The Tu-124s were phased out by 1981 to be replaced by the Boeing 737 jetliner.

Air bridge to the Himalayas

However, going back in history, an Indian defence delegation had visited Moscow in October 1960 primarily for negotiating the purchase of transport aircraft and helicopters related to the IAF's commitment towards maintaining the Indian Army deployed in Ladakh and NEFA. The four-engined Antonov An-12B was selected for tactical freight and strategic transport tasks despite some move to consider the contemporary American C-130 instead, and an initial order for eight aircraft was placed. The first An-12 arrived on 1 March 1961 and No. 44 Squadron was formed on the type. A second order for eight An-12s was placed early in 1962 and the Indian Air Force gradually assumed a credible heavy airlift capability with the An-12s which established a virtual 'air bridge' for the land forces from plains of the Punjab to the Himalayan mountains of Ladakh.



Backbone of the Himalayan airlift was the Antonov An-12 which established a virtual 'air bridge' between air bases in the Punjab and advanced landing grounds in Ladakh through most of the 1960-80s.

The An-12Bs were to be fully committed during the frontier war in the Himalayas during October-November 1962. Transporting men and material to the isolated front, An-12s operated around the clock, supply dropping in Ladakh, where they were subjected to hostile ground fire, and airlifting troops and equipment to Assam. Pivoting their efforts West to East and back, the An-12s proved rugged and capable of the strenuous operations involved in the four grim weeks of fighting, also airlifting some urgently required field guns and light tanks to eastern Ladakh.

In aftermath of that conflict the Indian Air Force's operational infrastructure was required to be expanded. Under a loan agreement signed in July 1963, the Soviet Union supplied a further twenty-five An-12Bs for the two Squadrons (Nos. 44 and 25) operating the type and becoming the mainstay of the airlift to the Himalayas. Flying the Chandigarh-Leh route, the An-12Bs, became synonymous with the Government of India's effort to open up the hitherto 'forbidden' and inaccessible areas of north-east Kashmir.

Indian Air Force An-12Bs retained their 23 mm twin-cannon barbette in the tail and, fitted with terrain-plotting radar, were well considered for supplementary bombing and maritime patrol tasks as well. Successful trials were transformed into reality in December 1971 when a number of specially-fitted An-12Bs were used for

The very first : Ilyushin Il-14 transport aircraft of No.42 Squadron IAF at Leh airfield (11,500 feet above sea level).

concentration bombing. With a freight load capacity in excess of (18 tonnes,) the An-12Bs lent bombing-weight to the I.A.F. and were successfully employed for low level nocturnal attacks on 'soft' strategic targets. On the 3-4 December nights the An-12Bs with 500 lb. (227 kg.) and 1000 lb. (454 kg.) high explosive and incendiary bombs slung out from conveyors, bombed important enemy fuel and ammunition dumps in the Changa Manga forest south of Lahore. The next few nights Changa Manga was raided again in the face of intense ground fire and the forest left with multiple conflagrations; this prophylactic was to be of the greatest magnitude. Although some An-12Bs were 'peppered' by ground fire, none were lost inspite of the considerable risk entailed in flying the lumbering transports deep into enemy airspace.

A number of An-12Bs were also employed for long-endurance low-level maritime reconnaissance over the Arabian Sea and one aircraft was specially fitted out as an airborne Air Defence Control Post to monitor and, when necessary, direct interception of incoming enemy air raiders.

The An-12Bs were in their more conventional habitat on India's eastern front, airlifting the bulk of heavy equipment, jeeps, para field guns of the Parachute Regiment who were airdropped near Tangail in East Bengal on 11 December 1971. An-12s thereafter airlifted troops to the western front after the surrender at Dacca.

The An-12s soldiered on with the Indian Air Force for another two decades until they were finally phased out on 31 May 1993, to be replaced by the larger, four jet-engined Ilyushin Il-76.

The Antonov An-32 as METAC

In the mid-1970s, the Indian Air Force evaluated a number of options to select a suitable medium tactical transport aircraft (METAC) to replace the various obsolescent types in service at the time. The An-32 was selected to fulfill Indian Air Force's METTAC (Medium Tactical Transport Aircraft) requirements possessing good hot and high characteristics coupled with good field performance and the ability to operate from unpaved strips with minimal support. The Indian Air Force initially placed an

The Antonov An-32 is operated by six IAF squadrons in the tactical transport role.

The An-12s were replaced by the much larger Ilyushin Il-76, one seen here on landing. (photo : Angad Singh)

order of 95 aircraft in 1981. The first three An-32 aircraft arrived at Palam airport and officially received on 10 July 1984 and the Type eventually equipped six IAF squadrons including Nos. 12, 19, 33, 43, 48 and 49 plus the Paratroop Training School (PTS).

The An-32 is basically a re-engined An-26 whose launch customer was the Indian Air Force, which ordered this aircraft in quantity. High placement of the engine nacelles above the wing allowed for larger diameter propeller, which is driven by 5,100 hp rated AI-20 turboprop engines, almost twice the power of the An-26's AI-24 power plants, for exceptional STOL (Short take off and landing) it is capable of operating from the most demanding, hot and high altitude airfields. The fully pressurised cabin can carry 48 passengers in tip up seats, 44 paratroopers or 24 stretchers with three medical attendants.

The An-32s are extensively employed for flying 'air maintenance' sorties from Chandigarh to Ladakh in the in the north and from Jorhat in the north east, to advance landing grounds in Arunachal Pradesh on the Himalayan frontiers with Tibet.

In the deep south of the subcontinent, the first An-32s to land In Sri Lanka during 'Operation Pawan' were from No. 19 Squadron in July 1987 airlifting troops, weapons, food and ammunition for the Indian Army. The An-32 was the main workhorse during the 33 month Operation in Sri Lanka flying more than 6,200 sorties, lifting over 150,000 troops and 8,400 tonnes of load.

The Indian Air Force purchased a total of 120 An-32 aircraft, of which some 105 remain in service, providing vital support and link to ground forces in far flung areas of India. History was created on 31 May 2008 when an An-32 of No. 48 Squadron landed at the Daulet Beg Oldi Advance Landing Ground in Ladakh at 17,000 ft above sea level.

The Indian Air Force signed a contract with Antonov in June 2009 to overhaul its existing An-32 fleet with new avionics, communication equipment and landing aids, which upgrade will increase the life-span of the aircraft by 15 years.

'King Elephants' of the IAF

Named 'Gajraj' by the Indian Air Force, the Ilyushin Il-76 has thereafter remained mainstay of the IAF's strategic heavy lift force for over 30 years. The Ilyushin II-76 prototype first flew on 25 March 1971 and has proved to be a first class strategic and tactical transport aircraft for military use, with very powerful engines, all fitted with thrust reversers, a high lift wing for good STOL performance and a high flotation landing gear with 20 wheels. The fuselage is fully pressurised and incorporates a powerful auxiliary power unit and freight handling system. The IL-76 has set numerous world speed and height records and is also used as an air refueling tanker and an extensively modified version is also used as AWACS (Airborne Warning and Control Systems).

The Il-76MD (Gajraj or King Elephant) strategic/heavy transport aircraft was inducted in the Indian Air Force with No. 44 Squadron in October 1985, the Government of India having ordered seventeen such aircraft, initially in March 1983. A second squadron (No.25) was formed with the Type but eventually only No.44 continues to operate the Il-76 while a number were allotted to the Aviation Research Centre (ARC) for special operaitons.

The Il-76 is extensively flown in the Ladakh sector and north-eastern India for air transportation of troops and equipment on a continuous basis and this type has formed a virtual 'air bridge' right across northern India. Il-76s from Agra were deployed at very short notice to transport troops and equipment during 'Operation Cactus' in the islands of Maldives to neutralise mercenaries in 1987. They also provided vital support to the Indian Peace Keeping Forces, airlifting heavy equipment including T-72 tanks to Sri Lanka from 1987 to 1990.

Il-78 MKI of the IAF mid-air refueling pair of IAF Mirage 2000s.

Russian Helicopter

The Il-78 MKI mid-air refueller

Based on the essential Ilyushin Il-76, the Ilyushin Il-78MKI was selected by the Indian Air Force as a mid-air refueller in 2000 and six customised variant of the IL-78ME were procured as especially developed for the Indian Air Force. The Uzbekistan-built aircraft are fitted with Israeli fuel transfer systems which can refuel multiple fighters, ranging from Su-30MKIs to Mirage 2000s and Jaguars in one aerial mission. In December 2002 No. 78 Squadron was raised on the IL-78MKI, the first of which reached Agra on 3 March 2003.

Within a year of its formation, the Il-78s supported six Jaguars, flying across the globe from northern India to Alaska for 'Exercise Cope Thunder' in 2004, an excellent feat by any account. These aircraft have since then participated in several other International exercises, in South Africa, France, Singapore, UK and Oman.

Il-78MKIs flew over 20,000 kms each way, along with eight Su-30MKI fighter aircraft participating in 'Exercise Red Flag-2008' held at Nellis AF Base in the USA. The Il-78MKI is now dedicated to support fifteen fighter squadrons of the IAF and two squadrons of the Indian Navy in the AAR role. The Il-78MKIs have also been adapted to fulfill other roles such as aid to civil power and relief missions during natural calamities. No.78 Squadron aircraft reacted with lighting speed during the Tsunami disaster in December 2004 when they flew over 250 hours lifting 600 tonnes of load and 350 passengers in twelve days.

Beriev A-50 (AWACS)

Another adaptation of the essential Il-76 platform was for creating the the Beriev A-50 airborne warning and control system (AWACS) which entered service with the Russian Air Force in 1984. The A-50 Early Warning and Control Aircraft is intended to perform the following missions: detection, tracking and IFF determination of the air and surface targets, surveillance, command, control and communications functions for both commands posts of automatic control systems, guidance of fighters to air targets.

The Indian Air Force selected this AWACS in the late 1990s the three aircraft, were flown from Russia to Israel

Beriev A.50 AWACS of the IAF's No.50 Squadron on arrival at Palam airport, Delhi.

to become the 'Phalcon AWACS' after integration with mission sensors and management suites, the early warning electronic subsystems designed and manufactured by IAI subsidiary Elta Systems. IAI also designed the 11m (36ft) composite radomes in a one-piece design that is cheaper and lighter than multi-piece designs, and is claimed to reduce electrical interference by eliminating overlapping segments. The first of the three Indian Air Force A-50 AWACS arrived in India on 25 May 2009 and was inducted in the newly raised No. 50 Squadron.

The A-50 AWACS have bolstered India's air-surveillance capability multifold giving it an eye-in-the-air to detect enemy aircraft and missiles while in flight. The AWACS provides low level radar cover well inside enemy territory, not only to direct own forces but also to track hostile aircraft departing for missions from their bases thus facilitating positive identification and increasing substantially the reaction time available to the air defence system.

To meet with the needs of the 2020s, the size of the AWACS fleet would have to be enhanced and possibly augmented by DRDO's systems.

Russian Rotorcraft with the Indian Armed Forces

In their search for a suitable medium helicopter for logistic support and utility duties on the Himalayan front, Indian interest in the MIL Mi-4 was founded and negotiations for an initial number of ten helicopters finalised at Moscow in October 1960. High altitude evaluation trials by a Mi-4 had been conducted in northern India, including the Ladakh region from the middle of 1960 and the type found more suitable than contemporary western types. A further order for sixteen Mi-4s was placed early in 1962, leading to the formation of a number of Helicopter Units in North-Eastern India.

Earlier, some Mi-4s had operated out of Sambre (near Belgaum in Maharashtra) during the swift police action in Goa during December 1961. The Mi-4s then

MIL Mi-4 helicopter of the IAF in the north eastern part of India during the early 1960s.

Rusavia

transported general staff officers, flew in mail and despatches and evacuated the few wounded personnel. A fourth Mi-4 was detached for Air Sea Rescue duties at Bombay. A year later, in October-November 1962, Mi-4 units were under severe pressure running the gauntlet of enemy small arms and anti-aircraft fire while flying in troops and supplies and evacuating casualties from advance landing pads in the high mountains. After the frontier war with China, Mi-4s sporting the red cross insignia were utilised for evacuation of released Indian P.O.Ws in NEFA, particularly from Walong and Along.

Orders were thereafter placed in 1963-64 and again in March 1966 for about ninety additional Mi-4s. A number of medium helicopter units were formed as further quantities were received, taking the total to 121 such rotorcraft, some being returned to USSR for periodic inspection and maintenance. A few Mi-4s were used for VIP transportation from Palam and one example resplendent in royal insignia was presented to the King of Bhutan in April 1968.

A particularly valuable feature of the Mi-4 was a version with large clamshell doors fitted at the rear of the capacious interior which could have seat 10 fully-laden troops.

During the eventful 'Operation Cactus Lily' in December 1971, Mi-4 units were continuously in action, providing logistic and communications support to the Indian Army from the desert wastes around Naya Chor to the snow-bound mountains of Kargil.

The Mi-4's place in history was assumed on the night of 7-8 December 1971, when eight Mi-4s in a special heliborne assault on Sylhet, in East Pakistan, ferried Indian Army troops from Kulaura across the river Surma, a distance of 56 km, each helicopter carrying a section of troops and making about ten round trips each. The 12 serviceable Mi-4s at the Taliamura heliport of Eastern Air Command, provided the vital 'air bridge' during the Indian Army's blitzkrieg and often worked around the clock ferrying troops, guns and supplies across the formidable rivers of Bangladesh, in Magura on the Madhumati and across the Meghna at the famous Ashuganj crossing. Between sunset and sunrise on the night of 9-10 December, the Mi-4s operated incessantly, 'air bridging' 1,270 men and 40 tonnes of equipment including 9 artillery guns across the River Meghna from Brahmanbaria to Raipura and by the 11th there was sufficient force on the far side to resume the advance to Dacca, capital of erstwhile East Pakistan.

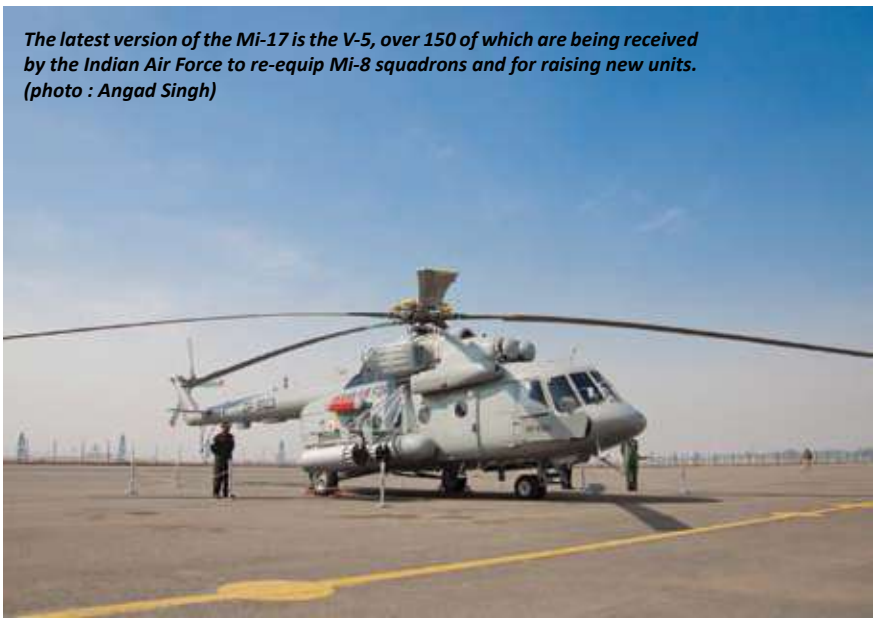
The ubiquitous Mi-8/17 family

Following the Mil Mi-4s which had become the bedrock of tactical helicopter operations with the IAF, the Mil Bureau has remained in the forefront of providing virtually all medium and heavy lift helicopters to the IAF and also attack helicopters which continue to serve with the IAF in India and overseas, supporting UN troops in peace keeping missions in Africa.

The Mi-8 medium lift utility helicopter was evaluated by the Indian Air Force in the jungle mountain terrain of NEFA in mid 1969 and an order for thirty eight Mi-8 helicopters was placed. The first batch arrived in late 1971 and this helicopter has proven to be exceptionally reliable with its ability to carry as many troops and as much freight as the fixed wing C-47 Dakota. Additional batches of Mi-8s were received to finally replace all Mi-4 in IAF's service, with over one hundred Mi-8 helicopters equipping eight helicopter units. Specially configured Mi-8s, were inducted in the Air Headquarters Communications Squadron in 1984.

In addition to its primary role, the Mi-8 was also utilised for special heli-

MIL Mi-17s of the IAF during an assault demonstration



The latest version of the Mi-17 is the V-5, over 150 of which are being received by the Indian Air Force to re-equip Mi-8 squadrons and for raising new units. (photo : Angad Singh)

Mi-17 comes into land

borne operations and the offensive role with rockets. It has been flood relief and aid to civil power. Mi-8s were operated extensively during the 33-month Indian Peace Keeping Force mission in Sri Lanka where they were a virtual lifeline for the army, being extensively used for transport, communication, para-dropping, air maintenance, casualty evacuation. The Mi-8 has undergone several life extension programmes by the Indian Air Force, enhancing its service but has been steadily replaced by the more powerful Mi-7 and the indigenously developed Dhruv ALH.

The Mi-17 medium lift helicopter is essentially a more powerful and modernised derivative of the Mi-8 and externally virtually indistinguishable from its precursor, the Mi-8, apart from marginally shorter engine nacelles and the portside tail rotor.

The Indian Air Force selected the upgraded Mi-17 helicopter for its more powerful engine and its ability to operate from high airfields in the mountainous regions of North and North Eastern India. The IAF initially ordered 50 Mi-17s, equipping six helicopter units from 1985 as also Air Headquarters Communications Squadron, flying VIP and VVIPs all over the country. Mi-17 Helicopter Units are deployed throughout the country, playing a vital logistic support role, also operated for commando assault tasks. Mi-17s are also employed for search and rescue operations and provide logistic support to the island territories.

In the summer of 1999, Mi-17 helicopters of the IAF operated 620 sorties during the Kargil War and were also initially used for rocket attack against enemy infiltrators. In May 2000 the IAF ordered forty additional Mi-17 helicopters to expand its helicopter fleet, being the Mi-17 IV variant, with more powerful engines and a redesigned rear fuselage with rear ramp door, in place of the previous clam shell doors, allowing quicker disembarkation of personnel. The first four helicopters were delivered in October 2000 and the last batch reached India in mid-2001.

In 2008, the Indian Government approved purchase of 80 Mil Mi-17V5 medium-lift helicopters to augment its existing fleet of around 250 Mi-8/17 family rotorcraft. In February 2010, under the original contract, an order for procurement of an additional 59 Mi-17V5 helicopters was agreed to, and in December 2012, this number was again

The world's largest transport helicopter, the MIL Mi-26, is operated by the Indian Air Force for special and strategic helilift.

amended, bringing the second batch total up to 71. The cumulative order, valued at around $2.6 billion involved 151 aircraft, with deliveries to be completed in 2015.

The Mi-17V5 is a thoroughly modern evolution of the venerable Mi-8 design, dating back to the 1960s. Featuring the same Klimov TV3-117VM engines as the Mi-28NE attack helicopter, the Mi-17V5 is being procured in large numbers to bolster the IAF's medium airlift capability, which has long been centred on the Mi-8 family. The helicopter is capable of carrying 4 tonnes of cargo internally or 5 tonnes slung externally. Alternatively it can accommodate up to 36 troops for transport or 12 stretchers in the MEDEVAC and CASEVAC roles. It also features a powerful searchlight, loudhailer 'bambi-bucket' for firefighting. It features a loading ramp at the rear instead of the clamshell doors featured on older Mi-17 variants, along with a weather radar in a distinctive 'dolphin-shaped' nose.

In addition to its utility capabilities, the Mi-17V5 also provides 6 external stations for 1,500kg of munitions, ranging from rockets, to missiles to gun pods.

The world's largest helicopter

Indian Air Force has been one of the few air arms of the world to operate the Mil Mi-26, arguably the world's largest transport helicopter. The Mi-26 prototype first flew on 14 December 1977 and was on display to the world at the Paris Air Show in 1981.

The Mi-26's primary purpose was to move military equipment, including AFVs and outsize stores, to remote locations, lifting up to 20 metric tons (44,000 lb) of load.

The Mi-26 was ordered by the Indian Air Force to meet its heavy lift requirements, and the first two Mi-26 helicopters inducted in May 1986. The second batch of two helicopters arrived in February 1989, soon setting a world record by landing at an altitude of 17,000 ft in Ladakh.

The IAF's Mi-26s have been virtual 'force multipliers', and very effectively used in the helilift of heavy artillery guns to forward outposts in mountain terrain. For logistic support in remote and inaccessible regions, the Mi-26 has the capability to carry external slings loads making it a very vital addition to Indian border road building programmes in the high mountains. The Mi-26 has been used to transport bulldozers or 2 infantry combat vehicles or can also carry 82 fully equipped assault troops or 60 patients on stretchers.

During the Orissa flood relief operations in 1999, they played a vital role in transporting relief material and evacuating casualties. In the very recent 'Himalayan Tsunami' in Uttarakhand in June 2013, Mi-26s transported road clearing equipment and positioned tonnes of aviation fuel for lighter helicopters on forward helipads in the mountains.

Attack helicopters

The Mil Mi-25/35 (IAF code name 'Akbar') has been the Indian Air Force's prime attack and anti-tank helicopter for over three decades, having inducted the type in the newly raised No. 125 Helicopter Squadron on 5 May 1984, which was followed by No. 104 Helicopter Squadron in 1990.

This heavy gunship is formidably armed and employed for destruction of various targets in the battlefield, flies extremely low and fast and because of its armoured plating, and can take heavy punishment against small arms. The IAF operated Mi-25s in Sri Lanka in support of the IPKF and received their baptism of fire during operation 'Pawan', flying their first close support air mission in the Jaffna area in late 1987. Thereafter for the next two years, Mi-25s were regularly called for air support to Indian ground forces and on occasion escorted Mi-8s on troop induction sorties in the thick jungles of Vavuniya, also operating from China Bay (Trincomalee).

While the Indian Air Force has continued to operate the Mi-25/35s, command and control has been with the Army at the Corps level. Mi-25/35s have also been deployed in support of UN Forces in the Congo.

The IAF's Mi-25/35 Fleet has undergone an extensive upgrade programme which includes day-night sight with TV and FLIR, mission computer NVG-compatible cockpit with MFDs and moving-map display, support for helmet-mounted sights, a counter measures suite, Global Positioning System (GPS) satellite navigation network receiver, support for the AT-6 Spiral and Rafael Spike antitank missiles.

Packing a punch is this Mil Mi-35 attack helicopter of No.125 Squadron, during a fire power demonstration at Pokhran ranges in February 2013. (photo : Angad Singh)

Vigilant Eagle

Su-27s and CF-18s escort a mock-hijacked Tupolev airliner (photo: Cpl Vicky Lefrancois, DAirPA)

Closer US-Russian cooperation

From 27 August 2013, fighters from the North American Aerospace Defence Command and the Russian Air Force scrambled to track and intercept "hijacked" aircraft during an air defence exercise viewed as a stepping stone toward closer military-to-military cooperation in additional areas.

"Vigilant Eagle '13 had scenarios that presented the United States, Canada and Russia with a common enemy : terrorist hijackers", Joseph Bonnet, director of joint training and exercises for NORAD and US Northern Command, said during a telephonic interview.

The Exercise is the fifth in a series based on a 2003 agreement between the present US and Russian Presidents to strengthen the two militaries' relationship and their ability to work together. The threat of international hijackers served as a foundation to help advance that effort, resulting in an exercise programme that addresses a recognised threat, Bonnet explained.

Vigilant Eagle was initiated in 2008 as a command post exercise. At Russia's request, it now alternates between CPXs that test out principles and procedures in a computer-based setting and "live-fly" exercises that apply those principles and procedures the following year.

This year's exercise is the third in the series to incorporate actual aircraft. A Russian Tupolev and a commercial aircraft contracted by the United States simulated commercial airliners is seized by terrorists. The USAF's Airborne Warning and Control System and Russia's A-50 Beriev serve as command-and-control platforms.

Real fighters – Canadian CF-18 Hornets and Russian Sukhoi Su-27s – would track, identify, intercept and follow the hijacked aircraft with both Canada and Russia conducting air-to-air refueling operations. The Canadian Air Force has been integral to past *Vigilant Eagle* exercises, but now contributed aircraft for the first time this year, Bonnet said. In addition, the Federal Aviation Administration and its Russian equivalent participated.

The scenario involved two 'hijacked' commercial aircraft that challenged participants on the ground and in the sky to provide a coordinated response, Bonnet explained. The first flight, to originate from Anchorage, Alaska, then traveled into Russian airspace. The following day, a Russian aircraft took off from Anadyr in Russia, toward US airspace.

When the aircraft failed to respond to communications, NORAD, the US-Canada command that safeguards US skies under *Operation Noble Eagle*, and the Russian Air Force moved into action. Both launched or diverted fighters jets to investigate and follow the suspect aircraft headed toward each other's airspace. At that point, they handed off the missions to each other to complete.

Working together in Anchorage and Anadyr and at the NORAD headquarters in Colorado Springs, participants cooperated in escort and handoff procedures using two distinct communications, command-and-control and air traffic control systems, Bonnet continued.

Vigilant Eagle has become more ambitious and valuable with each iteration, Bonnet said, noting that this year's exercise was no different. "This is the culmination of everything that has gone on in previous exercises, and we expect it to continue to mature," he said. "Like us, the Russian Air Force is eager

CF-18s mid-air refuel from a CC-150 Polaris (Airbus A310-300) tanker during Ex Vigilant Eagle (photo: Cpl Vicky Lefrancois, DAirPA)

to expand the scope and complexity of the exercise, and to look into other areas, such as related search-and-rescue and airfield operations."

Bonnet called continuation of *Vigilant Eagle*, particularly at a time when budget costs have caused the cancellation of many other exercises, "a success in itself." With fewer than 100 people directly involved from the United States, *Vigilant Eagle* offered tremendous "bang for the buck."

"This is a small, relatively inexpensive exercise with a huge payoff," he said. "It doesn't cost any of the countries a lot of money, but it is building things that have immediate value for all of them. When you have procedures and a means of communicating information between both sides, that has a lot of value."

Another big success, Bonnet said, is that the exercise transcended leadership changes both in the United States and in Russia, as well as recent political tensions between them.

Both countries recognised the importance of continued cooperation to keep their international borders safe. "It is one of the biggest single areas where the Russian Federation, USA and Canada can truly cooperate," he said. "All three countries share a common objective in thwarting, combating and cooperating against terrorism."

As their militaries work together to confront terrorist hijackers, they are laying the foundation for future cooperation in other areas.

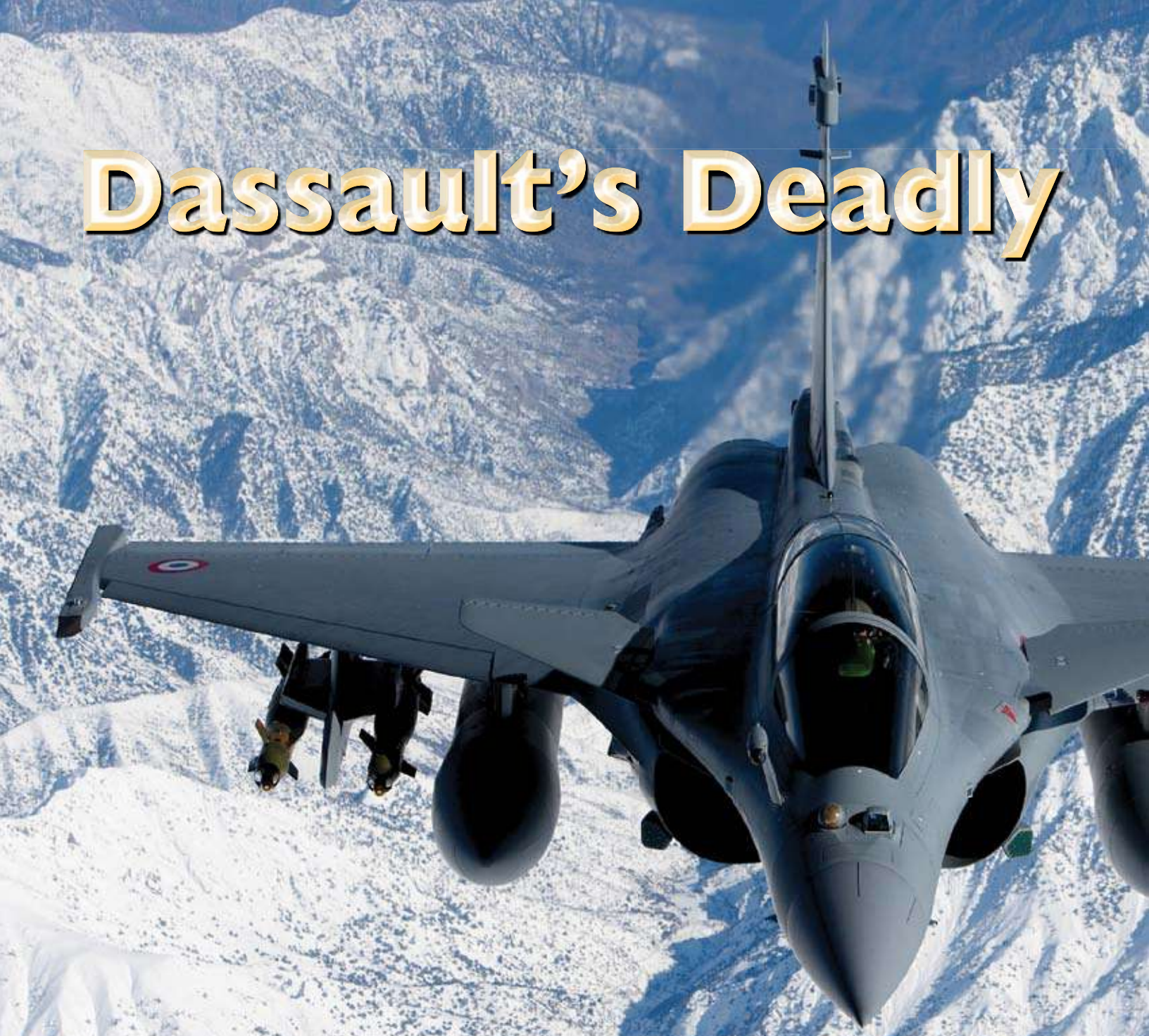
"What we are trying to do is continually build and expand the exercise and use this as a basis for moving the relationship forward. That, to me, is the biggest value of *Vigilant Eagle*."

Donna Miles
American Forces Press Service

Su-27s over North American skies – a rare sight indeed!

HYD Air Show

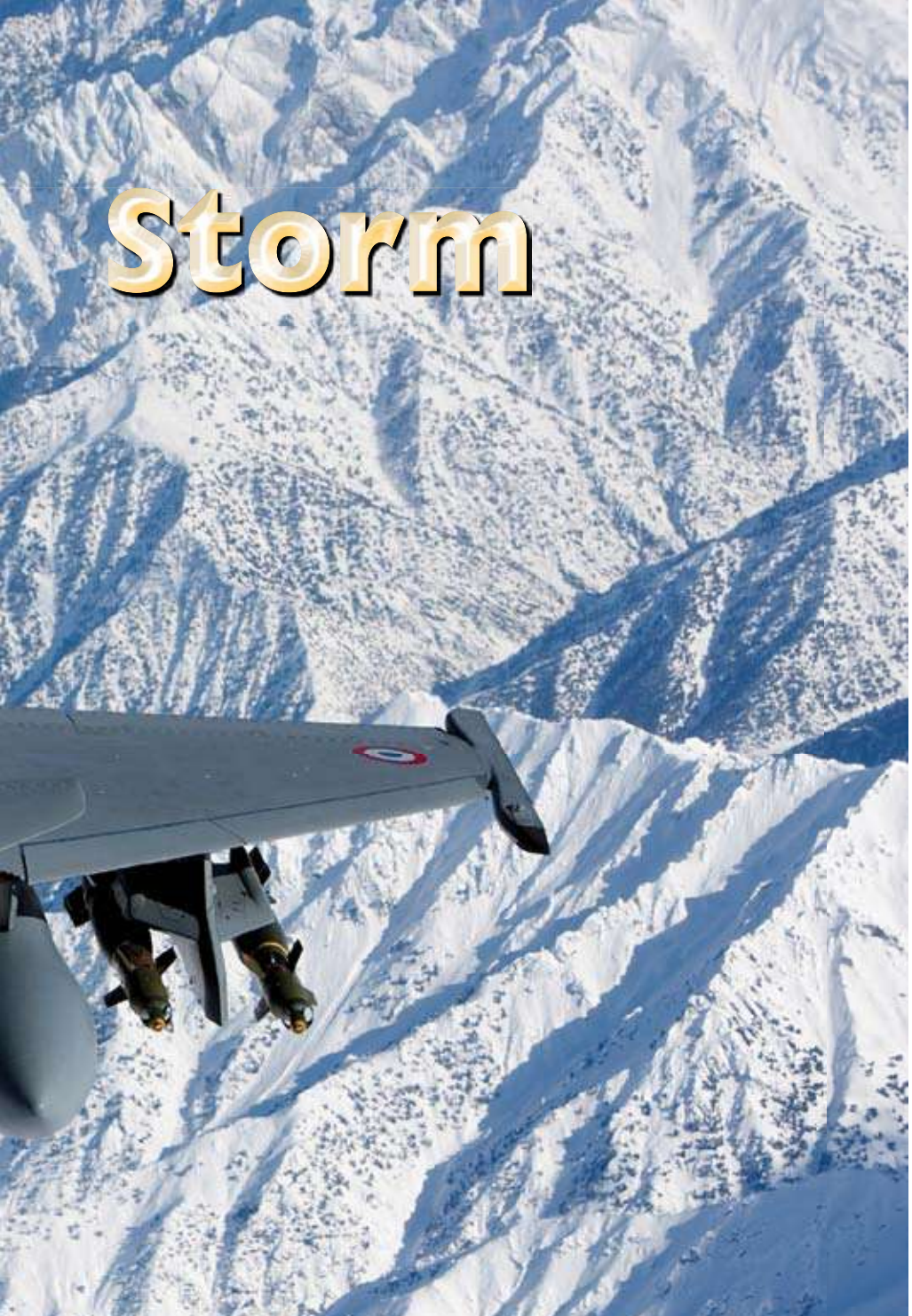
Dassault's Deadly



The omni-role Rafale

Posterity will record that the Dassault Rafale (French for storm or squall) 4+ generation multi-role combat aircraft actually entered the Indian Air Force's Medium-Multi Role Combat Aircraft (M-MRCA) competition consequential to the United States Administration's "clearance" to Boeing to offer its F/A-18E/F Super Hornet to compete for the same. In the process, the French administration tactically withdrew the Mirage 2000-5 Mk2's candidature, which type had long remained the frontrunner. It is important to recollect that in the export arena, US-developed combat aircraft had edged past French-origin ones whenever a direct competition took place since in the majority of cases, technical characteristics and abilities of the competing platforms never assumed the deciding factors : the United States inherently enjoyed greater political leverage to swing multi-billion dollar deals in their favour. However, in the IAF's M-MRCA competition, and to the immense satisfaction (and surprise ?) of the French administration and of Dassault, their aviation ace, the Rafale, not only "broke the jinx" but secured a much desired voluminous "jackpot", of at least 126 fighters, possibly 189, arguably the 21st century 'mother of all deals'.

Storm



As had happened with the Mirage 2000, the Indian Air Force could well be the second air arm in the world to operate top-of-the-line French combat aircraft. On 27 June 2006, Escadron de Chasse 1/7 'Provence' at Saint-Dizier became the first French Air Force squadron to operate the Dassault Rafale omni-role fighter, which through constant upgradations, promises to reach a 'near fifth-generation' status (alongside the IAF's Russian-origin Sukhoi Su-30MKI). This would be after progressive developments to robustly compete with emerging fifth-generation designs during the first decades of the present century. However, it is also ultimately the French political 'reliability' particularly as concerns Indo-French cooperation in the nuclear arena, that may have been the deciding factor for the Rafale. Recent events includes emergence of an IAF manned airborne nuclear deterrent in shape of suitably modified Mirage 2000H/TH platforms, and refusal of the French administration to impose sanctions upon India after the 'Pokhran II' nuclear blasts. Incidentally, there are unconfirmed reports that *Aéronavale* (French Naval Aviation) Rafale M fighters made their official combat debut over the Indian sub-continent during 2002, carrying out optical and electronic reconnaissance close to the then tense India-Pakistan border, in cooperation with United States Navy (USN) aircraft types.

It is assumed that at least part of the IAF's M-MRCA fleet will be assigned the role of manned airborne nuclear deterrence, operating under India's SFC (Strategic Forces Command) which was officially established in January 2003 as part of the long planned Nuclear Weapons Command & Control structure. IAF multi-role strike fighter squadrons, spearheaded by the Sukhoi Su-30MKI, are reportedly being configured to deliver a punishing 'retaliatory nuclear strike' on any nuclear aggressor, also being capable of conducting pre-emptive conventional 'counterforce' precision strikes on enemy nuclear arsenals. The Dassault Rafale F3 version, which appeared around 2008-2010, was to be an omni-role strike fighter from the outset, with priorities considerably shifted towards nuclear strike and conventional attack yet at the same time retaining formidable air superiority attributes.

To execute successful nuclear strike and precision conventional attack missions, the Rafale with its excellent manoeuvrability and high degree of cockpit automation, is designed to make use of terrain following and masking, including at night and in adverse weather conditions to fly a terrain/obstacle-avoidance profile at 5.5g and down to 100-feet altitude. This is thanks to its Automatic Flight Control System (AFCS) that can operate in either digital terrain following or a radar terrain following modes. With digital terrain following, the AFCS manoeuvres the Rafale over terrain, based on a three dimensional map database which is pre-programmed into the AFCS software. The radar terrain- following mode of the RBE-2 AESA radar scans the terrain ahead and safely guides the jet over obstructions before resuming nap-of-the-earth profile. In these missions, its digital Fly-By-Wire (FBW) controls and canard-type fore planes allow it to secure all advantages of the delta wing platform including high fuel storage, low drag, increased manoeuvrability but with considerably more authority in pitch, fewer control surfaces and reduced Radar Cross-Section (RCS) while minimising

Rafale at Aero India 2011

such as the 'glass cockpit', Thales developed CTH3022 wide-angle (32x20-degrees) holographic Head-Up Display (HUD), Hand-On-Throttle and Stick (HOTAS) and four Thales-developed colour Multi-Function Displays (MFD) with extensive use of active-matrix and Liquid-Crystal Display (LCD) technologies, which enable carefree handling and allows the single pilot to focus more on combat parameters and essential aspects. The 'head-level' 254x254-mm MFD is meant to present a broader tactical situation to the pilot to enhance his situational awareness without disorienting him from developments projected by the HUD as he need not refocus his eyes in the process. Situational awareness is further enhanced by a direct-voice-input (DVI) system with a 50 to

most of the instabilities that arise when the aircraft carries significant external stores during lowlevel missions. The digital FBW controls in particular endow the Rafale with remarkable manoeuvrability at low altitude as well as high resistance to g-bumps, enabling faster and lower flights for delivering ordnance on targets with a high degree of accuracy. The Rafale is simultaneously capable of defending itself against intercepting enemy fighters with its formidable defensive weaponry and electronic warfare suite.

The Rafale will also provide invaluable battle damage assessments, thanks to its Thales-developed Reco NG/ AREOS reconnaissance pod consisting of two bi-spectral (IR and visible) sensors for long-range strategic reconnaissance and a high-speed tactical IR line scanner for low-altitude reconnaissance. This is optimally networked via a broadband datalink system (that offers 360-degrees coverage) with terrestrial elements consisting of a mission-planning system and a station for receiving, processing and disseminating intelligence data in real time. The Reco Management System (RMS) includes functions for itinerary surveillance, multiple-point image gathering, ad-hoc stereoscopic data acquisition, real-time data link management and digital recording. Flying in a two aircraft reconnaissance mission, each aircraft can photograph the same target from different angles or directions or from different altitudes. Alternatively, the route of the aircraft can


Rafale shows its form at Aero India 2013 (photo: Angad Singh)

be adjusted so that each fighter on the task will photograph widely separated targets on each side. For the IAF, enhancements of airborne strategic and tactical reconnaissance at short notice have emerged as necessary after phasing out of IAF MiG-25RB 'Foxbat' strategic reconnaissance platforms.

Accurate navigation is primarily facilitated by two Sagem Sigma 95N (RL90) laser-gyro Inertial Navigation Systems (INS) with embedded Global Positioning System (GPS) receivers. Advanced Pilot/System Interface (APSI) 300-word vocabulary in the English language. The Rafale is the first French-fighter equipped with the Link 16 datalink which is fully integrated into the fighter's weapon system, through which pilots share surveillance and targeting data, give and receive orders. The inclined position of the Martin-Baker Mk16F 'zero-zero' ejection seat allows the pilot to resist higher load factors.

To complicate the tasks of its adversary, the Rafale enjoys significantly lower RCS with its stealth characteristics, designed from the conceptual phase.

The two 'kidney shaped' side-mounted intakes were meant to lower Rafale's frontal RCS by shielding moving parts of the SNECMA M88-2 engine compressors while the vertical fin was made of electromagnetic transparent composites. High acceleration SNECMA M88-2 engines with 72.9-kN of thrust each enables Rafale to fly in 'super cruise' mode, performing supersonic flight without use of afterburners during part of the ingress and egress route without imposing serious penalty to its range. Consequently exposure to enemy air defence systems and networks are reduced which enhances survival capability. This statement holds truth especially in the egress route when at least part of enemy air defence systems and networks would be on full alert.

The low RCS attributes of the Rafale are further boosted by Thales-integrated *Système de Protection et d 'Evitement des Conduites de Tir du Rafale* (SPECTRA) self-protection suite integrated with three specific computers and called the *Gestion de l 'Interface et Compatibilité* (GIC) offering high sensitivity detection. This is capable of tackling multiple threats, and operating smart data fusion between multi-spectral sensors, in the process providing the identification, location, jamming and decoying against an extensive range of electromagnetic, Infra-Red (IR) and laser threats. The SPECTRA consists of Thales-developed Radar Warning Receiver (RWR) integrated with a built-in active Self Protection Jammer (SPJ) with prominent square-section antennas mounted on lower corners of the engine inlets and at rear of the fin-top pod. MBDA-developed Missile Approach Warning System (MAWS) working in two infrared (IR) bands, Thales developed Laser-Warning System (LWS) and four chaff/flare dispensers are all integrated into a single system.

The RWR and SPJ system were integrated as the *Détection et Brouillage Electromagnétique* (DBEM) system reported to be capable of detecting hostile transmitters over the frequency range of 2-40 GHz on the F2 standard with a high accuracy of up to 1-degree in azimuth. The DBEM automatically detects, classifies and identifies emitters and inputs information about them into the central computer. The SPECTRA's active jamming subsystem uses phased-array antennas located at roots of the canards and reportedly capable of producing a pencil beam compatible with accuracy of the receiver system to concentrate power on the threat while minimising the chances of detection. Highly placed officials have hinted at "active cancellation devices & procedures" which is a low RCS technique in which the aircraft, when painted by radar, transmits a signal which mimics the echo that the radar will receive in return, yet one half-wavelength out of phase, so 'blinding' the target radar in the process. Power requirements are very low, compared with conventional electronic warfare systems and provide little clue to the aircraft's presence but require very fast processing and high technological finesse. The low RCS of the Rafale was strikingly demonstrated during June 2002 over the Indian Ocean when air exercises were conducted between Rafales of *Flottille* 12F Squadron deployed on board the Marine Nationale (French navy) aircraft carrier *Charles de Gaulle* and United States Navy (USN) F-14 Tomcats and F/A-18 Hornets operating from the USS

Pulling out of its soft top hangar at Armée de l'Air at Base Arienne BA118 Mont-de-Marsan, France (photo: VSC)

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

Rafale Marine with Sagem AASM guided weapons (photo : Philippe Wodka-Gallien)

John C. Stennis. The Rafale was reported as hardly detectable by radars of USN aircraft and was usually able to conduct 'first-look-first-shoot' procedures with Beyond Visual Range Air-to-Air Missiles (BVRAAM) apart from being very agile in the close-combat arena.

Since a considerable portion of the Pakistan Air Force (PAF) and the Chinese Peoples Liberation Army Air Force (PLAAF) air-combat inventory is composed of fighters limited to fair weather operations, advanced sensors on new IAF aircraft would facilitate surface strike capability, especially at night and in adverse weather situations. While the Thales Damocles navigation and targeting pod is standard, the IAF may well settle for the tried and tested Israeli Litening series. Recent reports do suggest Israeli Rafael Litening 2 Laser Designation Pods (LDP) fitted with IAF Sukhoi Su-30MKIs. Still, surface strike capability will be greatly enhanced if the IAF chooses to integrate the new Israeli Rafael third-generation Litening 3 LDP that uses an advanced thermal sensor, based on a focal-plane array of 640x480 detectors, operating at the medium thermal band (3-5µ). According to Rafael, image quality of the Forward Looking Infra-Red (FLIR) is identical to the Charged Coupled Device (CCD). The new pod also employs a more powerful dual-wavelength laser, which enables unrestricted operations at high altitude and long range and can also be operated in an 'eye safe' laser mode for training. Further the Litening G4 targeting pod, reportedly offered to IAF, is an excellent candidate with a full one mega pixel (1000×1000) Forward Looking Infra Red (FLIR) in addition to mega pixel size Charge-Coupled Device (CCD) sensors and optics already introduced in the earlier Litening AT version. This offers wider field of view and enhanced zoom to ensure more accurate target identification and location at longer ranges than previous generations of the Litening. Another new feature is the Laser Target Imaging Programme (LTIP), employing a Short-Wave Infra Red (SWIR) laser augmented imaging, to enhance the targeting system's capability to capture images in situations where Medium-Wave Infra Red (MWIR), FLIR and CCD are ineffective. In addition, the Litening G4 employs an integral digital two-way data link, facilitating encrypted data communications with compatible land-based or airborne digital datalink devices. Litening G4 will facilitate employment of a broad spectrum of French, Israeli and US-origin Precision Guided Munitions (PGM) effective even at high altitude and urban environment with minimum collateral damage. The Rafale/Litening combination will arguably overshadow any such PAF capability as even after further purchases of F-16C/Ds from the United States, a significant portion of the PAF fleet is incapable of nocturnal operations with their F-7 (MiG-21 derivatives) and French Mirage III/5s.

The Rafale 's avionics and electronics are integrated through four Mil STD-1553B data buses and two Mil STD-1760 data buses operating in the ADA language to enable integration of a wide range of state-of-the-art weaponry. The standard Conventional Attack Stand-Off Missile (Casom) with the Dassault Rafale is MBDA's turbojet-powered 5.1-metre long, 1,300-kg weight and 250-km+ range SCALP/Storm Shadow CASOM pack. This 'qualifies' as a mini-cruise missile, capable of successful counterforce operations against enemy high value and nuclear infrastructure by conventional strikes alone, yet out of range from anticipated enemy ground-based defences. Designed to cruise at low-levels on power of a micro-turbo engine to avoid radar detection, it has inertial guidance and TERrain PROfile Matching (TERPROM) navigation with an integrated GPS in the terminal target approach phase of flight. During terminal phase in combination with passive Imaging Infra Red (IIR) sensors with Autonomous Target Recognition (ATR) system, the missile retains considerable autonomous capability over long ranges, while its effective Bomb Royal Ordnance Augmented Charge (BROACH) unitary penetration warhead is programmed to inflict extensive damage on impact even against buried and hardened targets including heavily protected bunkers.

Recent enhancement programmes of the Scalp EG include capability to relay target information just before impact, utilisation of link-back data-link to relay battle damage assessment with an option for in-flight re-targeting capability, utilising a two-way data-link. The Storm Shadow was successfully deployed on Tornado GR4 combat aircraft by the Royal Air Force's No. 617 'Dambusters' Squadron during *Operation Telic* in 2003. A total of 27 missiles were fired during the conflict proving the missile's exceptional capability to accurately home-in on targets at extended ranges whilst avoiding collateral damage and ensuring that the launch aircraft remained safely away from enemy defences.

However the IAF's other option appears to be the MBDA Taurus KEPD 350, an ambitious programme which commenced in 1998 by pooling the industrial capabilities in the field of

precision stand-off guided missile systems of LFK-Lenkflugkörpersysteme GmbH (now MBDA Deutschland) near Munich, with those of Bofors in Karlskoga, Sweden. This led to the establishment of a joint venture company, TAURUS Systems GmbH, based in Schrobenhausen, Germany, which is responsible for the development, production, marketing and logistical support of the Taurus stand-off weapon system. The Taurus KEPD 350 (Kinetic Energy Penetration Destroyer) weapon system is a modular cruise missile type weapon initially developed for German Air Force Tornado IDS strike fighters, yet adaptable for the F/A-18, Rafale, Gripen and Eurofighter Typhoon. The Taurus KEPD 350 has also had an extremely short development time, which began

Snecma/ Safran M-88 engines on the Rafale (photo : Philippe Wodka-Gallien)

MBDA's Scalp EG is carried by the Rafale

in 1998 and final testing completed in March 2004 and thereafter entering German Air Force service with 33 Strike Wing on 21 December 2005.

Five metres long, the 1,400-kg KEPD 350 has a range of beyond 100-km and is equipped with the MEPHISTO tandem penetration warhead which can effectively neutralise stationary fortified targets such as underground bunkers and shelters whilst avoiding collateral damage. MEPHISTO is based on a large tandem warhead concept comprising a precursor/ shaped charge and a high explosive filled kinetic energy penetrator. To trigger the penetrator charge so as to achieve optimum damage, Taurus uses the world's first smart active decision-making hard target fuse, the Programmable Intelligent Multi Purpose Fuse (PIMPF). Its shock sensor and intelligent signal-processing algorithm determines impacts and exits of hard layers and thus detects and counts layers and voids. Reliable autonomous navigation is provided by fusion of sensor data from three sensors and includes Image Based Navigation (IBN), Terrain Reference Navigation (TRN) and MIL-GPS subsystems, the use of such fusion enabling the Taurus KEPD 350 to navigate over long distances without GPS support. The mission planning system does support preparation of terrain-hugging flight paths at high subsonic speeds and terminal targeting in order to penetrate enemy air defences, and is loaded into the weapon by a ground loader unit. The MBDA Scalp/ Storm Shadow, during its terminal phase in combination with passive high resolution Imaging Infra Red (IIR) sensors with Autonomous Target Recognition (ATR) system with its highly sophisticated line extraction algorithm, retains considerable autonomous operations capability over long ranges. For a future enhancement, the use of a data link is being examined for confirmation of a correctly performed mission and partial BDA.

The Indian Air Force has reportedly evaluated Sagem's AASM (*Armement Air-Sol Modulaire*) Precision Guided Munition (PGM) also for its Sukhoi Su-30MKI fleet which forms the standard PGM of the French *Armée de l 'Air* Rafales. In a typical surface attack mission, the Rafale carries up to six AASM/SBU-38/SBU-64 Hammers (all can be ripple fired in one pass to strike on six different targets with clinical precision for simultaneous attacks on multiple targets), plus four Mica BVRAAM and three 2,000-litre drop tanks. A conversion kit for 250 kg. class bombs exists, the guidance section at the front including an INS and GPS

receiver enabling 10-metre accuracy even in adverse weather. The bomb's body (general purpose or penetration) is at the centre and the rocket motor is aft. For long distance engagements, the AASM is equipped with a bolt-on tail unit/range extension kit which comprises a solid rocket motor and flip-out wings. Folded wings enable a glide range of 15-km when dropped at low altitude or 50-km when dropped from medium to high altitudes with the guidance processor enabling the pilot or weapon systems officer (WSO) to select the angle at which the bomb impacts the target. This allows it to manoeuvre aggressively to engage distant, off-boresight targets. There is provision for an IIR seeker for contingency-type operations and capable of being programmed before launch with a template of the target derived from reconnaissance imagery, so 'acquiring immunity' to GPS jamming and giving it 'meter-class' accuracy against precision targets. ATR algorithms compare the actual scene with the memorised scene, identify the designated target, and select the impact point and hit it with outstanding precision, which was extensively battle proven over Libya.

Airborne Nuclear Deterrent

Little known, but widely rumoured has been French assistance in creating an IAF manned airborne nuclear deterrent, obviously closely guarded by both French and Indian governments. During the late 1980s, the IAF "discovered" the Mirage 2000H/TH platforms to be excellent nuclear delivery platforms and reportedly initiated necessary conversions, Apart from experimenting with a brown-grey camouflage scheme, more radical changes were internal with assistance of the French government and aviation industry. It is rumoured that the Dassault Electronique/ Thomson-CSF Antilope V terrain-following radar, as with French Mirage 2000N nuclear strike platforms to permit automatic flight down to 60-metres and altitude-contrast updating of navigation system, had been installed on selective IAF Mirage 2000H/THs. Optimum performance during nap-of-the-earth penetration of enemy airspace is thus facilitated.

Similar cooperation from Dassault is perhaps sought in the 'hardwiring' of Rafales, including airframe reinforcements especially near the appropriately shorter and thickened central pylon and the inboard wing pylons. The pylon databus is of a more complex nature with additional connecting pins in conjunction with differently programmed attack computers. In French Air Force service, the ASMP-A Land-Attack Cruise Missile (LACM) is tasked for the airborne nuclear strike. The concept of ASMP-A was derived from ASMP, utilising this air vehicle pre-developed for the Vesta activity (ramjet air vehicle) in conjunction with the ANF future anti-ship programme that was suspended at the end of 1999. The ramjet/ stratoreacteur mode of propulsion, compared to a conventional rocket propulsion system, allows for significant reduction of both the required space within the missile as well as missile weight in relation to the required range and warhead charge. This allows the missile to cover a large part of the flight envelope at high supersonic speeds. The compactness of the ASMP-A can be judged from the fact that the formidable nuclear missile measures just over 5-metres in length with a mass of only about 400kg. ASMP-A has a range of about 500-km with a speed of up to Mach 3. The extended range ensures survivability of the launch platform from enemy air defences. The missile retains a speed of Mach 2 during low-level and complex penetration mode with a high (yet undisclosed) degree of accuracy. The missile in turn is hardened for nuclear-attack. The pristine 300-kt TNA (*tête nucléaire aéroporté*) warheads developed by *Commissariat à l'Energie Atomique* (CEA) are a medium energy thermo-nuclear charge, first to be developed in France without recourse to separate nuclear tests, using intensive computer calculations and simulation. However necessary physical data was generated to validate the concept during the last nuclear testing campaign.

A similar indigenous or joint-developed LACM integrated with the Rafale's centreline pylon will enable the IAF's Rafale fleet, with the assistance of air-to-air refuelling (AAR), to conduct precision strikes against an array of enemy counter-force and counter-value targets. Conformal Fuel Tanks (CFTs) will ensure considerable portion of external fuel to be used for extension of range in lieu of drop-tanks.

Still, despite being designed with significant strike potential, Rafale remains a formidable air superiority fighter. The primary sensor for air combat is the RBE2 radar with its passive Electronically-Scanned-Array (ESA) antenna, with a single power source, transmitter, receiver and physically fixed array of phase-shifter modules to steer the beam to variety of interleaving modes. According to French Ministry of Defence sources, the RBE2 radar has a modest range of about 100-km against fighter-sized targets. Yet, it is speculated that the figure in fact refers to 'look down' mode with naturally greater ranges at 'look level' or 'look up' modes. It operates in a Low-Probability-of-Intercept (LPI) mode, with the output pattern varying in a seemingly random pattern to confuse an adversary RWR and is resistant to detection & deception jamming. The RBE2 radar operates in the X-band and can use low, medium, and high pulse-repetition frequencies. It can track up to 40 air targets in range while scan (RWS) mode and reportedly can engage up to eight of them with MICA BVRAAMs 'ripple fired' at intervals of 2-seconds. Electronic beam steering enables the RBE2 radar to search the airspace in various patterns, probably up to 60-degrees in any direction from the fixed antenna axis and even allows for simultaneous tracking and scanning in different sectors.

Currently, extreme detection range is provided by French Air Force E-3F Sentry Airborne Early Warning & Control System (AEW&C) platforms and French Aéronavale E-2C Hawkeye platforms, transmitted as a common air picture via the Multifunctional Information Distribution System (MIDS) which is part of network-centric operations. It is reported that by teaming with the Link 16-equipped Adl'A E-3F AEW&C, even the present Rafale F2 have acquired a 360-degrees detection capability, allowing for new innovations in aerial combat tactics. Evaluations have shown that two flights of two Rafale F2ss each, controlled by a single E-3F AEW&C using Link 16, can achieve 'total air superiority' over a theatre the size of France ! It implies that perhap, two IAF-operated squadrons of Rafales dedicated for the air superiority role will guarantee adequate coverage of virtually the entire Indian airspace in combination with IAF A-50EI Airborne Early Warning

& Control (AEW&C) platforms and subsequent indigenous developments. In any case, on sensitive strike missions, IAF Sukhoi Su-30MKIs will fulfil the vital role of providing 'top cover' to the Rafale fleet, including destruction of enemy ultra-high-value enemy airborne Intelligence, Surveillance & Reconnaissance (ISR) platforms without necessarily having to deal with fighter escorts, using the 400-km range Indo-Russian R-172 (AAM-L) ultra-long-range BVRAAM which is reportedly under joint-development.

The AESA radar & OSF

Meanwhile, the French are developing a variant of the phased array electronically-scanned multi-mode RBE2 radar whose architecture is fully adapted to integrate the Active Electronic Scanned Array (AESA) antenna. The AESA is based on technology developed under the Thales/BAE Airborne Multi-mode Solid-state Active-array Radar (AMSAR) programme. Presently under rigorous tests under the *Démonstrateur Radar à Antenne Active Modes Avancés* (DRAAMA) programme, it is deriving benefits from the latest developments in radar and solid-state technology. The AESA, set with the active array made up of solid-state Gallium Arsenide (GaAs) transmit/receive modules can steer and reposition the radar beam at very high speed in any direction. The new radar variant also incorporates a new data processing unit and a strengthened structure to cope with higher weight of the AESA. The AESA radar will have greater range with detection range considerably increased by more than 50-percent, scan the sky much more quickly as the radar can look in many directions at the same time, offering significantly enhanced tracking capabilities with improved angular coverage in azimuth to allow targets to be tracked outside the selected search volume and their radar modescan interleaved. For air-to-ground operations in high-resolution Synthetic Aperture Radar (SAR) modes, this will provide greater situational awareness and fast rate of data transfer between force multipliers, and in conjunction of Meteor active-radar homing BVRAAM, also capable of providing robust defence against lower Radar Cross Section (RCS) cruise missiles.

Thales has developed a very advanced built-in electro-optical (EO) targeting system for the Rafale, the *Optronique Secteur Frontal* (OSF). Mounted in front of the cockpit, the system consists of a 90-km range long-wave (8-12 µm) Infra-Red Search & Track (IRST), Charged Coupled Device (CCD) TV camera and also an eye safe laser rangefinder for use against aerial targets. During air combat the OSF will be the preferred system for acute angular resolution, with radar for ranging at long distances, OSF laser range finder for shorter distances and SPECTRA for passive identification of threats by comparison with a database. Even during surface strike procedures, the radar and OSF continue to track & scan the sky for hostile targets. When used in conjunction with the MICA IR missile, the OSF allows entirely passive interceptions to be carried out without radar emissions. In the air-to-ground mode, the OSF is used to accurately determine target coordinates before attacking with precision weapons such as the AASM or GBU-12/22/24 Laser Guided Bombs (LGB). A new generation medium wave (3-5 µm) infrared sensor for passive search and track of airborne targets and for night identification could be integrated with the OSF at a later stage.

MBDA MICA short range AAM is a core weapon system for the Rafale

The MICA & Meteor

The number of BVRAAM missiles carried is usually six MBDA-developed MICA EM/IR for air defence missions. The MICA (*Missile d 'Interception et de Combat Aérien*) constitutes standard armament of the Dassault Rafale and is also selected as part of the upgradation package for IAF Mirage 2000H/TH fighters. This 3.1-metre long, and 112-kg weight MICA was originally designed as a 'multi-aircraft' missile that could easily be integrated onto any modern fighter aircraft without significantly reducing the aircraft speed or negatively affecting its aerodynamic characteristics. MICA is capable of both BVR (60km+) and close range interception thanks to dual active radar (as in MICA RF) and Imaging Infra Red (as in MICA IR) seeker and Lock On Before Launch (LOBL) as well as Lock On After Launch (LOAL) capability. Minimum range is said to in the region of 500-metres.

Carried under the aircraft fuselage or under wings and fired by ejection or from rails, the MICA is 'permitted' to be ejected from the airframe points up to 4-g while wings pylons can release MICA up to 9-g. Products of research & development during the 1990s, both MICA RF and MICA IR have a range in excess of 60-km as the MICA IR version receives mid-course update commands from the radar to compare the target location with the location of its seeker 's track for LOAL engagements. In case of MICA RF after the target has been designated by the host aircraft's radar, it makes the first phase of its fight in inertial guidance mode and then latches onto the target using its '4A' active-radar homing head. MICA remains well reputed for its general level of sophistication and its reliability in terms of 'kill percentage' even in European adverse meteorological conditions alongside dense electronic warfare environment infested with saturation jamming. The missile in turn sports a formidable ECCM system to burn through hostile jamming. The seeker is cooled by an onboard closed-cycle system, which is powered electrically and can be operated for long periods. Complex algorithms have been developed to provide the IIR seeker with the ability to track at longer range and to reject flare decoys. When fitted to aircraft with track-while-scan radars, the MICA weapon system is capable of attacking several targets simultaneously with individual missiles.

The missile's excellent manoeuvrability is aided by combination of long chord wings, efficient tail control surfaces while at short range, thrust vector control (TVC) facilitates high off-boresight angle (HOBA) engagements. Interestingly the MICA IR seeker may also be utilised for discrete optronics monitoring prior to launch. Again MICA IR with its excellent angular resolution will be able to mount stealthy strikes on unsuspecting opponents especially if the launch platform is pre-positioned by own AEW&C platforms.

The lethal 12-kg high-explosive blast fragmentation warhead is triggered by a Doppler radar proximity fuse.

Surprise had always been the key to successful execution in air combat, with as much as 50-percent of the shot-down pilots totally unaware of the fact that they were under attack.

Air combat capability will dramatically increase with service entry of the MBDA Meteor active-radar homing BVRAAM with 80+ nautical miles range. This will provide ultra-long range interception capability against fighter-sized targets, critical for the IAF in response to the proliferation of BVRAAMs in its neighbourhood including AIM-120C-5 variant of the AMRAAM with the Pakistan Air Force. The Meteor is a 3.65-metre long, stealthy, low drag, lightweight (185-kg) BVRAAM design from MBDA and the 80+ nautical miles range missile has a more linear velocity profile. Born out of the multi-national Project S225X examining future BVRAAM technologies and designed for a network-centric warfare (NCW) environment, the Meteor has data-link capability and can be guided not only by the launch aircraft but also by another fighter or even by AEW&C platforms. The extended range is ensured by Meteor's solid boron fuelled Variable-Flow Ducted Ram-rocket (VFDR) propulsion system also referred to as Throttle-able Ducted Rocket (TDR) and has a speed of more than Mach 4 with high terminal velocity. Thus even when launched from extreme stand-off ranges, the missile will retain the energy to defeat fast, manoeuvring targets. The control system consists of four small moving tail surfaces and at high speed, sufficient to perform sharp manoeuvres. The engine's two air intakes, positioned on the both sides of the lower part of missile's body, are shaped to reduce the missile's radar cross-section.

The need for controlled airflow for the ramjet ducts ruled out the 'skid-to-turn' manoeuvring of a conventional rocket-powered missile, as this would risk masking an intake and instead 'bank-to-turn' manoeuvring is adopted. Meteor is capable of engaging a wide range of airborne targets autonomously, including cruise missiles with less than 1-metre square Radar Cross Section (RCS). For mid-course navigation guidance. Meteor utilises inertial navigation system (INS) combined with update commands provided by the launch, or any friendly aircraft via the two way secure microwave data-link, During terminal phase. The Ku-band (NATO: X band) active-radar homing seeker (advanced version of the MICA RF'4A') employs advanced proportional based navigation software. Rumours persist that the system can operate passively in the K-band given the consortiums previous research efforts. The seeker is said to be more resistant to electromagnetic jamming and operate in stealthier mode than the seekers of the MICA RF and Aster. To ensure total target destruction, the missile is equipped with a combination of Saab Dynamics laser proximity and impact fuses and a fragmentation warhead that is detonated at an optimum point to maximise lethality.

As Meteor is designed for the NCW environment, it is suitable for the futuristic concept of cooperative fighter operations or Mixed Fighter Force Concept (MFFC) that is essential for future BVR engagements and optimum results. Conceptually. in IAF service pairs of Sukhoi Su-30MKI or Rafales will be data-linked : as one illuminates, the other launches missiles against targets. In such engagements the 'striker' fighter will impart greater kinetic energy to the Meteor BVRAAM by accelerating up to Mach 2 and then manoeuvring out of the engagement cone. The illuminator with the powerful radar, capable of performing like a mini-AEW&C, would remain firmly subsonic keeping a 'decent' distance from the target and providing command-guidance updates alongside illuminating the target.

Since Meteor is a six-nation project, MBDA officials are reluctant to comment on its possible integration with IAF Sukhoi Su-30MKI fighters, yet there were sufficient hints given to this *Vayu* correspondent by senior MBDA officials during Aero India 2007 that integration is very much possible in response to formal request by the Indian Government. The Meteor will assist the IAF Sukhoi Su-30MKI and Rafale fleet reach their full combat potential in BVRAAM combat scenario that may prove critical in any confrontation. For 'eyeball to eyeball' confrontation, the Rafale is equipped with a single 30-mm GIAT 791B cannon mounted on the right engine duct with a rate of fire of 2,500 rounds per minute, carrying 125 rounds of ammunition.

At onset of the new millennium the IAF had initiated creation of considerable strategic punch, including multi-fold increase to its capabilities in the sphere of nuclear strike, conventional attack, interoperability with established powers and potential overseas deployment in conjunction with force multipliers like AEW&C and AAR platforms. The strategic transformation was headed by Sukhoi Su-30MKI multi-role strike fighters presently equipping ten operational squadrons in conjunction with Beriev A-50EI AEW&C system platforms and Ilyushin Il-78MKI MAR tankers.

Intriguingly the emerging possible commonality of weaponry with IAF-operated Sukhoi Su-30MKIs and Rafales may well have served as a strong catalyst for selection of the French fighter. Meteor BVRAAM, AASM … the list may well be longer. Looking ten years down the line, an IAF multi-role strike fighter fleet of Sukhoi Su-30MKIs, Dassault Rafale and upgraded Mirage 2000H/TH comprising around 24 squadrons may well represent the most potent air power in the Asian continent in terms of strike potential. The different types in service may not quite be a logistic nightmare as there will be commonality in sub-systems and weaponry. Meanwhile, Russia's tactical missile corporation (TMC) has announced a $ 36 million contract for the integration of its Kh-31 with the Rafale. But this has not been confirmed.

Assimilation of the Dassault Rafale into IAF service will be relatively smooth as the IAF have followed a considerable amount of French combat tactics and procedures developed along with formulation of syllabus and Standard Operational Procedures (SOP) following induction of the Mirage 2000H/TH. The results were well apparent during multi-national air exercises which the IAF started participating in turn of the millennium. To the United States Air Force, British Royal Air Force and the French Air Force among others it was very apparent that the IAF had 'freed' itself from 'Soviet era' rigid ground-control interception procedures and demonstrated immense flexibility during air exercises. In the words of the former CAS Air Chief Marshal Anil Yaswant Tipnis, himself a highly esteemed fighter pilot and who was highly impressed with Rafale, "France is the country which has the requisite R&D base for keeping up with the best; it is also fiercely independent – such French partnership augers well for the future".

Sayan Majumdar

Armed and ready at the operations readiness platform.

French Minister of Defence Jean-Yves Le Drian meeting with his Indian counterpart A.K. Antony outside South Block in New Delhi.

"We are confident about the Rafale"

During his visit to India on 25-27 July 2013, French Defence Minister Jean-Yves Le Drian, said that discussions on the Rafale MMRCA programme for India were progressing well and that "a new bilateral pact would underpin the deal". The massive and complex contract involves Dassault delivering the first 18 Rafales to the IAF as 'fly aways' with the remainder 108 to be produced under licence by Hindustan Aeronautics Limited (HAL).

The Government of India had initially set the end of 2012 as 'target' to conclude the purchase of 126 aircraft, one of the biggest ever defence contracts in the century but deadlines have repeatedly slipped. "I will not be announcing the date for signing the contract but would like you to know that the negotiations are going well and I have full confidence," Le Drian told Indian media. He added that a "framework Indo-French inter-governmental agreement for this contract" would be signed which would "provide all the necessary guarantees of the French State".

Le Drian confirmed he had discussed the Rafale deal with his Indian counterpart AK Antony, "I am not at all concerned about the delays (in signing the Rafale deal). I feel the pace of progress is perfectly normal for a project of this magnitude". Dassault and the French government are hoping that India's choice will send positive signals to other potential operators of the Rafale, including Brazil, which is looking for 36 aircraft, and also Canada, Malaysia and the United Arab Emirates.

The French defence minister also sought to reassure the Indian Government over the progress on building of six *Scorpene* submarines that have been dogged by huge delays and cost overruns. The *Scorpenes* have been under construction by French company DCNS at Mumbai since 2005 and the first delivery is only expected next year. "There is complete transfer of technology and co-operation with the Indian industry on the *Scorpene* deal", the minister added.

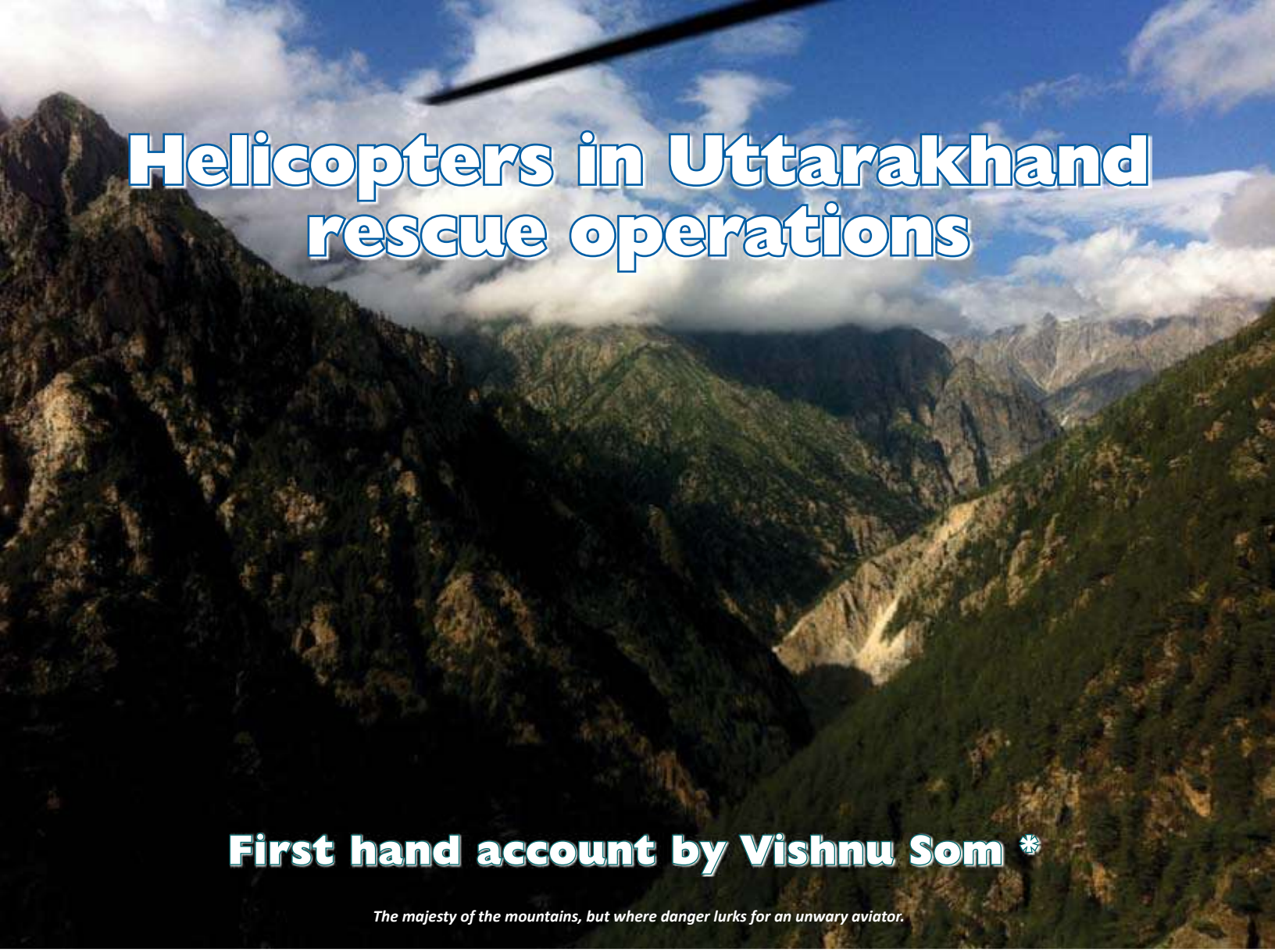
He also said upgradation of IAF Mirage 2000s was "proceeding well." At the end of this upgrade, the aircraft will match the most modern standards and continue to be in service for many more years," Le Drian predicted.

Later, visiting the IAF Museum at Palam, the Minister saw the first two French fighter types used by the IAF, the Dassault Ouragan ('Toofani') and the Dassault Mystere IVA, "a testimony to 60 years of uninterrupted cooperation and unflinching support by France in the field of military aircraft".

The French Minister later flew to the IAF base in Gwalior where he was given an extensive briefing on the Mirage 2000 squadrons and their role during the Kargil War. He toured the flight line as well as the maintenance hangars and witnessed a Mirage 2000 fly past. The Minister reiterated France's commitment to boosting Indo-French Defence ties, including exchange of pilots, training and joint exercises *Garuda* planned later in 2014.

Helicopters in Uttarakhand rescue operations

First hand account by Vishnu Som *



The majesty of the mountains, but where danger lurks for an unwary aviator.

Almost a decade ago, Suneet Sohal, then a Major in the Army, was flying me in an Army Cheetah helicopter from Partapur, a Brigade Headquarters in North Ladakh, to the Army's Siachen base camp, the hub of all operations along the Siachen glacier. We were flying low over a valley above the Nubra river alongside the mighty Saltoro range dominated by soldiers of the Indian Army.

Everything was fine. The weather seemed clear and we would reach our destination in minutes. Then, all hell broke loose! All of a sudden, out of nowhere, we flew into a snow storm and the good visibility we had was reduced to zero visibility in a matter of seconds. This was a complete white-out, nothing at all could be seen, not even the skids of the helicopter just a few feet to my side. There was no perception of depth whatsoever. Beneath us, there was a river. Along the sides, there were vertical cliff faces and no one had a precise idea of just how close we were to their jagged edges. We were flying blind and in danger.

Cool as a cucumber, Suneet brought his Cheetah to a hover. And waited. "We are just a few hundred metres from the base camp. I'm looking for an opening in the weather," he told me. But there was none to be found. We couldn't hover at one spot indefinitely. Fuel was running low. Suneet took a decision. Abort the mission. Fly back!

Colonel Suneet Sohal and the Dhruv ALH

I learnt a lesson that day. When pilots tell you that weather changes in the high Himalaya in moments, they're deadly serious.

Now, in mid-June 2013, when I travelled to Gaucher, a tiny air landing ground north of Rudraprayag in flood-torn Uttarakhand, I saw a familiar face. It was Suneet, now Commanding Officer of the 205 Army Aviation Squadron. He had been flying his Dhruv Advanced Light Helicopter over several previous days on the Kedarnath front and had rescued countless pilgrims and others stranded on the heights.

Suneet knew the terrain here well and was flying to the worst affected areas along the Gaurikund-Rudraprayag axis. With Army Headquarters having cleared me for a sortie, I asked Suneet if I could accompany him. Within half an hour we were airborne. This was already Suneet's third sortie of the day. We were to fly to Junglechetti,

File photo of Indian Army Dhruv ALH during exercises

from where the Army had been struggling to evacuate pilgrims, a thousand of whom had been discovered overnight.

And then it happened. Again! Ahead of us, as we approached the Gaurikund area, the clouds closed in. This wasn't as dramatic as the Siachen episode but the writing was on the wall. This mission had to be aborted.

"We're diverting," Suneet told me and proceeded to fly in the direction of the pilgrimage site of Hemkund Sahib where he had been ordered to pick up stranded pilgrims and trekkers and drop them off at Badrinath. By the time the mission ended, each and every pilgrim had been rescued and we returned to Gaucher.

But that's hardly where the day ended. Rushing into the lone hangar at the Gaucher air-landing ground, Suneet grabbed a bite to eat. No proper lunch. Just some hastily cooked dal, chawal and vegetables.

That was when a call came in : the weather had opened over Gaurikund-Kedarnath. And there was no time to complete his meal.

"We're going to the Kedarnath side. Two helicopters. Get onboard. We leave immediately."

With a roar of its French-designed Turbomecca *Shakti* engines, Suneet's Dhruv was airborne in moments. There was no air traffic control here to guide us. No watchful radar. Helicopters, military and civilian, had been operating on a special frequency for the rescue operations. Communicating is important and chatter between pilots on the radio is constant. There were dozens of rotorcraft in the skies and the only way to get a fix on their location was via the radio.

As we entered the narrow Kedar valley in Sonprayag, the extent of the devastation became immediately clear. The narrow pilgrimage path cut into the mountain was a wreck every few metres. It seems as if parts of the track had been destroyed by an earthquake.

Except there was no earthquake here. It was the river. The Mandakini river had risen, perhaps sixty feet! It seemed unbelievable but the destruction of the path had been caused by torrents, the ferocity of which went on to claim perhaps 10,000 lives. We may never know for sure.

As we flew up the steep valley, on my left I spotted the wreckage of a civilian helicopter which had crashed just a day earlier trying to land on a postage stamp-sized helipad. The pilot had been lucky to survive, his helicopter was inches away from plunging into the ravine.

Minutes later, we were over Kedarnath. The only structure standing was the temple. Everything else had been destroyed or very seriously damaged. Kedarnath looks like an island. The temple and the remains of structures at

the centre, with two streams of the river passing on either side.

Our mission was to air drop supplies to stranded pilgrims. But we couldn't slow down too much to ensure our drop was accurate. At this rarified altitude, the Dhruv helicopter needed to maintain a certain airspeed given the weight we were carrying onboard. Within minutes, we spotted a group of stranded people and dropped supplies, freshly cooked meals, drinking water and medicines.

As we regained some airspeed and altitude, Suneet decided it was possible to fly a circuit of the area to try and spot survivors. And then it happened again!

Fast moving clouds. Kedarnath, which was visible just moments back was blanketed by clouds. Suneet did not wait a moment, banking sharply to the right in a U-turn to a part of the valley where visibility was still OK. A call came in on the radio. There were pilgrims waiting to be rescued at Gaurikund.

Suneet glanced over at his co-pilot. They needed to take a call. The weather was closing in fast but there were people who desperately need to be picked up. It would be close. The last thing anyone wanted was to operate in these heights in poor visibility and changing weather, but ultimately, the choice for the crew of this Dhruv was simple - there were lives to be saved. If it was dangerous, so be it.

Suneet picked up airspeed to close the distance to Gaurikund. Aligning himself with the small helipad, he quickly descended and touched down. Engines still roaring, the cabin door slid open. What happened next has come to define my experience as a reporter covering the Uttarakhand tragedy.

Six children with their parents had been waiting for days for a chopper to fly them to safety. The youngest was just four. Our chopper was at the right place at the right time. If Suneet had thought twice about going into Gaurikund, these children would have been stranded. Their ordeal would have been extended until the next batch of helicopters could make it in, perhaps a day later.

We flew back to Gauchar and all was well. But I will never forget the story one of the survivors told me: "There was a man who went into the forests to try and find a friend of his. He saw a bear eating the remains of a man who had died. Even after we survived the deadly waters, there were so many other dangers. Thank god, we've managed to get out."

Back in Gauchar, Suneet switched off his Dhruv helicopter. Half-joking, I told him we hit a cloud every time he flies me. Neither of us laughed.

It's hard to imagine that just a few weeks ago, a part of this airstrip was used as a pasture for cows and goats belonging to villagers. No one would have ever known that within a day of the Kedarnath tragedy, on 17 June, Gaucher would become the stage of a war, a war not to kill an enemy, but to save lives. The warriors were our men and women in uniform, determined, tireless and remarkably skillful in getting to remote areas hit by disaster, helping stranded pilgrims get out from morning till late at night.

As the operations picked up pace, there were helicopters simultaneously taking off and landing here at Gaucher every few minutes. The pace of operations had to be seen to be believed. Air-rescue efforts in the Kedarnath area, will go down as one of the biggest peacetime air-rescue missions in history.

From 18 June, the Indian Air Force flew 2,200 sorties, evacuated 19,000 people and flown in 336,930 kg of equipment and supplies. The Indian Army, with its smaller fleet of helicopters, flew 774 sorties and rescued 3500 people. Civilian pilots operating smaller helicopters which ferry pilgrims in these areas played a yeoman role as well, saving countless lives. But these numbers do not really express what lay at the heart of the mission: the hope these men and women made possible by undertaking an operation in such unbelievably difficult terrain, amidst sharp, biting winds and on tiny helipads, some constructed in hours by army para-commandos blasting holes in the rockface.

Flying here has always been and will always be about the most challenging in the world. The air operations have come at a huge cost. When you push the limit, like our forces did, accidents happen, sometimes despite the skill of the pilots. On 25 June, tragedy struck the Indian Air Force. A recently inducted Mi-17 V5 helicopter on a rescue mission from Gauchar to Guptkashi and Kedarnath crashed North of Gaurikund. All 20 persons onboard including five Air Force Officers, nine NDRF personnel and six ITBP personnel were killed. Undeterred by this tragic loss, the Air Chief's message to his officers was direct : "keep the rotors churning, the job is not complete".

By the time the operations gained their full momentum, the Indian Air Force had thrown in some of their most precious assets, including the world's largest helicopter, the Mi-26, which flew in fuel bowsers and recently acquired C-130J transports which flew in mobile hospitals. In all, there were upwards of 60 civilian and military aircraft deployed on the Uttarakhand front, the bulk of them helicopters.

When hope faded fast in the Garhwal mountains, the sound of churning helicopter rotors signalled that all had not been lost.

Vishnu Som in Uttarakhand

***The author is Editor Documentaries & Special Programmes, NDTV**

THE CIVIL FACTOR

Bell 412EP of Global Vectra Helicopters

Vishnu Som on the under-played but crucial role of gutsy private pilots

When news broke of the angry waters of the Mandakini river tearing through the Kedar Valley, Captain Bhupinder, a civilian helicopter pilot in Uttarakhand, was given a mission. Bhupinder, who commercially flies pilgrims on the Char Dham route to remote Hindu shrines, was asked by the state government to fly to Kedarnath, the epicentre of the devastation caused by flash floods. His task was to give the state government a first-person account of what he saw.

There was a sense that something major had happened in Kedarnath but no one could be certain. By the time Bhupinder dodged the clouds to enter the narrow Kedar valley, the torrent of death that swept through the area had changed the geography of the region and had taken with it countless lives.

Bell 407 at a remote village

"I did a recce on the 17th (of June) - that was the first information to the outside world that something really terrible had happened at Kedarnath and Rambara. On the evening of the 17th, I took off and we could barely proceed to Rambara and when I tried to find Rambara, I got a shock of my life because Rambara, a huge place, now did not exist at all. In fact, there now was not a single blade of grass and I had difficulty in placing my finger on where Rambara used to be."

Bhupinder and several other civilian pilots, mostly former pilots of the Air Force and Army, spearheaded the relief effort in parts of Uttarakhand that remained marooned because the raging waters washed away roads and bridges.

We joined Bhupinder on a mission to the north of Uttarkashi to a village totally cut off from the rest of the district.

Landing in these areas is extremely difficult - the helipads are no more than matchbox-size. The risk of landing here is huge. The gap between the rotors and the nearby hillside is tiny - just a few feet. Landing in these conditions is a real challenge, but these civilian pilots had been doing it from day one.

Moments later, after picking up stranded villagers from this remote village called Pilang, we flew to an ITBP base in Matli, a staging area for all operations in Uttarkashi. We refuel, pick up supplies and head next to Harsil, one of the trickiest areas to land at in all of Uttarakhand. Positioned at at the confluence of two valleys, Harsil is a chopper pilot's worst nightmare. The winds change direction here suddenly and without any warning. A head wind, which pilots need to maintain their altitude and ability to climb, often gives way to a tail wind - winds from the back of the chopper. Tail winds can make the chopper drop alarmingly, a precarious situation to be in when landing a helicopter.

The dangers in operating here became all too apparent as we landed. A few feet away, I spotted the wreckage of a Pawan Hans helicopter which had made a hard landing a few days earlier. Though no one was injured, the tail section of the chopper had broken off from the fuselage.

Pilgrims evacuated by Span Air Bell 407 at Gaucher

But there's hardly a moment to spare in Harsil. The weather changes here within moments and the relief operations must continue here while this window of good weather remains.

At that time there were 12 villages where helicopters can land in Uttarkashi. The government was supplying these villages with flour, rice, sugar and candles, also sending diesel for bull dozers of the Border Roads Organisation, which is working through the day to clear the roads.

According to Captain DS Choudhary, one of the relief pilots, "Flying in valleys, the toughest thing we found is that there are a lot of high tension wires criss-crossing the valley. They are not marked. Invariably when you want to stay below the clouds, there's always a danger that you might strike

Despite the loss of two helicopters in accidents after the Kedarnath disaster and one which was washed away by flood waters, civilian helicopter operations continue to pick up pace post the tragedy. The government needs these helicopters desperately, to distribute a month's provisions for 30,000 affected families in Uttarakhand.

But this was just a first step. The ultimate goal is to stock provisions for three months - an ambitious target but one that's essential for lakhs of people in the region.

Meanwhile, with road access expected to take months to restore, these helicopters and their gutsy pilots remain Uttarakhand's lifeline.

Bell 407 lifts off for another mercy mission

From Sky to the Sea

IAF C-130Js in formation (photo: Lockheed Martin)

C-130J: A Proven Solution for India

The Indian Air Force may be one of the newest C-130J Super Hercules operators, but lately it's been one of the busiest especially, this past summer ! In June 2013, the IAF deployed one of its C-130J-30s of No.77 Squadron ('Veiled Vipers') to evacuate 244 people stranded in Uttarakhand by paralysing floods in the area. Then, in August, an IAF C-130J-30 was in the news again when the crew landed a Super Hercules at Daulat Beg Oldi (DBO) airstrip.

The C-130 Hercules certainly knows austere airstrips. The rugged aerial workhorse was designed to handle landing in the dirt and has done so successfully for almost 60 years. But, the landing at Daulat Beg Oldi took austere to a new level, literally! Daulat Beg Oldi's dirt runway has the distinction of being the world's highest airstrip, located at 16,614 feet in a remote area of the Karakoram mountains. The other aircraft of near-comparable size to land here was an Antonov An-32 in 2008.

This landing marked the first time a C-130 of any type had landed at Daulat Beg Oldi.It's certainly a record for the *Veiled Vipers* crew operating the aircraft and most likely a new mark for the C-130J.

Making history isn't new for the IAF's C-130Js. In 2011, one of IAF Super Hercules fleet's first missions was a deployment to support relief operations in Sikkim after the massive earthquake in the treacherous Himalayan mountain region, which marked the first time a C-130 had ever landed in the region. From the highest of heights to the wettest of floods, IAF crew have demonstrated that India's six C-130Js are ready for any mission, anywhere, anytime.

The IAF's fleet of six combat ready C-130Js are operated by No. 77 Squadron at Hindan Air Force Station, near Delhi. The new fleet was ordered under a U.S. $1.2 billion Foreign Military Sale (India's first) in late 2008, representing the first major military contract between the U.S. and India in more than 40 years

This contract was India's first experience with the C-130 and the total purchase package was comprehensive, the contract including the six aircraft, aircrew and maintenance technician training, spare parts, ground support and test equipment, servicing carts, forklifts, loading vehicles, cargo pallets and a team of US technical specialists based in India during a three-year initial support period.

Also included in the package was 'India-unique' operational equipment designed to increase special operations capabilities. The IAF C-130Js were delivered during 2010 and 2011, ahead of schedule, and the IAF officially began its C-130J operations in 2011.

"The Indian Air Force is happy to induct the C-130J Super Hercules, the most potent and versatile aircraft in its class,"stated the then CAS, Air Chief

IAF C-130J head on (photo : Angad Singh)

Marshal PV Naik, upon delivery of the first IAF C-130J. "It is an important milestone in transformation of the IAF that is presently underway. The IAF will fly an American aircraft after a gap of more than two decades after the 'Super Connie' and it is a historic moment for both countries."The Lockheed Model 1049 Super Constellation was a four-engine, long-range personnel and cargo transport airplane.

The Indian Air Force's C-130J Super Hercules features a highly integrated and sophisticated configuration primarily designed to support India's special operations requirements. Equipped with an Infrared Detection Set (IDS), the aircrew can perform precision low-level flights, airdrops and landings in blackout conditions. Self-protection systems and other features were included to ensure aircraft survival in hostile air defence environments. The aircraft also is equipped with air-to-air receiver refueling capability for extended range operations.

The C-130J is ideally suited to India's mission environment which often involves operating out of austere, high-elevation airstrips in hot conditions – like Daulat Beg Oldie. The C-130J is powered by four Rolls Royce AE2100 turboprop engines and Dowty six-bladed props that provide the aircraft tremendous power.

Partners in Hercules, Partners in Business

While India's relationship with the C-130J is relatively new, Lockheed Martin's presence in India now spans 20 years, as the world's largest defence contractor opened its New Delhi office in 1993.

With strengthening of the Indo-US relationship over the past decade, Lockheed Martin has increased its presence in India. In 2005, the corporation expanded its office to better support the global security needs of the Indian Ministry of Defence. Today, Lockheed Martin's largest effort in India is the C-130J Super Hercules programme.

Beyond programmes and capabilities, Lockheed Martin also supports corporate social responsibility activities such as its flagship effort, the India Innovation and Growth Programme (IIGP).

Additionally, Lockheed Martin supports science, technology, engineering and mathematics (STEM) initiatives including a partnership with Delhi Technological University's award-winning UAV (unmanned aerial vehicle) design team. The corporation also sponsors Science and Inventor's Fairs at local elementary schools, encouraging younger students todevelop an interest in science and engineering education.

It's noteworthy that Lockheed Martin and Tata Advanced Systems have also formed a joint venture company in India, Tata Lockheed Martin Aerostructures, Ltd. (TLMAL), for manufacturing airframe components in support of the worldwide C-130J fleet. Lockheed Martin has partnered with Tata Advanced Systems in February 2011 to form the joint venture that manufactures aerospace components for the C-130J in a factory near Hyderabad. Work at the facility includes producing empennages and center wing box components that are included in all C-130Js. TLMAL was honoured with the 2013 Aerospace & Defense "Best Joint Venture of the Year" award, which was announced at Aero India 2013 in Bangalore. The awards are presented annually and sponsored by *International Aerospace* magazine.

What the Future Holds

Earlier this year, the C-130J worldwide fleet surpassed one million flight hours. Thirteen Super Hercules operators – including India's —flew 290 C-130Js to achieve this milestone. The hours, which were logged from the C-130J's first flight in April 1996 through April 2013, represent test, production and mission flight hours. With more than a million hours to the C-130J's credit, Super Hercules operators are focused on what the next million flight hours will bring.

One of the C-130's hallmarks throughout its near-60 years of operation hasbeen its multi-mission flexibility. More than 70 different variants of the aircraft have been produced to support missions ranging from airlift to fire fighting to medical transport. The C-130J follows in this tradition. To date, there have been seven C-130J model designations in production, including the C-130J combat delivery; C-130J-30 combat delivery extended fuselage, or stretch; U.S. Coast Guard HC-130J long-range surveillance; EC-130J psychological warfare; KC-130J combat delivery tanker; WC-130J weather reconnaissance; U.S. Air Force HC-130J personnel recovery aircraft; and the MC-130J special operation forces tanker.

The C-130J's unique combination of flexibility, affordability, availability and reliability has customers (there are 15—including India—operating or on contract to receive C-130Js) seeking additional mission capabilities for the Super Hercules.

Lockheed Martin recently introduced the SC-130J Sea Hercules, a maritime patrol and long-range search and rescue aircraft. This J-model can be equipped with a range of equipment to allow crews to carry out such relatively straightforward missions as monitoring a coastline to firing standoff missiles or launching torpedoes.Available in three configurations, the SC-130J aligns with mission requirements similar to those of the Indian Coast Guard and Navy.

Like the Hercs' before it, the SC-130J leverages the proven airframe of the C-130J and its flexible capabilities to not only successfully complete missions, but redefine them as well.

As the C-130J worldwide fleet flies toward two million flight hours, many of these hours will be logged by Super Hercs with new mission capabilities. And, these hours will be flown by operators who continue to build upon the Super Hercules' reputation as the world's most proven airlifter.

Thanks to the IAF and the missions its C-130J crews support, the Super Hercules is not only proven, but still proving it.

Stephanie Stinn and Jeff Rhodes, Lockheed Martin

C-130J landing on a dirt strip at Pokhran, during Exercise 'Iron Fist' (photo: Angad Singh).

Ethiopia to get ex-IAF Su-30Ks?

Rosoboronexport have confirmed that negotiations are underway for the sale of 18 second-hand Sukhoi Su-30Ks to the Ethiopian Air Force. These former Indian Air Force examples (serials SB-001 to SB-018) were "traded-in" by the IAF in exchange for new production Su-30MKIs. According to a spokesman, "we propose to modernise the aircraft to improve their tactical and technical characteristics, also equipping them with modern air-to-ground missiles. If the customer is ready to finance the work, we are ready to make repairs, upgrade and deliver the aircraft within four to six months."

Presently the property of Su-30 manufacturer Irkut Corporation, the Su-30Ks were moved to Belarus to avoid Russian import taxes. Currently, all remain stored at Baranovichi in the eastern European country, according to Russian sources.

Royal Navy orders Scan Eagle

An unspecified number of Scan Eagle unmanned air vehicles have been ordered for the Royal Navy. Built by Insitu, a subsidiary of Boeing Defence UK Limited, these will be used for maritime reconnaissance and are capable of being launched from Royal Navy and Royal Fleet Auxiliary ships for intelligence and survey. The UAV has a wingspan of over 10 ft(3m), weighs 48lbs (22kg), and is launched from ships by a pneumatic catapult. According to an RN spokesman, "Scan Eagle represents an important addition to the Royal Navy's Intelligence, Surveillance and Reconnaissance capability. Its ability to deploy during the day and night coupled with the technology it uses, will give commanders a clearer picture of the operational situation whenever it is required."

Reduction of A400M, Typhoon and NH 90 orders by Spain

Indicative of the economic crises and attempts to pare down defence expenditure, the Spanish Ministry of Defence has reduced the number of Eurofighter Typhoons by 14 and Airbus Military A400Ms by 13 for the Spanish Air Force (*Ejército del Aire*). Details of the proposed changes were revealed to Spanish Congress by the Secretary of State for Defence, who said that defence re-equipment budget cuts would save €3.85 billion over the next few years. Spain had previously announced that it was postponing delivery of 15 Eurofighters from 2012 to 2015, while also attempting to sell off some of the early production aircraft already delivered to cut expenditure.

Spain's purchase of 24 Eurocopter Tiger attack helicopters for the Spanish Army Aviation (*Fuerza Aeromóviles*) will go ahead as planned but Spain's NH90 order will be cut from 45 to 22 helicopters.

Polish AJT 'finalists'

Three OEMs have submitted initial proposals in response to a Polish Ministry of Defence tender for a new integrated advanced jet training (AJT) aircraft, plus an option to order a further four later. The Polish MoD confirmed that offers were received from Alenia Aermacchi (M-346 Master), BAE Systems (Hawk AJT) and Lockheed Martin UK (KAI T-50 Golden Eagle). Aero Vodochody declined to bid for the L-159.

It is expected that a winning contendor would be selected before the end of 2013 with a view to delivering the eight aircraft in 2016-17, along with a logistics support system. The aircraft will be based at Deblin-Irena, home of the Polish Air Force's 41 *Baza Lotnicza Szkolnego* (Air Base School) with the TS-11 Iskra.

Gripen fires MBDA Meteor

Saab and the Swedish Defence Materiel Administration (FMV) have successfully conducted first test firing of the production

MBDA Meteor radar-controlled air-to-air BVRAAM (beyond visual range air-to-air missile). The trials which involved the first Meteors in production configuration, successfully demonstrated separation from the aircraft and the link function between the aircraft and missile, as well as the missile's ability to lock on the target. They were launched from a JAS-39 Gripen at a remote-controlled target.

More F-35A squadrons planned

Luke Air Force Base at Arizona will house a further 72 Lockheed Martin F-35A Lightning IIs in three squadrons, making an eventual total of 144 F-35s to be based there, with six squadrons operating the type for pilot training. The F-35As will begin arriving at Luke in spring 2014, with preparations for the F-35 already underway there. As well as training US pilots, Luke will serve as an F-35A International Partner Training of site and will continue training of F-16 pilots until at least 2023, although by 2021 most F-16s are expected to have been replaced by F-35As.

First CH-147F Chinooks for Canada

The first Boeing CH-147F Chinook helicopter for the Royal Canadian Air Force was handed over on 24 June during a ceremony at Boeing's factory in Philadelphia and then flown to Ottawa International Airport. Later, the helicopter was flown to its new base at Garrison Petawawa, Ontario.

The CH-147F Chinook's primary mission will be to transport equipment and personnel during domestic and deployed operations, but it will also respond to humanitarian emergencies such as fire, floods and earthquakes. These Chinooks have been modified to meet requirements for operating in Canada, including the installation of long-range fuel tanks, allowing them to fly twice as far as previous models. They are also equipped with advanced radar and laser warning systems, three machine guns and a laser-based active missile counter measures system.

The purchase contract for 15 CH-147Fs was signed with Boeing on 10 August 2009 and these will be delivered to the RCAF over the course of the next year. On 2 May 2012, the RCAF re-established 450 Tactical Helicopter Squadron at Garrison Petawawa, Ontario, to operate the new fleet.

Grob 120TPs for Argentina ...

Four Grob 120T basic trainers were handed over to the Argentina Air Force (*Fuerza Aèrea Argentina*) on 10 June at the manufacturer's facility in Tussenhausen, Germany, the first of ten on order for basic training of pilots for all three branches of the Argentine armed forces. The aircraft will be shipped to Argentina by sea. The purchase was completed after a year of negotiation at an approximate cost of € 20 million, which includes ten aircraft plus spare parts and the provision of technical support.

...and Indonesia

Grob Aircraft handed over the first four of 18 Grob 120TP basic trainers to the *Tentara Nasional Indonesia – Angkatan Udara* (Indonesian Air Force). They arrived in Yogyakarta on 6 August. Also included in the contract are maintenance support, computer-based ground training and embedded cockpit simulation.

400th MH-60 Seahawk for US Navy

Sikorsky has delivered the 400th MH-60 Seahawk helicopter to the US Navy. The milestone consists of 166 MH-60R anti-submarine and anti-surface warfare helicopters and 234 MH-60S utility/armed helicopters. The Navy took possession of the 400th, an MH-60R aircraft, on 24 June. MH-60S ('Sierra') helicopters carry supplies and sailors between ships, and protect US ships from surface threats in an armed configuration. 'Sierra' aircraft are expected to take on an airborne mine countermeasures role starting in 2014. MH-60R ('Romeo') helicopters employ radar, acoustic sonar, communications links, torpedoes and air-to-surface missiles for the anti-surface and anti-submarine warfare roles.

All but two of the 400 MH-60 Seahawk aircraft delivered to date are operated by the US Navy. In 2011, the Royal Thai Navy took delivery of two MH-60S helicopters via the US Government's Foreign Military Sales (FMS) programme. The US Navy has acquired all MH-60 Seahawk aircraft since 2002 via five-year contracts. The current 2012-2017 contract funds 193 MH-60R/S Seahawk helicopters, plus another 24 'Romeo' helicopters for the Royal Australian Navy.

Three AW139s for Armed Forces of Malta

The Armed Forces of Malta have signed a contract for one AW139 helicopter plus two options, to perform maritime border patrol and SAR missions. The plan foresees the acquisition of three aircraft by 2015 including an Integrated Logistic Support package and the training of 10 pilots including four ab-initio students, as well as 20 technicians. The first helicopter will be delivered by June 2014.

Vietnamese Navy Guardian 400

Flight training has been completed for the first Vietnam People's Navy pilots on the Viking Air Twin Otter Guardian 400. The flight and maintenance training programme was provided by Pacific Sky Aviation and encompassed English Second Language (ESL), ab-initio, private and commercial pilot licensing, multi-engine, night and amphibious float training. The Guardian 400 training was carried out on the Navy's new aircraft over the course of four months, clocking approximately 500 flight hours and 350 cycles on runway and soft field and water-based operations. The Vietnam Navy has purchased six Guardian 400 Twin Otters, the first ever fixed-wing aircraft to be operated by the Vietnamese Navy.

CATIC presents two-seat FC-1

On display at the China National Aero-Technology Import and Export Corporation (CATIC) stand at Le Bourget was a model of a proposed two-seat version of the single-seat Chengdu FC-1 Xiaolong (*Fierce Dragon*) multi-role fighter. The type has only been sold to the Pakistan Air Force (PAF) as the JF-17 Thunder and is being produced under licence for the PAF at the Pakistan Aeronautical Complex Kamra.

French radar systems for UAE

On 24 July 2013, the United Arab Emirates ordered 17 anti-aircraft radar systems from the French firm Thales for around 300 million euros ($397 million). The deal, clinched during a visit by French Defence Minister Jean-Yves Le Drian, came a day after the UAE signed an agreement worth more than 700 million euros for two French military surveillance satellites. The crown prince of Abu Dhabi, Sheikh Mohammed bin Zayed al-

Nahyan, "gave his green light to Mr. Le Drian for the purchase of 17 Thales GM200 radars," a ministry spokesman said. Le Drian has re-established trade ties with the UAE, a traditional customer for the French arms industry. Before the two deals in two days, the last significant military orders received by France from the UAE dated back to 2007.

Dutch F-16s for Jordan

It is confirmed that the sale of 15 Royal Netherlands Air Force F-16s in Mid-Life Update (MLU) configuration will be to Jordan. On 8 April 2011, the Dutch Government had announced that 19 F-16s would be retired due to budget cuts, with 15 of them put up for sale, while the other four would be stripped for spares. The majority of the aircraft remain stored in flyable condition at Leeuwarden and Volkel Air Bases, while a few are still in operational use. On average, they have flown around 4,500 hours each.

This would be a follow-on order, as the Royal Jordanian Air Force (RJAF) took delivery of six ex-RNLAF F-16BMs in July 2009. A further 36 Dutch F-16 MLUs (29 F-16 AMs and seven F-16 BMs) were delivered to Chile between 2006 and 2011. A political decision on the type to replace the F-16 within the RNLAF is expected soon, although it is known that the RNLAF has a strong preference for the Lockheed Martin F-35A Lightning II. Retirement of the last Dutch F-16s is expected by 2025.

USAF F-16s in Jordan

US Air Force/Ohio Air National Guard F-16Cs from the 180th Fighter Wing/112th Fighter Squadron 'Stingers' flew into Azraq Air Base in northern Jordan on 10 June to participate in Exercise 'Eager Lion' 2013, which ended on 20 June. However, the F-16s have remained on "to provide additional security amid continuing violence in neighbouring Syria." US administration officials confirmed that about a dozen F-16s will stay in Jordan where they will conduct training missions.

First Israeli C-130J-30

Lockheed Martin handed over Israel's first C-130J-30 Super Hercules during a ceremony at its production facility in Marietta, Georgia on 26 June. This is the first of three currently on order for the Israel Air & Space Force (IASF), which has operated legacy C-130s since 1971. The IASF has given its C-130Js the name 'Shimshon' (Hebrew for Samson). Israel has ordered its C-130Js through a Foreign Military Sale (FMS) contract with the US Government. After delivery all three will be modified with Israeli-specific systems.

Pakistan orders Hawker 4000s

Two Raytheon (Hawker Beechcraft) Hawker 4000 executive jets have recently been acquired by the Pakistan Government, although it is unclear which organisation is operating them. It is speculated that they may be for use by the country's national security and intelligence agency. The 'serial' applied to one of the Hawker 4000s wears only 'EYE77', perhaps indicating that it has a surveillance capability.

30 Mi-17V-5s for Afghan Air Force

Russian State arms export agency Rosoboronexport and US Army Contracting Command have signed a contract to deliver 30 Kazan-built Mi-17V–5 helicopters to the Afghan Air Force. The firm, fixed-price Foreign Military Sales contract is valued at $572 million including spare parts, test equipment and engineering support services. Contract completion is due by 31 December 2014. The US is continuing to buy from Rosoboronexport because most Afghan servicemen are already familiar with the Mi-17.

The Pentagon had previously ordered 43 Mi-17V–5s for Afghanistan, the first ten of which were delivered during 2010. On 26 May 2011, a further 21 were ordered with 12 options, which were later converted into firm orders. Those 12, the final aircraft outstanding, are due to be delivered before the end of 2013.

UK MoD "interim helicopter training"

According to reports from London, the UK Government is likely to decide on an "interim" solution to provide rotary-wing training for all three branches of the armed forces by 2013. The UK Ministry of Defence had delayed for 10 years the award of a £400 million ($614 million), 20-year contract under its UK Military Flying Training System (MFTS) programme as a "money-saving exercise".

Its current contract with Cobham-owned FB Heliservices, which provides tri-service training at the Defence Helicopter Flying School (DHFS), ends in 2018 and the government is seeking a temporary solution. FB Heliservices presently operates Eurocopter AS350 Squirrel HT1 light singles and Bell 412 Griffin HT1 twins for the DHFS.

First ATR for Turkish Navy

Alenia Aermacchi has delivered the first ATR 72-600 utility aircraft to the Turkish Navy, as part of a recently revised maritime patrol and anti-submarine warfare acquisition. Turkish instructor pilots have completed training on the adapted regional aircraft at the company's Turin-Caselle site in Italy "both to be used for utility roles, personnel and cargo logistic transport," according to Alenia Aermacchi, which has added military radios, identification friend or foe equipment and tactical mission positions to the commercial type.

Turkey has adjusted its Meltem 3 programme from a plan to acquire 10 modified ATR 72-500s, to the two utility aircraft plus six -600s in a maritime patrol and anti-submarine warfare configuration. Deliveries of the latter will start in February 2017 and conclude in 2018, with Turkish Aerospace Industries to modify the aircraft.

First RAF Squadron on F-35s is No. 617

The RAF has announced that the Tornado GR4-equipped No. 617 Squadron is to be disbanded in April 2014, before re-forming in 2016 as the first RAF unit to operate the F-35 Lightning II. With a mix of RAF and Royal Navy Fleet Air Arm personnel, the 'Dambusters' squadron will be based at RAF Marham, Norfolk.

Meanwhile, the "multi-role Typhoon is being taken very seriously by other air forces and governments around the world," according to Vice Marshal Edward Stringer, RAF assistant chief of the air staff, who added that the type is now "over-delivering". "Red Flag was a real eye-opener about how we should think about Typhoon," said the CO of No. 11 Squadron RAF. The RAF will soon gain the ability to use Raytheon's Paveway IV precision-guided bomb, with the MBDA Brimstone air-to-surface weapon, Storm Shadow cruise missile and Meteor beyond visual range air-to-air missile.

First UAV carrier landing

The Northrop Grumman X-47B Unmanned Combat Air System Demonstrator (UCAS-D) carried out its first arrester landing on an aircraft carrier on 10 July 2013, landing on the USS *George HW Bush* (CVN 77) sailing in the Atlantic Ocean off the coast of Virginia, having flown from NAS Patuxent River, Maryland. A second successful landing and trap was carried out on the same day.

The carrier trials are the culmination of a two-year development effort. Both X-47B demonstrators have been involved in deck trials on carriers and in May 2013, a catapult take-off was performed as well as precision approaches and nine touch-and-gos at sea. The lessons from the landings and the development programme will be fed into the Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) programme, which has the aim of creating a production-standard UCAV for operation from US Navy carriers.

Second Pakistan Navy ATR 72

Pakistan's Naval Air Arm has received a second ATR 72-500, which was a former Air Botswana airliner that was refurbished at Las Palmas and departed on its delivery flight to Pakistan on

8 July. The first example had been handed over to Pakistan in March. Both will be used for pilot training and as utility transports with a mixed freight and passenger configuration.

'New' Lavi for Israel

The Israeli Air Force have bestowed the name Lavi ('Young Lion') to the Alenia Aermacchi M346 Master, thirty of which advanced trainers are to be delivered to Israel from 2014. These will replace upgraded Douglas TA-4H/J and A-4N Ayits ('Eagle') at Hatzerim AB, home of the Israel Air and Space Force's academy. 'Lavi' is a reuse of the name given to the indigenous fourth-generation fighter developed by Israel Aircraft Industries in the 1980s but the programme was cancelled in August 1987.

Third A330 MRTT for RSAF

The Royal Saudi Air Force (RSAF) has received its third Airbus Military A330 Multi-Role Tanker Transport (MRTT), delivered on 25 June 2013. The aircraft was ferried from Getafe in Spain to Al Kharj Air Base. Its arrival completes delivery of the first batch of three A330 MRTTs ordered in January 2008. An order for a second batch of three was revealed on 27 July 2009. The first is currently undergoing a conversion with Iberia at Barajas Airport outside Madrid, with delivery scheduled for 2014.

Egyptian F-16 deliveries "suspended"

The next four F-16C/D Block 52s for the Egyptian Air Force "will not be delivered at this time" according to the Pentagon. "Given the current situation in Egypt, we do not believe it is appropriate to move forward at this time with the delivery of the F-16s". Egypt had ordered 20 F-16C/D Block 52s, eight of which have been delivered, the first four on 22 January, followed by four more on 11 April 2013.

US Navy order more P-8A Poseidons

Boeing has been awarded a supplementary $2 billion by US Naval Air Systems Command for the procurement of 13 P-8A Poseidon multi-mission maritime low-rate initial production (LRIP) Lot IV aircraft, including 13 ancillary mission equipment kits. In addition, there is purchase of long-lead parts associated with the manufacture of a future 16 P-8A full-rate production Lot I aircraft. US Navy P-8A orders comprise two ground test airframes, six Lot I LRIP, seven Lot II LRIP, eleven Lot III LRIP and this batch of 13 LRIP Lot IV aircraft. Deliveries to date have included the two ground test airframes, six development aircraft, all six Lot I aircraft and three of the Lot II aircraft.

More Su-34s delivered to Russian Air Force

On 9 July, a batch of three Sukhoi Su-34s were handed over to the Russian Air Force to enter operational service. An initial production contract for 32 Su-34s was signed in December 2008 to begin replacement of the Russian Air Force's Su–24 front line bomber fleet, followed by a major order for 92 announced on 1 March 2012, taking production through to 2020.

Testing of Il-76MD-90A, aka Il-476

The upgraded Il-76MD-90A prototype made its third flight as part of joint tests with the Russian Ministry of Defence on 12 July at the Gromov Flight Research Institute at Zhukovsky. The aircraft, built by Aviastar at Ulyanovsk, had made its maiden flight on 22 September 2012; the new variant differs from the older Il-76 models in having more powerful Aviadvigatel PS-90A-76 engines, a glass cockpit, new wing structure, reinforced fuselage and new avionics and communications systems.

A $4 billion order for 39 of these for the Russian Air Force was announced in October 2012 by President Putin. Eventually, the Russian Air Force intends to take delivery of 100 of the type, which will be formally designated as the Il-476.

Korean FX-III programme

The South Korean government is initiating a new tender for acquiring 60 fighter aircraft for the Republic of Korea Air Force, the third attempt to secure offers that come below the 8.3 trillion won ($7.3 billion) ceiling set for this acquisition under the FX-III programme. Three types are in the shortlist for the requirement: the Boeing F-15SE Silent Eagle, Eurofighter Typhoon and Lockheed Martin F-35A Lightning II. Korean spokesman has said, "If there's no entry within the project budget after the resumption of bidding, we'll pursue the project again through reviews. Despite finishing first in the evaluation, a firm whose bid exceeds the budget will not be signed for the F-X contract."

Philippine Air Force to buy FA-50s

The Philippine Air Force (PAF) is to purchase 12 KAI FA-50 lead-in fighter-trainers. The Philippines has been seeking

new fighter aircraft for some time and has previously considered various options, including surplus second-hand F-16C/Ds from the USA and also new Aermacchi M-346s from Italy. The selection of the FA-50 to meet the requirement was made in 2012 and the type will be used by the Phil. Air Force both as a trainer and a light attack aircraft.

Initial HAD/E Tiger in maiden flight

Eurocopter's Tiger combat helicopter programme crossed an important new milestone with maiden flight of the initial Tiger HAD/E variant assembled at Eurocopter's Spanish facilities in Albacete, Spain in end-July. The milestone helicopter assembled in Albacete, designated HAD/E-5002, will be the first unit to enter service with the *Fuerzas Aeromóviles del Ejército de Tierra* (FAMET) with delivery planned by the end of 2013. It follows the first prototype (HAD/E-5001) – assembled at Eurocopter's Marignane, France facilities – which has been performing the certification and qualification flight campaign in Spain since 2010. The helicopter will significantly reinforce the six French-assembled Tiger HAP/E variants currently operated by the Spanish Army including missions in Afghanistan with these rotorcraft.

Rolls-Royce joins BAE Hawk AJTS Team to pursue USAF T-X Contract

BAE Systems and Rolls-Royce announced that the latter was joining the Hawk Advanced Jet Training System (AJTS) team as an exclusive partner to compete for the US Air Force's T-X programme. As the engine supplier to BAE Systems on this pursuit, Rolls-Royce will lead the support and integration of the Adour Mk951 engine on the Hawk AJTS aircraft.

"Rolls-Royce's extensive propulsion expertise, coupled with their lengthy relationship with the U.S. Air Force, makes them the perfect choice to integrate their Adour Mk951 engine in the Hawk AJTS aircraft," said Robert Wood, vice president of BAE Systems' Hawk Advanced Jet Training System team. "The selection of Rolls-Royce rounds out the Hawk AJTS team as we pursue the T-X programme win."

Rolls-Royce joins BAE Systems, Northrop Grumman and L-3 Link Simulation & Training as the fourth member of the Hawk AJTS team, which plans to offer the Hawk AJTS as the replacement of the T-38 trainer. "The Hawk AJTS is uniquely tailored to meet the training needs of the U.S. Air Force and will be manufactured in the United States with the involvement of a strong U.S. supply chain."

The Hawk AJTS integrates live and synthetic air- and ground-based elements to train pilots for 5th generation fighters such as the F-35 Lightning II and the F-22 Raptor. It is the "world's only fully-integrated, off-the-shelf system in service today that is ready now to train U.S. Air Force combat pilots. More than just an aircraft, the Hawk AJTS teaches student pilots how to address the critical flow of information, learn to interpret it correctly, and make the right decisions to maintain operational advantage", according to the Team.

Almost 1,000 Hawk aircraft have been sold till date, "helping produce trained pilots in 18 countries for newest-generation aircraft such as Typhoon, F-35 Lightning II, and JAS 39 Gripen."

Bell OH-58F Kiowa Warrior programme

Bell Helicopter has provided a programme update on the OH-58 Kiowa Warrior programme : in addition to the accumulation of over 820,000 combat hours, all OH-58 units are reporting that they continue to achieve over 90% mission capable rates. With a focus on the future, the next generation Kiowa Warrior, the OH-58F, is designed specifically for the US Army's next generation Scout mission. Under the Army's *Cockpit and Sensor Upgrade* programme (CASUP), OH-58F aircraft offer several upgrades, including enhanced sensors, new cockpit control hardware and software, and three colour multi-function displays. Other near-term improvements include increased engine power, weight reduction initiatives and the latest condition-based maintenance technologies. These enhancements will provide greater capability, better performance, increased safety and even more operational readiness.

E-2D Advanced Hawkeyes for US Navy

The US Navy has awarded Northrop Grumman Corporation a $617 million contract for five full-rate production Lot 1 E-2D Advanced Hawkeye aircraft. "Moving from low-rate production into full-rate production is a significant milestone for the E-2D Advanced Hawkeye programme," said Bart LaGrone, vice president, E-2/C-2 programmes, Northrop Grumman Aerospace Systems. "We look forward to manufacturing and delivering a mature and effective airborne early warning, battle management, command and control system."

On 3 August 2007, the first E-2D Advanced Hawkeye first flew over St. Augustine, Fla and since then, Northrop Grumman has delivered 10 new production E-2Ds to the US Navy, "on cost and on schedule." An additional 10 aircraft are in various stages of manufacturing and pre-delivery flight testing at the company's St. Augustine Aircraft Integration Centre. Initial operational capability with the Navy remains on track for 2015.

Thales attains Type 45 communications milestone

Thales UK has marked one year of successful operations for the Fully Integrated Communications System (FICS) onboard the Type 45 Destroyer, the Royal Navy's most advanced class of surface ship. First of class HMS *Daring* was deployed operationally to the Arabian Gulf in 2012, followed by the operational debuts of HMS *Dauntless* and HMS *Diamond*. During these deployments, the three ships were tasked with a variety of operations and exercises that thoroughly tested the communications systems.

Thales is lead contractor supplying the system to all six ships of the new Type 45 Class. These 8,000 tonne vessels are designed to shield the Fleet from air attack, as well as being used as general purpose warships. Type 45 Destroyers are also fitted with Thales UK's new fully digital Radar Electronic Support Measures (RESM) system, in addition to S1850 million radar (with BAE Systems).

EC645 T2 for German Special Forces Command

Eurocopter and the German Federal Ministry of Defence have signed a contract for 15 EC645 T2 Light Utility Helicopters (LUH) to be used by *Kommando Spezialkräfte* (KSK), Germany's Special Forces Command. The contract, worth 194 million euros, includes not just the helicopters but also the related equipment packages to allow KSK to carry out its special operations missions. Deliveries of the 15 aircraft begin in late

2015 and will be completed by mid-2017. The LUH contract enhances the Special Forces Command's operational capability. The day and night missions that these helicopters will perform include insertion and extraction of special ops, fire support and reconnaissance.

Saab contracted for Skeldar UAS

Saab has been contracted to deploy the Skeldar Unmanned Aerial System (UAS) for maritime operations, which will be operationally deployed before the end of 2013 and used in naval operations where the benefits of a Vertical Take Off and Landing UAS are most essential. Skeldar is a flexible multi-mission system set to successfully meet mission objectives on land or at sea and

based on the same smart design and innovative technological solutions that have become the trade mark for Saab's aeronautical products and systems.

"Skeldar UAS is an excellent choice for maritime operations thanks to its high flight performance, heavy fuel engine and easy-to-maintenance design. We continuously improve the system with the integration of new sensors and different payload according to customer needs," said Lennart Sindahl, Head of Saab's business area Aeronautics.

Boeing's 250,000-kit milestone in JDAM weapon programme

Boeing has marked recent production of the 250,000th Joint Direct Attack Munition (JDAM) guidance kit, a major milestone for a programme that, since 1998, has reliably and affordably converted unguided munitions into near-precision weapons. "With a range of more than 15 nautical miles, JDAM can defeat high-value targets in any weather, day or night, with minimal risk to air crews." New variants such as Laser JDAM and JDAM Extended Range allow warfighters to prosecute moving targets and deploy the weapon from greater distances, capabilities that come with little to no development risk since they are based on proven technology.

Raytheon SM-6 trials by US Navy

The US Navy has launched two Raytheon Standard Missile-6 interceptors from the USS *Chancellorsville*, successfully engaging two cruise missile targets (BQM-74 drones) in the missile's first over-the-horizon test exercises at sea.

The SM-6 will provide US Navy with extended range protection against fixed- and rotary-wing aircraft, unmanned aerial vehicles and cruise missiles as part of the Naval Integrated Fire Control - Counter Air (NIFC-CA) mission area. In February 2013, Raytheon delivered the first SM-6 from its new $75 million, 70,000 square-foot SM-6 and Standard Missile-3 all-up-round production facility at Redstone Arsenal in Huntsville, Ala. In May, a Defence Acquisition Board approved full-rate production of the SM-6 missile.

Airbus delivers its 1,000th A330

Airbus has celebrated the delivery of the 1,000th A330, an A330-300 powered by Rolls-Royce Trent 700 engines to Cathay Pacific Airways at special ceremony in Toulouse. Cathay Pacific together with its sister airline Dragonair is the world's largest operator of the A330, with a total of 56 now in service.

The 1,000th delivery comes as the A330 continues "to enjoy increasing popularity with airlines across the globe". Continuously enhanced to maintain its economic advantage, the aircraft remains the most cost-efficient twin engine widebody airliner in service today for both regional and long haul routes, with the latest versions capable of flying non-stop on sectors of up to 7,250 nautical miles / 13,420 km.

Airbus delivers its 8,000th aircraft

Airbus has delivered its 8,000th aircraft, an A320 for the Indonesian wing of AirAsia. "AirAsia has a long-standing, special relationship with Airbus. This is a very special moment for all of us. The people behind Airbus and their commitment in delivering the best product are key to our fruitful relationship, and we are extremely proud to have the 8,000th Airbus as a member of our fleet. It is the same pioneering, forward-looking mindset and a lot of hard work that have brought both AirAsia and Airbus to their respective leading positions," said Tan Sri Tony Fernandes, Group Chief Executive Officer of AirAsia.

AW189s for Bristow Group

AgustaWestland and Bristow Group have signed a contract for 11 AW189 Search & Rescue (SAR) helicopters that will be used to deliver SAR services in and around the UK. In addition to the aircraft, AgustaWestland will provide related training, maintenance and support services. The 11 AW189s will be built at AgustaWestland's Yeovil facility and operated by Bristow in the UK, with a phased introduction to service between 2015 and 2017. The overall programme value to AgustaWestland, which was announced in March 2013, is in excess of €275 million. Bristow Helicopters Ltd. was awarded a contract by the UK Department for Transport in March 2013 to provide SAR services to the UK for 10 years and selected the AW189 SAR variant as one of the central platforms for the UK SAR programme.

Rolls-Royce Trent engines for SAS

Rolls-Royce has received an order worth $1 billion, from Scandinavian Airlines System (SAS) for Trent XWB and Trent 700 engines plus long term TotalCare services. The Trent XWBs will power eight Airbus A350-900 aircraft and the Trent 700s will power four A330-300s. Rickard Gustafson, SAS Group President and CEO, said: "We launch an extensive fleet renewal plan that gives SAS a state of the art long haul fleet. To maximise the fuel efficiency and reach of our aircraft, we have selected engines from Rolls-Royce. I'm very pleased with Rolls-Royce as our engine partner, who will contribute to offering our customers a comfortable and efficient journey."

MASwings acquires ATR 72-600

Malaysia Airlines' regional subsidiary MASwings procured its very first ATR 72-600 aircraft on 25 July 2013, which was delivered in a handover ceremony held at the ATR's facilities in Toulouse and was witnessed by Datuk Ik Pahon, Permanent Secretary, Ministry of Tourism Sarawak and Chairman of BIMP EAGA - Sarawak Chapter. Malaysia Airlines and ATR had signed

a deal in late 2012 for the purchase of a total of 36 ATR 72-600s (20 firm orders plus 16 options) to be operated by the airline's regional subsidiaries, MASwings and Firefly.

WestJet order 65 Boeing 737 MAX

WestJet Airlines has signed a letter of intent with Boeing and CFM to purchase 65 737 MAX airplanes powered by CFM's advanced LEAP-1B engine. The pending engine order, which consists of 40 737 MAX 8s and 25 737 MAX 7s, is valued $1.7 billion at list price. The foundation of the LEAP engine is embedded in advanced aerodynamics, environmental, and materials technology development programmes. The LEAP-powered 737 MAX will provide 13 percent better fuel consumption and an equivalent reduction in carbon dioxide emissions compared to most fuel-efficient single-aisle aircraft currently available, along with a 50 percent reduction in oxides of nitrogen emissions, "which brings with it CFM's legendary reliability and low maintenance costs."

EC135s for THK Gökçen Aviation

THK Gökçen Aviation, the commercial arm of the Turkish Aeronautical Association THK, has received the first five EC135s to provide medical airlift duties throughout Turkey. THK Gökçen Aviation and Saran Holding will deploy a fleet of 17 EC135 to ensure helicopter medical emergency services (HEMS) in the framework of a five-year contract with the Turkish Ministry of Health. The remaining helicopters will be delivered in the spring of 2014.

Belgium's first NH90 Naval Helicopter

Eurocopter has delivered the first NH90 NFH (NATO Frigate Helicopter) to the Belgium Armed Forces, providing an advanced, highly capable and fully-qualified rotary-wing aircraft for multi-role mission requirements. The NH90 NFH received by Belgium is also the first built at Eurocopter's Donauwörth, Germany industrial site demonstrating this facility's capability to assemble and deliver these new-generation twin-engine helicopters. Belgium will become the fifth country to put the

European-developed NH90 NFH version into service, joining France, Italy, the Netherlands and Norway. The aircraft is rated at Full Operational Capability (FOC), ensuring its aptitude for the full range of Belgium naval missions such as Search and Rescue (SAR) or military missions at sea.

ILFC expands LEAP engine order for A320neos

"Expanding our order for the LEAP engines to power more of ILFC's Airbus A320neo Family aircraft is a reflection of our company's long-standing commitment to providing our global customers with a choice of the industry's most technologically advanced products," stated ILFC Chief Executive Officer Henri Courpron. "CFM is our largest aircraft engine supplier, and we continue to look to the manufacturer's future engine generation for advancements in new technologies that offer operational and economic efficiencies for our customers' fleets." "This order is a continuation of what has already been a phenomenally good relationship," said Kevin McAllister, vice president of sales for CFM parent company GE Aviation. "We believe these engines will prove to be real assets for ILFC and its lessees"said President and Chief Executive Officer of CFM International Jean-Paul Ebanga. "The more testing we do, the more confident we become that the LEAP family is a more than worthy successor to the CFM56 engines and will become a critical part of airline fleets around the globe."

CFM International has set aggressive technical targets for the LEAP programme and testing to date confirms that the engine is meeting those goals. Compared to current "best" engines, LEAP engines are expected to provide ILFC customers with 15 percent better fuel efficiency, which equates to an equal reduction in CO_2 emissions; a 50 percent margin compared to today's oxides of nitrogen (NOx) requirements and meet the newly announced 2018 ICAO noise requirements with significant margin, all with CFM's legendary reliability and comparable maintenance costs.

Rafael's re-structuring and two new Divisions

Rafael Advanced Defence Systems Ltd., is undertaking a series of organisational changes and re-structuring, including the establishment of a Land & Naval Division. This division will also be responsible for the Systems Integrated Security (SIS) solutions for Critical Asset and Infrastructure on land and at sea. Rafael's substantial investment in R&D is being bolstered with the establishment of an R&D and Engineering Division. The new division will amalgamate Rafael's entire R&D activity.

Rafael has also established a new Sector, called Air & C4ISR Systems Sector. This new Sector will include Air-To-Ground Systems (SPICE), Electro-Optical Systems (Litening, Reccelite, etc.), Communications and Intelligence. Rafael's Air Defence Directorate has been transformed into Air superiority Systems Sector, and will be responsible for Air & Missiles Defence Systems along with the Air- to-Air product line.

CFM initiates LEAP engine ground testing

CFM International has initiated testing of the first full LEAP engine, launching an extensive ground and flight test certification programme that will encompass 60 engine builds over the next three years. The programme will culminate in engine certification in 2015 and first entry into commercial service on the Airbus A320neo in 2016.

The LEAP-1A engine, which is the powerplant for the Airbus A320neo, fired for the first time on 4 September, two days ahead of the schedule. After a series of break-in runs, the engine was operating smoothly and has reached full take-off thrust.

"In the past five years, we have completed thousands of hours of component testing leading up to this day," said Chaker Chahrour, executive vice president of CFM International. "Everything we have seen tells us the LEAP engine is going to deliver all we promised, and much more. Now, we get to put it through its paces in the most comprehensive test programme we have ever undertaken. By the time this engine enters services, we will have simulated more than 15 years of airline service with 60 different engine builds."

The engine, which shares common turbo-machinery with the LEAP-1C, is installed at Site 3B at GE's Peebles, Ohio, outdoor test facility, where it will be on test. The overall certification programme, which encompasses all three LEAP engine variants, includes 28 ground and CFM flight test engines, along with a total of 32 flight test engines for Airbus, Boeing, and COMAC. Over the next three years, these engines will accumulate approximately 40,000 hours (18,000 engine cycles) leading up to entry into service.

"This is an exciting day for us," said Cédric Goubet, executive vice president for CFM. "We are very proud of the fact that we have had 21 entries into service in our history; each of them was as on time and met all the specifications. From everything we have seen so far, the LEAP programme is going to maintain that record. We believe we have the best team in aviation. Today, we thank each member for their tireless dedication to this project and congratulate them for the phenomenal job they have done in keeping this programme on schedule. In fact, the first engine to test was actually two days ahead of the planned target to fire date we set nearly three years ago."

CFM officially launched the LEAP engine, which is the company's first all-new centerline engine in nearly 40 years, in 2008. At the time of the launch, there was no specific aircraft application. However, in 2009 COMAC of China chose the LEAP-1C engine as the sole powerplant for the C919 in 2009; Airbus followed in 2010 when it selected the LEAP-1A engine as an option on the A320neo family; and in 2011, Boeing selected the LEAP-1B as the sole powerplant for its new 737 MAX.

Airbus Military A400M : Initial Operating Clearance received

On 31 July 2013, the Airbus Military A400M new generation airlifter received its Type Acceptance at the contractual Initial Operating Clearance (IOC) Standard from OCCAR, the Organisation for Joint Armament Cooperation, on behalf of the launch nations (Belgium, France, Germany, Luxembourg, Spain, Turkey and the United Kingdom). This is a major milestone of the A400M programme after 10 years of development and more than 5,000 flight test hours.

A400Ms at Seville, Spain

This first military standard acceptance is the last step prior to the aircraft acceptance of MSN7, the first serial aircraft, by the French Defence Procurement Agency DGA and its subsequent delivery to the French Air Force (see next item). The common basis for Military certification was approved on 19 July following a recommendation by representatives of the seven launch nations known as the Certification and Qualification Committee (CQC). Airbus Military accordingly received on 24 July the Military Type Certificate for A400M aircraft from DGA.

First A400M Atlas for French Air Force

On 1 August 2013, Airbus Military formally delivered the first A400M new generation airlifter, known in French service as the Atlas, to the French Air Force to be based at Orleans-Bricy. The event marks culmination of 10 years of development by Airbus Military and more than 5,000 flight-test hours, involving close to 40,000 people working for this major European defence programme.

Domingo Ureña Chairman and CEO of Airbus Military said, "Today is a truly historic day for the European aerospace industry marking the moment at which it becomes the new global leader in the military transport sector with an entirely new aircraft. I would like to express my sincere thanks to everyone at Airbus Military, Airbus and our suppliers whose unflagging efforts have made this enormous achievement possible, as well as our customers and OCCAR whose inputs over the years have been crucial to the success of the programme."

This first aircraft delivered to France will initially be used for the continuing training of aircrew before becoming part of the French Air Force operational transport fleet. An official ceremony to celebrate the delivery in its Final Assembly Location in Sevilla will take place after the 'summer break'.

First A400M for Turkish Air Force

The first production Airbus Military A400M new generation airlifter for the Turkish Air Force made its maiden flight, at Seville in Spain, on 9 August and landed back in Seville 5 hours and 30 minutes later. The A400M programme for the Turkish Air Force is also making "good progress" at the Airbus Military International Training Centre at Seville, where pilots, loadmasters, and maintenance technicians have begun their training. Turkey has ordered 10 A400Ms.

New Airbus Military deliveries to Cameroon …

The Cameroon Air Force has received a CN235 medium transport aircraft, making it the sixteenth sub-Saharan nation to operate Airbus Military´s family of light and medium aircraft, underlining the range´s suitability for the challenging operating conditions found in the region. Altogether 61 countries now operate the Airbus Military light and medium family of airlifters and surveillance aircraft, being the C212, CN235 and C295. The CN235 is a robust aircraft with a six tonne payload that is well-proven in hot, dusty and humid conditions and on unprepared runways. It is flexible and reliable with good short take-off and landing capability, and its cabin can be easily reconfigured for a variety of transport missions such as carrying troops, cargo, mixed loads or for medical evacuation.

… and United Arab Emirates

Airbus Military has delivered the third of three A330 MRTT multi-role tanker transports ordered by the United Arab Emirates (UAE). 17 aircraft of this type are now in service with four operators, Australia, Saudi Arabia, UAE and the United Kingdom.

Converted from an Airbus A330 commercial passenger jet by Airbus Military at Getafe near Madrid, the aircraft will serve with the UAE Air Force and Air Defence at Al-Ain airbase. Following an extensive series of flight-tests in Abu Dhabi, the aircraft has successfully completed receiver qualification of the two fighter types that the UAE AF&AD will refuel in service : the F-16E/F Block 60 and Mirage 2000.

MBDA's performance in 2012

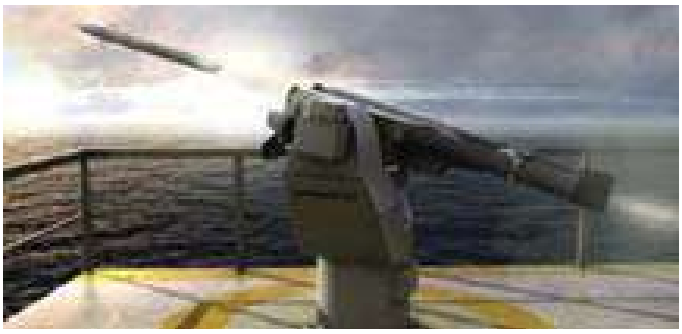
MBDA, Europe's leading and global player in the missile and missile system sector, achieved a turnover of 3 billion euros in 2012, equaling that in 2011. However, order intake at 2.3 billion euros as compared to 2.6 billion euros in 2011 was "less satisfying" despite the level of export orders which reached an unprecedented 1.4 billion euros. The order book, at 9.8 billion euros, continues to represent more than three years of business activity at current levels.

2012 was a year of contrasts for MBDA. Business performance concerning its principal programmes (Meteor, Aster, MdCN, etc.) was "excellent", as was responsiveness in supporting customers, with several major milestones being achieved during the course of the year. However, domestic order intake was down, reflecting on the exceptional pressures exerted on the European economy.

"Our operational performance well illustrates MBDA's ability to master the risks associated with our major programmes which are by and large carried out in cooperation," commented Antoine Bouvier, the CEO of MBDA. "Cooperation and our ability to manage all the technological and industrial aspects are MBDA's main attributes which allow us to contribute to European national sovereignty and to supply critical military equipment. Nonetheless, we are very aware of the constraints imposed on our domestic customers by the budgetary crisis even though their strategic and capability issues have not diminished accordingly. This is why MBDA takes its responsibilities as head of the complex weapon sector very seriously, making all the necessary efforts in partnership with its customers. We are adopting a global approach regarding the whole sector and all the programmes, both currently underway and those to come, incorporating an export perspective in order to create the conditions that are favourable to the launch of new programmes. These aspects are essential if we are to maintain sovereign capabilities within Europe and if we are to increase the export attractiveness and competitiveness of our missile systems and the platforms they equip, all the while remaining committed to the safeguard of highly qualified and non-transferable industrial jobs".

MBDA Simbad-RC air defence system

MBDA has signed an export contract for its naval air defence system Simbad-RC, just a year after launching its self-financed development. The first prototypes are currently in the production process and initial deliveries will take place in 2015. The system will be installed on a fleet of patrol vessels and each vessel will be equipped with two turrets. The Simbad-RC is a remotely-controlled, very short range naval air defence system that provides highly efficient capabilities against a wide range of threats, from fighter aircraft through to anti-ship missiles or small-sized threats such as Unmanned Air Vehicles. The SIMBAD-RC uses the Mistral missile which has already been ordered by nearly 30 countries worldwide.



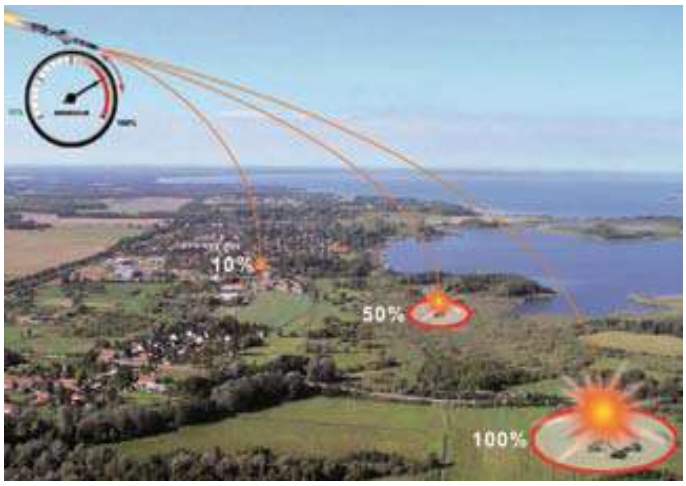
MBDA/ TDW demonstrates 'scalable' warhead technology

Engineers at TDW GmbH have developed a new effector technology with which armed forces can achieve scalable target-adapted effectiveness. This subsidiary of MBDA Deutschland recently became the first company to successfully demonstrate this technology in a series of tests. The demonstration, which took place on the grounds of Bundeswehr Technical Centre 91 (WTD 91) in Meppen, used 100 kg of explosive in a Mk82 shell with a scalable warhead. The effect of the tested warhead was comparable to the effect of 10 kg of high explosive. The purpose of the test was to significantly reduce the effective radius, i.e. to be able to effectively engage targets while at the same time minimising the damage to nearby buildings and vehicles.

Missions in asymmetrical scenarios call for high precision and a warhead with an effectiveness accurately adapted to the type of target. With present-day effector systems, this is possible either only to a limited extent or not at all.

An answer to this challenge is available in the form of effector systems that are capable of 'scalable' effectiveness. Scalable means that the type and magnitude of the intended effectiveness in the area of operations is adjustable. In the case of an air-to-ground mission, for example, the desired degree of effectiveness in the target area can be selected by the pilot from the cockpit. The advantages of the so called 'dial-a-yield' capability are that unintentional damage is minimised whilst high flexibility in operational use is guaranteed using just one effector type.

The German Air Force's Eurofighters and Tornados are equipped with such weapon systems. In principle, the effector technology can also be employed in army and navy missiles.



Cassidian 'SmartRadar'

Cassidian, the defence and security division of EADS, has developed a uniquely flexible airborne ground surveillance radar, which can be deployed on a variety of manned and unmanned platforms for the detection of ground and sea targets. As part of a major flight test series carried out from the German air base in Hohn (in the Federal State of Schleswig-Holstein), Cassidian's 'SmartRadar' showed record detection performance, now including various operating modes for maritime surveillance.

This success confirms Cassidian's concept of a software-defined sensor, which can be used for different surveillance tasks while only requiring minor modifications. The use of a special modular architecture permits scalability of bandwidth, frequency band and processing performance. This signifies great progress compared to conventional radars, which are normally optimised for a specific task in a narrow frequency band. Rapid adaptation to new operational requirements through simple, configurable firmware and software together with a variable cooling design make SmartRadar suitable for a multitude of manned and unmanned platforms of different sizes.

The high performance of the radar is largely because of state-of-the-art AESA technology, which are developed and manufactured by Cassidian in its own facility.

Cassidian systems proven in US exercise 'Bold Quest 13'

Advanced status of Cassidian's identification systems was proved during the "Bold Quest 13" exercise, a Coalition Capability Demonstration hosted by the US Armed Forces. The exercise involved aircraft, ships and ground stations from five NATO nations aiming at testing and improving 'identification-friend-or-foe' (IFF) equipment which is indispensable for avoiding casualties from fratricide.

Cassidian supported the German forces in the BQ'13 exercise held in North Carolina with equipment over the entire IFF action chain: MSSR2000I interrogators in ground stations, LTR400 transponders employed in a German Luftwaffe C160 Transall mission aircraft and the latest QRTK3/4NG cryptographic computers. This equipment proved highly successfully its interoperability with employed allied IFF Mode 4 and 5 equipment. This demonstrated successfully the proper employment of the next-generation IFF standard Mode 5, which is to be introduced in NATO forces from 2014.

Cassidian's SPEXER 1000 security radar

Cassidian has showcased the capabilities of its newly developed SPEXER 1000 security radar in a series of large-scale field trials, employing realistic scenarios. The company announced that in the course of demanding tests conducted in Africa and South-East Asia the radar demonstrated exceptional detection capabilities under the toughest conditions : coastal situations, difficult terrain and poor weather. SPEXER 1000 thus proved its suitability as a cost-effective solution for stationary or mobile intelligence and surveillance protecting critical infrastructure.

SPEXER 1000 is a security radar that is optimised for the surveillance of critical territory and infrastructure such as oil fields, power plants, harbours, airfields or military camps. It also serves as a 'gap filler' radar for border surveillance in areas with limited lines of sight because of hilly terrain. With a range of between 0.1 and 18 kilometres and an extremely high update rate it is able to detect suspicious movements on the ground, in the air or on the water at a very early stage, because of its high doppler, the radar is able to reliably locate difficult-to-detect, very small and slow-moving objects – such as unmanned aerial vehicles or individual people – with a very low false alarm rate.

CAE to train Predator and Reaper aircrews

CAE USA has been awarded a United States Air Force contract to provide comprehensive Predator and Reaper remotely piloted aircraft aircrew training services. CAE USA will provide classroom, simulator, and live flying instruction as well as courseware development in support of the MQ-1 Predator and MQ-9 Reaper training programmes. Training will be conducted at four USAF bases where approximately 1,500 MQ-1/MQ-9 pilots and sensor operators train annually. CAE USA will provide fully qualified instructional staff to conduct academic as well as live flying instruction at Holloman Air Force Base (AFB), New Mexico; Creech AFB, Nevada; March Air Reserve Base, California and Hancock Field Air National Guard Base, New York. In addition, CAE USA will provide courseware development services, primarily at the formal training schoolhouse located at Holloman AFB, as well as implement a new learning content management system.

The Predator remotely piloted aircraft.

Hawk full-mission CAE simulators for RAAF

CAE has been contracted by BAE Systems to provide three Hawk Mk127 full-mission simulators for the Royal Australian Air Force (RAAF) as part of a comprehensive upgrade and training systems support package that BAE Systems will be providing to the RAAF under the Project AIR5438 programme.

CAE will design and manufacture three Hawk Mk.127 full-mission simulators that will include a high-fidelity replica of the Hawk cockpit surrounded by an 11-foot projection dome display featuring the CAE Medallion-6000 image generator and Boeing's Constant Resolution Visual System. The Hawk Mk.127 full-mission simulators will also feature the CAE-developed common database (CDB), an open database architecture that enhances the ability to correlate and rapidly update databases to support

training and mission rehearsal requirements. The simulators will be delivered to RAAF Base Williamtown and RAAF Base Pearce in 2016 and 2017 respectively.

Full-flight CAE simulators for Etihad Airways and China Eastern

CAE have received contracts for nine full-flight simulators (FFSs) and nine flight training devices with Etihad Airways, and with China Eastern Airlines. The contracts are worth more than C$230 million at list prices and bring the total number of FFS sales that CAE announced to date in fiscal year to 15. List prices include the value of OEM aircraft-specific data, parts and equipment (DP&E), normally procured by CAE in the manufacture of its simulators.

In the case of the Etihad contract, the DP&E is being furnished to CAE by the customer. "The pilot training requirements for Etihad Airways, as well as members of our equity alliance, continue to grow and these new full-flight simulators will ensure we are ideally placed for the next phase in our expansion," said Etihad President and Chief Executive Officer James Hogan. "We place great emphasis on the efficiency of our operations and the safety of our passengers and this deal means we will be using the most advanced training technologies for the broadest range of aircraft types. The construction work at the training academy will double its size and eventually house 11 full-flight simulators and be among the best in the world."

"We are pleased to be able to leverage the broad range of aviation training solutions that CAE offers, all providing the latest and most innovative technology in safe and efficient airline operations," said Capt. Liu Shao Yong, Chairman of China Eastern Airlines.

Eurofighter Typhoon achieves 200,000 flying hours

Eurofighter Typhoon has now achieved more than 200,000 flying hours since the entry-into-service of its worldwide fleet. Eurofighter Jagdflugzeug GmbH confirmed the milestone adding that, with 719 aircraft on contract, 571 aircraft ordered and 378 aircraft delivered, the programme has "never looked stronger".

The first 5,000 flying hours were achieved in November 2005. 10,000 hours came in August 2006 and 20,000 in May 2007. By August 2008, the Eurofighter Typhoon fleet had surpassed 50,000 hours and 100,000 flying hours was reached in January 2011. In the course of these flying hours, Eurofighter has demonstrated 100 per cent availability in numerous international deployments including: Alaska; Malaysia; the United Arab Emirates; the USA and India.

Raytheon SM-3's against single ballistic missile target

In a Missile Defence Agency test, the US Navy launched two Raytheon Standard Missile-3 Block IBs from the USS Lake Erie against a complex, separating short-range ballistic missile target. The first guided missile successfully destroyed the target using the sheer kinetic force of a massive collision in space. The SM-3 is a defensive weapon used by the US and Japan to defend against short- to intermediate-range ballistic missiles.

During the test, two SM-3 interceptors were launched at a single target consecutively. The first SM-3 eliminated the target. The second SM-3 was designed to test the ship weapons system's ability to launch multiple missiles at one time against a threat. An intercept for the second SM-3 was not part of the test scenario. The test was the 25th successful flight test for the SM-3 programme and the fourth back-to-back successful test of the next-generation SM-3 Block IB variant. SM-3s destroy incoming ballistic missile threats by colliding with them, a concept sometimes described as "hitting a bullet with a bullet." The impact is the equivalent of a 10-ton truck traveling at 600 mph.

LM's new Aegis BMD system successfully intercepts target

Lockheed Martin, the Missile Defence Agency and the U.S. Navy successfully demonstrated, on the first attempt, the second generation Aegis Ballistic Missile Defence (BMD) Weapon System's capability to engage a sophisticated, separating short range ballistic missile target with two Standard Missile-3 (SM-3) Block IB guided missiles that were fired and guided to intercept nearly simultaneously. The test, known as Flight Test - Standard Missile-21 (FTM-21), was an operational test for Aegis BMD and SM-3 Block IB guided missile to engage and defeat a ballistic missile threat. FTM-21 marked the tenth time the USS Lake Erie (CG 70) and crew have successfully performed in Navy and Missile Defence Agency at-sea test events against cruise and ballistic missile targets using the second generation of the Aegis BMD configuration.

The central component of the Lockheed Martin-developed Aegis BMD Combat System is the SPY-1 radar, the most widely fielded naval phased array radar in the world. Currently, 27 Aegis BMD-equipped warships have the certified capability to engage ballistic missiles and perform long-range surveillance and tracking missions, as well as an additional four ships in the Japanese Maritime Self-Defence Force.

Sikorsky begins final assembly of first S-97 Raider prototype

Sikorsky began final assembly of its S-97 Raider high-speed scout and attack helicopter prototype in late September, putting manufacturer, which is competing for the US Army's Armed Aerial Scout (AAS) programme, on track for a first flight at the end of 2014. The Raider is based on the X-2 technology demonstrator developed by Sikorsky in the late 2000s, but includes significant size and weight changes. Where the X-2 demonstrator was a one-person, 2.5-tonne platform, the Raider will be roughly 5 tonnes, with room for six troops in combat assault mode. In reconnaissance mode, the extra space could be used for mission equipment or ammunition. Despite the growth, Sikorsky is confident that the design will result in a mix of speed and manoeuvrability that helicopters have not yet achieved. The company is, for example, targeting a speed of over 220 knots at cruise, along with a 10,000 ft ceiling in temperatures as high as 35ºC.

The Armed Aerial Scout programme aims to replace the Army's fleet of OH-58 Kiowa Warriors, in use since the late 1960s. The winner of the programme is expected to last well past 2050, meaning the competition would be a long-term windfall for the winner.

"Massive opportunities" for Gripen E

"The rising interest for Gripen reflects the long-term analysis of the market for Gripen E, as the most cost-efficient and modern state-of-the-art multirole fighter jet system. The business opportunities seem to be quite promising", stated Håkan Buskhe, President and CEO of Saab.

During recent months Saab has received increased interest in Gripen E, the next generation of its multirole righter. This is concurrent to the fact that Saab in February 2013 had received an order from the Swedish Defence Material Administration (FMV) for the development of the Gripen NG (now 'E') and has started the assembly of the system. "Approximately 6000 fighters will need to be replaced on the world market during the coming 15-20 years". Owing to Swedish export restrictions and other prerequisites, Saab has access to approximately half of this market. Previously Saab estimated that Gripen could potentially capture about 10 per cent of this market over the coming 15-20 years but based on the increased interest for Gripen, particularly in Asia, Europe, South America and Sub-Saharan Africa, Saab now forecast the potential for future business with Gripen E more positively over the coming 15-20 years.

A news report from Washington DC has it that Boeing and Saab could team up to offer the two seat Gripen for the US Air Force's T-X future lead-in fighter trainer requirement, which is alone for over 350 such aircraft alone.

Swiss Parliament votes for Gripen E procurement

On 18 September 2013, the Council of States (Ständerat) which is one of the two chambers in the Swiss Parliament, voted "yes" with an absolute majority for the cancellation of the spending ceiling for Switzerland's procurement of Gripen E. The Ständerat had already voted in favour of the procurement of Gripen E Saab's next-generation multi-role fighter and for a special procurement fund in March this year. At end of the current parliamentary session, on 27 September, both chambers of the Swiss Parliament; the Ständerat and the National Council (Nationalrat), would revisit and revote on all federal decisions taken during the session, which would include the procurement of Gripen E.

"This a strong endorsement of Gripen, which is the most modern state-of-the art fighter and the most cost-efficient option for Switzerland. The Gripen E is based on a proven platform, and with Sweden committed and the fighter already in pre-production this is a comparatively low risk acquisition. If the votes are reconfirmed at the end of the current session of parliament we have to see if a public referendum on the procurement of Gripen is called. If so, then a referendum will need to be held, before any order for the fighter is received," says Lennart Sindahl, Senior Vice President and Head of Saab's Aeronautics business area.

Major order for 172 Cessna Skyhawk Aircraft

Cessna Aircraft Company has announced an order for 79 Cessna 172 Skyhawk aircraft, one of the largest orders on record for the aircraft. Moscow-based ViraZH, plans to use the Skyhawks for training purposes at various flight schools throughout western Russia. The order is part of a multi-year agreement between Cessna and ViraZH, with all 79 aircraft set to be delivered by the third quarter of 2014.On completion of the final delivery, ViraZH will have one of the world's largest fleets of Skyhawk 172 aircraft in operation.

The 172 Skyhawk has become the best-selling, most-flown single-engine aircraft in the world. With an all-glass Garmin G1000 integrated flight deck, the Cessna 172 Skyhawk has earned a reputation for offering the "best combination of modern features and proven dependability among general aviation aircraft".

Bombardier CSeries aircraft in maiden flight

A major milestone was notched by Bombardier which flew prototype of the new generation CSeries airliner (FTV1) on its maiden flight at Mirabel on 16 September 2013. This flight marks the beginning of the CSeries aircraft's flight test programme leading up to the first customer deliver, and was also the first flight for Pratt & Whitney's new Geared Turbofan Pure Power engine as part of an aircraft certification programme.

Bearing Canadian registration markings C-FBCS, the CS100 jetliner was under command of Captain Charles (Chuck) Ellis, Chief Flight Test Pilot, Bombardier Flight Test Centre, Capt. Ellis was assisted by his colleagues, Capt Andris (Andy) Litavniks and Andreas Hartono in the role of First Officer and Flight Test Engineer, respectively.

"This is a very proud day for Bombardier and a true validation of the CSeries aircraft's design and development, and of our extensive ground test programme," stated Rob Dewar, Vice President and General Manager, CSeries Programme, Bombardier Commercial Aircraft. "Five years in the making, the CSeries aircraft's first flight is the culmination of an incredible amount of hard work and dedication from our employees, partners and suppliers around the world".

The first CSeries flight was witnessed by more than 3,000 Bombardier employees and Board members, customers, partners and suppliers, at the company's Mirabel, Québec facility, where the final assembly line for the CSeries aircraft programme is now under way. A total of five CS100 flight test vehicles, all of which are currently in various stages of assembly, will join the flight test programme in the coming months.

First flight of Boeing 787-9 Dreamliner

Powered by Rolls-Royce Trent 1000s, the first Boeing 787-9 Dreamliner made its maiden flight from Seattle's Boeing Field on 17 September 2013, beginning a comprehensive flight-test programme leading to certification and delivery in mid-2014.

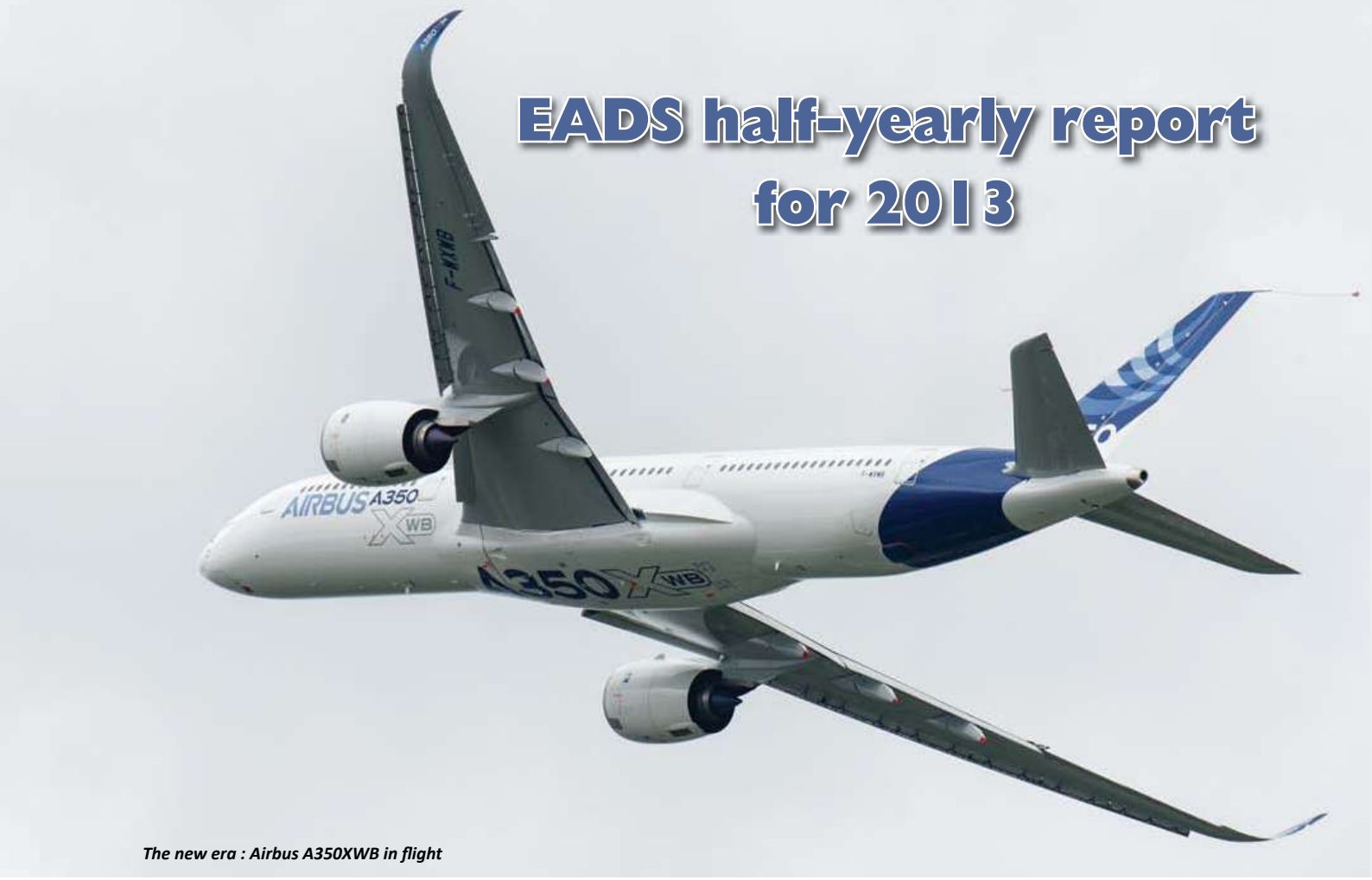
During the flight, 787-9 Senior Project Pilot Mike Bryan and 787 Chief Pilot Randy Neville departed to the north, reaching an altitude of 20,400 feet (6,218 meters) and an air speed of 250 knots, or about 288 miles (463 kilometers) per hour, customary for a first flight. While Capts. Bryan and Neville tested the airplane's systems and structures, onboard equipment transmitted real-time data to a flight-test team on the ground in Seattle.

Powered by two Rolls-Royce Trent 1000 engines, the first 787-9 will be joined in flight test by two additional airplanes, one of which will feature General Electric GEnx engines. Those airplanes are in the final stages of assembly in Boeing's Everett factory. Over the coming months, the fleet will be subjected to a variety of tests and conditions to demonstrate the safety and reliability of the new airliners design.

The 787-9 will complement and extend the 787 family, offering airlines the ability to grow routes first opened with the 787-8. With the fuselage stretched by 20 feet (6 meters) over the 787-8, the 787-9 will carry 40 more passengers an additional 300 of the 787-8 nautical miles (555 kilometers). The 787-9 leverages the design of the 787-8, offering features such as large, dimmable windows, large stow bins, modern LED lighting, higher humidity, a lower cabin altitude, cleaner air and a smoother flight. Launch customer is Air New Zealand, with 25 customers having ordered 388 787-9s.

"A Solid Performance"

EADS half-yearly report for 2013



The new era : Airbus A350XWB in flight

"We report a solid performance for the first six months and reaffirm our full year guidance," stated EADS CEO Tom Enders. "Cash generation and programme execution are key management priorities for the second half of the year" as EADS' order intake increased sharply to € 96.6 billion with the order book value reaching € 634.8 billion at the end of June. The reported EBIT amounted to € 1.5 billion with a half-year Net Cash position of € 5.9 billion.

Airbus' consolidated revenues increased to € 18,924 million (H1 2012: € 17,525 million) amid increased commercial and military aircraft deliveries. The Airbus consolidated EBIT rose sharply to € 1,093 million (H1 2012: € 563 million) with net order intake rising to € 90.4 billion (H1 2012: € 21.2 billion). Airbus Commercial's revenues rose to € 18,235 million (H1 2012: € 16,864 million), reflecting the increase in Airbus series aircraft deliveries to 295 aircraft (H1 2012: 279 aircraft).

Airbus Commercial's reported EBIT amounted to € 1,092 million (H1 2012: € 558 million) with the EBIT before one-off at € 1,228 million (H1 2012: € 840 million).

Revenues at Airbus Military increased to € 1,067 million (H1 2012: € 843 million) with an EBIT of € 10 million (H1 2012: € 2 million). In the first six months of 2013, Airbus Commercial recorded 722 net aircraft orders (H1 2012: 230 net orders).

It had a "successful Paris Air Show," receiving firm orders for 241 aircraft. Strong momentum for the A350 XWB continued at the show with firm orders for 65 aircraft from Air France, KLM, Singapore Airlines and United Airlines. Airbus also signed an agreement with new A380 customer, Doric Lease Corp., for 20 A380s. The A320 Family also scored well during the show, receiving firm orders for 170 aircraft including major deals with Lufthansa for 100 A320 Family aircraft, and with ILFC for an additional 50 NEOs. ATR meanwhile received 68 gross orders during the first half of 2013. Airbus continues to make significant progress on the A350 XWB programme. Since the first flight in June, the entire flight envelope has been cleared and first tests of all major aircraft systems have been successfully performed. Airbus is now entering the most critical phase of the A350 programme. The industrial ramp up preparation is underway and risks related to the ramp up are being closely monitored in line with the schedule,

Airbus Military A400M seen at Seville

Eurocopter Tigers have seen service in Afghanistan

aircraft performance and overall cost envelope.

Airbus Military received 8 net orders (H1 2012: 21 net orders) and delivered 12 aircraft (H1 2012: 7 aircraft). Airbus Military is in the very final discussions with OCCAR and the seven launch nations on the A400M Initial Operating Clearance (IOC) and Type Certificate. Notwithstanding contractual rights, discussions are progressing well. The IOC is a pre-requisite for the delivery of the first aircraft to France to follow within days (*see news item*). During the second quarter, Airbus Military delivered its 100th C295 transport and surveillance aircraft to Oman.

At the end of June, Airbus' consolidated order book was valued at € 595.8 billion (year-end 2012: € 525.5 billion). The Airbus Commercial backlog amounted to € 575.7 billion (year-end 2012: € 505.3 billion), which comprised 5,109 Airbus aircraft excluding ATR orders (year-end 2012: 4,682 units). Airbus Military's order book was worth € 20.8 billion (year-end 2012: € 21.1 billion).

Revenues at Eurocopter fell by 7 percent to € 2,584 million (H1 2012: € 2,771 million) as deliveries declined to 190 helicopters (H1 2012: 198 helicopters). The Division's EBIT declined by 35 percent to € 128 million (H1 2012: € 198 million). Flight restrictions for the EC225 Super Puma weighed strongly on the operational performance as expected.

Eurocopter has now taken major steps towards the Super Puma "recovery" The European Aviation Safety Agency (EASA) and Civil Aviation Authorities of the UK and Norway have officially approved the prevention and detection solutions developed by Eurocopter for the EC225. Eurocopter is supporting helicopter operators to return their fleets back to service. Eurocopter's second quarter order intake included a contract for 34 NH90 Tactical Transport Helicopters (TTH) from France. The Division also delivered the first Tiger helicopter in the HAD attack configuration to France. In the first six months of 2013, Eurocopter booked 167 net orders (H1 2012: 195 net orders). At the end of June 2013, the Division's order book was worth € 12.8 billion (year-end 2012: € 12.9 billion), comprising 1,047 helicopters (year-end 2012: 1,070 helicopters).

Eurofighter with an array of MBDA weapon systems.

Cassidian's revenues were € 2,286 million (H1 2012: € 2,186 million) with an EBIT of € 86 million (H1 2012: € 81 million). Programme execution was as planned and supported revenues and EBIT. Border security projects remain challenging in terms of commercial and programme delivery. Cassidian's restructuring programme announced in the fourth quarter of 2012 is on track. Major business highlights include the contract signature of the Eurofighter consortium in June to integrate the Meteor air-to-air missile system on board the fighter aircraft. Additionally, an important export contract in the Tornado Sustainment Programme was awarded in the aircraft missile business. Net order intake fell to € 2.0 billion (H1 2012: € 2.8 billion). At the end of June, Cassidian's order book was worth € 15.1 billion (year-end 2012: € 15.6 billion).

Anatolian Eagle 2013

Patch of Anatolian Eagle at AE HQ.

Turkish Air Force F-16s and F-4s at Konya

'Red Flag' the Turkish Way !

On a regular Wednesday morning in June, the silence of the Anatolian province in central Turkey is rudely disturbed. From the airfield of Konya, some four hours south of the capital Ankara, some 45 fighters thunder into the sky. Another mission in the second *Anatolian Eagle* exercise of 2013 has begun…

Background

Turkey initiated *Exercise Anatolian Eagle* in 2001 to simulate air warfare scenarios in the context of national and multinational training (simulations of tactical firing and electronic warfare were initially based on the American *Red Flag* model). The task of hosting *Anatolian Eagle* is carried out by the 3rd Air Wing (*Ana Jet Üs or AJÜ*) of the 1st Air Force Command (*Hava Kuvvet Komutanligi*) of the Turkish Air Force (*Türk Hava Kuvvetleri*) in Konya. This base, which is located on the periphery of the vast Konya plains in Central Anatolia, a sparsely populated flat basin, was an ideal choice for an exercise of this magnitude.

The Turkish Air Force established the extensive training area for *Anatolian Eagle* between 1998 and 2001. It is 290 km in length and 345 km wide. At Konya Air Base the *Anatolian Eagle* training centre consists of a command and control centre, a main briefing auditorium, and four separate briefing buildings for the participant groups known respectively as the White, Blue 1, Blue 2, and Red Forces. *Anatolian Eagle* exercises, two weeks in duration, are held four times a year: generally one for Turkish forces only and three with multinational participation.

Ideal location

The location chosen to host the Anatolian exercises is ideal. Owing to its central location it is easily accessible for countries in Europe but also the Middle East and Southern Asia lies around the corner.

Because of this, participating countries do not have to travel too far like they would have to for *Maple Flag and Red Flag* exercises and still get a high standard training equal to the level of the afore mentioned exercises in Canada and the USA. More than 12,000 square kilometers of airspace around Konya is available as are different ranges to drop live ammunition. Combine these facts with the modern facilities and high level of experience available at Konya Air Base and foreign participants are assured of the best environment for their training purposes.

Participation

During the second edition of *Anatolian Eagle* 2013, held from 10th till the 21st of June, participation consisted out of several Turkish Air Force units flying F-16's and F-4E-2020 'Terminators', two NATO E-3A AWACS, eight F-15C/D Eagles of No.13 Squadron of the Saudi Arabia Air Force (*Al Quwwat al Jawwiya as Sa'udiya*) and six F-16E Desert Falcons of the United Arab Emirates Air Force normally based at Al Dhafra Air Base. Also a C-130 and CN235 of the Turkish Air Force were used in the logistics support role and Turkish KC-135s provided the much needed fuel in the air.

F-4E-2020 of the Turkish Air Force taking off

F-16D block 50 Turkish.

F-16E 'Desert Falcons' taxiing at Konya.

F-15C of 13 Squadron, Royal Saudi AF

Unfortunately there were some cancellations for this *Anatolian Eagle* edition. Six Tornado IDS of the Saudi Arabia Air Force did not arrive, and six F-16s of No. 18 Squadron of the Royal Air Force of Oman (al *Quwwat al Jawwiya al Sultanat Oman*) had to cancel their participation at the last moment. Aircraft of the Royal Air Force of Oman would have been first timers and welcome additional participants for this exercise after having sent observers in earlier editions.

Missions

With the experience of the *Anatolian Eagle* training centre as well as the participating nations a wide variety of missions are established and employed during the two-week exercises. Missions vary from Air Defence Operations, Close Air Support and Combat Search and Rescue among others and are often combined during one mission. The foundation of the scenario consists of attack by the Blue Forces (AE students) making use of Combined Air Operations (COMAO) on the tactical and strategic targets of the Red Forces (played by the Konya Wing, in particular 132 Filo) which are defended by fighter aircraft and Surface To Air Missile (SAM) systems.

During the morning mission at time of the authors' visit, the Blue Forces had to attack four Red Forces strategic locations. On the way over to the Red Forces strategic area Ground Based Air Defence (SA-6 and SA-11 missile stations) gave the students of the Blue Forces a hard time as did the Red Forces air power. NATO E-3 AWACS gave the Blue Forces Command and Control while a land-based radar station at Konya gave GCI (Ground Controlled Interception) information to the red Forces. Finally, Turkish KC-135s provided air-to-air Refueling support to both the Red and Blue Forces.

F-16E of the United Arab Emirates.

Turkish F-4E waiting for next mission.

Debriefing

The AE Command and Control Centre is the headquarters where all information (location, position and flight information) of aircraft, which is transferred through ACMI (Air Combat Maneuvering Instrumentation) can be observed in real-time. The tracks observed by AWACS and land radars and real-time searching, locking and shooting images of SAMs and anti-aircraft systems can be observed. Also at the MASE (Multi Aegis Site Emulator) Operations Centre, local and *Anatolian Eagle* missions are controlled and commanded from here. The main briefing room has a capacity of 450 people thus all the above mentioned information can be reviewed after each single mission with Blue and Red forces together in the same room. In this way both sides learn from each other's tactics and flaws in order to improve their skills.

Success

The success of *Anatolian Eagle* is apparent in the fact that since its inception, the number of participants in the exercise has increased dramatically. While two countries (the United States and Israel) and sixteen aircraft joined Turkey in the first exercise in 2001, other countries, including Germany (2003), the United Arab Emirates (UAE) (2002), Pakistan (2004) and Jordan (2004) have since participated in the multinational training sessions while other have shown interest or sent observers. *Anatolian Eagle* provides an invaluable opportunity for member forces to train together for future operations, improve interoperability, test and develop doctrine, and validate operational concepts. Certanly, *Anatolian Eagle* nurtures positive and productive dialogue among the air forces of NATO and the Middle East.

Remco Stalenhoef/ Patrick Smitshoek / Stephan van Geem

Saudi Air Force F-15C

Phantom Pharewell
The Luftwaffe phases out its F-4F

Outside the United States, the German Air Force (Luftwaffe)was one of the largest operators of the US-built McDonnell Douglas F-4 Phantom II. The Luftwaffe had a total of 10 F-4Es, 88 RF-4Es and 175 F-4Fs in active service in West Germany during the Cold War and the Phantom built up a great reputation over 40 years of active duty. Over the years the Luftwaffe had four operational Fighter Wings (*Jagdgeschwader* or JG), which flew the F-4F. These units were JG-71 at Wittmund, JG-72 at Rheine-Hopsten, JG-73 at Laage and JG-74 at Neuburg. JG-72 and JG-73 were originally fighter-bomber units (*Jagdbombergeschwader* or JBG) that operated as JBG-35 and JBG-36 respectively. Since the introduction of the F-4F Phantom in 1973, the aircraft's front-line service finally came to an end this year.To commemorate the service of the Phantom II, the Luftwaffe organised a"Phantom Pharewell" event at the German airbase of Wittmund on 28-29 June 2013.

The Background

The McDonnell Douglas F-4 Phantom II was originally developed for the US Navy. The development of the aircraft was direct result of the Korean War when it became apparent the F-86 Sabre was no match for the follow on MiG-17. The prototype Phantom made its first flight in 1958 and soon proved to be far ahead of its time. The Phantom was a breakthrough in design, being able to reach a top speed of Mach 2.2, which was exceptional. In 1963, the first F-4 Phantoms were delivered to the United States Navy. The aircraft quickly demonstrated its superior capabilities, prompting the USAF and the US Marines to also order the aircraft. The USAF would go on to become the largest operator of the type.

Compared to contemporary combat aircraft, the Phantom was a big and heavy fighter, but was powered by a pair of extremely powerful GE J79 turbojets that endowed it with very favourable combat characteristics. High performance and formidable weapon-carrying capacity(9 hardpoints) saw the F-4 achieve great fame during the Vietnam War. The Phantom was originally not equipped with an internal gun but this changed when the needs for this weapon became painfully visible early during the Vietnam War, and the Phantom was quickly modified – first with gun pods and from the F-4E onward, with an internal 20mm cannon.The Phantom was dominant over the older MiG-17 and MiG-19s over Vietnam and also outmatched the newly introduced Soviet MiG-21. After the Vietnam War, the Phantom remained an important aircraft with the USAF through the 1970s and 1980s, after which it was phased out of frontline combat service in favour of the F-15 and F-16.

Phantoms, after 40 years of Service

In US Navy service, the Phantom was eventually replaced by the F-14 Tomcat and later also by the F/A-18 Hornet. However, the F-4 remained in use with the USAF as a reconnaissance aircraft and a SEAD (Suppression of Enemy Air Defence - 'Wild Weasel') variant, eventually being permanently phased out in 1996. Besides the USA, countries such as Australia, Egypt, Germany, Greece, Iran, Israel, Japan, South Korea, Spain, Turkey and the UK operated the F-4 Phantom.

The Phantom in Germany

The West German Luftwaffe was only 16 years old when the Phantom entered service in 1971, but despite its young age, the Luftwaffe was a formidable air force with a large fleet of F-104G Starfighters and Aeritalia G.91Rs. In 1968, a contract was signed for the purchase of 88 RF-4Es, this being the first variant of the Phantom to enter service with the Luftwaffe. The Germans would soon build the Phantoms in their own factories in the complex of Messerschmitt-Bölkow-Blohm. The first RF-4E was flown from St. Louis, Missouri to Bremgarten in Germany in 1971. The first units to be equipped with the RF-4E were Reconnaissance Wing (*Aufklärungsgeschwader* – AG)AG-51 at Bremgarten and AG-52 at Leck. The aircraft were delivered at the rate of eight per month and both units were up to full strength within two years. The German RF-4E was equivalent to the USAF RF-4C, but with improved engines. The RF-4E was equipped with four cameras in the nose section of the aircraft and could be used for reconnaissance missions by day and night. The RF-4E was also equipped with an IRRS (Infrared Recognition System) and SLAR (Side-Looking Airborne Radar). These modules were installed along the side of the fuselage. The RF-4E had a system to develop film in flight and the aircraft was able to drop cartridges with developed photos in flight. Over time the RF-4E fleet was upgraded with increasingly sophisticated reconnaissance and surveillance payloads. For a short period, the RF-4Es were also updated with bombing capability, but this was removed on grounds of cost in 1988.

With the changed strategic scenario in Europe, the Luftwaffe finally retired the RF-4E in 1994 with 20 aircraft sold to Greece and 32 to Turkey, and the remaining aircraft scrapped. AG-51 was re-equipped with the Panavia Tornado, while AG-52 was disbanded.

In addition to the RF-4E units, the Luftwaffe had also planned to equip two air defence units and two fighter-bomber units with the Phantom. Initially intending to co-develop a single seat version of the F-4 with the USAF during the TFX programme, rising costs instead led to the procurement of a modified version of the

The first 8 F-4Fs were stationed at George AFB for the training of Luftwaffe pilots. In 1976, these aircraft were replaced by 10 F-4E Phantoms which took over training tasks while the F-4Fs were flown to Germany and made operational. Training of Luftwaffe F-4F crewswas based entirely in the USA. Student pilots initially trained at Sheppard AFB on the T-37 Tweet and T-38 Talon during a 13-month basic programme. They then moved to the German training wing at George AFB where they converted to the F-4E. After this training, the pilots were assigned to operational units in Germany.

In the early 1980s, the F-4F fleet began to be comprehensively modernised under

F-4E. The result was the F-4F, developed as an air defence variant of the F-4E, with one of the seven internal fuel tanks removed to reduce weight. The F-4F was equipped with the AIM-7 Sparrow and AIM-9 Sidewinder as primary munitions, and was also able to carry various air-to-ground stores like Mk.82 gravity bombs, BL755 cluster bombs and also later AGM-65 Maverick missiles. The aircraft featured leading edge slats for better manoeuvrability at the expense of a small reduction in top speed. The F-4F had a very high thrust weight ratio, giving it excellent climb performance – essential for an interceptor. The first German F-4F made its maiden flight on 18 March 1973.

the 'Improved Combat Efficiency' (ICE) programme. The modernisationprogramme added in-flight refueling, AIM-120 AMRAAM compatibility and the new APG-65 radar along with a host of minor upgrades to many of the aircraft's systems. Initially limited to 70 aircraft, drastic capability shortfalls in the Luftwaffe due to delays in the Eurofighter programme prompted the German government to extend the ICE upgrade to all 110 F-4Fs in service. The F-4F ICE was therefore the backbone of German air defence through the 1990s, in service with four fighter wings, these being JG-71, JG-72, JG-73 and JG-74. As the Eurofighter began to enter service in the early 2000s, the F-4F wings gradually phased out their Phantoms and transitioned to their new aircraft, the last unit to do so being JG-71, in June this year.

Phantom Pharewell Ceremony

The F-4F Phantom Pharewell ceremony was held on 28 and 29 June 2013. The Luftwaffe organised a special "spotters day" for photographers at the North German airbase of Wittmund on Friday, 28 June, while Saturday featured the public ceremony. The Phantom is an 'all-time favorite aircraft' for many people within the European air enthusiast community, with the popular aircraft's cult status originating in the 1980s and1990s. Luftwaffe pilots and ground crew who worked with Phantoms share this enthusiasm and the *Pharewell* ceremony showed the pride they took in their work with this legendary aircraft. It was clear that the departure of the Phantom was an emotional occasion for both Luftwaffe members and aviation enthusiasts.

For the *Phantom Pharewell*, aircraft from other units in Germany and a few invited from abroad made their way to Wittmund. Several Luftwaffe Tornados from different units along with one RAF Tornado were present, as well as helicopters such as a CH-53G Stallion and a Bölkow Bo-105. The Luftwaffe had painted four Phantoms in a special colour scheme especially for the *Phantom Pharewell* event. The first Phantom (serial "38+33") was painted in the green and grey camouflage colour scheme used in the 1970s and early 1980s. The second (serial "38+10") was painted in the blue-grey and brown colour scheme dating to the late 1980s and the early 1990s. The third aircraft (serial '37+15') was from the Bundeswehr Technical and Airworthiness Center for Aircraftand was painted in the farewell scheme of WTD-61, which is based at Manching-Ingolstadt. The last Phantom (serial '37+01') was resplendent in a stunning blue and gold scheme. Aircraft 37-01 carried the text 'First In Last Out' on the fuselage as this Phantom was the first F-4F delivered to the Luftwaffe in1973! F-4F Phantoms in regular greypaint were also parked in front of their shelters during the day and were extensively photographed.

The official farewell ceremony took place on 29 June. During this ceremony, the four coloured Phantoms were to take-off and perform a display but unfortunately during startup of aircraft 38+33 something went wrong and the pilot had to fly a grey-coloured ICE Phantom instead. The four aircraft then taxied past the 130,000-strong crowd of people from all over the world who had gathered at Wittmund to see the Luftwaffe *Phantom Pharewell* ceremony. After a spectacular take-off the aircraft made a few passes over the airbase along the crowd, trailing their signature black clouds of smoke. Then two Phantoms left the formation to make place for a pair of Eurofighters and the mixed formation of two F-4Fs and two Eurofighters thundered overhead. Following the display, the two Eurofighters of JBG-31 landed at Wittmund, and the aircraft were welcomed as replacements for the F-4F Phantom. A detachment of JBG-31 will be stationed at Wittmund initially with 10 Eurofighters, and eventually growing to 20.

The last Phantom 37+01 remained airborne to make a few wild low approaches before its final touchdown and the pilots were greeted as heroes after this last flight. Everybody said goodbye with a tear and a smile to a fighter which was a legend in the history of aviation.

Text and photos from Joris van Boven's 'Sentry Aviation News' and Alex van Noye's 'Runway28'

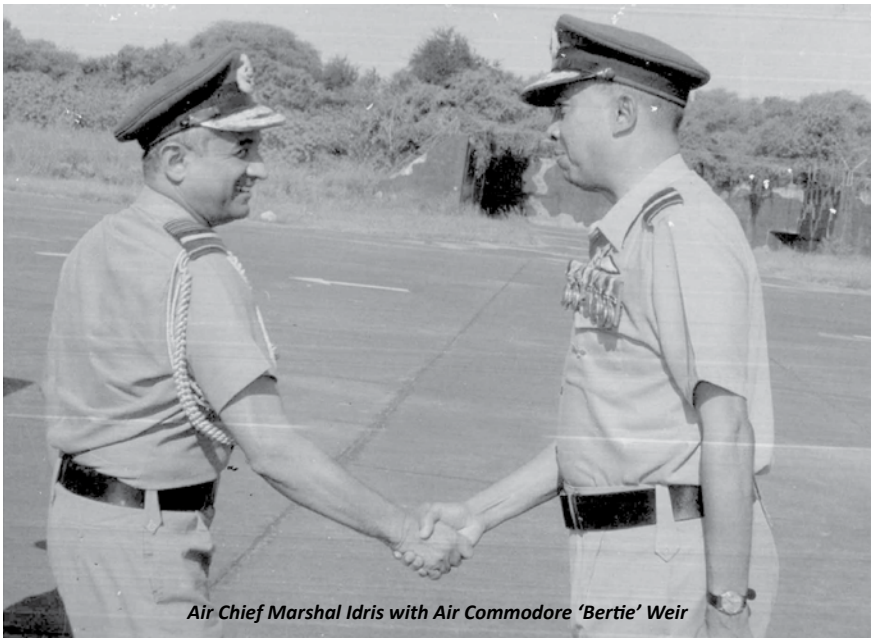
Bertie's War

Bertie and his 'volunteers' with Harvard at Poonch, December 1971

The life and times of Air Commodore Robert Arnold 'Bertie' Weir. VrC, VM

Heroes create legends; legends are enshrined in history. Robert Arnold Weir (popularly 'Bertie') of the Indian Air Force was certainly one of them!

RA Weir was commissioned into the Indian Air Force in April 1950, a time of much turbulence and turmoil especially for the armed forces of a nation that had achieved Independence just three years earlier. His illustrious career with the Indian Air Force began as a young pilot with No. 7 Squadron flying the Vampire FB 52. While posted with No. 7 Squadron, he was amongst the few chosen to validate the new air-to-ground rockets in presence of then Prime Minister Jawahar Lal Nehru. In this demonstration, he made an impact, setting an unbroken record for achieving 16 consecutive direct hits. The Vampire twin-boomed fighter remained



Air Chief Marshal Idris with Air Commodore 'Bertie' Weir

one of Bertie Weir's favourite aircraft throughout his service with the Indian Air Force.

In 1954, after his course at the Flying Instructors' School at Tambaram, he continued as an Instructor at the Air Force Academy at Jodhpur in August 1956 and was then posted in New Delhi with the Air Headquarters Communication Squadron. During this tenure, he also had the privilege of serving as Lady Mountbatten's pilot on her visits to India. Subsequently, he joined No.20 Squadron equipped with Hawker Hunters at Halwara as the Flight Commander.

On promotion to the rank of Squadron Leader in December 1959, he moved to Simla and subsequently to Udhampur at the Advance Headquarters which brought him in close proximity to the Army with whom he maintained a long and propitious relationship. With his experience and flair in liaising with different arms of the services, he was especially assigned by the then AOC-in-C Operational Air Vice Marshal Erlic Pinto and Air Commodore Shivdev Singh in December 1961 to liaise with the Army for the Goa Operations. Shivdev Singh entrusted him with 'secret plans' for the Goa Operations and Sqn. Ldr. Weir actually had them in a steel container 'handcuffed' to his wrist.

On 14 April, 1962, Bertie Weir was given his first command, No. 108 (*Hawkeyes*) flying Vampire PR55s. It was a Photo Reconnaissance Squadron and also tasked with checking on Chinese troops on the Aksai Chin road. These photo recce missions were 'one way' missions with no possibility of ejecting at such high altitudes !

This is just a glimpse of the man who lived life on the edge for his country. In 1965 similar photo missions in the Raan of Kutch led to the confirmation that the Pakistan Army had deployed US-aided Patton tanks in this theatre.

In May 1965, Bertie Weir was promoted to the rank of Wing Commander and given command of No.16 Signals Units (SU) at Ambala. In November that year, he took over as CO of No. 27 Squadron (Flaming Arrows) equipped with Hunters. He was sent to England twice to ferry Hunters to India.

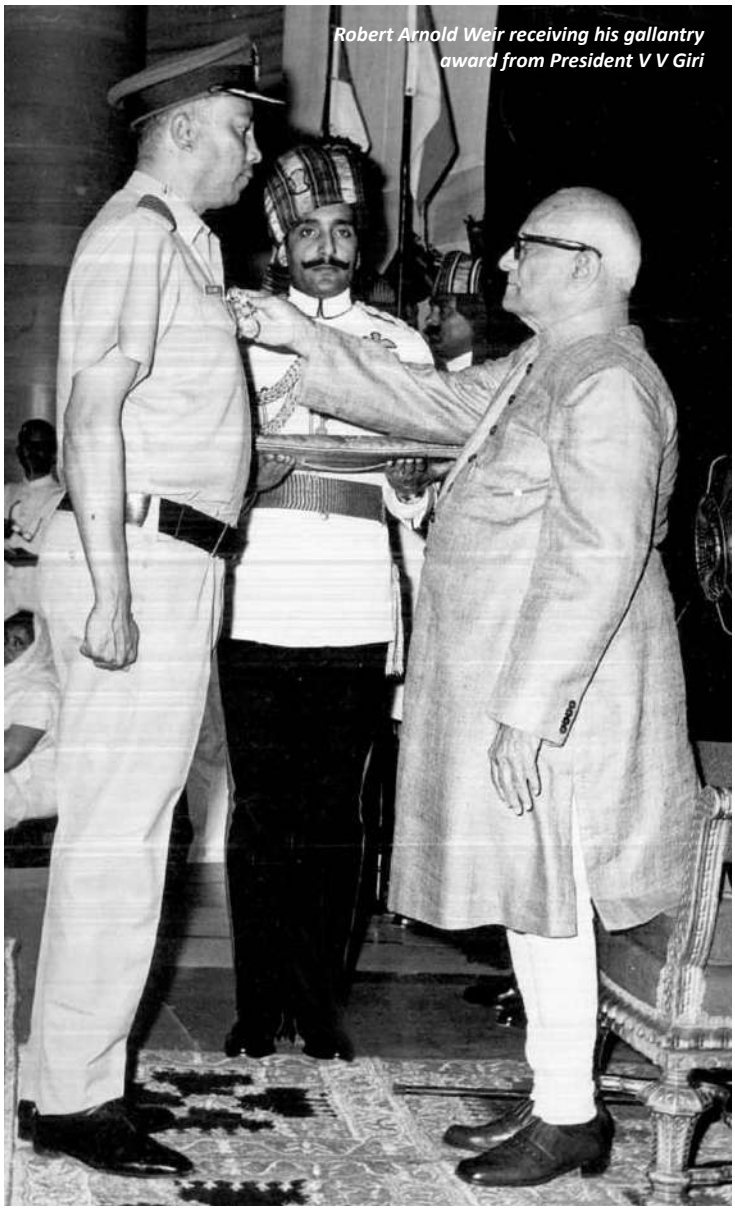
In 1967, he took over command of No.4 Squadron (*Oorials*) which was one of the first MiG-21 squadrons. The Squadron, initially based at Chandigarh, moved to Tezpur in 1968. At a time when only select officers got command of a fighter squadron, Bertie Weir had the unique distinction of having commanded four squadrons over a decade including No. 108 (Vampires), No.27 (Hunters) and No. 4 (MiG-21).

Under Bertie's command, No.4 Squadron had the lowest accident rate amongst all fighter squadrons. As Wing Commander, he was awarded the Vayu Sena Medal in 1970 for his "excellent leadership" and for "maintaining a high standard of operational readiness at all times". He was promoted to the rank of Group Captain in June 1970.

Then came 1971. On the Jammu front, Pak Army howitzers were deployed in the hilly regions and pounded Indian Army positions without counter fire to neutralise them. The IAF's jets could not manouvre in the narrow valleys. So Air HQ decided to deploy Harvard trainers with strap on armament to get them and Bertie Weir was hand picked to lead ad hoc formation.

Group Captain Bertie Weir, then Joint Director Training at Air HQ was called

What comprised No.123 Squadron during the 1971 War



Robert Arnold Weir receiving his gallantry award from President V V Giri

by Air Chief P C Lal and tasked to find a group of volunteers to fly the Harvards and provide close support to 25 Infantry Division in the Poonch sector. With the need to fly at ultra low levels and the Harvard's vulnerability to enemy fire coupled with the fact that parachutes were redundant at such low altitudes meant that the missions were virtually 'suicidal'. Bertie Weir took it on and also managed to motivate and inspire four Instructor pilots to join him.

The newly formed was titled No. 123 Squadron, from Hindon to Pathankot. However, as Pathankot was under attack the Harvards had to make it to Rajouri at night. The Harvards landed on the rough airstrip lit by headlights of Army vehicles. So Rajouri became home base. The task was to attack the infiltrators in the hills. The Harvards were flown low through the valley at speeds down to 90 mph and unseen by enemy fighters. However, with no navigational aids, the Harvards had to be flown in visual contact and the rockets fired using traditional ring-and-bead sights. Communication with the ground troops were carried out through hand-held walkie-talkies!

Between 8-11 December, 1971, Bertie Weir and his pilots engaged and destroyed a large number of enemy positions in the face of considerable small arms fire. Besides they undertook numerous recce missions in support of the ground forces in the Rajouri-Poonch sector. Bertie Weir showed intrepid flying skills : flying at barely 50 feet above ground level, knowing fully well that the aircraft was highly vulnerable to small arms fire and that forced landings in the event of damage to the aircraft was impossible, required courage of an unusual kind. Bertie Weir and his pilots were indeed of another era !

In January 1973, Group Captain Robert Weir was awarded the Vir Chakra for "displaying professional skills and leadership of a high order" during the 1971 war in the Rajouri-Poonch sector. However, all the medals and accolades could not match the appreciation and praise which Air Chief P C Lal showered upon him. On introducing Bertie Weir to the President of India, the Chief said, "If we have officers like this, the Air Force and the Nation are in good hands."

In 1976, Air Commodore Bertie Weir took over as Director to Air Defence and was subsequently selected for the one-year course at the National Defence College (NDC).

After the NDC and a brief stint as AOC, Ambala, Bertie Weir settled in retirement at Ajnala near Amritsar and very close to the border with Pakistan Punjab. He had served the Indian Air Force with courage and devotion. In an era of many good men, Bertie Weir was one of the best !

Air Cmde S S Tyagi VM (retd)

As Group Captain, Bertie at his desk

25 Years Back

From Vayu Aerospace Review Issue V/1988

The IAF at 56

The Indian Air Force marked its 56th Anniversary on 8 October 1988 at Palam. Forming an impressive backdrop to the parade were some of the IAF's latest fighter, transport and helicopter types, including pairs of the MiG-29, MiG-27, Mirage 2000, Jaguar, An-32, Mi-17 plus a single Il-76 flanked by eight SA-3 Pechora surface-to-air missiles.

Following flypast of IAF vintage aircraft, the Tiger Moth, HT-2, Spitfire Mk.VIII and Vampire FB 52, was the scintillating display by a lone MiG-29 'Baaz' flown by Wing Commander Harish Masand CO of No.28 Squadron. Finale to the flying display was provided by 8 Hunters of the 'Thunderbolts' aerobatic team which carried out a superb 10-minute display, climaxing it as always with the spectacular bomb burst.

Vayudoot expansion plans

All district headquarters in the country are to be air-linked with their respective state capitals, which in turn will be connected with Delhi, by the end of the VIII Five-Year Plan (1995). Although the primary responsibility of Vayudoot, as defined by its charter, is to provide air connections with communities in the North-East and sub-Himalayan region, the regional airline has been expanding its services at a rapid rate all over the country and is planning to link some 400 points in India by 1995, the carrier currently serving 96 points. The present fleet of ten Dornier 228s, six HAL-HS 748s and four Fokker F-27s is to be augmented by some 33 airliners of the 40-50 seat category as also 35+commuter aircraft of 20-seat capacity.

Development of the MiG-21

The Soviet Union has proposed a major joint development programme with India to evolve an advanced performance, light-weight fighter at minimal cost and time. Based essentially on the MiG-21bis fighter, the Mikoyan-de-sign bureau has apparently developed a prototype incorporating new wing technology, a higher trust turbofan engine (reportedly the R-33D), advanced cockpit layout and with contemporary avionics and flight management systems.

This MiG-21 re-incarnation is possibly designated the MiG-35, the existence of which has both puzzled and excited the world's aerospace community since early this year.

India-USA co-operation on LCA

India and the United States have signed a "Letter of Offer and Acceptance" (LOA) opening up the possibility of US cooperation in the Rs 2,000 crore Light Combat Aircraft (LCA) project. It provides a basis for discussion for the purchase of front line technology if found more cost-effective in the US than elsewhere and also if that country is willing to part with it. "The LOA is not an agreement as such but a step towards that goal". What raises hopes of an ultimate agreement, the sources said is the US willingness as manifested recently in its sale of 11 GE 404 engines for the prototype and pre-production LCAs.

'MiG-35' evaluated

Although a Government of India spokesman has queried the existence of a MiG-35, much less the IAF test flying the type, it is reported that the Soviet Union is developing a new fighter in the class of the General Dynamics F-16. Designated the 'MiG-35', it is seen as a complementary combat aircraft to the advanced MiG-29 interceptor, both for Soviet Air Force service and the export market in the mid-1990s.

The single-engined MiG-35 believed to be at an advanced stage in its development programme, was already revealed to the Indian Air Force as a fallback solution to its indigenous Light Combat Aircraft programme now getting underway. Some sources have gone so far as to state that IAF test pilots flew the MiG-35 inside the Soviet Union, probably at the Ramenskoye flight test centre, in May.

Although details are sketchy the aircraft is described as being smaller than the MiG-29, with a single fin and engine, probably the MiG-29's R-33D, which is fed by a single chin-type air inlet. The F-16 style inlet, a hitherto neglected feature of Soviet fighter design, appears to have been derived from the Mikoyan Bureau's Ye-32 prototype, which flew in the late 1970s.

Soviet officials have suggested to India that it is still not too late for the MiG-35 development to permit the integration of the LCA's characteristics into the Soviet project. The MiG-35, in much the same class as the F-16A/B air defence fighter, but with a secondary air-ground role, is also viewed by some analysts as the missing component in the Soviet Air Force's fighter force for the 1990s. The MiG-35 seems to signify the Soviet's current concern with cost and quality for their own forces, plus their apparent perception of a gap in the export market for a follow-on fighter to the US- built F-5.

India to buy Mi-28s ?

According to sources in Europe, the Indian government is considering purchase of an unspecified number of Mi-28 twin-engined attack helicopters from the Soviet Union which would be used primarily for anti-tank operations. The aircraft has been test flown by Indian Air Force and Army pilots.

Earlier an Indian team visited Europe to evaluate the Agusta A129 Mangusta and the MBB Bo 105. Apparently, the Indian Army prefers these two types to the Mi-28 but procurement from the Soviet Union is most likely because of economic reasons.

Mi-35 for India

The existence of a new Soviet helicopter model, the Mi-35, has recently been confirmed with the agreement between India and the USSR for supply of a number of these gunships to the IAF.

According to press reports from New Delhi, an agreement for the supply of some 20 Mi-35s was finalised during the visit to India of the Soviet Defence Minister Dmitry Yazov. Contrary to earlier speculation that the Mi-35 was the export designation for the Mi-28 dedicated gunship helicopter (NATO *Havoc*) which has just gone into service with the Soviet armed forces, the Mi-35 is in fact an upgraded Mi-25 model, with more armour protection, increased weapon-carrying capacity, new avionics and protective devices. Externally, the Mi-35 has little to distinguish it from the Mi-24/Mi-25, a small number of the latter type having been in IAF service since 1984 and engaged in strenuous action in Sri Lanka since October 1987.

Tale Spin

Return of the Founder

In the beginning … and now back to the future ! An electrifying announcement that the house of Tatas' are coming back with a brand new airline for India, to be headquartered in Delhi, in partnership with Singapore Airlines. Tatas' were the pioneers of commercial aviation in India, beginning in October 1932 with a modest single-engined de Havilland Puss Moth, flown by the legendry JRD Tata himself from Karachi to Bombay via Ahmedabad.

The exotic stature of Air India was virtually submerged in the decades thereafter and even though the 'Maharaja' continues to fly, the magic was long gone. Now JRD's successors have done him proud with the formation of this Tata–SIA carrier. Cheers !

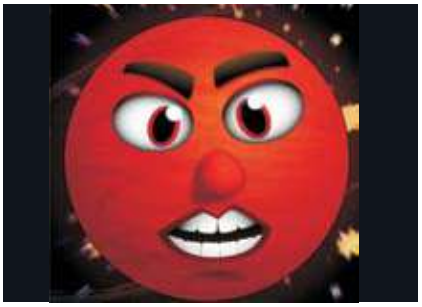
"Jeete Raho !" Defence Minister AK Antony seemingly paying obeisance to Marshal of the Air Force Arjan Singh DFC at a ceremonial function and receives blessings.

Or was Antony simply reaching down to pick up a paper he had dropped ?!

We are ALL from Mars !

Even as the Americans and British plan to send men to Mars in the next decades comes the revelation that life on earth was 'kick-started' billions of years back thanks to a key mineral which formed part of a meteorite from Mars. The vital ingredient was an oxidized mineral form of the element molybdenum, essential to building blocks of life.

According to a scientist in Florida, "we are actually all Martians, with life beginning of Mars and being introduced to the earth via the meteorite".



Now, billions of years later, the evolved (?) man goes home !

Indians were there first !

Some 8000 Indians are reportedly queuing up for the one-way trip to the red planet, following the 'Mars One' project which plans to establish a colony there in the next decades.

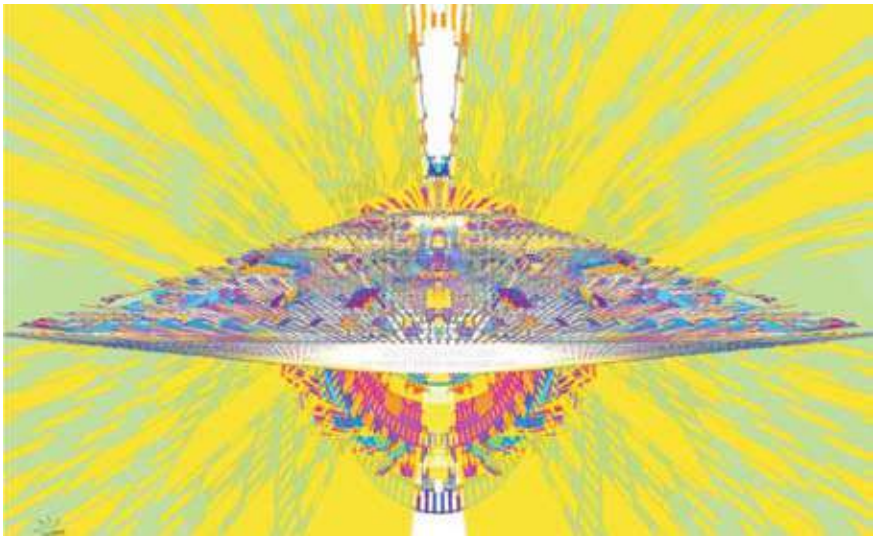
Even though people from 140 countries are reportedly volunteering to cross the 'final frontier', the Indians have a head start. According to the ancient scriptures Brahmastra and Vimana of the pre-Mahabharata period these are nothing but the earlier versions of today's nuclear weapon systems and spacecraft, the latter using light energy to travel around the cosmos at incredible speeds not only to Mars but far beyond the solar system.

Stand aside!

Cadets march on their stomach

The Ministry of Defence have invited applications from reputed caterers to supply 69 different types of bakery items to feed the National Cadet Corps gathered in Delhi Cantonment at the Republic Day Camp in 2014. Mouth watering chicken patties, black forest pastries, jam rolls and lemon tarts will feed the young boys and girls who will also feast on burgers, plum cakes, *pav-buns* and *kulchas*. As munchies, they will have roasted kaju and peanuts, badams, pinnies and idli dhoklas. And much else.

No wonder the NCC contingents are amongst the most sprightly on Rajpath !



Afterburner

Shinmaywa