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Aerospace & Defence Review

III/2015

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An intriguing scenario which depicts IAF Rafales engaging PLAAF J-10s over the forbidding terrain of the Tibetan Autonomous Region.
(Painting by Priyanka Joshi)

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Rafale and beyond

It seemed interesting that on the eve of Prime Minister Narendra Modi's departure for France, the Indian and French governments issued similar statements on the prospects of an agreement on the purchase of the Rafale aircraft: that no single deal should be allowed to overshadow the Prime Minister's visit. Indeed, India-France relations are much bigger than any one contract; they represent the cultural affinity and historic relations between two vibrant democracies. The items on the Prime Minister's agenda reflected the range of commonalities — from the preservation of ancient architecture to the development of Puducherry and Chandigarh as smart cities; from the construction of semi-high-speed railway lines to cooperation on a space mission to Mars; from discussing anti-terror training to tackling climate change through renewable technologies and a robust nuclear partnership. The economic aspect of the relationship has been ignored for too long. Although more than a thousand French companies have a total investment of about $20 billion in India, bilateral trade is worth just $8 billion. While all this deserved attention, it was disappointing that the Prime Minister put the spotlight back on defence ties by making a surprise announcement on the purchase of 36 Rafale aircraft as the highlight of his talks with President François Hollande. If the outright purchase was a crucial military necessity, it could have been discussed a few weeks before or after the visit, as a political push for the deal was secondary to the technical specifications and delivery requirements. Moreover, the deal, which involves purchasing products off the shelf abroad, detracts from Mr Modi's 'Make in India' initiative.

The breakthrough on the Areva nuclear equipment deal, on the other hand, shows the positive outcome of Mr Modi's and Mr Hollande's political push, combined with a 'Make in India' twist. As in the case of Indo-US nuclear negotiations, Modi and Hollande decided to clear the logjam by splitting the problem into different silos — allowing for separate mechanisms for the pricing issues and for the technical and legal aspects. The supplementary deal involving Areva and L&T producing heavy forging metal casing for nuclear reactors is an important step in localising some of the expensive parts. During his visit to Canada, where he hopes to sign a deal for uranium supplies, Mr Modi means to take forward his plan to increase nuclear energy production. Given this objective, it may be useful for him to round off the visit by discussing his nuclear energy plans in Germany as well, which is now winding down on nuclear power but is at the cutting edge of nuclear safety research for the European Pressurised Reactors that are being considered for India.

From *The Hindu*

A good deal

Prime Minister Narendra Modi's request to Paris to provide 36 Rafale fighter aircraft was a highlight of his bilateral visit to France. India had already chosen the Rafale fighter for the Indian Air Force, following a stringent technical evaluation process after a multi-billion dollar tender for 126 medium multi-role combat aircraft. In the deal being negotiated by the defence ministry with Dassault Aviation, 108 of those aircraft were to be made in India under a transfer of technology clause. That deal has been held up over procurement procedures and pricing negotiations, putting pressure on the IAF's depleting combat power. Modi's decision will meet the IAF's immediate operational needs. India will get the fighters on a much tighter timeline than under the original tender.

But there is a downside to the deal. During his overseas tours, the PM has made a strong pitch to foreign manufacturers under his signature 'Make in India' campaign. Defence manufacturing is one of the key areas for 'Make in India'. Buying 36 fighters without any provision to manufacture them in India goes against the PM's major thrust area. There is thus a danger of this deal — sans a 'Make in India' component — setting a precedent for future defence procurements. The government should be careful not to go down that road. It should, instead, identify the reasons for India's long-winded defence procurement process, where foreign suppliers either end up getting blacklisted or get entangled in protracted negotiations. Defence Minister Manohar Parrikar has already promised a streamlining of the defence procurement process in line with the 'Make in India' programme. The earlier he does it, the better.

The future of the 126 fighter deal is mired in uncertainty and a decision needs to be taken quickly. Whether India chooses to go with the original deal with Dassault or signs a follow-up inter-government order with France, it must include a clause for transfer of technology and manufacturing in India. In this current 36 aircraft deal, there is still an opportunity to promote defence manufacturing, particularly in the private sector. Under the provisions of the Defence Procurement Procedure (2013 revised), the maintenance transfer of technology contract for these 36 Rafale fighters must be given to a private-sector vendor instead of the public-sector HAL. Dealing with a modern fighter will expose the chosen vendor to R&D and advanced technology. The infrastructure, training, processes and equipment developed by the vendor will generate bigger spin-offs in the future for India's defence manufacturing sector.

From *The Indian Express*

To Nepal's Aid

In wake of the massive earthquake in Nepal, the Indian armed forces have once again stepped up to undertake rescue and relief operations. Condenamed Operation *Maitri*, at least 24 military aircraft have been pressed into service along with Unmanned Aerial Vehicles and scores of armed forces personnel to aid Nepalese authorities in copying with the sheer scale of destruction. From ferrying critical supplies to rescuing thousands of Indian tourists trapped in Nepal, the Indian armed forces were the first foreign teams to respond to the disaster.

That Operation *Maitri* comes close on the heels of Operation *Rahat* – where Indian citizens trapped in war-torn Yemen were rescued – buttresses the humanitarian capabilities of the armed forces. Even during the Kashmir floods last year, it was the Indian army that won hearts with its relief operations. Against this backdrop, there's a case for institutionalising the armed forces'

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relief and rescue competencies for dealing with calamities. As it is, India's security environment with nuclear-armed Pakistan and China doesn't yield itself to conventional warfare. Low-intensity asymmetric conflict continues to be a threat. But today the bulk of the armed forces' resources are geared towards bolstering deterrence.

While this is important, much of the underutilised military assets can be reoriented towards humanitarian efforts. This makes strategic sense too. A force that's capable of providing quick disaster relief in foreign countries becomes a great ambassador for India. It could facilitate diplomatic breakthroughs in other areas. Moreover, the armed forces have accumulated rich experience and become a critical player when it comes to disaster relief within the country. To beef up and bring a degree of professionalism to India's disaster relief agencies, the military's role in disaster management should be institutionalised.

From *The Times of India*

Politics and Defence

Unlike some militaries in India's neighbourhood, which have exercised a deep political influence on their country - in many cases even overthrowing Governments through coups - India's armed forces stand apart in sharp contrast. The Indian military has been a powerful but loyal instrument for democratically elected governments. It has played a big role in upholding India's integrity as a nation but has never sought to systemically challenge civilian supremacy over the armed forces exercised by the democratically elected political leadership represented by the Prime Minister and his Council of Ministers.

While loyalty of the armed forces to the Government of the day is unquestioned, management of India's complex security challenges requires able leadership over the military. For the most part, civil-military relations have been cordial and stable. The principal underlining civil-military relations is that the government will define the task but the military will have the operational freedom to achieve the objective. This also requires the military system to have the freedom and autonomy to manage its personnel and decide on promotions and postings based on merit.

But there have been instances of political interference in military matters which have led to unhappy and even disastrous results. The first and the biggest instance of turbulence in relations between the military and its political masters remain the events leading up to the 1962 War with China. The run up to India's humiliating defeat in this War is replete with attempts by the then Defence Minister Krishna Menon seeking to undermine the military leadership, encourage unprofessionalism by appointing to key posts favourites beholden to political masters, and imposing unrealistic objectives on the military, including an unwinnable war. Menon's direct interference in the domain of Generals is well documented by military historians.

A much-harassed Army Chief General KS Thimayya, a widely respected military leader, put in his papers, but was persuaded by the then Prime Minister Jawaharlal Nehru to withdraw his resignation. But Krishna Menon went about undeterred, ignoring professional advice from the military, playing favourites and setting the stage for India's abject military defeat at the hands of the Chinese in 1962. Menon persuaded his mentor Nehru into ordering the disastrous 'forward posture' against China. This involved deployment of Indian troops in small pickets in territories held by China, without providing the back-up, wherewithal and logistics to sustain such a posture. When the inevitable Chinese backlash took place, ill-equipped Indian troops were outnumbered and completely outmanoeuvred.

By contrast, India's campaign in the 1971 war was hugely successful. The principal reason was that the civil and military worked in perfect harmony to achieve India's national objectives. The victorious Army Chief, General (later Field Marshal) Sam Manekshaw had a big role in scripting this win. While accepting the political brief from the political masters, Manekshaw ensured that the timing and war strategy was left to him and his military colleagues. He brooked no interference in the conduct of the war. It is well known that he stood up to even Defence Minister Jagjivan Ram. He ensured that the conduct of the war was left to those who knew the business of war fighting, and gave India its biggest military triumph. He went to war some eight months after it was initially broached by Indira Gandhi, at a time of his choosing when his forces were fully prepared.

Defence procurement has been at the receiving end of the incompetence of the politico-bureaucratic establishment in providing the aircraft and weapons it needs to defend India. It took the Ministry of Defence close to 20 years to acquire an advanced jet trainer. The result of this delay was that scores of young pilots were killed in crashes. Now, the focus is on procuring a desperately needed multi-role fighter aircraft amidst sharply falling force levels. The IAF conveyed its requirement for 126 such fighters in 2001. With the procurement programme deadlocked even 14 years later, Prime Minister Narendra Modi had to intervene personally to arrange the import of 36 Rafales from France, citing "critical operational necessity". There has also been frustration in the military establishment of having to fight wars or being pushed into war-like situations with no clear objectives defined by the Government.

The bitterest tug-of-war is over issues like the Armed Forces Special Powers Act (AFSPA), which has been made the subject of political contest in Jammu and Kashmir and the North East. This law is the enabling provision for the armed forces to operate within the country on counter-insurgency and counter-terrorist operations.

A political mis-impression has been created in disturbed states that this law gives the armed forces license to commit murder. The deployment of the Army has been made a bitter political issue. Observers feel this affects motivation and morale, thwarts military initiative, and gives encouragement and time to terrorists to re-group. The fractious political debate forces the Army on the defensive, reduces the momentum of operations against anti-nationals, and further increases the stresses of having to conduct military operations among one's own people. An oft voiced sentiment is: "We the unwilling, led by the unqualified, are doing the impossible, for the ungrateful".

Wg. Cdr (Retd) Anupama Joshi in The Doon School Weekly

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There is something about the procurement of fighter aircraft from Western commercial sources that generates interest far greater than perhaps the sum of its economic or strategic content. The entire spectacle of open tendering, nail-biting selection followed by endless negotiations, all played out in the public arena, resembles a soap opera more than the very serious business of dealing with a strategic weapon system for war fighting. In the heated debate that has followed the latest announcement by the prime minister regarding Rafale, the sanest voice has been that of the *raksha mantri* when he said that such strategic systems should not be "open tendering and lowest bid" affairs, but of agreements between national governments.

We have, since 1962, procured and licence-produced Soviet and Russian fighter aircraft in hundreds so that the Indian Air Force's inventory today is predominantly Russian. More recently, the IAF and the Indian navy have procured aircraft worth over $10 billion from the United States of America alone. As the defence minister said, these have all been government-to-government deals. None has elicited the feverish media debate and partisan comment that some others following the tender route have done. One example of the latter is when, after the 1971 Indo-Pak conflict, the Indian Air Force began to look westwards to both diversify its sources of supply and meet its long-range strike requirements. At the time being, an integral part of the planning and procurement process within Air HQ, this writer had a ring-side view of the media scrutiny and games played by vested interests of all hues.

Then there were three contestants, the Mirage F1, the Jaguar and the Viggen. With two contenders left, a news magazine published what was portrayed to be adverse views on one of the test pilots involved in the flight evaluation. With the decision pending with the cabinet committee on political affairs, the then prime minister, Morarji Desai, was concerned enough to request the air chief to arrange for the test pilots to meet him one-to-one. It was only after the prime minister had met the two very distinguished test pilots, PK Dey and Pirthi Singh (both now deceased), and satisfied himself of the report being fabricated, did the CCPA proceed to consider the matter.

One is reminded of the above history, because the IAF's current proposal for medium multi-role combat aircraft has been facing its own share of problems. Having won a stiff competition, Dassault Aviation, the makers of Rafale aircraft, have made little headway in negotiations lasting three long years. One of the main obstacles being Dassault's reluctance to take responsibility for the quality of aircraft produced by Hindustan Aeronautics Limited, a pre-condition spelt out in the initial tender and one they must have been privy to. Why, one wonders, was such a self-defeating condition put into the tender in the first place? What does this say about HAL's confidence in itself specially when its website claims its vision to "become a significant global player in the aerospace industry"? Did this amount to a tacit admission that it was not confident of manufacturing an aircraft like the Rafale fighter without being shepherded by Dassault?

Since the principle articulated in the foreword to the defence procurement procedure is for the process to be impartial and transparent, we were now caught in a trap of our own making. This is where processes become more important than the outcome and no one dare deviate, even for valid functional or operational reasons, for fear of being accused of *mala fide* intent at some future date. Fortunately, the framers of the DPP had the dexterity to put a clause allowing for deviations arising out of strategic considerations, which, in turn, allowed flexibility for imperatives of strategic partnerships or major diplomatic, political, economic, technological or military benefits. That the government has

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taken the bold step to invoke this clause to wriggle out of the corner it found itself in merits applause, because for the first time there is a message to the armed forces that their essential operational needs will not be held hostage to abstract notions of transparency and impartiality.

In Paris, the PM announced that in view of the critical operational needs of the air force he had requested the French president for a quick supply of 36 Rafale jets in flyaway condition through an inter-governmental agreement on terms better than those demanded by Dassault as part of a separate process. Not surprisingly, this announcement has taken both the strategic community and observers of the Indian aeronautics scene completely by surprise, used as they are to being slaves to the DPP and which, as the defence minister admitted, got us into a "loop or vortex with no solution in sight".

By opting for the government-to-government route, both countries have no doubt been guided by self-interest. On our part, since aeronautics is the greatest driver of technology, Indian aeronautics needs to strive to find a place amongst the international players. Only when this happens can we hope to reap the benefits of "Make in India" in the field of aeronautics. There are no short cuts, and finding strategic partners is the only cost effective route. Those critical of the prime minister's move as being against the "Make in India" concept clearly fail to understand what modern aeronautics industry and its broader eco-system truly entail. On the other hand, military aircraft R&D and costs are spiralling with orders dwindling worldwide and manufacturers like Dassault finding it difficult to use economies of scale to make affordable products after amortizing R&D investments. For them, the way ahead is to find reliable strategic partners, share costs and benefit from economies of scale.

It is even possible that recognising India's operational imperatives and looking at its own longer term interests, the French government may be willing to let IAF Rafales take priority over French Air Force orders on the production line. This perhaps explains the two-year ambitious delivery that the defence minister has stated. It is worth recalling that in the case of the Jaguar purchase in the Seventies, the United Kingdom's ministry of defence had diverted aircraft on loan from the RAF reserves to help IAF bridge the gap in anticipation of its own deliveries.

In the absence of the contours of this decision being available in the public domain, this writer would like to believe that the surprise announcement by the prime minister in Paris was a consequence of a well thought out and strategised move for putting Indian aeronautics on the international stage in keeping with its human and technological potential, a journey that must encompass the genius of the Indian private sector, the large public investments in aeronautics and international strategic partnership.

Planners of the prime minister's 'Make in India' mission are only too aware that in the longer term it is the aeronautical industry that will add technological depth to this mission. They are mindful that in the United States of America, a Congressional commission on the future of the aeronautical industry in 2001 had reported the sector as a whole contributing 9 per cent of GDP and 11.2 million jobs. In China, there has been a dramatic growth in the aeronautical ecosystem during last 10-15 years. The Chinese are using terms like 'aeronautical patriotism' and have invested large sums in this ecosystem. Viewing these developments with equanimity is inimical to our national security.

To begin this ambitious journey of Indian aeronautics, the first priority clearly was to make good the IAF's operational requirement with a weapon system that had been found the most suitable after due evaluation and to leverage this for the longer term 'Make in India' vision. The next was to reach understanding at the highest levels in France for a strategic partnership in the aeronautics sector. For India, the take-away is partnering with one of the most sophisticated aeronautical countries in the world, one with which we have a history of aeronautical ties from the days of Ouragans, Mystères and now Mirages. It is also one that has never flinched in product support during crises, and has a major presence in the international civil aeronautics field with the Airbus series of aircraft. It is commercial aviation that will be the primary driver of any aeronautics sector of the future, so the prime minister's visit to Airbus Industries assumes significance. For France, the problem is that purely military aircraft business is becoming unsustainable without finding suitable partners and with the focus shifting to the Asia Pacific region. A regional footprint adds commercial flexibility to their military aeronautics.

Third, the concept of joint Indo-Russian design and development of a fifth-generation fighter has been rendered sterile with Russian prototypes already flying with no Indian design involvement so far. This can usefully be replaced by a joint Indo- French successor to the Rafale that would be an attractive option for the future international market. And finally concurrent with this strategic partnership will be the development of an aeronautics ecosystem of small and medium, high technology enterprises in India that are the backbone of any mature aeronautics country. This fledgling ecosystem, presently struggling because of the absence of our aeronautical footprint internationally, will get a well-deserved boost.

If, indeed, this has been the strategic vision behind the prime minister's bold announcement in Paris, then all that is left for his planners to do is dust out the already existing proposal for a comprehensive national aeronautics policy, prepared by the Aeronautical Society of India and let the proposed aeronautics commission take the captain's seat in guiding Indian aeronautics to its rightful place on the international stage.

Air Marshal Brijesh D. Jayal (Retd)

OPINION

Pakistan opens door for China's domination

One of the abiding mentor-protégé relationships in recent history, of nearly 60 years' vintage, notwithstanding differing ideologies, is easily the one existing between Communist China and Islamic Pakistan. That Pakistan, having been a part of the 1950s-60s US-led anti-Communist military alliances, CENTO and SEATO, successfully manipulated the "milking" of billions of dollars and military largesse from an indulgent Uncle Sam for years, while simultaneously being a willing supplicant of US *bête noire* China's geo-strategic regional formulations, may appear surprising, but is attributable to just one common factor. No prizes for guessing the strand that binds both China and Pakistan together — a common animosity for India. That, despite being for many years the US' "frontline state in the global war on terror", Pakistan continues with its terrorist-friendly machinations and the US keeps turning a blind eye to Pakistan's mischief is inexplicable.

China's generous military aid, comprising nuclear weapons, strategic missiles and modern weaponry for its client state Pakistan since years, is exclusively directed against India. The world community has disregarded China violating its treaty obligations under the NPT and MTCR as it assists Pakistan acquire nuclear weapons and ballistic missiles, while also helping it build the Chashma and Khushab nuclear reactors to produce weapons-grade plutonium, as also facilitating export of North Korean *Taepo Dong* and *No Dong* ballistic missiles to Pakistan.

Unquestionably for China, Pakistan is a low cost guarantor for needling India and keeping it hemmed in subcontinental affairs and so restrict its multifarious endeavours within South Asia. For Pakistan, China is a free yet a high value guarantor of security against India. This congruence of strategic interests between China and Pakistan confers on this relationship an "all weather", a "deeper than the oceans" and "sweeter than honey" configuration, as parroted by the leaders of both these countries. Thus, the much hyped visit to Pakistan by Chinese President Xi Jingping on 20-21 April, after the earlier cancelled proposed visit in September 2014, has administered the vitally needed sustenance to both Pakistan's military arsenal and its rapidly depleting coffers.

The joint statement issued by both countries at the end of Xi's visit formalises the ambitious plans of China's "Silk Road and Economic Belt" initiative. China plans to invest US $46 billion in Pakistan in the coming years. A total of 51 agreements covering a vast canvas in defence and security aspects, power generation, trade, banking and communications were signed during the Chinese President's visit, adding in the joint statement phrases like "shared destiny" and "perpetual continuity in Pakistan-China friendship from generation to generation". Thus, China's stranglehold over cash-strapped Pakistan in the coming years speaks adequately of the latter's subjugation to China's long term objectives in the region.

The China-Pakistan Economic Corridor will create a massive network of roads, railways, bridges, dual use tunnels, pipelines linking China's restive Xinjiang to the deepwater port of Gwadar on the Arabian Sea. Gwadar lies east of the Strait of Hormuz through which much of the West Asian crude production is carried. This project is part of China's 'Belt and Road' plant to expand its economic and security footprint across Central and South Asia. Once completed, China will be able to avoid too much reliance on what currently bothers it, namely all the China bound sea traffic, which has to pass through the narrow Malacca Straits in the Indian Ocean. In addition, Chinese presence in the Gilgit-Baltistan and Pakistan Occupied Kashmir regions along India's north-west has serious security implications for India.

It has also been recently reported that China plans to sell eight modern diesel-electric submarines to Pakistan, which will enable a doubling of Pakistan's current submarine fleet. In addition, it has been officially announced that Pakistan will acquire 110 new JF-17 Thunder fighters from China, with 50 of these slated to be delivered over the next three years. That all this modern weaponry and much more in the pipeline is only for use against India hardly brooks any profound military analysis.

The bee in the Chinese bonnet is that the major infrastructure of the highway leading to the Gwadar port goes through the restive, insurgency ridden province of Balochistan, where Pakistan has been facing a violent separatist movement since decades. The Pakistan Army has used mass

murder and extermination of many young Balochis to quell the insurgency, but sporadic audacious attacks by the proud Balochis carries on unabated. The Chinese fears for their personnel working on these projects are well-founded and highlighted by Andrew Small in his recent book *The China-Pakistan Axis*. Small opines that despite all the security worries for the Chinese, "the scale is so large that it should still have a major economic impact regardless".

In addition to the Balochi insurgency, the Chinese are also wary of continuing support by some of Pakistani and Afghanistan-based Islamic terror groups to the Uighur militants of the East Turkmenistan Liberation Front, who are engaged in a freedom movement in China's restive Xinjiang province.

The ever growing China-Pak Axis has major security implications for India. Politically speaking, in the so-called "disputed territories" of Gilgit-Baltistan and POK, how is Pakistan allowing another nation to virtually occupy territory, even if on long lease, to build infrastructure by a third nation? In 1963, Pakistan had unilaterally ceded 5,100 sq km of J&K territory in the Shaksgam Valley, thus this so called economic and connectivity project will further add to the complex solution-finding of the J&K problem.

China, as one of the world's major powers, growing rapidly both economically and militarily, has to conduct itself with a sense of balance, a visionary approach to global and regional matters and maturity required of an emerging global power. China's silence over 26/11 mastermind Zakiur Rehman's recent release by the Pakistanis does not bring any laurels to its image. It cannot condone terrorism in any form, even if it is emanating from its junior ally, Pakistan.

Prime Minister Narendra Modi, in his visit to China, will have to factor in all what the Chinese have been up to in the past few years to bolster Pakistan, even in areas which were not required. How India manages to resolve the long outstanding India-China border issues and at least contain the growing Pakistan-China axis, will be the most crucial test of Indian diplomacy and Indian resolve. Meanwhile at home, let us go full steam ahead to build up our military capabilities as part of a clear-cut national security strategy.

Lt Gen Kamal Davar (Retired)

36 Rafales 'ordered' for IAF

At the very start of his state visit to France on 10 April 2015, Indian Prime Minister Narendra Modi announced that he had 'requested' the French Government to make available 36 Dassault Rafales for the Indian Air Force to meet its urgent requirements. Although the Rafale had been selected as the M-MRCA of choice by the IAF and Indian Government in January 2012, protracted discussions since have kept the formal contract in abeyance and in

making this decision public, the Indian Prime Minister has swept aside the bureaucratic impasses which have dogged the programme. Detailed discussions between French and Indian Government representatives are to follow, with the option of manufacturing the type in India still unknown at this stage (*see article 'Rafale Resurgent' in this Issue*).

G-to-G negotiations on Rafale

In early May, Indian Defence Minister Manohar Parrikar stated that a Government-to-Government Committee will be set up to begin negotiations on the (Rafale) deal "…. and we have to conclude this in a time-bound manner." French Defence Minister Jean-Yves Le Drian was in India during early May, following his visit to Qatar (formalising that country's Rafale deal), to "set up the negotiations with India", according to French Ambassador François Richier. As per MoD officials, Dassault Aviation are providing "technical assistance to the teams nominated by India and France leading towards an inter-governmental agreement (IGA) which task will be facilitated by the fact that negotiations on the Rafale have continued for over three years now". Also, "we have had the experience of procuring the Mirage 2000 in 1982" which will "come in handy". Dassault could well enter into a joint venture for the Rafale's license production in India either with HAL or a selected private company.

First upgraded Mirage 2000s for IAF

The first two upgraded Mirage 2000 fighters landed at AFS Gwalior on 24 April 2015, flown by Indian Air Force pilots from France to India via Greece, Egypt and Qatar over a period of seven days. Leader of the formation, Group Captain M Minocha (CO No 9 Squadron), was welcomed by the AOC Air Commodore HS Basra, who also formally accepted the aircraft documents.

The upgrade enhances the overall capability of aircraft with advanced avionics, weapons and defensive suites. The upgrade contract was signed with Thales and Dassault in 2011 and the French portion of the upgrade programme now stands completed and on schedule. Subsequent series upgrade of the IAF's Mirage 2000 fleet is being carried out by HAL at Bangalore. *[See detailed article in this issue]*

UP Expressway as IAF runway

Following the pattern of several other Air Forces, including Singapore, Pakistan, Israel and Sweden, the IAF is considering demarcating stretches of expressways to become runways for emergency operations. According to reports from Lucknow, the IAF has proposed that a 3-kilometre section of the 300km Agra-Lucknow expressway (the largest such Greenfield project in the country), could serve as a runway, the IAF bearing the project cost

which will include taxiways and ramps. Surface of these segments will be thicker than the normal road surface, with specialised support equipment stored nearby. The Pakistan Air Force has several such facilities along the Lahore-Islamabad highway where PAF fighters exercise regularly.

Meanwhile, such capability was demonstrated by the IAF on 21 May with a Mirage 2000 doing a touch-and-go along the Yamuna Expressway, near Mathura (*see image*).

Defence Acquisition Council clears series of proposals

The Defence Acquisition Council chaired by Defence Minister Manohar Parrikar cleared a series of high-profile proposals on the evening of 14 May 2015. Of note is the fact that three long pending major procurements approved appear calculated not only to boost the Prime Minister's 'Make in India' initiative but also to maintain a balance between India's three major arms suppliers : the USA, western Europe and Russia.

Airbus Defence and Space C295 fitted with winglets (photo: Airbus)

Approved was the procurement of 56 C295 tactical transport aircraft from a Tata-Airbus consortium, which will supply 16 aircraft in a flyaway condition from Europe and build 40 more at an assembly line in India, with progressively increase of indigenous content. This Rs 12,000 crore (nearly $2 bn) project, which has long been referred to as the 'Avro replacement programme,' will likely see larger numbers of this twin-turboprop transport built in India as other Indian military services have such an aircraft type in mind for their specific requirements. Amongst these are the Indian Coast Guard which could adopt the C295 as platform for its Multi-Mission Maritime Aircraft (MMMA) requirement, six aircraft at present with options for more. The Indian Navy also have a requirement for large numbers of what is termed as the MRMR (medium range maritime reconnaissance) aircraft. The Border Security Force (BSF) and Aviation Research Centre (ARC) are potential operators of this transport type as well.

Ka-226T during RSH trials in India (photo: Russian Helicopters)

The DAC also cleared the long pending RSH (reconnaissance and surveillance helicopter) requirement for 197 helicopters to meet both the Indian Army and Air Force's needs. The DAC selected Russian Helicopters' Kamov Ka-226T to fulfil the Army and IAF's joint requirement for 200 helicopters, all of which will be built in India in a government-to-government deal worth over $700 million. Kamov will now be the lead contractor for such helicopters to be made in India, even while HAL continues with development of its own light utility helicopter (LUH).

A BAE Systems M777 howitzer in action

For the Army, the DAC approved the long-delayed ultra light howitzer (ULH) requirement, with BAE Systems "willing" to produce their M777 155mm/39 towed guns in India. The MoD has approved a $700 million procurement of 145 such howitzers

to be built and maintained in partnership with an Indian firm. As with the Avro replacement programme, the 145-gun initial purchase is likely to be expanded in time through periodic repeat orders. In addition, BAE Systems have offered to make India the global centre for assembly, integration and testing (AIT).

File picture of INS Rajput firing Brahmos missile

For the Navy, the DAC cleared a Rs 2,700 crore ($422 million) proposal to replace the 3M24 Uran (SS-N-25 'Switchblade') anti-ship missiles on all three *Delhi*-class destroyers and 3M54 Klub (SS-N-27 'Sizzler') missiles on the first three *Talwar*-class frigates, and install Brahmos cruise missiles.

Boeing 777-337 ER of Air India

Other requirements which were cleared on 13 May include procurement of communication terminals for the IAF's Advanced Landing Grounds (ALGs) and transfer of two Boeing 777-300ER airliners from state-owned Air India to the IAF, suitably modified as dedicated VVIP aircraft, which will obviate the need to take Air India airliners whenever state visits take place abroad.

PM Modi addresses boundary issue in China

Prime Minister Narendra Modi raised a series of contentious issues, including the international boundary dispute, during his three-day state visit to China 14-16 May. The PM held a round of informal talks with Chinese President Xi Jinping on 14 May, followed by structured talks with Premier Li Keqiang in Beijing the next day. PM Modi, who had earlier taken up the issue on

clarification of the 3,400 km Line of Actual Control (LAC) during President Xi's visit to India in 2014, spoke of the "urgent need" for clarity on the LAC, where aggressive patrolling has frequently resulted in tense stand offs between the two armies. Amongst other issues, the PM also highlighted India's concerns on the proposed China-Pakistan Economic Corridor that will traverse parts of POK.

However, such disagreements were not the focus of Modi's trip to China, as 21 business agreements worth about $22 billion were signed at the India-China Business Forum. The PM also interacted with Chinese industry executives and encouraged them to do business in India as part of his 'Make in India' initiative.

"Strategic Partnership" agreements with S. Korea

India and South Korea signed seven agreements and upgraded their ties to a "special strategic partnership" including "deepening of defence co-operation" during Prime Minister Modi's visit to the East Asian nation 18-19 March 2015. Seven of the ten points in the joint statement with President Park Geun-hye related to defence co-operation, including exchanges between the Indian and S Korean Navies and their respective shipyards. The Indian PM also visited the Hyundai Heavy Industries' main shipyard, reportedly one of the world's largest, in the southern city of Ulsan, this mega-corporation being reportedly keen on co-operation with Hindustan Shipyards to build a series of warships.

China's Gwadar and India's Chabahar port projects

Reminiscent of the nineteenth century 'Great Game' between Russia and Britain, but now being played out in the northern Arabian Sea, the Indian Government has a long-term plan to "secure the seas" following China's build up of facilities at Pakistan's Gwadar Port in Baluchistan, some 500km west of Karachi and 120 km from the Iranian frontier. On 17 April, the Chinese Government had announced a $ 46 billion economic corridor plan linking Xinjiang with Gwadar, with roads and rail lines running through Pakistan Occupied Kashmir (POK). In this context, Vice Admiral SPS Cheema, FOC-in-C Western Naval Comand has said that "our response mechanism is always in place...the northern Arabian Sea is very critical for the Gulf and also northern Africa from where energy sources are located... (monitoring of the area) is the Indian Navy's job."

On 6 May 2015, the Government of India signed an MoU with Iran for the development of Chabahar Port, located in Sistan-Baluchistan Province along Iran's south eastern coast, which is considered to be of strategic utility for India to get a sea-land access route to Afghanistan. Chabahar is 170km from Gwadar.

Indian interest in V-22 Ospreys

According to reliable sources in New Delhi, the Aviation Research Centre (ARC), which was established in the early '60s and functions under the Cabinet Secretariat, have expressed interest in acquiring four Boeing V-22 Osprey tiltrotor aircraft from the USA under a G-to-G route. Eight Ospreys were recently deployed by the US Marines in Nepal for rescue and rehabilitation operations and their utilisation in the mountainous terrain was "most impressive". According to the report, Ospreys could be used for induction and evacuation of special forces in hostile conditions as also for logistic support to the Special Frontier Force (SFF). Taking off and landing vertically, the Osprey can transport 30 troops over medium ranges and fly at upto 450 kmph. The Indian Navy is reportedly also "interested" in the V-22 Osprey for transporting personnel and stores from shore bases to aircraft carriers at sea.

An additional aircraft type with the ARC, as reported and photographed by international media, is the Bombardier Global 5000 business jet converted for special missions by IAI's subsidiary Elta Systems in Tel Aviv, essentially for ELINT/SIGINT tasks.

Russian Helicopters Ka-226T 'selected' for RSH

Approvals by the Defence Acquisitions Council on 14 May 2015 were on a 'non-tender' basis which included the Ka-226T light helicopter made by Russian Helicopters (part of State Corporation Rostec). Once the contract is concluded, Rosoboronexport in partnership with Russian Helicopters will be responsible for execution of the programme on the "Make in India" basis, the helicopters to be produced in partnership with Russian Helicopters' Kumertau Aviation Production Enterprise.

Russian Helicopters CEO Alexander Mikheev has said that "the contract envisages construction of a record number of Ka-226T helicopters, (which) will require considerable work and collaboration with Indian industry. It is important to note that Kumertau Aviation Production Enterprise will be crucial in fulfilling this order, as it will play the main role in enacting this project."

The Ka-226T light helicopter, designed by the Kamov Design Bureau (a Russian Helicopters company) received certification in Russia in March 2015 and had previously participated in the Light Utility Helicopter tender first announced by India's MoD in 2003 but thereafter withdrawn. Flight evaluation of the Ka-226T in mountainous and desert terrain was carried out in 2014.

Repaired Ka-31s for Indian Navy

Russian Helicopters (part of State Corporation Rostec) has recently delivered the first two repaired Ka-31 AEW helicopters, produced by Kumertau Aviation Production Enterprise (a Russian Helicopters company), to India. In 2004, Kumertau Aviation Production Enterprise had supplied nine Ka-31 helicopters to India, six have since needed comprehensive repairs before their first scheduled overhaul, and were sent to Kumertau for this work. A total of 14 Ka-31 helicopters were manufactured for India and a special service centre established in Goa for their maintenance.

Requirement for 100 Naval Utility Helicopters

While the Defence Acquisition Council (DAC) has "cleared" the long pending reconnaissance and surveillance helicopter (RSH) requirement of the Indian Army and Air Force (specifying the Kamov Ka-226T), the Indian Navy's requirement for some 100 new-generation utility helicopters (NUH) remains pending. The IN has operated the venerable HAL Chetak (Alouette III) for close to four decades and these need replacement for which the Government has reportedly approved a 'Made in India' approach. Eleven Indian industrial houses have been identified for the purpose, including Tata Advanced Systems, Bharat Forge, Mahindra Aerospace, Reliance Defence & Aerospace and Larsen & Toubro, all of whom are reportedly in discussions with international companies such as Airbus Helicopters, Bell Helicopters and AgustaWestland for their AS 565 MBe, Bell 429 and Super Lynx 300 respectively.

Unlike the Army /Air Force's RSH, specifications of the NUH include folding rotor blades, wheeled undercarriage and 'marinisation' of the powerplant and key systems to ensure optimal utilisation during extended operations at sea.

New Procedures on Defence Procurements

As stated by Defence Minister Parrikar on several occasions, the Government plans to issue a new defence procurement procedure (DPP), which will incorporate changes in the offset policy; 'make procedure' and take a nuanced approach on 'blacklisting of companies'. Also incorporated will be the policy wherein 80 per cent of R& D funding for 'Make in India' projects would be provided by the Government to either a public or private-sector company to develop an identified product, and in return, assure orders over a certain period.

CAG criticism of LCA programme

In its report tabled in Parliament on 8 May, the Comptroller & Auditor General of India (CAG) has been severely critical on two particular areas that affect Indian defence: continuing shortage in ammunition reserves that adversely affect operational readiness of the Indian Army as also technical issues that impact on operational capability of the Tejas light combat aircraft (LCA). The LCA Mk.I, inspite of having been granted Initial Operational Clearance (IOC) 'twice', has still 53 "signification shortfalls" which "greatly reduces its capabilities and survivability in combat" which could prove to be the IAF's "Achilles heel in battle". The CAG Report warns that the delays in clearance of the LCA and continued slow manufacture and supply of the LCA has set the IAF back by Rs 20,037 crore which is the amount spent as the IAF was forced to opt for "temporary measures such as upgrading its existing fighter fleet" in face of rapid combat force depletion.

Low production rates at HAL

There have also been critical references to slippages in aircraft production and delivery rates by Hindustan Aeronautics Limited, with Parliament's Standing Committee for Defence specifying "slack in production" in two particular programmes: "against contract orders for 138 Dhruv ALHs, HAL has produced only 78 while 150 Su-30MKIs have been delivered against 180 ordered for delivery by 2013-14, from a total of 272". The IAF presently has 10-11 squadrons equipped with the Su-30MKI, with three more squadrons to be equipped in the next 4-5 years. In their defence, a HAL source stated that this PSU follows a 'Batch Mode of Production' pattern which is different to the "Mass Production" approach.

Travails of IAF pilot training

The travails of pilot training in the Indian Air Force continues, with the reported failure by HAL to overcome problems with the HAL HJT-36 Sitara. This intermediate jet trainer was designed and developed as replacement for the HAL HJT-16 Kirans which have been employed for Stage II training in the IAF flight training syllabus for four decades and need to be urgently replaced. In fact, the delays in inducting Sitaras has led the IAF to continue with the Kiran Mk.IA and force disbandment of the *Surya Kiran* aerobatic team so as to utilise its inventory of Kiran Mk.IIs. Meanwhile, the Indian Navy has transferred all its Kiran Mk.IIs to the Air Force from INAS 551 which is now entirely equipped with the BAE Systems' HAL Hawk Mk.132.

Defence Minister at Army Commanders' Conference

The bi-annual Army Commanders' Conference, held m 20-25 April 2015 in New Delhi, deliberated on major operational, human resources and logistic issues involving the Army. Defence Minister Manohar Parrikar emphasised on national security matters and capability development, reiterating that capacity building was a continuous process that must proceed apace and unabated. He highlighted some key issues and challenges, both external and internal and congratulated the Indian Army "as one of the most professional institutions of the country" and complemented the manner in which the Army dealt with very difficult challenges including "proxy wars".

Lauding the selfless response of the Army in dealing with the Jammu & Kashmir floods, he also emphasised that one of the topmost priorities of the Government was the welfare of ex-servicemen in which the 'One Rank One Pension' scheme implementation process was underway.

Akash SAM inducted by Army Air Defence

Formal induction of the indigenous Akash SAM system into the Indian Army's Air Defence Corps took place at the Manekshaw Centre at Delhi on 5 May 2015. The ceremony was marked by handing over of "key of the weapon system" by CMD of BDL to General Dalbir Singh, COAS, who thereafter dedicated the weapon system to the Corps of Army Air Defence by handing over the symbolic key to Lt Gen VK Saxena, DG Army Air Defence.

The Akash Missile System is an indigenously-developed supersonic short range surface-to-air missile system with the capability to engage a wide variety of aerial threats including aircraft, helicopters and unmanned aerial vehicles up to a maximum range of 25 km and upto an altitude of 20 km. The system is capable of simultaneously engaging multiple targets and is capable of providing comprehensive short range missile cover to the vulnerable assets in the field force of the Army, employs command to line-of-sight guidance and relies on sophisticated radars and control systems.

Modernisation and re-equipment of IA artillery

With some 264 artillery regiments, mostly equipped with 105mm (Indian) and 130mm (Russian) guns in its order-of-battle, the Indian Army's long term plan is to replace these with 155mm howitzers. The Ordnance Factory Board (OFB), has been engaged over the past several years in development of 155mm howitzers for the Indian Army. Based on the technical specifications and manufacturing know how received nearly three

decades back from Bofors of Sweden, OFB have been cleared for serial production of the 155mm, 45-calibre howitzer now named 'Dhanush'. It is learnt that following the delivery of six Dhanush howitzers for extended field trials in Sikkim and Rajasthan, the OFB will build another 114 of these to equip a number of medium artillery regiments, with 300-plus more numbers expected to follow.

Even as this indigenous programme continues, the MoD has issued several tenders to procure 155mm howitzers in three categories: towed (1580 numbers), self-propelled (100 numbers) and wheeled (180 numbers). In addition, the DRDO has invited several private-sector firms including Bharat Forge, L&T, Tata Power SED and Punj-Lloyd to participate in the Advanced Towed Artillery Gun (ATAG) programme (155mm, 52 calibre howitzers) which will have an effective shoot range of 60 kilometers while weighing only 12 tonnes.

Also factored in is the procurement of 145 ultra light howitzers (ULH) from BAE Systems, considered an essential for mountain warfare. Weighing only 4.2 tonnes (compared with 10-12 tonnes of the conventional 155mm howitzer), the ULH could be heli-lifted for deployment in mountainous terrain. In this context, "downsizing' of the proposed XVII Mountain Strike Corps to half that initially planned, has been questioned by the Congress Party which queried whether "there is a shifting of goalposts on this key strategic issue".

Two Mi-17V5s for BSF Air Wing

The BSF formally inducted two Mil Mi-17V5 medium lift helicopters into its Air Wing on 9 April 2015. The helicopters flew into New Delhi's Safdarjung Airport, where they were received with a tricolour watercannon salute (*see picture*). The helicopters are crewed by pilots on deputation from the Indian Air Force, and are drawn from the IAF's order for over 150 of the type, bearing a standard IAF paint scheme, markings and serials (ZP5240 and ZP5241). The BSF plans to eventually operate a fleet of 8 Mi-17V5s, replacing older Mi-17s currently in service.

D&D activities at HAL

HAL has recorded its highest ever turnover of Rs. 15,480 crores (provisional) for the financial year 2014-15 as against Rs. 15,128 crores achieved in FY 2013-14. The operating profit for the year was at Rs. 1,560 crores against Rs. 1,551 crores in 2013-14.

Meanwhile, as part of its Design and Development activities, HAL's light combat helicopter (LCH) had made 384 flights with the Board approving production of a 4th technology demonstrator to expedite the process of its Initial Operational Clearance (IOC). Concerning the Light Utility Helicopter (LUH), the Ground Test Vehicle (GTV) tests were successfully carried out recently. The HJT-36 Intermediate Jet Trainer meanwhile has accumulated 1004 flights so far.

As per HAL, "Detailed design, jig fabrication and commissioning have been completed for HAL's Basic Turboprop Trainer (HTT-40) and assembly activities initiated. The LCA has so far completed 2871 flights out of which 364 were carried out during 2014-15 for IAF variant. The LCA naval variant has made 43 flights, of which 24 flights were in FY 2014-15. Regarding the Hindustan Turbo Fan Engine-25 (HTFE-25), detail design of the core engine is complete and assembly tools and required test setup /test bed under progress. This medium thrust class engine is aimed at military trainer aircraft, small regional jets and unmanned aerial vehicles."

Indian Navy's next carrier

Amongst numerous Defence funding "allocated" by the DAC on 14 May 2015 was a modest amount of Rs 30 crore for the second indigenous aircraft carrier (IAC-II), which formally allows work to begin on the 65,000-tonne carrier. Reportedly named the INS 'Vishal', the Indian Navy's largest and most advanced aircraft carrier will take least a decade to construct and will possibly be powered by nuclear-propulsion, and configured for *CATOBAR (Catapult assisted take-off* but *arrested recovery)* aircraft operations. In this context India and the USA are moving towards collaboration in new generation aircraft carrier technologies, including installation of EMALS (Electromagnetic aircraft launch system) developed by General Atomics. This has been listed as amongst the key subjects of discussion under the bilateral Defence Trade and Technology Initiative (DTTI), with meetings to be held in New Delhi in early June in presence of visiting US Defence Secretary Ashton Caster.

The Indian Navy's 'wish list'

According to the CNS Admiral Robin Dhowan, the Indian Navy has proposed that "in lieu of conventional submarines, we would like to have (six) more nuclear-powered submarines", even as nuclear power is considered an option for the next aircraft carrier. In 1999, the Navy had articulated their plans for 24 conventional submarines by 2030 and Admiral Dhowan has listed a multi-pronged plan, essentially to ensure that timelines are met in the ongoing construction of the six *Scorpene*-class submarines and "top priority" given to the second tranche of six such submarines, which will have stealth features, air-independent propulsion (AIP) and land-attack missile capabilities. Presently, the IN has 13 conventional submarines and a lone nuclear-powered one (INS 'Chakra' leased from Russia) while the first indigenous nuclear-powered submarine (INS 'Arikant') is undergoing sea trials (*see Vayu Issue II/2015*).

Navy identifies 'Make in India' requirement

In his "long term naval technology road map", CNS Admiral Robin Dhowan has stated that "we have put the 'Make in India' thrust on an overdrive... with focus on weapons, sensors and cutting-edge technologies, with certain milestones and required timelines". Some one hundred such areas have been identified, including new-generation radars, sonars, rapid-firing guns and a range of missiles. "The DRDO will have to deliver in the timeframes required", the CNS emphasised.

Multi-layered surveillance of the western seas

In recent interviews, Vice Admiral SPS Cheema, FOC-in-C Western Naval Command has outlined multiple manners in which the western seas along India's peninsula are being kept under constant surveillance. These include space-based automatic identification system for ships, coastal radars, long-range trackers for ships and aircraft, apart from the regular maritime surveillance by aircraft of the Indian Navy and Coast Guard from a string of airbases. These are supplemented by unmanned aerial vehicles (UAVs), with all information collated and analysed in real time at the Information Management and Analytical Centre (IMAC).

Admiral SPS Cheema has also said that vast numbers of Indian fishermen have been factored in, becoming "our eyes and ears and in a way part of the security system". The Navy regularly interacts with these lakhs of fishermen, who are trained and sensitised for such surveillance. Meanwhile, installation of the second phase of coastal radars is continuing after the first phase of 46 such radars were made operational, also at India's Offshore Island territories.

Strengthening of Andaman & Nicobar Command

In an interview, CNS Admiral Robin Dhawan has stated that "a very big plan" is underway to progressively strengthen the strategic Andaman & Nicobar Command (ANC). "All the three Services are involved...ANC will get better equipped in terms of force levels and infrastructure over time and has been given priority by the Defence Ministry," the CNS said. "There will be more jetties for warships, more airstrips and extended runways for aircraft." The A&N Islands are an invaluable strategic asset with its location straddling the Bay of Bengal, the northernmost Andaman island being close to Myanmar and the southernmost close to Sumatra. While the Indian Navy has several warships based at Port Blair, the Indian Army have garrisoned an Infantry Brigade and the Air Force has airborne assets in Car Nicobar, midway in the Archipelago. The southernmost tip of Nicobar, Pygmalion Point, now has an airstrip used by Dornier 228s of the Indian Navy and Coast Guard.

First Project-15B destroyer launched

The 3,000-tonne hull of the first Project-15B guided missile destroyer, INS *Visakhapatnam* was launched on 20 April 2015 at Mazagon Docks in Mumbai with the Chief of Naval Staff Admiral RK Dhowan, as Chief Guest. The CNS lauded the contribution by MDL in meeting the Navy's growing requirements and also commended the efforts put in by the Navy's own Director General of Naval Design (Surface Ship Group), Rear Admiral AK Saxena, and his team in the design of the state-of-the-art warships.

The four Project-15B ships being built at MDL have been indigenously designed by the Directorate of Naval Design and displace 7,300 tonnes with a length of 163 m and beam of 17.4 m. and embarking two multi-role helicopters. They will be propelled by four 'Zorya' gas turbines from the Ukraine to achieve speeds in excess of 30 knots. The P-15B destroyers incorporate new design concepts for improved survivability, sea keeping, stealth and manoeuvrability. Enhanced stealth features have been achieved through shaping of

hull and use of radar transparent deck fittings, which make these ships difficult to detect.

INS *Visakhapatnam,* will be followed by two sister ships (reportedly named INS *Porbandar* and INS *Marmagoa*), all equipped with the Israeli Multi Function Surveillance Threat Alert Radar (MF-STAR) to provide targeting information for 32 Barak 8 long-range surface to air missiles. The Barak 8, co-developed with Israel, is currently being integrated in the Navy's new destroyer INS *Kolkata* and will be test-fired by October 2015. Like the INS *Kolkata*, the *Visakhapatnam* will have 16 long range Brahmos anti-ship missiles.

Fifteenth ICG FPV

On 22 April 2015, Cochin Shipyard launched BY-515, named ICGS *Arinjay*, the fifteenth of twenty Fast Patrol Vessels (FPVs), being built for the Indian Coast Guard. Capt RS Sundar laid the keel of BY-516, the sixteenth FPV, on the same day. CSL has so far delivered 12 vessels of the 20-ship order, and the thirteenth vessel is being readied for sea trials. The twelfth vessel, ICGS *Ankit*, was handed over to the Indian Coast Guard on 7 April 2015.

Seminar on Naval Aviation

The Directorate of Naval Aviation, under Rear Admiral Devender Sudan, ACNS (Air) organised a seminar on naval aviation 30 April to 1 May 2015, with the theme 'Indian Naval Air Arm - Transforming for Future Challenges'. Held at the Dr DS Kothari Auditorium, DRDO Bhavan, in New Delhi, the key note address was delivered by the CNS Admiral RK Dhowan, while the Chief Guest was Ashok Gajapathi Raju, Minister of Civil Aviation. Rao Inderjit Singh, Minister of State for Defence in his address stated that ensuring a multi-dimensional Navy which is capable of securing India's growing interests in the near and extended neighbourhood "is of the highest priority". He also said that the Government is committed to strengthening preparedness of the armed forces and will provide full support to the Navy for its modernisation and development plans.

The seminar was attended by a large number of senior naval aviators including former Navy Chiefs Admirals RH Tahiliani, Arun Prakash and Sureesh Mehta. Contemporary aspects of Maritime Air Operations particularly aircraft carrier operations were discussed, along with the 'Make in India' initiative in the Aerospace sector. The seminar also envisaged enhancing the synergy between DRDO, PSUs and the private sector.

Indo-French Exercise *Varuna 2015*

14th edition of the Indo-French naval exercise *Varuna 2015* concluded on 2 May 2015 off the coast of Goa, the ten-day

exercise including both harbour and sea phases. The French Navy was represented by the aircraft carrier *Charles de Gaulle* and her air-wing of Rafales, Super Etendards and E-2C Hawkeyes, as well as the destroyers *Chevalier Paul* and *Jean de Vienne*, replenishment tanker *Meuse* and Breguet Atlantique 2 patrol aircraft.

From the Indian Navy, INS *Viraat*, INS *Mumbai*, INS *Tarkash*, INS *Gomati*, replenishment tanker INS *Deepak*, Type-209 submarine INS *Shankul* and some Fast Attack Craft (FACs) participated. Aviation assets of the Indian Navy included carrier-borne Sea Harriers, Boeing P-8Is and Dornier 228s, along with Sea King Mk.42B and Chetak helicopters.

The scope of *Exercise Varuna* included the entire gamut of maritime operations ranging from aircraft carrier operations, anti submarines warfare exercises, maritime interdiction operations to multi-ship replenishment exercise. As reported, "Regular IN-FN interaction over the years has allowed both navies to gradually and systematically increase the complexity and professional content of the joint exercises and *Varuna* aimed at deriving mutual benefit from the experiences of the two navies." Other joint exercises included coordinated anti-submarine exercises, surface exercises, cross deck flying, damage control and fire fighting, air defence, firing drills, air to sea firing, tactical exercises and visit-board-search and seize operations.

First Indian *Scorpene*-class submarine *Kalvari* undocked

On 6 April 2015, with Defence Minister Manohar Parrikar in attendance, the Indian Navy's Project-75 (*Scorpene*-class) achieved a major milestone at Mazagon Dock Limited (MDL) with the 'undocking' of INS *Kalvari*, the lead boat of the class. The Defence Minister, accompanied by CNS Admiral RK Dhowan, said that all six *Scorpene* submarines being built at MDL in collaboration with French firm DCNS will be in service by 2020. He urged PSU shipyards to increase their production capacities and "complete projects on or before time." He also warned that the MoD would penalise firms for delays but also reward them with bonuses if programmes are completed ahead of schedule. The first of the *Scorpenes* was supposed to have been commissioned in 2012, and the programme is an alarming 40 months behind schedule.

The 'undocking' of *Kalvari* marks movement of the submarine mounted on pontoons from the berth area in the dock to the harbour where it will undergo further tests. If the tests are successful, the

submarine will separate from the pontoon and be launched in September this year for sea trials, after which it is expected to be commissioned next year.

INS *Sardar Patel* commissioned

INS *Sardar Patel*, latest shore establishment of the Indian Navy, was ceremonially commissioned on 9 May 2015 at Porbandar, Gujarat, by Mrs Anandiben Patel, Chief Minister of Gujarat. This facility is an important addition in the Navy's efforts to augment security infrastructure in the coastal states and islands of the country.

INS *Sardar Patel* will function as Forward Operating Base (FOB) and Headquarters of the Naval *Officer-in-Charge* (Gujarat, Diu and Daman) responsible for enhancing logistic support to Indian Navy units deployed in the Northern Arabian Sea and along the International Boundary Line with Pakistan. Commodore BR Prakash, Naval Officer-in-Charge (Gujarat, Diu and Daman) has been appointed as first Commanding Officer of INS *Sardar Patel*.

ASW *Kavaratti* launched

The fourth anti submarine warfare (ASW) corvette of Project-28, INS *Kavaratti*, was launched at Kolkata on 19 May 2015 with RRM Rao Inderjit Singh presiding as Chief Guest at the occasion. In his address, he lauded the contributions made by GRSE, Kolkata in meeting the growing requirements of the Navy. The four ships of Project-28 built by GRSE, Kolkata have been designed indigenously by the Directorate of Naval Design, New Delhi and are propelled by four diesel engines to achieve speeds in excess of 25 knots with an endurance of more than 3000 nm.

IAF Commanders' Conference

The Air Force Commanders' bi-annual Conference 2015, held at Vayu Bhawan from 20-25 April 2015 was inaugurated by Defence Minister Manohar Parrikar. The CAS reported on operational status of the IAF, induction of the C-17 Globemaster III. He also highlighted the efforts to increase the aircraft serviceability and the corresponding increase in flying task as compared to the previous year. Achievements of the IAF especially during the Humanitarian Assistance and Disaster Relief (HADR) operations were covered by the CAS.

Earlier at the Annual Commanders' Conference of Western Air Command, the CAS Air Chief Marshal Arup Raha emphasised the need to build up mission capability of all platforms and weapon systems and reiterated the crucial role of Western Air Command in future operations. He stressed on aspects of flight safety, besides appreciating WAC's rapid response and lead role in providing Humanitarian Assistance and Disaster Relief (HADR) over the past year during Operations *Megh Rahat*, *Rahat*, *Neer* and *Maitri*.

British VCDS visits India

Air Chief Marshal Stuart Peach, Vice Chief of Defence Staff of United Kingdom seen calling on Chairman Chiefs of Staff Committee (COSC) and Chief of the Air Staff, Air Chief Marshal Arup Raha at Air Headquarters (Vayu Bhavan), at New Delhi on 20 April 2015.

IAF and Army in Nepal relief operations

Following the series of violent earthquakes which rocked the Himalayan nation of Nepal on 25 April 2015, the Indian military was first to go into action for rescue and relief operations. Less than six hours after the first tremor, the first Indian Air Force C-130J from No. 77 Squadron 'Veiled Vipers' landed in Kathmandu with a 39-man NDRF team plus over 3.5 tonnes of relief material on board. This was the first sortie in an incredible humanitarian aid operation, named *Maitri* that Indian armed forces carried out over the next weeks.

Indian Army and Air Force units worked relentlessly for transporting relief material and evacuating quake victims, operating without pause from airfields in Northern India as well as Nepal itself. The IAF used a mixed force of fixed wing transports including the C-17, Il-76, C-130J and An-32, as well as Mi-17 helicopters during the operation. As of 15 May 2015, the Air Force had flown a combined total of 986 sorties, evacuating over 3,800 people and transporting over 966 tonnes of aid material. The Indian Army deployed a squadron of HAL Dhruv ALHs, and two senior Army officers for co-ordinating the operation.

[See detailed article in this issue]

Airbus ready to 'Make in India'

Airbus committed to 'Make in India' during Prime Minister Narendra Modi's visit to Toulouse on 11 April 2015, where he was received by Airbus Group Chief Executive Officer (CEO) Tom Enders as well as other members of the Airbus Group Executive Committee. "We are honoured to host Prime Minister Modi in Toulouse and convey to him our desire to forge a stronger industrial bond with India," said Tom Enders. "India already takes a centre-stage role in our international activities and we want to even increase its contribution to our products. We support Prime Minister Modi's 'Make in India' call and are ready to manufacture in India, for India and the world." Tom Enders was joined by Airbus CEO Fabrice Brégier, Airbus Defence and Space CEO Bernhard Gerwert and Airbus Helicopters CEO Guillaume Faury.

In India, Airbus Group presently operates two engineering centres, one focused on civil aviation and the other on defence and a research & technology (R&T) centre which together employ over 400 highly qualified people.

Airbus aircraft form a significant part of the fleets of most major Indian carriers and have well over 70 per cent market share. Prime Minister Modi was later given a tour of the A380 Final Assembly Line (currently, four daily A380 flights serve India). "With much larger markets waiting to be tapped, the potential for the A380 to help Indian carriers win greater international market share with a flagship aircraft is enormous."

Air India seeks additional capital

The Civil Aviation Ministry has sought additional capital for Air India to enable the state-owned airline to service repayment of loans taken for aircraft purchase. In this year's Union Budget, Finance Minister Arun Jaitley made a provision of Rs 2500 crore for Air India (against the airline's demand for Rs 4,277 crore) as additional equity infusion needed for payment to oil companies, the Airports Authority of India and repayment of interest on government-guaranteed debentures.

Even as losses have starting reducing over the last few years from Rs 5,140 crore in 2011-12, to Rs 3,807 crore in 2012-13 and Rs 2,123 crore in 2013-14, Air India faces an operational loss of Rs 2,171 crore in 2014-15. The Civil Aviation Parliamentary Committee had backed AI's demand observing that "as the airline was on the path of recovery and performing well, the Government should provide (the extra) Rs 1,777 crore … during the financial year." Meanwhile, there are concerns on repeated maintenance lapses which have resulted in frequent grounding of Air India aircraft.

Financing Air India's Dreamliner

Air India is seeking funding from banks and financial institutions to raise $110 million as advance payment for six Boeing 787-8 Dreamliners which the airline has to acquire in the next fiscal year. In January 2006, Air India had placed orders for 68 aircraft with Boeing (41 B-777s and B-737-800s plus 27 B-787-8s) and the

airline is required to pay an advance of 10% towards the aircraft cost 12 months before delivery. According to the Company website, the Boeing 787-8's 2014 list price is $218.3 million. Perhaps easing the situation is the receipt of $200 million by Air India from the Ministry of Defence for the purchase of two of its Boeing 777-300ERs for VVIP operations.

Air India in talks for 14 A320neo

Air India is negotiating with Airbus Industrie for fourteen A320neo single-aisle airliners. To be acquired on a sale/lease back basis, these will join six others in replacing the carrier's ageing fleet of ex-Indian Airlines A319-100s and A320-200s. The decision to buy the A320 neos was taken at a board meeting in December 2014 after an RFP for the lease of nineteen A320neo did not generate "suitable responses".

Jet Airways to "optimise" fleet inventory

According to a company spokesman, "Jet Airways is evaluating several options concerning its fleet inventory in context of an ongoing network evaluation to drive sustainable profitability". As part of this exercise, Jet Airways are considering the sale of all its Boeing 777 and Airbus A330s to raise cash and reduce part of its Rs 12,000 crore debt. Jet Airways presently operate 10 Boeing 777-300 ERs and 12 Airbus A330s, six of the latter type being on operating lease while the other sixteen are on a financial lease. 10 of its wide-bodied aircraft have been leased to Etihad Airways and Turkish Airlines.

Jet Airways also operate Boeing 737 and ATR-42/72s on domestic and regional services.

Airbus H125 helicopters for Heritage Aviation

In an acceptance ceremony held at Marignane in France, Heritage Aviation received two H125 helicopters acquired for charter and utility missions, with a special focus on pilgrimage heli-tours. The first H125 arrived in India at the end of April followed by the second in early May.

Heritage Aviation has been operating to pilgrimage sites in India with leased aircraft. After operating various types of single-engine helicopters for the past seven years, Heritage Aviation selected the H125 to be part of its permanent fleet.

The H125 is well-known in India as the AS350 Ecureuil before its renaming last month. It has been playing an instrumental role in many key sectors that Airbus Helicopters has been working hard to develop in India, including geophysical surveys, power grid management, electronic news gathering, emergency medical services, law enforcement and border patrol.

Air Pegasus commences operations

The new Indian regional airline Air Pegasus commenced commercial operations on 12 April, with flight services from Bangalore to Hubli and Thiruvananthapuram. Air Pegasus is promoted by ground handling services provider Decor Aviation, the company planning to operate ATR-72s in southern Indian routes by December 2015, expanding the fleet size to 20. Flight services have commenced with two 66-seat ATR-72-500s and Air Pegasus will expand services to Kochi, Chennai, Tuticorin, Belgaum, Rajahmundry, Pondicherry and Madurai.

Honeywell and Indigo contract for cockpit technologies

Honeywell has contracted with IndiGo to supply its on-order Airbus A320neo fleet with a suite of avionics technologies, including several Honeywell safety-focused cockpit systems that will enable pilots to better monitor the surrounding airspace and provide greater situational awareness. IndiGo's A320neo fleet will feature Honeywell's SmartRunway/SmartLanding system for increasing awareness during taxi, takeoff and landing phases by helping pilots ensure that the aircraft has a stabilised approach and is configured to land. In addition to cockpit technologies, Honeywell will provide products and handle maintenance requirements for the Honeywell 131-9A Auxiliary Power Unit (APU) for IndiGo's new A320neo fleet.

G Mohan Kumar appointed new Defence Secretary

Senior IAS officer G Mohan Kumar has been appointed as new Defence Secretary for a two-year term. A 1979 batch IAS officer of the Odisha cadre, he was earlier Secretary in the Department of Defence Production and took over from Radha Krishna Mathur, a 1977 batch Manipur-Tripura cadre IAS officer. Kumar, who hails from Kerala, has also served as Steel Secretary before taking over as Secretary in Department of Defence Production on 1 September 2014.

Mr Kumar will be replaced as Secretary Defence Production by Ashok Kumar Gupta, a 1981 batch IAS officer of the Tamil Nadu cadre who earlier was Special Secretary in the Department of Defence Production.

Vice Admiral SPS Cheema is FOC-in-C WNC

Vice Admiral Surinder Pal Singh Cheema took over as Flag Officer Commanding-in-Chief (FOC-in-C) of the Western Naval Command from Vice Admiral Anil Chopra on 31 March 2015. Vice Admiral Cheema has the unique distinction of shouldering responsibilities as a Commander-in-Chief for the fourth time, a record of sorts in the Indian armed forces. He has also served in Mumbai in various capacities over the past four decades and has commanded five frontline ships, including the missile boat INS *Nishank*, the guided missile frigate INS *Trishul* and the aircraft carrier, INS *Viraat*.

He had earlier headed the Tri-Services Headquarters at Delhi as Chief of Integrated Defence Staff to the Chairman, Chiefs of Staff Committee and thereafter the Strategic Forces Command.

Air Marshal BBP Sinha is new AOA

Air Marshal BBP Sinha took over as the new Air Officer-in-Charge Administration (AOA) at Air Headquarters on 1 May 2015. Prior to his present appointment, he was Director General (Works and Ceremonials) at Air Headquarters. Commissioned in the Administration branch of the IAF in June 1979, he has held many important appointments, which include Chief Administrative Officer at two major flying bases, Principal Director (Pay, Pension & Regulations) at Air Headquarters, Senior Officer-in-Charge Administration (SOA) at HQ Western Air Command, IAF.

HAL Board reconstituted

The Board of Directors of HAL has been reconstituted with effect from 1 April 2015 with Chairman, T Suvarna Raju being re-designated as Chairman & Managing Director (CMD). The revised structure consists of five whole time directors, including the CMD, two government nominee directors and seven independent directors. The current position of Director Human Resources is held by VM Chamola and that of Director (Finance) by Dr. AK Mishra. S Subrahmanyan who was Managing Director (MiG Complex) is now Director (Operations). The position of Director Engineering and R&D will be announced shortly.

CMD Suvarna Raju

"The re-constitution is done considering the growth of the Company in the next two decades. This will also ensure extensive delegation and strengthen our management system", stated Suvarna Raju, the CMD. The posts of Managing Directors have been discontinued and HAL now has four Chief Executive Officers (below the board level): V Sadagopan, CEO (Helicopter Complex), R Kaveri Renganathan, CEO (Bangalore Complex), Daljeet Singh, CEO, MiG Complex and Rajiv Kumar, CEO, Accessories Complex.

V. Sadagopan

Rajeev Kumar

Kaveri Renganathan

Daljeet Singh

"The Air Force (has) no role in decision making"

Defence Minister Manohar Parrikar's candid statements on the

Rafale, LCA and much else!

French Air Force Rafale B in flight during a display at Aero India 2015 (photo: Angad Singh)

Q: Was the Indian Air Force on board when the government took the decision to buy 36 Rafale fighters under the government-to-government (G2G) route from France?

MP : I consulted the Air Force to the extent it was required. They have no role in decision-making, as ultimately it's the Prime Minister's call. I did discuss possibilities with the Prime Minister and he took a very bold decision, which was required. If we had missed this opportunity, the entire matter would have gone into a spin and we might have had to re-start the whole procedure this year. And in another five years our requirements might have changed. Rafale induction could begin in about 18 months.

Q: You said the fighter acquisition process will be G2G now. Will India buy more Rafales or could it source fighters from other countries too?

MP : I will say both options are open to us depending on reassessment of our requirements (after scrapping the tender for 126 aircraft). I will not spell out MMRCA's role but it will be very effective in certain areas. Two people travel on a scooter, four in a car and 20 in a bus. But two people can also travel in a bus but that would be wasting resources. So, we will not deploy this aircraft where it is not required. I can tell you our light combat aircraft (LCA) is also a very capable aircraft and can replace MiG-21s more than adequately. It cannot be compared with the Rafale as the latter is a heavier fighter with two engines.

Q : So India will buy more Rafales after re-assessing requirements? Where does the LCA fit in the picture?

MP : I feel that some more Rafale jets may be required but need to figure out how we can acquire them. But more importantly, we need large number of aircraft to replace MiG variants over the next 8-10 years, which is their extended life. So either we go in for large-scale manufacturing of the LCA or combine some other requirements and go for a medium-weight fighter under the Make in India plan.

HAL Tejas LCA in flight over Yelahanka at Aero India 2015 (photo: Angad Singh)

Some of it can be replaced by even proper stockpiling of missiles. Nowadays, one can attack some targets by proper use of missiles.

Q : Will the remaining Rafales come under the 'Make in India' programme and will Dassault Aviation set up a unit here?

MP : That decision will be taken after both India and France hold talks. It will also depend on what our financial outlay is. We operate various MiG variants, Mirage 2000s, Jaguars, Sukhoi-30s and we have the LCA now. All these warplanes have different capabilities and cannot be compared. Ultimately, we may also require certain number of Rafales but how many will hinge on the cost factor. Why just 126? I would want the IAF to have 500 planes, but the question is how much I can afford. We will have to do an analysis of minimum requirement and then take a decision.

Q : The 10 years of UPA is often referred to as the lost decade for the military with several key projects getting delayed or derailed. How do you intend to reverse the damage and speed up acquisitions?

MP : My focus is on projects that are stuck at different stages. I have managed to speed up these projects by 25%. There are 339 such cases that need to be dealt with. The ministry has managed to bring 58 of these to final stages of completion. Nearly 100 projects may not be required now due to long delays or changed requirements and we are looking at dropping them or putting them on the back burner. The thrust is on accelerating critical projects.

"Brahmos cruise missiles could be used in place of combat aircraft strikes in certain cases" (photo: Angad Singh)

Q : What stopped the previous regime from taking quick decisions: bureaucratic inertia or lack of leadership?

MP : I always say bureaucracy is colourless like water. It takes the colour of the government so you cannot totally blame them (bureaucrats). Part of the blame surely lies with them. But, it is the duty of the government or the minister to ensure proper follow-up action to crucial projects. I do not know what the previous government was doing but as

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ARROW-3

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far as I am concerned, review meetings are held in South Block on a daily basis.

Q : Pakistan is on course to buy eight diesel-electric submarines from China in what would be one of Beijing's biggest exports. How do you think it will change the dynamics in the Indian Ocean region?

MP : Of course, a submarine in itself is a very powerful platform in the ocean. It may, however, not directly pose a threat to India. But it does become a weakness in your armour of controlling the ocean. We will have to match it. I do not see it as a big problem because we will have enough submarines by the time Pakistan gets these 8. By the time they get the deliveries, we can manufacture 15-20 submarines.

Q : You have said the UPA regime cleared the Mountain Strike Corps project in the eastern sector without factoring in availability of funds. What outlay are you planning to set aside for it?

MP : The previous government had estimated it will cost Rs 88,000 crore and will have 70,000 soldiers. I have frozen the cost at Rs 38,000 crore over the next eight years. It will consist of 35,000 men. The CCS had cleared the original proposal, but where is the money? Rs 88,000 crore is the Army's revenue budget! The CCS kept clearing projects worth Rs 50,000 crore to Rs 100,000 crore but where is the actual money? So you have to be selective. I have cleared a Rs 48,000-crore project for seven stealth frigates (Project-17A), but I have factored in when the money will be required and at what stage.

Q : Are you satisfied with infrastructure in forward areas and the role of the Border Roads Organisation?

MP : Much more needs to be done. Environmental clearances have come in 64 cases. But I will be able to take the issue head on only when we are in a position to deliver in terms of roads. BRO is now in the process of outsourcing. Government machinery, the BRO in particular, has never developed the technique of outsourcing. They are very poor outsourcers. They do not have conceptual clarity on outsourcing. We are in touch with the Confederation of Indian Industry and may appoint consultants to push it.

Q : Can you elaborate on proposed changes in the new defence procurement policy?

MP : Different issues are being tackled separately and we are close to coming close to a conclusion. I think 8 or 9 main issues (including blacklisting and allowing agents) have been discussed extensively and decision-making is in an advanced stage. I am forming a committee that will go through all this material and do a final round of interaction (with stakeholders). It will then write a Defence Procurement Procedure, which will be published after the Ministry vets it.

Q : The Prime Minister has talked about skills as part of defence offsets but your ministry says skills cannot be a part of offsets.

MP : It can be. They are going by what is written there. But if we change that, the same people will say it is possible. Currently, there is a ban on services in offsets as someone used services to give kickbacks. I intend to take it up at the next meeting of the defence acquisition council and lift the ban on services.

Q : The Defence Research and Development Organisation (DRDO) has been without a chief for more than 2 months. What about appointing a Chief of Defence Staff?

MP : The selection process for the new DRDO chief is on and will happen soon. DRDO will play a key role in boosting the Make in India programme. We will encourage it to tie up with the local industry in the development phase. As for creation of the post of Chief of Defence Staff or Permanent Chairman of the Chiefs of Staff Committee, I will take up that issue after

Indian Navy Kilo-class submarine INS Sindhuvijay seen underway

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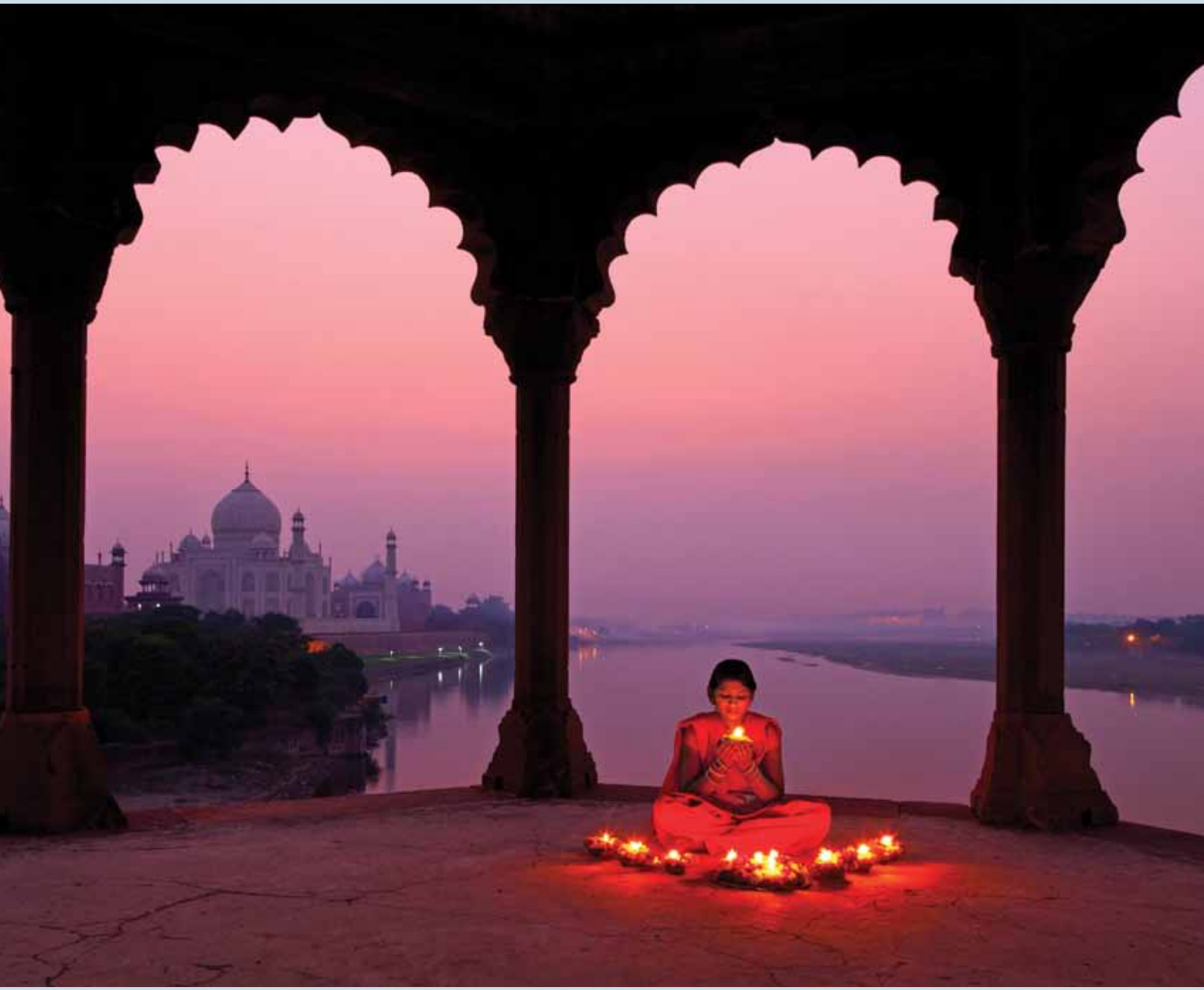

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Project-17A frigates are a follow-on class to the Project 17 (Shivalik-class) warships such as INS Satpura (above)

two months as I already have my hands full with other issues. We do intend to create that post but if I take up everything together I will not be able to do anything.

Q : Coming back to the Rafale, you said your predecessor had himself put a question mark on it.

MP : The previous Defence Minister had written that after the price negotiation is done, L1 should be verified again. But it did not come to that stage as it got stuck up because of interpretation of whether to take French man-hours into consideration for building the plane or Indian man-hours, which is 2.7 times the French number. I have not gone into too much detail on that, but my officers have expressed reservations about this 2.7-hour formula for local manufacturing.

(With excerpts from the Hindustan Times)

Defence Minister Parrikar with Defence Secretary RK Mathur, MoS for Defence Rao Inderjit Singh, and senior IAF officers at a recent Commanders' Conference

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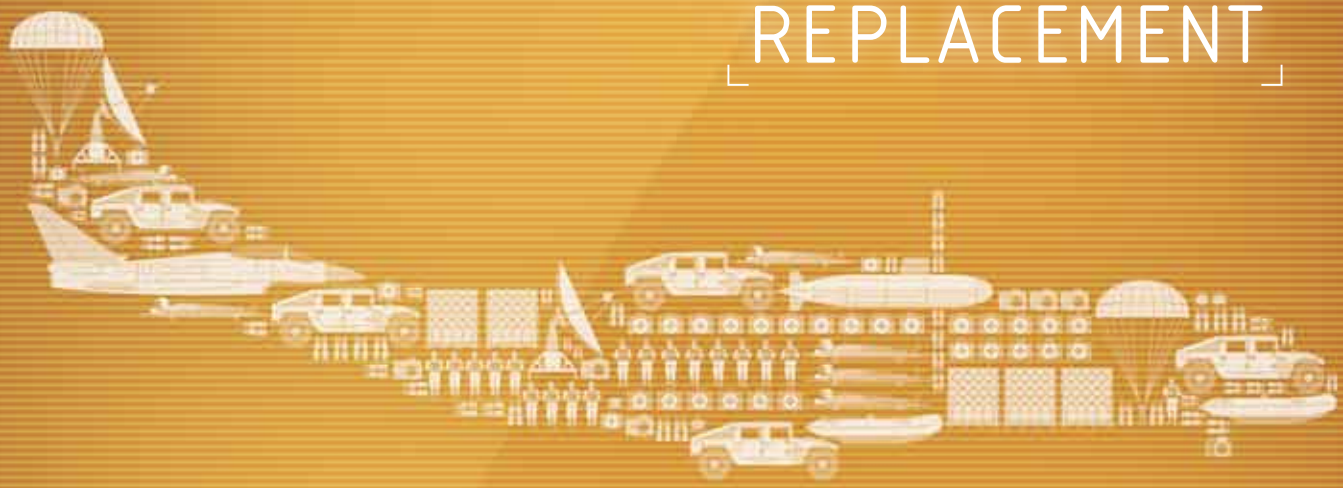

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"36 Rafales for the IAF"

The Type Resurgent

After years of repeated setbacks in the export market, 2015 has seen a positive resurgence for Dassault's Rafale multirole fighter programme. Early this year, even as the 'big-ticket' Indian MMRCA contract for 126 aircraft (18 flyaway plus 108 locally produced) was still struggling through negotiations, the Egyptian government initiated discussions to procure 24 Rafale fighters from France as part of a larger defence purchase that included a FREMM *(Frégate européenne multi-mission)* frigate and a range of MBDA missiles to equip the warship as well as the aircraft. In less than two weeks, on 16 February 2015, Egypt and France had agreed to terms and concluded a contract worth approximately $6 million. France's export credit agency Coface will finance a large part of the deal, owing to economic difficulties in Egypt.

Delivery of the aircraft is to be executed as rapidly as the contract itself, with at least three Rafales (drawn from existing French Air Force stocks) to be modified and handed over before Egypt inaugurates a new expansion of the Suez Canal in August 2015. The remainder will be delivered over the next 2-3 years, and will see the Egyptian Air Force eventually operate a mix of 16 Rafale B two-seat fighters and 8 Rafale C single-seaters.

Egypt's 'launch' of Dassault's export orders for the Rafale seemed to initiate a sudden turnaround in the type's fortunes. Less than two months after the Egyptian deal had been signed, Indian Prime Minister Narendra Modi, during a state visit to Paris, stunned defence observers and analysts as he broke the Indian MMRCA deadlock by committing to purchase 36 Rafales in flyaway condition "as quickly as possible." According to a statement released by the Ministry of External Affairs (MEA) during the PM's visit to France, "the aircraft and associated systems and weapons would be delivered in the same configuration as had been tested and approved by the Indian Air Force, and with a longer maintenance responsibility by France." Defence Minister Manohar Parrikar later clarified certain details, noting that pricing still needs to be "worked out" and that the first flyaway Rafales may take up to two and a half years to be delivered as contractual minutiae were yet to be ironed out.

As of this writing, it is clear that the MMRCA deal is effectively 'off the table,' with Defence Minister Parrikar declaring that negotiations for the larger order had "gone into a loop with no solution in sight." The Minister also stated that government-to-government (G2G) deals for 'strategic platforms' such as combat aircraft were preferable to RFPs, which are often burdened by a great deal of bureaucratic weight. All future 'strategic' purchases, he said, would be carried out via G2G negotiations. However, what remains unclear is the scale of India's eventual Rafale fleet, with no clarity on whether this 36-aircraft direct purchase precludes the possibility of local production of a larger number of aircraft, or even procurement of additional flyaway fighters. What is clear, however, is that these 36 Rafales, equivalent to just two operational

A trio of French Air Force Rafales at the Indian Air Force base at Jodhpur during the Indo-French joint air exercise 'Garuda' in 2014 (photo: Armée de l'Air)

squadrons (or one squadron plus a conversion unit), will certainly not be enough to meet the IAF's combat force requirements. In fact, in 2013, Indian Foreign Minister Salman Khurshid had pointed out that the Indian Air Force could have an eventual requirement for more than the 126 aircraft specified in the MMRCA RFP, and that an option clause for an additional 63 aircraft could well be exercised, taking the total Rafale purchase up to 189 fighters. Notwithstanding the demise of the MMRCA contract as previously structured, the IAF's requirements in quantitative terms will not have changed, and remain much higher than the 36 aircraft that PM Modi announced in Paris on 10 April 2015.

As further progress on India's order was awaited, a third export order was concluded with surprising swiftness — this time by the State of Qatar. The Qatar Emiri Air Force had been evaluating the Rafale since 2011, alongside a number of competing aircraft, and on 30 April 2015 Sheikh Tamim bin Hamad Al Thani confirmed that Qatar would order 24 Rafales, which contract was duly signed on 4 May 2015. The deal, worth approximately $7 billion, also includes MBDA missiles to arm the fighters, as well as a training arrangement that will see 36 Qatari pilots and 100 technicians trained by the French military.

With two contracts signed and one, with India, due shortly, Dassault is also in talks to supply the Rafale to Malaysia, Kuwait and the United Arab Emirates. Dassault Chairman and CEO Eric Trappier noted that the Qatar sale was "a good sign for all the countries of the region (the Middle East)."

"It's a little bit like the snowball effect — except it's in the desert," he quipped.

About the Rafale

The Rafale entered operational service in 2001 with the French Navy *(Marine Nationale)* after a lengthy development period that was initiated in 1984, followed France's exit from the 'Future European Fighter Aircraft' programme that was initiated as a multinational collaborative effort between the UK, Germany, France, Italy and Spain.

The first Rafales were built to the 'F1' standard, and lacked air-to-ground capabilities. This was viewed as an interim solution as the French Navy primarily needed an air-to-air fighter to replace ageing US-built Vought F-8 Crusaders in that role. Eventually, all Rafales were upgraded to the multi-role 'F2' standard, adding surface strike and reconnaissance capabilities, and leveraging the aircraft's incredible 9.5-tonne payload capacity. The present production standard, 'F3,' adds a nuclear strike capability, and all Rafales are now being produced with the Thales RBE2 AA (Active Array) AESA radar as standard fit. In addition, the aircraft incorporates a passive electro-optical (TV/IR) detection and tracking system, the *Optronique Sacteur Frontal*, which enables the employment of missiles such as the MBDA MICA at beyond visual range. Perhaps chief among the Rafale's key avionics is the SPECTRA (*Système de Protection et d'Évitement des Conduites de Tir du Rafale)* defensive aids system, a powerful EW suite that is able to detect, classify, jam and decoy hostile electromagnetic emissions.

A future 'F3R' standard, to be validated by 2018, is under development, and will add compatibility with a wider range of weapons, including the MBDA Meteor BVRAAM.

Rafale in Action

French Rafale fighters have been operationally deployed constantly since their induction, and have seen action over Afghanistan, Libya, Mali and Iraq. The Rafale's first combat deployment came in 2002, shortly after the type entered French Navy service. Rafale Ms operating from the aircraft carrier *Charles de Gaulle* conducted sorties over Afghanistan, but owing to the then-current F1 standard, were limited to the air-to-air role. The Rafale's first action in combat had to wait until 2007, when the type finally gained the ability to launch air-to-ground munitions. The first operational bomb release was a GBU-12 strike in March 2007, after which French Rafales conducted regular GBU-12 and AASM Hammer strikes in support of NATO/ISAF troops in Afghanistan from 2007 through 2011. The onboard GIAT 30M791 cannon also proved useful in strafing missions, with thousands of 30 mm rounds fired through the deployment.

In March 2011, French Rafales began operations over Libya as part of *Opération Harmattan,* establishing local air-superiority, providing escort to Mirage 2000D strike fighters, collecting key intelligence with the Reco NG recce pod and Spectra EW suite (so as to update joint databases and threat libraries), and then striking at targets with their Sagem AASM 'Hammer' PGMs. French Air Force Rafales played a crucial role during the allied air campaign *(Operation Unified Protector)*, flying hundreds of Destruction of Enemy Air-Defences (DEAD), Intelligence, Surveillance, Tactical Acquisition and Reconnaissance (ISTAR) and Strike Coordination And Reconnaissance (SCAR) missions. Rafales also fired, for the first time, Scalp cruise missiles at hardened targets inside hostile territory.

In fact, the Rafale's performance over Libya is widely acknowledged as being pivotal to the type's future, and elicited renewed interest from a number of potential operators during and after the conflict.

In 2013, Rafale combat experience was extended with *Opération Serval,* the French military intervention in Mali. The fighter set a new long-distance record for the *Armée de l'Air*, carrying out a daring transcontinental raid: four Rafales departed Saint Dizier air base in eastern France and headed south with aerial tanker support (five mid-air refuelings were completed through the duration of the raid). They were armed with a mix of GBU-12 laser-guided bombs and Hammer PGMs, striking four major targets around Gao, before turning east and heading towards N'Djamena in Chad, where they landed safely after an incredible 9 hours 35 minutes airborne.

In N'Djamena, the French Air Force established a permanent Rafale detachment, a mixture of Rafale C single-seaters and Rafale B two-seaters to undertake strike, air interdiction, dynamic targeting, close air support and ISTAR missions. From Chad, the Rafales also intervened in the Central African Republic, providing simultaneous coverage over two theatres of operation from a single forward operating base.

In 2014, when the security situation in Iraq began to rapidly deteriorate with the emergence of the Islamic State of Iraq and Syria (ISIS), French Rafales were among the first forces in the region to react and enter the air campaign against ISIS forces alongside American combat aircraft. The Rafales were able to integrate with US-led combat networks, and aircrews used their

French Navy Rafale M loaded with PGMs and drop tanks in flight over the carrier Charles de Gaulle

Rafale B loaded with PGMs, targeting pod and drop tanks during Opération Serval

Link-16 datalink to share tactical data with other assets flying in the area and with command and control centres. *Opération Chammal*, France's contribution to the on-going multinational effort to contain ISIS in the region has seen all three variants of the Rafale (twin-seat B, single-seat C, and carrier-based single-seat M) in operations.

The aircraft's high payload allows it to fly with a combination of drop tanks, PGMs (Paveway or Hammer), MICA missiles and a targeting/recce pod, providing substantial striking power, self-defence capability and endurance. *[See Vayu II/2015 for more]*

Today, the Rafale's mission remains the same: locate and destroy enemy elements that threaten civilians, to attack their logistic infrastructure, and support allies on the ground. Acting as a quick reaction pre-strategic combat force, the Rafale has become a key asset in the French air arsenal, having grown into a mature and battle-tested aircraft.

Angad Singh

French Navy Rafale Ms, Super Etendards and E-2C Hawkeye in formation with Indian Navy Sea Harriers during the 2014 Indo-French naval exercise 'Varuna'

Operation Maitri

In wake of the Nepal earthquake

On 25 April, a sudden release of built-up tectonic pressure unleashed a violent earthquake in Nepal, measuring 7.9 on the Richter scale. The quake, whose epicentre was in the village of Barpak, midway between Kathmandu and Pokhara, was felt as far away as Kerala in India and Chengdu in China. The devastation was immediate and widespread, and was only exacerbated by the multiple aftershocks that continued to rock the region for days afterward.

Within minutes of the quake, Indian officials were already springing into action. Even as military units geared up for relief operations, a cabinet meeting was convened at 1500h. Less than an hour later, at 1555h, the first Indian Air Force C-130J of No. 77 Squadron 'Veiled Vipers' took off for Kathmandu with a 39-man NDRF team and over 3.5 tonnes of relief material on board. The aircraft touched down at Tribhuvan International airport around 1745 h, less than six hours after the tremors first rocked Kathmandu. This first sortie was indicative of the incredible scale of humanitarian aid that India would go on to render in the landlocked Himalayan nation. Before the day was up, a 24-hour control room had been set up and additional aircraft arrived in Kathmandu. These included two Boeing C-17 Globemaster IIIs from No. 81 Squadron 'Skylords,' one carrying 96 NDRF personnel and 15 tonnes of relief material and the other with a Rapid Action Medical Team (RAMT) on board. The C-17s were followed by an Il-76 from Bathinda, carrying 160 NDRF personnel, five sniffer dogs and 28 tonnes of aid material. Rescue and relief operations began immediately, in close cooperation with Nepalese authorities.

By 26 April, Indian aid had expanded to ten fixed-wing transport aircraft, which carried in potable water, Army engineering task forces, field hospitals, 8,000 blankets, 500 tents, 14 tonnes of dry rations, 34 paramedics, 100 stretchers, 1 tonne of medicine, 6 tonnes of prepared food and additional NDRF personnel. Six IAF Mi-17 medium-lift helicopters were also brought in to more effectively conduct rescue and casualty evacuation operations. The combined Indian operation was named '*Maitri*' (Friendship).

Army Chief General Dalbir Singh, a Gorkha Rifles officer himself, called on his Nepalese Army counterpart General SJB Rana to assure him of the Indian Army's commitment in the operation. Two senior Indian Army officers, Major General JS Sandhu of 5 Gorkha Rifles (FF) and Brigadier J Gamlin were posted to Pokhara

Nepal Army HAL Dhruv ALH comes in to land as an IAF Mi-17 is parked in the foreground

and Kathmandu respectively, to coordinate the Army's efforts on the ground, and a multi-national coordination centre was set up with a branch headquarters in Pokhara. Army medical teams were quickly deployed, along with engineer task forces with heavy machinery to clear roads and debris so as to facilitate further rescue operations. It is understood that former soldiers from Gorkha regiments of the Indian Army were instrumental for guidance, relief and rescue on the ground.

An Indian Army Everest expedition team survived two avalanches at the base camp of the world's tallest peak, and immediately began rendering aid to fellow mountaineers until rescuers could reach affected climbers. The Army established a helicopter base in Pokhara, moving four HAL Dhruv helicopters and two HAL Cheetahs there to assist with casevac and relief operations.

Further IAF airlift sorties over the following days were able to provide light vehicles, a reverse-osmosis (RO) plant for water purification, oxygen regenerators, medicines, blankets, tents and many additional tonnes of food. More NDRF teams and field hospitals, were also airlifted into Kathmandu, along with two Air Force Communication Centre vehicles, which function as mobile communication relays

US Marine Corps MV-22B Ospreys from VMM-262 'Flying Tigers' attached to III Marine Expeditionary Force (III MEF) landing at Kathmandu

Off-loading relief supplies from an Indian Air Force Mi-17V5 helicopter

Evacuees aboard an Indian Air Force C-17 Globemaster III

An IAF C-17 is loaded up with aid material for flight to Kathmandu

Chinese aid personnel embarking an Air China Airbus A330

and were particularly useful given the scale of damage to Nepal's infrastructure. An-32s joined the IAF's relief missions on 27 April, along with additional rotorcraft, including HAL Dhruv advanced light helicopters. The Mi-17s and Dhruvs were particularly useful throughout *Operation Maitri*, both in rescuing quake victims from and delivering relief supplies to otherwise inaccessible areas.

Four days after the quake, an Indian Air Force C-130J made a short-field landing at the airstrip in Pokhara, delivering 6 tonnes of food and water. IAF An-32s with smaller loads followed shortly thereafter. Flexible and rapid air operations, both fixed and rotary wing, in close cooperation with Nepalese

Casevac in progress, with IAF Mi-17V5 and Il-76MD seen in the background

An ambulance being offloaded from an IAF C-17 Globemaster III

Sobering scenes of destruction as seen from the air

military and civilian authorities on the ground were crucial in sustaining relief operations under incredibly difficult conditions.

By 7 May 2015, the Indian Air Force and Army remained the spearhead of international aid efforts in Nepal, which by now had expanded to include other foreign nations, including China, USA, UK, Australia, Sri Lanka, Bangladesh, Pakistan, Canada, Germany, France, Israel, Japan, Russia and others. The IAF had, over these twelve days, conducted 674 sorties (fixed wing and helicopters), delivered over 792 tonnes of relief material, and rescued over 3,600 people.

[The efforts continue as this Issue goes to press].

The Indian Thunderbolts

Pair of IAF Mirage 2000s with Super 530D BVR and Magic II missiles and firing infrared flares (inset ; depiction of the Vajra weapon)

Mirage 2000s in Indian Air Force service

There were Thunderbolts in Indian skies circa 1944 when Republic P-47 Thunderbolts were used for conversion of RAF squadrons at Yelahanka. Four decades later, another 'Thunderbolt' appeared in Indian skies, when the first batch of Dassault Mirage 2000s arrived in the country.
The IAF named the Mirage 'Vajra,' after the mythical thunderbolt weapon of Lord Indra. The story continues ... !

Evolution of the Mirage 2000 had stemmed from a December 1975 directive from the French Government to Dassault-Breguet to proceed with full development of a fighter to replace the Mirage III, 5 and F.1 in service with the *Armee de l'Air*, as also to fulfil future export requirements. Essentially intended for the high-altitude interception and air superiority roles, but with robust ground attack capability, the Mirage 2000 prototypes were powered by a single Snecma M53-5 low bypass turbofan engine of 9,000 kg thrust, which was suitable for high altitude interception but un-economical in low-level combat. Development of the M53-P2 engine with 9,700 kg thrust followed in series production aircraft.

Unlike the preceding Mirage F.1, the 2000 reverted to the classic tailless-delta configuration since incorporation of fly-by-wire technology largely overcome the problems of induced drag in medium and slow speed combat. It had long been considered that the delta wing merely provided an interim solution to the problems of building a supersonic wing and was superseded by development of highly swept-back conventional-winged fighters. In the late 'sixties, however, Dassault was induced by advances in control technology to revert to the delta formula for its next generation Mirage 2000, which was configurationally similar to the earlier-generation Mirage III, but exploited negative longitudinal stability and thus removed the principal shortcomings previously inherent in the tailless delta.

Refined by computer-aided design to produce a highly optimised shape (regarded by many as the most 'beautiful' of fighters), the Mirage 2000 could be flown with substantial instability, the lift gain being as much as 25 per cent over a conventional stable delta, with automatic leading-edge flaps permitting safe operation at high angles of attack. With an internal fuel capacity representing approximately 30

per cent of the clean take-off weight and a highly effective nav-attack system with a radar range more than twice that of the Mirage F1, the Mirage 2000 represented a quantum advance in capability advance when it entered French service in its initial single-seat air superiority version in 1984.

Pour l'Inde !

In October 1982, the Government of India signed a contract with Avions Marcel Dassaul-Breguet Aviation (AMD-BA) for the supply of 36 single-seat and four twin-seat Mirage 2000 fighters, in a deal worth $3.3 billion. The India-specific aircraft were given an 'H' suffix (for 'Hindustan'), with the single-seaters designated Mirage 2000H while the twin-seaters were the Mirage 2000TH.

Given that India was the first export customer of the type, the Mirage 2000s initially delivered were equipped with the Snecma M53-5 engine, an early variant of the single-shaft turbofan with 54/86 kN dry/wet thrust. These initial powerplants were in service only for a short period, and were eventually replaced with the M53-P2, boasting a significant performance increase to 64/95 kN thrust dry/wet.

Primary armament of the IAF Mirage 2000H/TH were the Matra Super 530D BVR missile and R.550 Magic 2 IR-guided close-combat missiles, along with a pair of internal 30mm DEFA cannon and various air-to-ground munitions. Core of the weapon-system effectiveness was intended to be the RDI (*Radar Doppler à Impulsions*) Pulse-Doppler radar being developed by Thomson-CSF and Électronique Marcel Dassault but owing to protracted progress, the RDM (*Radar Doppler Multifunction*) radar was adopted, and progressively upgraded over the years.

The Indian Air Force was to receive the Mirage 2000 within a year after the type entered service with the French *Armée de l'Air*, this multi-role 'digital delta' fighter being endowed with contemporary systems that would propel the Service into a new generation of technology. Following a tradition of bestowing aircraft with Indian names, the Mirage 2000 was to be known as 'Vajra' in IAF service, after the mythical thunderbolt weapon of Lord Indra.

Production of the Mirage 2000 H/TH for the IAF began shortly after the contract was finalised, and the very first single-seater

The very first Mirage 2000H for the IAF (KF101), sans IAF markings

Quarter century later, Mirage 2000H at Gwalior AFS with Israeli (IAI/Elbit) ACMI pod on an APU-73 launch rail made for Russian R-73 CCMs (photo: Angad Singh)

for India (KF101) made its maiden flight on 21 September 1984 at Dassault's Bordeaux-Merignac facility where the final assembly lines were located (and where the Rafale is produced today). The delivery programme was announced to be "exactly on time" and the first two-seater (KT201) followed soon after, both aircraft being utilised to complete company acceptance test flights before being handed over to an Indian Air Force team in France.

The Government of India had sanctioned the raising of two new fighter squadrons for operating the Mirage 2000 and, accordingly, Nos. 51 and 52 Squadrons were formed. However, senior IAF officers felt that the Service's premier squadrons must be granted the honour of receiving this advanced new fighter type: thus Nos. 1 and 7 were chosen to re-equip with the Mirage 2000, their MiG-21Ms then being 'transferred' to the newly sanctioned squadrons. Air Chief Marshal Lakshman Katre, then Chief of Air Staff, had earlier commanded No. 7 Squadron ('Battleaxes') and, not unusually, the Battleaxes were first to receive the Mirage 2000, followed by No. 1 ('Tigers') just after. A third Squadron (No. 9 'Wolfpack') was to follow with an additional batch of aircraft delivered nearly twenty years later, in 2004.

The first batch of seven Mirage 2000 aircraft (KF102, 103, 104, 106, 107, 113 and 114) fitted with long-range tanks took off for India from Bordeaux-Merignac on 21 June 1985, led by CO No. 7 Squadron, Wg Cdr Ajit Bhavnani, touching down at Athens two hours later, for a night stop. The formation then departed for Luxor in Egypt on 23 June, then on to Doha in Qatar on the 24th. After a day's rest, the fighters headed for Indian shores and the first Mirage 2000s landed on Indian soil at Jamnagar on 26 June 1985.

On 28 June the Mirages launched for the final leg of their journey to Maharajpur air base at Gwalior in Central India, some 8,000 km from their Bordeaux birthplace. The historic first landing took place at 0900 hours with the Mirages and their pilots given a warm welcome by the AOC, Air Commodore Denzil Keelor (later Air Marshal), Gp Capt S. Krishnaswamy, who was Chief Operations Officer (later Air Chief Marshal and Chief of Air Staff), other personnel and their families. Also present was Madhav Rao Scindia, the Maharaja of Gwalior. A herculean effort had been made to upgrade the air station to become a modern base for the new fighters, and no praise was high enough for the AOC, Air Commodore Denzil Keelor and his intrepid team.

Drop tank painted in Tiger stripes at No.1 Squadron's anniversary parade

Barely six months later, on 1 January 1986, No. 1 Squadron 'Tigers' formally converted to the Mirage, and rest of the year saw an incredible amount of activity for the IAF's 'digital deltas,' as the Mirages were first 'worked up' and then enthusiastically involved in a variety of Air Force exercises, including the large-scale *Livewire* inter-command training exercise.

The Mirage 2000H had introduced many 'firsts' to the IAF : first pure delta-winged aircraft, first fly-by-wire system, and first aircraft with extensive composite construction. The Mirage 2000 provided quick-reaction interception capability with its rapid climb to height, excellent manoeuvrability and instantaneous turn-rates and, once the advanced weaponry selected for it was fully integrated, resulted in a highly potent addition to the IAF's air defence system. Most aircrew seconded to the Mirage 2000 were former MiG-21 or Ajeet fighter pilots and conversion to the new type was smooth. The Mirage 2000 was attractive to fly, most forgiving in handling and landings, even at high angles of attack, and far less demanding than earlier era fighters.

The last batch of Mirage 2000s from the initial order for 40 aircraft reached India in June 1986, and another nine were ordered that same year to make up attrition and provide maintenance reserves, taking the total Indian order up to 49.

Fifteen years later, following the stellar performance of the Mirage 2000 in the 1999 Kargil conflict, India opted to procure additional Mirage 2000s, with the Government placing orders for an additional ten aircraft, comprising four single-seat and six twin-seat Mirage 2000s. These were ferried to India starting November 2004, to equip a third IAF squadron raised on the type, No.9 Squadron ('Wolf Pack'), then flying HAL-built MiG-27MLs.

However, an option under the initial contract to build 110 Mirage 2000s in India was not exercised owing to several factors. The plan had been for Hindustan Aeronautics to begin with initial assembly at its Bangalore Complex, and move to progressive manufacture of 45 aircraft from CKD parts to be followed by another

65 Mirage 2000s from 'raw materials.' The option was time-limited to 30 June 1984. However, at this stage, the Soviets suddenly, and dramatically, offered their latest fighter, the MiG-29, which brought about a reassessment of the total scope of the Mirage 2000 programme. In the event, with three squadrons of either type in service, neither the Mirage 2000 or MiG-29 were licence-built in India. Instead, Sukhoi's much larger Su-30 was adopted and, as the two-seat Su-30MKI variant, has since been received in ever larger numbers by the IAF.

Mirage 2000s in action

Going back to 1987, the Mirage 2000's first employment 'in action' took place in June that year, when four aircraft from No. 7 Squadron escorted IAF Antonov An-32s on a supply-drop mission over the Jaffna peninsula of Northern Sri Lanka. Two years later, Mirage 2000s detached to Thiruvananthapuram in southern India were used in a 'show of force' over the Maldives after a coup attempt in the Island Republic had been thwarted by Indian paratroopers.

However, the Mirage 2000's position as spearhead of the IAF's multi-role force was to be demonstrated in dramatic manner in the summer of 1999…

Operation Safed Sagar

The Mirage 2000's 'finest hour' in the Indian Air Force came during June-July 1999 when aircraft from Nos.1 and 7 Squadrons dramatically changed the tide of battle to evict intruders from the glacial heights of north-eastern Kashmir, as part of a conflict now generally known as 'Kargil 1999.'

First ground intrusions in the Kargil Sector had been reported on 8 May 1999. In a deliberate and highly organised manner, the Pakistan Army had managed to infiltrate, undetected, many hundreds of troops and special forces up to almost 10 kilometres south of the LoC over a frontage of 200 kilometres, so precipitating the Kargil War in the summer of 1999. Air operations in the Kargil Sector of Northern Kashmir were conducted by the Indian Air Force over a period of seven weeks, from 26 May when the first air strikes were launched until 12 July 1999 when these were suspended to allow Pakistani forces to withdraw northwards to their side of the line of control (LoC). By this time, the Indian Army had recaptured most of the high positions occupied by the adversary.

When operations ceased on 16 July, the Indian Air Force had carried out some 1,700 fighter-reconnaissance, strike and combat air patrol sorties plus 2,185 helicopter support missions (logistics support and casualty evacuation). Mirage 2000s were in the thick of the action, being used for air defence, strike, reconnaissance as well as specialised Electronic Warfare (EW) and Electronic Counter-Countermeasures (ECCM) tasks. The Mirage 2000's all-weather day-night capabilities made it one of the premier strike platforms through the duration of the conflict, and the type had the distinction of conducting the first operational laser-guided bomb (LGB) strike mission in IAF history, when a pair of Mirage 2000s destroyed a pair of command bunkers on Tiger Hill with Paveway LGBs on 24 June 1999.

The employment of precision-guided munitions (PGMs) and associated targeting systems was carried out in unique circumstances on the Mirage 2000. The fighters were originally supplied with Thomson-CSF ATLIS II laser designator pods for use with highly capable (albeit very expensive) Matra 1,000 kg LGBs. The IAF decided to conserve these heavy bombs for higher value targets should the conflict escalate, and meanwhile augment precision-strike capability by employing standard 'dumb' 1,000 lb bombs coupled with Paveway II laser-guided bomb kits. The IAF had ordered a number of Paveway II guidance kits before the conflict, but they were supplied with an incorrect part, which was later put on the embargo list following the sanction that came into effect after the Pokhran II nuclear tests in 1998. Unable to acquire the correct parts, IAF technicians had to consequently re-manufacture this part in order to make the Paveway compatible for use with the Mirage 2000.

In fact, the Mirage had essentially been regarded as an air defence fighter

Its 'finest hour': Mirage 2000H over the high Himalayas

with a limited ground attack capability and consequently lacked certain resources such as bombs, pylons, tooling, testers and ground crew experience in matters relating to the surface strike role. A major effort had to be initiated at Gwalior AFS to prepare the type for strike operations in this extreme altitude terrain.

Meanwhile, at the Aircraft System Testing Establishment (ASTE) in Bangalore, the Israeli-origin Litening pod, a recce and target acquisition system, was in the process of being integrated with the Mirage 2000 and Jaguar. The trials were at a reasonably advanced stage, but the pod was still some time away from being inducted into service.

Mirage 2000TH with Litening pod on starboard fuselage pylon and Remora ECM pod on port wing (photo: Angad Singh)

ASTE Commandant Air Cmde Parvez Khokar, a veteran of the 1971 war and a seasoned test pilot, mustered all resources available to him and committed to making the Litening pod available for use in Kargil. ASTE identified a team to integrate the Litening system with the Mirage 2000 and also to train a few No. 7 Squadron pilots and technicians. The three test pilots were Wg Cdr R 'Nambi' Nambiar, Sqn Ldrs Rohit Verma and 'TV' Tiwari (presently Air Attaché at the Indian Embassy in Paris), with Sqn Ldr Mantha, a flight test engineer, as technical authority on the pod. Along with a group of highly trained and motivated armourers, these officers formed the core team that would pioneer operational PGM use by the Indian Air Force.

The Mirage 2000 centreline pylon was modified to carry a laser-guided bomb, with the targeting pod carried on a dedicated fuselage station on the starboard side of the aircraft. Mirages of No. 7 Squadron conducted the attacks, and the use of LGBs in the conflict changed the entire complexion of the war and of future operations. In addition, the high-resolution recce capability of the pod proved vital to the identification and targeting of enemy

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

assets, contributing important information to the overall ISR picture during the operations.

Nevertheless, the bulk of ordnance dropped remained unguided iron bombs, with only 9 LGBs used through the entirety of the Kargil conflict (8 dropped by Mirages and one by a Jaguar). A typical bombing mission would involve four Mirage 2000Hs from No. 7 Squadron loaded with iron bombs departing base together with a two-seat Mirage 2000TH carrying a single LGB and laser designating pod. These would rendezvous with 3 aircraft of No. 1 Squadron carrying BVR missiles (Matra Super 530D), operating from another base. Over the target the Mirages with 'dumb' bombs would visually acquire the target and drop their bombs while the two-seater, which would be filming the whole affair from behind, would use the LGB only if required to do so. This allowed the IAF to maintain PGM stocks in case the conflict expanded, while providing a prompt precision strike option on each strike mission, should the need arise.

During *Operation Safed Sagar*, of the 1,700 total jet fighter sorties flown, Mirage 2000s flew over 500, highlighting not only their value as operational assets, but also impressive availability and sortie generation rate. No. 1 Squadron flew 274 operational sorties, the majority of which consisted of air defence and strike escort missions while No. 7 Squadron carried out over 240 strike missions during the same period, dropping over 55,000 kg of ordnance. Several Mirage 2000 personnel from the air base at Gwalior received decorations following the end of operations. *(For a detailed report, see Vayu III/2013)*

The case for more Mirage 2000s

The impressive performance of Mirage 2000s during the Kargil conflict added impetus to the already on-going deliberations on acquisition or licence production of additional numbers of this versatile multirole combat aircraft. During the years 1999-2002, two successive IAF Chiefs pushed the Government to acquire up to another 126 Mirage 2000s for equipping an additional six squadrons. However, the then Chief of Integrated Defence Staff, while moving forward on the Acceptance of Necessity (AoN) accorded by the Government, instead initiated a global tender for the acquisition of 126 'Medium Multi-Role Combat Aircraft' (M-MRCA) and the rest is history…

Upgrading the Mirage 2000

Still, as the Indian Air Force awaited progress on acquisition of a suitable M-MRCA, the Government of India cleared the upgradation of existing assets, particularly the MiG-29 and Mirage 2000, while HAL proceeded with Jaguar upgrades (to DARIN III standard). After several years of discussion and negotiation, the Government contracted to upgrade the IAF's fleet of 51 Mirage 2000H/TH in a major programme involving Dassault Aviation and Thales. This was officially signed on 29 July 2011, and commented upon as follows : "Based on the integration of latest generation equipment and systems, the upgrade will further enhance the technical-operational capabilities of the Indian Air Force's Mirage 2000. The aircraft represents a long tradition of cooperation with French military aviation, initiated 50 years ago."

Among the upgrades planned for the IAF's Mirage 2000 were a night vision goggle-compatible 5-screen glass cockpit, advanced navigational systems, advanced Identification Friend or Foe (IFF) system, advanced multi-mode multi-layered radar, fully integrated electronic warfare suite and advanced beyond visual range (BVR) capability. The new weapons include 450 MICA missiles, contracted for in a separate agreement. Thales and another French firm, MBDA, are the weapons systems integrator and missiles supplier respectively.

The IAF Mirage 2000 upgrade was reportedly based on the Mirage 2000-5 Mk.2 standard, the most advanced variant of the aircraft. Enhancements to offensive systems included a datalink for the targeting of MICA ER missiles, addition of the Damocles targeting pod and a newer, stealthier Thales RDY 2 all-weather synthetic aperture radar with moving target indicator capability, which also gives the aircraft improved air-to-ground capability.

The avionics have been further updated with higher resolution colour displays, an optional Topsight helmet-mounted display, and the addition of the Modular Data Processing Unit (MDPU) as designed for the Rafale. A new Thales Totem 3000 inertial navigation system with ring laser gyroscope and GPS capability was added, providing much greater accuracy, higher reliability and shorter alignment time than the older ULISS 52 navigation system, which it replaces. Others are addition of an on-board oxygen generation system (OBOGS) for the pilot and an ICMS Mk.4 digital countermeasures suite.

The first two Mirages to be upgraded, KT201 (the first twin-seat Mirage 2000TH built for the IAF) and KF107 (single-seat Mirage 2000H) were ferried from India to Dassault's facilities at Istres Air Base in France in late 2011. From early 2012 to mid-2013, the upgrade programme was carried out on these two airframes in six phases – dismantling of the aircraft, mock-up installation of dummy equipment, embodiment of structural modifications

KF107 and KT201 undergoing upgrade work in France (photo: Dassault Aviation – V. Almansa)

and electrical fittings, electrical tests, final assembly of complete aircraft and lastly, ground tests as the final phase.

The Indian Air Force positioned a Programme Management Team (PMT) in France to oversee the upgradation programme, the team led by Gp Capt KJV Singh (ex MiG-29s) and including technical officers and a test pilot.

Following re-assembly, the Indian Air Force's first upgraded Mirage 2000 made its maiden flight at Istres-Le Tube air base on 5 October 2013. The aircraft was two-seat Mirage 2000TH (KT 201), with a new avionics suite, self-protection suite and Thales RDY 2 multimode radar among several new systems, effectively bringing it up to the Mirage 2000-5 Mk.2 standard. KF 107 made its first flight shortly after KT 201, in end-2013. The two aircraft were then comprehensively flight-tested in a campaign lasting over 250 flight hours.

Following the upgrades of KT201 and KF107 in France, the remainder of the IAF's Mirage 2000 fleet (47 aircraft) will be upgraded in India by HAL over the next seven years, at a reported cost of around € 1.8 billion. In early 2012, the Indian MoD had also signed a € 950 million contract to replace the Mirage fleet's older Magic-II and Super 530D missiles with new MBDA MICA air-to-air missiles.

HAL has since received an industrial 'data pack' from the French OEMs, containing all necessary information required to conduct the upgrade, in addition to personnel training at facilities in France. The first two Mirages to be upgraded in India have already reached HAL's Overhaul Division in Bangalore, and are expected to be handed over to the IAF by the end of 2015. In addition, the upgrade programme has been used as an opportunity to involve other Indian industrial partners, including Axis Aerospace & Technologies, Avio India, Centum, Rangsons Electronics and Samtel.

Upgraded Mirage 2000I climbing during a test flight above France (photo: Dassault Aviation – V. Almansa)

KT201 under upgrade at Istres (photo: Dassault Aviation – V. Almansa)

The upgraded aircraft will supplant the earlier Mirage 2000H/TH (single/twin seat respectively) and the fleet will hereafter be referred to as the Mirage 2000 I/TI. The most visible change to the upgraded aircraft is a new gray radome replacing the distinctive black radomes sported by earlier IAF Mirages. The overall finish however, remains a two-tone 'air superiority' blue.

The formal ceremony marking handing over of the first two upgraded IOC-standard Mirage 2000 I/TI aircraft to the Indian Air Force took place on 25 March 2015, inside the Dassault Aviation hangar at Istres Air Base, with KT 201 and KF 107 in immaculate condition providing a fitting backdrop to the proceedings (*see Vayu II/2015*). Dassault Aviation Chairman and CEO, Eric Trappier, along with Pierre Eric Pommellet, Executive VP of Thales Defence Mission Systems, the Indian Ambassador to France, Arun K Singh and head of the IAF Programme Management Team, Group Captain KJV Singh were in attendance, along with a host of other senior industry, government and military figures — and of course, the *Vayu*!

As Eric Trappier declared, "Today's ceremony is the result of the excellent understanding between the Indian and French partners and of our commitment to India. India is Dassault Aviation's first export client and the historical relationship we nurtured with the Indian Air Force has spanned 60 years, growing from strength to strength."

"The Rafale aircraft has been chosen by India after a comprehensive selection process in the frame of the MMRCA competition, and exclusive negotiation is ongoing. The Rafale is the next logical step. HAL and Indian industries will contribute to the 'Make in India' policy by developing and manufacturing the aircraft locally. The Rafale will fulfil all of the operational requirements of the Indian Air Force and the industrial requirements of India's economic policy as the Mirage 2000 continues to do."

Thales' Pierre Eric Pommellet then said "This ceremony gives us the opportunity to thank our customer, the Indian Air Force, and our long time partner, HAL, for the excellent team work we have carried out together on the Mirage 2000 upgrade programme. Not forgetting the many Indian companies with whom we are working on a daily basis, making the "Make in India" policy something concrete and real, we experiment with great success every day. Thales has been operating in India since 1953 and employs 300 people all over the country. We are trusted partners of the Indian armed forces and have developed a strong local supply chain, which helped us to make the upgrade of the Mirage 2000 a real success story. We are ready to continue developing this team work in the future".

Group Captain KJV Singh formally received the first two upgraded fighters, completing the handing over ceremony, following which IAF pilots conducted familiarisation flights with the upgraded Mirages at Istres, before beginning the ferry to Gwalior, where No. 9 Squadron

Arun K Singh, Indian Ambassador to France, speaking at the handing over ceremony with KF107 and KT201 in the background (photo: Dassault Aviation – Patrick Sagnes)

Mirage 2000TI (KT 201) during test flight in southern France

Indian officials at the handing over ceremony, in front of KT201 (photo: Dassault Aviation – Patrick Sagnes)

Standing in front of Mirage 2000TI KT201 (L-R): Gp Capt M Minocha, Air Cmde HS Basra, Wg Cdr Vivek Sharma and Sqn Ldr K Suryanarayana (PRO Air Force)

'Wolfpack' is the designated first squadron to receive this type. With the French portion of the upgrade programme successfully completed on schedule, the rest of the IAF Mirage 2000 fleet will now be upgraded by HAL in Bangalore, with comprehensive support and involvement from Dassault and Thales.

KT201 and KF107 departed Istres on 18 April, beginning a multi-day journey that took them to Greece, Egypt and Qatar, before they made their first landing on Indian soil at Jamnagar on 22 April. From there, the pair completed their journey at 1400hrs on 24 April, when they arrived at Air Force Station Gwalior, where they were greeted with a now customary water cannon salute whilst taxiing to the No. 9 Squadron dispersal. KF107 and KT201 came back to Gwalior having almost exactly re-traced the journey of the very first Mirage 2000s, which were delivered thirty years earlier, in 1985!

The formation leader and CO No.9 Squadron Group Captain M Minocha, who flew the single-seater (KF107) was welcomed by Air Commodore HS Basra, Air Officer Commanding of Gwalior AFS, who also formally received the aircraft documentation. The twin-seater (KT201) was flown in by Wing Commander Vivek Sharma and Squadron Leader K Suryanarayanan.

The Indian Air Force now awaits the balance Mirage 2000I/TIs, which will steadily be delivered from HAL's Bangalore Division even as in-country production of Dassault Rafales from this facility awaits Governmental decision.

KT201 receives the now traditional water cannon salute as it taxis to the No. 9 Squadron dispersal at Gwalior AFS on 24 April 2015 (PRO Air Force)

The links between DPSA (1978) and MMRCA (2015)

Does history repeat itself ?

The following extracts are from the 'Public Accounts Committee' report to the Ninth Lok Sabha in August 1990, without any attempt to amplify or identify aircraft types (which readers will in any case be able to ascertain!).

After the December 1971 war, a need was felt for a class of aircraft with deep penetration strike capability. The aircraft in use in the country were not so effective and were also affected with corrosion problems. In 1973, the need for a better aircraft was formally recognised by a body called APEX-I and in 1975 this was confirmed by another body called APEX-II. The Cabinet Committee on Political Affairs (CCPA) in October 1978 approved the acquisition of 'P' number of aircraft 'A'.

The selection of aircraft 'A' was based on the recommendations of a team which evaluated three aircraft (types) 'A', 'B', and 'C' for the deep penetration (strike) role. According to the Ministry of Defence the design concept of all the aforesaid three aircraft was of the 'sixties. The Committee had felt that between aircraft 'A' and 'B' to which the choice was confined, the latter with a multi-role capability would definitely have been a better choice at that time. Secondly, there was also an offer for the transfer of technology of aircraft 'L' (a real multi-role aircraft) in case it was agreed to purchase aircraft 'B'. The first prototype of aircraft 'L' had flown in March 1978. The Committee had observed that the position should have been thoroughly reviewed having regard to the changes already made in the prototype flown and predicted before approval in 1978.

The Committee strongly deprecated the lack of serious and purposive approach

on part of the concerned agencies in the matter of selection of the aircraft. The Committee had also recommended that the Government should be extremely judicious in the matter of selection of defence equipment and keep in view not only the existing but also consider the development of technology in the field.

In their action taken note, the Ministry of Defence stated as follows: "The assumption by the Committee that there was lack of purposive approach in the matter of selection of the aircraft is not correct. Aircraft 'L' was purchased basically for air-defence capabilities. Its utility for deep penetration role was an additional attraction. Deficiencies in deep penetration aircraft were expected to arise in the authorised squadron force from 1980. It would not have been operationally advisable to put up with this deficiency till sufficient quantity of aircraft 'L' became available. Further, as these aircraft were also (yet) to be inducted in squadron service in the country of its origin, adequate number of aircraft 'L' would not have become available to meet the deficiencies of DPSA aircraft till late '80s. It is pertinent to note in this context that there is no question of aircraft 'A' becoming obsolescent before the completion of its normal life cycle. Government are, therefore, unable to accept the implied criticism of PAC that the Government was injudicious in the matter in the matter of selection of Aircraft of Aircraft 'A'.

According to the approval accorded by the Cabinet Committee on Political Affairs (CCPA) in October1978, 73.3 per cent of 'P' number of aircraft 'A' were required to be manufactured. The scope of the indigenous manufacturing programme was reviewed during October 1981, as a result of which the indigenous manufacturing programme was curtailed to 50.6 per cent of 'P' number. The reduction was mainly on the grounds that the design philosophy of the aircraft was of the 'sixties, other countries had inducted new generation aircraft and the foreign manufacturers of this aircraft had themselves planned stoppage of production of the aircraft in 1982.

Keeping in view the obsolescence of the aircraft and other related factors, the CCPA had initially desired the indigenous manufacture to be confined to only 30 per cent of 'P' number but in 1982, it approved the proposal for additional 20.6 per cent of 'P' number, raising the licensed indigenous production programme to 50.6


'C'

per cent of 'P' number at a total cost of Rs. 1076.03 crores. Undoubtedly, the review conducted by CCPA in 1981 amounted to questioning the wisdom decision taken in 1978. Secondly, right from 1971 the Air Force requirements were stated to be of a very pressing nature due to the inadequacy and depleting strength by corrosion. Strangely enough the decision taken as a result of the review conducted in 1981 is not in consonance with the plea for urgent requirements of the Air Force for such an aircraft. These contradictions, undoubtedly, establish that the authorities concerned had neither a clear conception of their requirements nor the total perception of continuing technological advancements in the aeronautical field all over the world. The Committee strongly depreciated these contradictions and recommend that the Government should always keep themselves fully abreast of the technological research and advancement in the respective fields while working out the defence requirements so as to ensure that the Air Force is equipped effectively all the time.

The second order for 20.6 per cent of 'P' number of aircraft, to be manufactured from raw materials was placed on the PSU on 23 August 1982. According to the schedule, delivery of 10.6 per cent of aircraft was to be effected in 1986-87 and the delivery of the remaining 10 of the aircraft was to be made during 1987-88. This delivery schedule,


'L'

'Not well considered'

Commenting upon the selection aspect, the Committee had observed in their earlier Report that the selection of aircraft 'A' was not well considered. The Committee had felt that between aircraft 'A' and 'B' to which the choice was confined, the latter with a multi-role capability would definitely have been a better choice at that time. Secondly, there was also an offer for the transfer of technology of aircraft 'L' (a real multi-role aircraft) in case it was agreed to purchase aircraft 'B'. According to the Government, selection of aircraft 'A' had to be made due to the fact that deficiencies in deep penetration aircraft were expected to arise in the authorised squadron force from 1980 and it would not have been operationally advisable to put up with the deficiency till sufficient quantity of aircraft 'L' became available.

The Committee were not fully convinced with these arguments. The first prototype of aircraft 'L' (a real multi-role aircraft) had flown in March 1978 but the acquisition of 'P' number of aircraft 'A' was approved in October 1978. Further the agreement for supply of aircraft 'A' was concluded subsequently in April, 1979. Keeping in view the huge investment involved in the project and also when the aircraft was to serve the needs of the country during the next 25 years, the Committee feel that when the approval of the proposal could wait from 1971 to 1979, the authorities could have as well waited for some more time. As regards the contention that the deficiencies in deep penetration aircraft were expected to arise in the authorised squadron force from 1980, the Committee were of the view that pressing requirements of the Air Force, if any, at that time could at best be met by importing a few aircraft of that type. The Committee were fully convinced that had a thorough review been done at the time of according approval and again at the time of placement of the supply order, the huge expenditure incurred on aircraft 'A' would have been utilised in a much better way by selection of a multi-role aircraft like 'L' which ultimately the country had to go in for.

The Committee therefore, reiterated their earlier recommendation that the Government should be extremely judicious in the matter of selection of defence equipment so that the ultimate choice made is the very best for ensuring that the defence forces are kept effectively equipped all the time.

was reviewed and revised by the concerned project board in August, 1985. According to the schedule delivery,10.6 per cent of aircraft was to be effected in 1986-87. This delivery schedule was reviewed and revised by the concerned project board in August 1985. According to the revised schedule, supplies against both the orders of 1979 and 1982 were to be affected between 1982-83 and 1988-89. Till date the PSU had completed the supplies against the first order of 1979. According to the Ministry, supplies of the remaining aircraft were expected to be completed by 1989-90. There were deviations even from the revised schedule fixed by the Project Board in 1985. The Committee depreciated the lack of seriousness and purposive approach on the part of the concerned authorities in meeting the urgent and pressing requirements of the Air Force. The Committee recommended that concerted efforts should be made by all concerned to ensure that supply of the remaining aircraft is completed by 1989-90 positively.

The delivery schedule revised by the Project Board on 8 August 1985 was as follows:

Year	*Aircraft Delivery*
1985-86	14S
1986-87	10S + 3T
1987-88	9S + 2T
1988-89	10S + 2T
1989-90	11S
	S = Strike aircraft
	T = Trainer

In accordance with this, the delivery schedule for 85-86, 86-87 and 87-88 have been met except for one trainer aircraft scheduled for delivery in 87-88 since it was lost in a flying accident at HAL.

Sanction for raw-material phase of production was delayed as in the context of changed threats scenario from across our border and availability of a multi-role aircraft, a review of force-mix of DPSA and MRCA was considered necessary. While it is true that the time taken for this review led to additional outgo of FEE worth Rs. 5.33 crores, the Committee may note that an equivalent amount may have to be spent in Indian rupees if these components were manufactured indigenously, as scheduled. It is incorrect to assume that there was wasteful expenditure because the components worth Rs. 5.35 crores were imported.

It would be agreed there can be no remedial action incorporated nor for a delay in sanctioning raw material phase at that time. Once the delay had taken place, no components would be indigenously manufactured to meet the requirements of components for assembly line aircraft. These had to be imported by paying in FEE. Adequate precautions would be taken in future not to permit such delays to occur.

According to the Details Project Report dated July 1980, infrastructure required for manufacture of Aircraft 'A' from the raw-material phase was proposed to be completed by September 1983. Due to delay in according sanction for capital and DRE for the raw-material phase, setting up of infrastructure at PSU was completed by June 1985 in Aircraft Division and by July 1986 in Engine Division. Since production of aircraft 'A' was to be completed by 1989-90, the very costly and comprehensive infrastructure created, would be utilised only for 4-5 years. Since aircraft 'A' is the last of a particular technological line the Committee apprehend that the costly infrastructure may not be suitably utilized on completing the supply of 50.6 per cent of 'P' number of aircraft. The Committee strongly recommended that suitable ways and means should be devised to utilise that costly infrastructure to the maximum possible extent to strengthen the indigenous aeronautical base. The ways and means, so divised should be intimated to the Committee.

The Infrastructure

Most of the infrastructure created at PSU for production of 76 aircraft will be utilised for production of spares required by IAF as well as for repair/overhaul of the aircraft, engines, avionics and accessories throughout the service life of the aircraft. The capital facilities set up at PSU, to the extent they are not specific to the aircraft, will be utilised for

The Dassault Rafale was chosen as the IAF's MMRCA 'of choice' in 2012

'M'

How the aircraft 'A' (Jaguar) programme eventually panned out

Batch	Source and Mod State	Serials	Sub Type	Date of Delivery	Quantity	Total
I	Direct Supply NAVWASS	JS101-135 JT051-055 JM251	Jaguar IS Jaguar IT Jaguar IM	1981-1982	35 5 1	40 1
II	HAL Assembled and Manufactured DARIN I	JS136-194 JT056-065 JM252-258	Jaguar IS Jaguar IT Jaguar IM	1983-1998	59 10 7	76
III	HAL Manufactured DARIN I	JS195-205 JM259-262	Jaguar IS Jaguar IM	1996-2000	11 4	15
IV	HAL Manufactured DARIN I	JT066-082	Jaguar IT	2005-07	17	17
V	HAL Manufactured DARIN II	JS206-225	Jaguar IS	2006-09	20	20
TOTAL JAGUARS FOR THE IAF						169

Source: ***Phil Camp & Simon Watson***

other projects like the LCA, ALH etc. as well as for manufacture of aeronautical equipment for export, as and when efforts to export equipment and components bear fruit.

Owing to delay in selection and development of navigation system 'G', all the direct supply aircraft and 4 percent of 'P' number of aircraft supplied by the PSU were equipped with system 'H', which apart from low reliability, is prone to frequent repairs. Expenditure on repair abroad of system 'H' amounted to Rs. 4.99 crores upto October, 1986. According to the Ministry, there is no proposal to replace system 'H' fitted in some aircraft by system 'G'. The Committee were surprised that a superior nav-attack system is not to be fitted in a large number of aircraft inspite of its availability, particularly where so much trouble was taken, funds spent and delay undergone for development of the latter system 'G'. Since the aircraft are meant for role in which a superior nav-attack system might make all the difference, the Committee recommend that the decision for not fitting system 'G' in aircraft already having system 'H' should be carefully reviewed having regard to all the operational consequences.

The report continues … on the aspect of 'buy back arrangements which, it laments could not be met by the PSU because the production facilities could only be established progressively….'

What lessons have been learnt?

POINT

"Tejas Mk.I fails to meet IAF criteria, has 53 shortfalls" : CAG

2nd prototype vehicle (PV-2) of the Light Combat Aircraft which made its first flight on 6 June 2002 ...

The Tejas Light Combat Aircraft project, under development for over three decades has come under severe criticism from the CAG during its presentation to Parliament on 8 May. The LCA Mk.I has 53 "significant shortfalls" which have reduced its operational capabilities as well as survivability. Not only that, the IAF would be "constrained" to induct the fighter LCA without availability of a trainer model, thereby "adversely impacting pilot training", the audit body headed by former Defence Secretary Shashi Kant Sharma reported.

Owing to the delay in manufacture and supply of the LCA, the IAF had to go for alternative "temporary" measures such as upgrading its MiG-21bis, MiG-29, Jaguar and Mirage 2000 aircraft at a cost of Rs 20,037 crore and revise the phasing out of MiG-21s, which (type) will perforce continue in frontline service well beyond their initially cleared structural lives.

The report refers to the LCA Mk.I's Initial Operational Clearance in December, 2013 (17 months back) pointing out significant shortfalls (53 permanent waivers/ concessions in meeting ASR (Air Staff Requirements) as a result of which it will have reduced operational capabilities and reduced survivability, thereby limiting its operational employability when inducted into IAF squadrons".

Listing the shortcomings, the CAG said that the LCA Mk.I "fails to meet the electronic warfare capabilities sought by IAF as the Self-Protection Jammer could not be fitted on the aircraft due to space constraints'. Also, the Radar Warning Receiver/Counter Measure Dispensing System fitted on the aircraft had raised performance concerns. The CAG report added that the shortcomings in the Mk.I (increased weight, reduced internal fuel capacity, non-compliance of fuel system protection, pilot protection from front, reduced speed) are expected to be overcome in the Mk.II variant. "LCA Mk.I does not meet the ASR. The deficiencies are now expected to be met in LCA Mk.II by December 2018."

While the DRDO has always showcased LCA Tejas, as an indigenously-developed aircraft and the indigenous content of the LCA was estimated by ADA to be 70 per cent, the CAG said it "actually worked out to about 35 per cent" as of January 2015. Systems such as the Kaveri engine, Multi-Mode Radar, the radome itself, Multi-Functional Display System and Flight Control system actuators which were taken up for indigenous development "could not be developed successfully, resulting in LCA's continued dependence on the import of these systems".

The Indian Air Force had proposed, in the early 1980s, that a new aircraft be developed to replace the MiG-21 fleet, which were manufactured by HAL during 1966 and 1987, after its projected phasing out in the 1990s. The project for indigenous design and development of LCA was sanctioned in 1983 at a cost of Rs 560 crore, which was enhanced from time to time up to Rs 10,397.11 crore.

The CAG said that ADA's decision to advance the building of two prototypes from Full-Scale Engineering Development (FSED) to the next phase so as to utilise its savings on the grounds of accelerating the development process of LCA, "had failed to yield the desired results".

This was because the prototype vehicles "were deficient in terms of critical onboard systems (Multi- Mode Radar, Self-Protection Jammer, Radar Warning Receiver)" which led to ADA using the Limited Series Production (LSP) aircraft (meant for IAF induction) towards flight testing/evaluation of these critical on-board systems. "This was in contravention of the Cabinet approval (November, 2001) for phased development of the prototypes in FSED Phase-II after Technical Demonstrators had been built and flight tested for 210 hours," the CAG noted.

The Indian Air Force, in the interim is using an upgraded Full Mission Simulator (FMS) at ADA for pilot training, pending supply of an FMS by HAL at the LCA's operating base. It said that the long gestation period has led to a change of weapon systems on LCA, necessitating the acquisition of new ones.

However, the CAG had a word of appreciation for the ADA, noting that some of its work centres working on the indigenous development of the LCA are "comparable to many contemporary aircraft (programmes) in the world". The manufacturing facilities at HAL cater presently to the production of only four aircraft per annum as against the envisaged requirement of eight owing to delays in procuring plant and machinery, tools and also construction of production hangars, which would further impact on production of LCA and induction into IAF squadrons. Repair and Overhaul (ROH) facilities for the LCA, as specified in the ASR, have not been fully created at HAL.

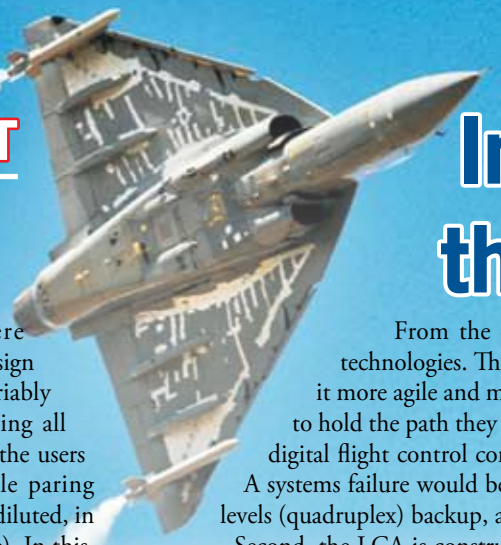
The CAG stressed on the need for more efficient management of planning and execution of aircraft development programmes, closer interaction and coordinated efforts among all the stakeholders involved. It recommended that realistic timelines should be set by MoD while seeking approval for such projects from the government and that the same should be adhered to during their execution with coordinated planning and an effective in-built monitoring mechanism.

"The agencies, DRDO, ADA and HAL, should undertake the projects strictly in conformity with the specifications projected by IAF, who should be involved right from the planning stage so as to ensure timely achievement of their requirements. Indigenisation efforts should be made in coordination with all the agencies involved by having a well-defined indigenisation plan and a clear roadmap for developing a quality product as per the requirement so as to avoid import substitution," the CAG stated.

"The MoD should award contracts to production agency at an appropriate stage of development of a system/equipment in order to avoid the necessity of extending delivery schedule due to a delay in the development of the system, apart from the resultant blocking of funds/inventory and to overcome obsolescence of the components procured by the production agency," the CAG concluded.

... Tejas LCA 2nd limited series production aircraft (LSP–2) which first flew on 16 June 2008

In defence of the LCA



The CAG Report nowhere recognises that, in fighter design anywhere, prototypes invariably go overweight while accommodating all the capabilities and weaponry that the users optimistically specify. Then, while paring down weight, some capabilities are diluted, in consultation with the user (air force). In this, the LCA has trodden a well-worn path.

The CAG also finds the LCA's claimed indigenisation "exaggerated." While the Aeronautical Development Agency (ADA), which oversees the LCA project, has estimated the LCA's indigenous content to be 61 per cent, the CAG says it "actually worked out to about 35 per cent" as of January 2015. In arriving at this percentage, the CAG does not differentiate between essential design-related and high technology aspects of the LCA and readily available products.

Criticising the slow pace of the LCA's entry into service, the report notes that Hindustan Aeronautics Ltd's manufacturing facilities can build just four fighters annually against an envisaged requirement of eight fighters per year. The CAG overlooks the fact that the IAF has ordered only 20 LCAs with another 20 promised after the fighter obtains final operational clearance. Even so, HAL is enhancing production to 16 LCAs per year, a decision that a future CAG report might comment on unfavourably if more IAF orders are not forthcoming.

Essentially, the CAG report is an auditor's review of a complex, high technology platform development, which involves risks and uncertainties that are not easily captured in a simple balance sheet assessment of targets and budgets. Any assessment of the LCA must start from the fundamental question: what was the objective of developing this fighter? All such programmes choose between two objectives: either utilising readily available technologies to build a fighter that could rapidly enter operational service, e.g. the Sino-Pakistani JF-17 Thunder, which is a cleverly re-engineered MiG-21; or pursuing a "technology leapfrog" in building a next-generation fighter, developing new technologies alongside the fighter itself. Obviously, this would take longer, since inevitable delays in the new technology areas would delay the project further.

From the outset, the LCA was based on fourth-generation technologies. The first of these is its "unstable design", which makes it more agile and manoeuvrable than "stable" aircraft that are designed to hold the path they are flying on. Unstable design requires an on-board digital flight control computer that continuously trims the flight controls. A systems failure would be catastrophic, so the flight control system has four levels (quadruplex) backup, a sophisticated design challenge.

Second, the LCA is constructed largely of composite materials that are lighter than conventional metal alloys. This results in a lighter fighter that can carry more fuel and weapons. Third, the LCA has "microprocessor-based utilities", which means that computers control all the on-board systems like fuel, weapons, environment control, etc. Fourth, the LCA has an all-glass cockpit, in which conventional dials are replaced by intelligent multi-function displays, and the pilot can fly, aim and operate weapons through a helmet-mounted display.

"In our very first attempt, we went in for a frontline, state-of-the-art aircraft. It was complete technological audacity to decide, that 'We've never built a fighter before but we'll start with a Gen-4 design'. Astonishingly, we've managed this feat, albeit with delays", says an ADA official who works at the cutting edge of the LCA programme.

Given the conflict between a high-risk development path and the need to induct fighters quickly, the stage was set for confrontation between the users (IAF) and the developers (ADA, HAL, et al). A former ADA chief says, "The core challenge is managing technology risk. The users demand more and fast; but you don't have the technology in your hand. This pits the IAF versus DRDO."

Consequently, the LCA programme has seen more confrontation than cooperation between the IAF and ADA. The CAG notes that, as early as in 1989, an LCA Review Committee had recommended the "need for a Liaison Group between Air HQ and ADA to ensure closer interaction between the design team and the user". Yet, "no such liaison group was formed and active user (Air HQ) participation in the LCA programme started only after November 2006, which also impacted the LCA development."

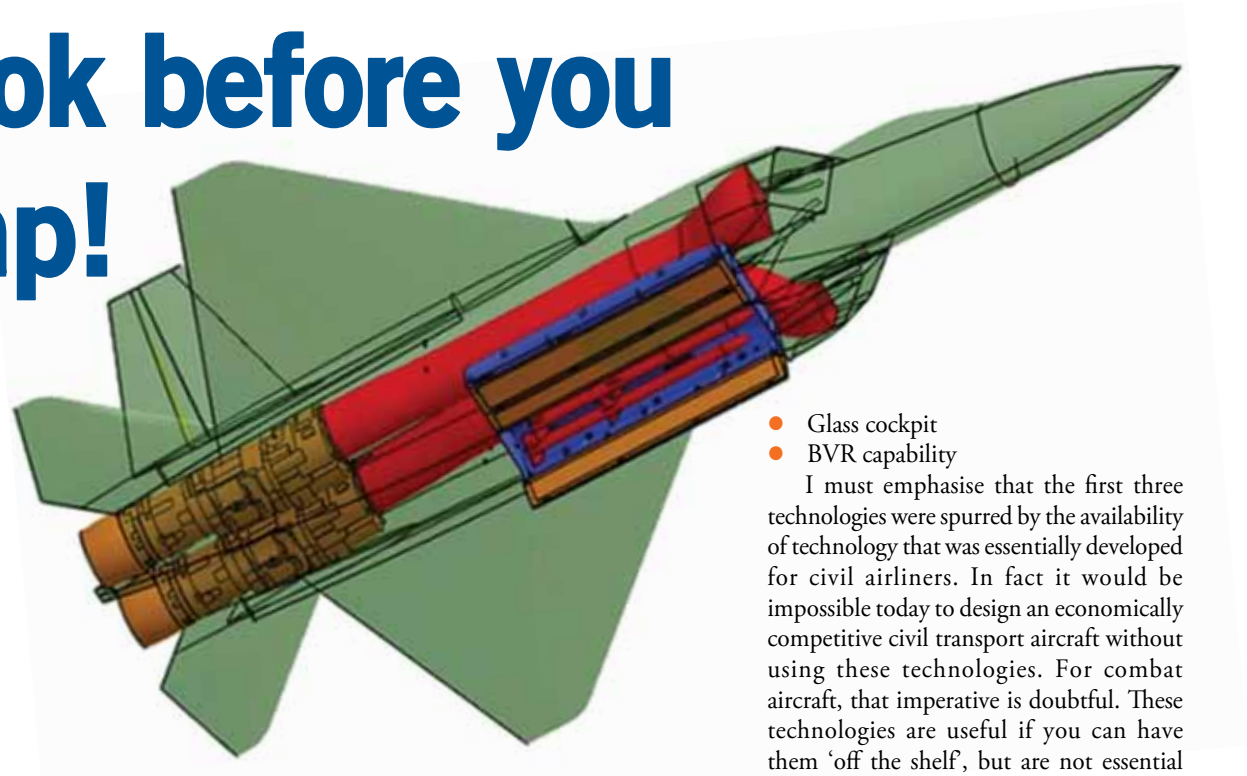
Even as the IAF criticised ADA, its demands for additional capabilities in the LCA kept delaying the operational clearances. The CAG report points out that in December 2009, the air force asked for the R-73E air-to-air missile to be integrated with the LCA's radar and the pilots' helmet mounted displays. The CAG also blames the air force for taking too long to identify a "beyond-visual-range (BVR) missile" for the LCA. Continuing IAF demands for modifications still prevent the LCA design from being frozen for series production.

Unlike the IAF, the IN adopted the LCA Navy programme from the start, committing personnel and over Rs 900 crore from the navy budget. Says former naval chief and distinguished fighter pilot Admiral Arun Prakash, "The navy knows the importance of indigenisation, having experienced how foreign aircraft like the Sea Harrier fighter and Sea King helicopter were grounded for lack of product support. Unlike the air force, we are not critically dependent upon the LCA, since we have the MiG-29K. But we will support it because it is an Indian fighter."

Equally misunderstood is the figure of Rs 14,047, which includes the cost of developing both the IAF and naval LCA, covering both the Mark I version as well as Mark II. The Air Force Tejas Mk.I has so far cost Rs 7,490 crore, and is within its budget of Rs 7,965 crore. For that amount, tiny compared to the billions that get sucked into developing fighters abroad, ADA says it has developed not just the LCA (and built 16-17 flying prototypes) but also an aerospace ecosystem–DRDO laboratories, private industry, academic institutions, and test facilities like the National Flight Testing Centre (NFTC)– that would allow India to build advanced fighters in the future (read the Advanced Medium Combat Aircraft AMCA).

Ajai Shukla

Look before you leap!



In light of the LCA 'experience', Professor Prodyut Das moots caution on the AMCA

Overall, cost of the LCA programme not including the engine and as the arithmetic sum of all tranches of funding released from time to time, is somewhere around Rs 8,425 crore (E&OE). The present day value, adjusted for inflation, would be closer to Rs 40,000 crore, which is a four fold increase over the initial estimate, also adjusted for inflation. The time scale overshoot is of the same order. Still, the money does not matter, as this can be regenerated but the time lost is irretrievable. Such is the price paid for what is the longest running development programme in aviation history - ever.

We are now about to sanction the same techno-structure to commence development of a fifth-generation fighter, the Advanced Medium Combat Aircraft (AMCA). It is therefore important for us to pause and reflect, lest we get swept away by ill conceived dreams. The AMCA is several orders of magnitude more sophisticated than its fourth generation predecessor and the time is now to re-think without emotion. Fundamental changes in the existing techno-structure are required if we are not to repeat the LCA frustration.

As a start we need to ask ourselves the following :

- What is a fifth generation fighter and what is its logic?
- Do we need the fifth generation?
- Do we have the required basic infrastructure to develop such a fifth generation fighter ?
- What is the level of usable research done to solve myriad problems posed by futuristic technologies ?
- What is a realistic time scale - and most importantly, the budget?

If we sweep aside these awkward questions in our rush to 'get' the project sanctioned or we trammel our thinking into creating a 'same as' product, we may be squandering scarce resources which could have been deployed elsewhere in the field of defence engineering.

Reviewing the fourth and fifth generations

The so-called fourth generation fighter aircraft introduced the following technologies :

- Composite structures
- Fly-by-wire flight controls
- Glass cockpit
- BVR capability

I must emphasise that the first three technologies were spurred by the availability of technology that was essentially developed for civil airliners. In fact it would be impossible today to design an economically competitive civil transport aircraft without using these technologies. For combat aircraft, that imperative is doubtful. These technologies are useful if you can have them 'off the shelf', but are not essential to give the opposing 'baddies' a fright in a fight. The fourth generation is no more than a convenient index of the equipment sophistication level of the aircraft and it would be unwise to believe that a fourth generation aircraft will naturally beat a third generation opponent. The best example is perhaps the initial production series of the MiG-29 which had none of the first three (if one overlooks a 8% use of composites for the engine nacelles, that too later converted to metal because of problems) but was nevertheless *THE* bully-on-the block as far as air-to-air combat was concerned. On a frivolous vein, if Airbus were to equip the A350 with BVR missiles, it could technically be considered a fourth generation combat aircraft!

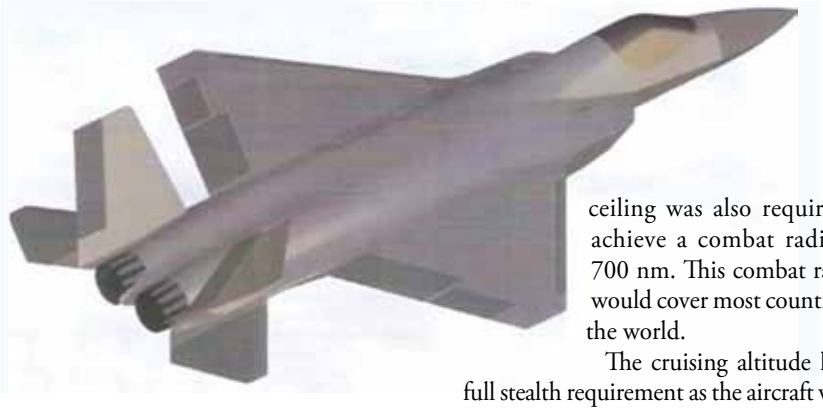
The so called 'generation' is descriptive of the technology level of the aircraft and is not to be automatically equated as an index of lethality in combat.

Genesis of the Generations

The Fifth Generation Fighter Aircraft introduced, along with the above technologies, the following capabilities:

- Supercruise
- Stealth
- Sensor fusion

The relatively poor performance of US equipment versus the'crude' Soviet equipment in the Vietnam and the Arab-Israeli wars had a profound effect on US military equipment designers. The appalling losses suffered by the very seasoned Israeli



Air Force to Soviet SAMs in the Yom Kippur war led to a search for RCS reduction. From that direction, 'full stealth' was then a real Yankee step. The back breaking logistics of the Vietnam effort led to supercruise while the problem of controlling massed fighter strikes in clinically restricted airspace over hostile Vietnamese territory led to sensor fusion as the AWACS was horribly vulnerable when it was most needed. Sensor fusion was a actually form of phased array multiple dispersed AWACS. These improvements coalesced to form the fifth generation, which essentially is a US-oriented requirement.

For example, the specifications that led to the Lockheed Martin F-22 Raptor required the following capabilities:

- Super Cruise at a speed greater than Mach 1.7
- Combat radius of 700 NM
- Stealth
- Cruise altitude of 21,000 m
- Ability to operate from 600 m strips
- Sensor Fusion

In fact, this set of requirements has less to do with direct general combat lethality and more to do with the American views of worldwide power projection, consequently being more relevant to *air superiority over hostile territory* (italics mine), which is fundamentally different in level of technical sophistication required for air superiority over home territory.

Let us now examine supercruise. USAF F-105s going to Vietnam would stage from McClellan AFB in California to Hickam AFB in Hawaii to Anderson AFB in Guam and then on to Takhli in Thailand. It took three days, seventeen flying hours and 18 in-flight refuelings. Considering the logistics problems because a high level cruise altitude was mandated as air density and hence drag would be greatly reduced thus requiring fewer mid-air tankings. Such high service ceiling was also required to achieve a combat radius of 700 nm. This combat radius, would cover most countries of the world.

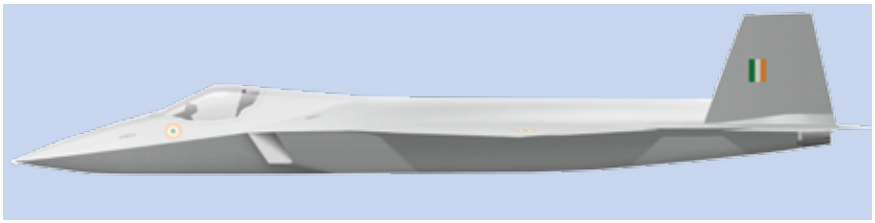
The cruising altitude led to full stealth requirement as the aircraft would be picked up on radar from afar. Super cruise was introduced to cut down the transit time. TVC was needed because at high altitudes, the reduced 'q' values made conventional aerodynamic controls sluggish.The other requirements such as AESA and sensor fusion consequently became necessary because once the aircraft was deep over hostile territory, AWACS/ADGES support, was not available. Such immediacy of information updates urged the need for AESA whereas a defensive fighter would be continuously updated from ground-based systems. Whilst the AESA is great if you already make it, it would not be quite such an imperative as was for US strategy. It must be noted that a defensive aircraft would get, from ground based support system, all information updates almost instantly and that too as a'voice over the shoulder,' thereby reducing the pilot's workload without any increase in weight of the aircraft.

The US aircraft achieved enviable operational autonomy but at technical and fiscal costs that are unaffordable for most other nations. In fact for countries without global aspirations, the US specifications are an unattainable folly because for instance, each F-22 Raptor reportedly costs US $ 2 billion if one factors in the development and operating costs. These values presumably do not include the enormous global infrastructure: air bases, tankers, hangars and so on, that only the USAF can have or afford. I must stress that many of these fifth generation capabilities pose a deterrence rather than provide actual combat lethality. One of the many penalties of stealth is that the warload is ridiculously low. If the past is anything to go by, the F-22 and the F-35 may well prove to be the poorest in terms of cost-effectiveness when opposed by a generic lighter fighter operating within ADGES.

Most of there self-styled 'sacred' specifications have an infusion of folly in them. For instance, supercruise cuts the transit time by half but mid-air refuellers barely fly at 400knots. Fifth generation aircraft will require refuelling every 70-80 minutes or so, which means that frequent hook ups will do away with any supercruise gains. Also worth remembering is that supercruise will need the most advanced technology in engines, available only to the West.

India does not appear to have the technological base yet to manage a 'predictable' AMCA programme. We must examine the thought that the counter to a haunting ghost (a.k.a. the J-20/J-31) is not your own ghost but an *Ojha* (witch doctor)! The counter to a Raptor may not be another Raptor, but instead improved methods of stealth stripping, methods for confusing or degrading PGM accuracy and destruction of aircraft at high altitudes using thrust vectored missiles with new warheads.

The scenario is everything - the 'generation' less so!



The generic Light Combat Aircraft (gLCA) is an unabashedly 'defensive' fighter designed to an austere philosophy that "less is better". It cannot be compared to an F-22 point-for-point as one may compare cars in a catalogue. In actual combat it has historically been proved that the gLCA will always outperform the 'full service' fighter. There is no magic involved. The LCA uses off board facilities with ADGES, SAMs etc to supplement what it is carrying on board.

Let us consider the following scenarios:

- When Fg Off Nirmaljit Singh Sekhon (of No.18 Squadron at Srinagar in December 1971) scrambled in his Gnat to intercept six attacking Sabres,

his chances were about the same as Leutnant Werner Voss's epic last stand or about 3%. Would his chances of survival have improved significantly if he had been flying an F-22 Raptor, assuming, of course that an F-22 Raptor could be scrambled within 40 seconds like the Gnat ?) Moving forward into time if his hypothetical Raptor was facing even six F-6s or F-7Ps, would he have survived? One certainly knows that if Fg Off Sekhon had a wingman in place, his chances would have improved by a factor of ten.

- The chance of a MiG-21 Bison surviving against an F-22 with both aircraft heading towards each other at 20,000 metres 90 km apart at Mach.0.9 is in the low 20 per cent. What is the probability that such a situation will occur?
- What role would the 'game changing' ground based systems of stealth stripping, particularly IR scans, play in warning the MiG-21 Bison which would presumably be over friendly territory? So what will be the number of MiG-21s 'helplessly' shot down by the Raptor? If the Raptor can be detected by IR sensors, it can be brought down or its efficiency degraded by SAMs modified for high altitude intercepts.
- Comparing the specifications of equipment and performance of the *third generation* Mirage III, F-105 and the F-4 against the *second generation* MiG-17, the latter appears to be a 'no hoper.' However, in the wars over Vietnam and in the Middle East, the modest MiG-17 achieved remarkable success in air defence and ground attack even when flown by crews whilst lacking nothing in courage, had standards of training which were no match for the high standards of the Israelis and the USAF/USN. In fact, it was the US that went back to school and the highly professional Israelis never repeated the Aswan clashes.
- Relevance of the equipment is everything. After the quite effective PAF B-57 attacks in 1965, the IAF chose the 'all-weather' MiG-21FL (Type 77) with a bigger radar over the initial MiG-21F-13 (Type 74). Analysis of the sorties as given in the book 'Eagles over Bangladesh' shows that employment of the MiG-21F-13 may well have resulted in the PAF losing several more Sabres. Could it be said that the R2L radar was more of a nuisance than a an aid ?
- We do tend to get carried away by foreign requirements which are actually irrelevant to our situation. On the internet (where else?) a rather well informed discussion on 'hot refuelling'came up as a means of reducing turnaround times. My own reactions are that hot refuelling will not reduce turnaround time because in India brake cooling is the problem. (As an aside, the LCA's reported brake cooling problem will be solved when the weight is corrected). In any event, hot refuelling is extremely hazardous with plenty of chances of accidents.

The Swedish AF has hot refuelling because if you shutdown a fighter in the artic tundra, getting it started again –in the open – is a devil of a job. The German F-104 crashes were partly owed to an idiotic decision about "getting the fighters used to the German weather!" The point to be stressed is that we will be cheated if we use the thoughts of others without due circumspection. Is the AMCA approach something like that ? Scepticism for the newly fangled and over-advertised ASRs is not out of place.

There has been continuous marketing efforts that the fifth generation fighter is, somehow, the ultimate weapon for dominating the skies - but in reality, this is a highly specific weapon. One will note that the US terminated F-22 production after only 187 aircraft. Either they have a lemon on their hands and are too proud to say it or it is so specific to become indispensable for certain USAF scenarios and – dare I say it – completely pointless for others. We must think of our own scenarios : China may need the J-20/J-31 in case they plan to take over Taiwan sometime in the future. Do we want to take back the Aksai Chin and then will the AMCA help in such a scenario ? Also, does the cost indicated include the cost of the associated infrastructure?

Whistling in the dark : a review of present fifth generation fighters

Reliable information on the fifth generation is actually hard to come by so, with a grain of salt, here is my take on the current line up.

The F-22 Raptor is virtually gold-plated. It is truly a marvel of technology and US manufacturing expertise, incorporating all that the US has learned in deploying aircraft all over the world and from combat operations of aircraft such as the F-117 and B-2. Sanctioned in August 1985 with first flight in September 1990, the F-22 entered production in 1997 and after a total of 195 were built (including development aircraft), production was terminated.

They still took 12 years to get the F-22 to IOC in spite of considerable prior experience in developing and operating elements of such technology in two service aircraft, the F-117 and the B-2. It must be emphasised that the formidable Americans took 27 years to design, build, test, produce and conclude that programme.

The F-22 Raptor

The PAK-FA (or T-50)

The Chengdu J-20

The Shenyang J-31

The Russian PAK-FA is actually a very sensible middle-of-the pack design, drawing on the typical Sukhoi/MiG layouts and just 'stealthing' them, much as our Navy has done with its frigates. It would hardly be a surprise if much of its under-skin systems were not from the Su-27 family. It is the most 'right looking' of the crop, which I cannot say about the F-22 Raptor, which looks like a jet-age 'Jug' (Republic P-47 Thunderbolt).

The Chinese Chengdu J-20 is a dark horse, drawing upon the Chinese concept of *Sashoujian,* meaning 'the assassin's mace.' It is larger than the F-22 (23 m long against 18.92 m) and has less powerful engines but uses an interesting 'long-coupled' canard configuration. The configuration will give a good CG range, hence the ability to handle a greater variety of weapons. Perhaps the Chinese might be thinking "if stealth is so good, one doesn't need to go fast". Better to use the power to enlarge the internal weapons bay and carry a larger warload so that loiter times over targets such as Quemoy or Taipei increase, and multiple targets can be struck, using the 'invisibility' advantage of stealth. The Chinese aircraft is a technology demonstrator/stealth intruder/ fighter-bomber and not, sensibly, a fighter to match the F-22.

The Shenyang J-31 is inspired by the Raptor and F-35, but somehow has a daintier looking approach.

Apna AMCA

Reportedly there have been two AMCA mock ups and frankly these continue to show lack of design supervision of details that ADA has displayed in the past. The first horror was the vertical fin which looked as if it had come off the HAL HA-31 Basant agriculture aircraft! The near-vertical leading edge is non-stealthy and certainly would have led to controllability and structural problems at high speeds. This has only recently been corrected and we have a stealthier fin on show. The other is the intake : sure the Raptor has splitter plate intakes – which are suboptimal for stealth– but the Raptor was conceived 30 years ago. I had hoped to see diverter-less supersonic intakes (DSI). Is anyone in ADA looking at the J-20, the F-35 or even the JF-17? Further, the design does not seem to have taken much care to 'mask' the exhaust petals with the empennage : the F-35 and J-31 do make that effort. Actually, all information on the internet about the AMCA is ludicrous in real terms. The thing is supposed to be capable of carrying the Helina ATGM. Why should anyone even think of wasting a high value resource like the AMCA on basic close support duties ??

Reports of the AMCA being capable of carrying the Brahmos (stealthily or otherwise) strain the imagination. How does one carry a missile that is 650 mm wide and

6,558 mm long between the nosewheel well and the engine face ? This is fanciful even if the air-launched version needs a shorter booster. The relatively low operating ceiling means that the radar returns will be 3-8 times bigger. These may seem as trifle but as our ancients had said a long, long time back : "These trifles if continued, will lead to grave evils."

Do we even need the fifth generation?

The fifth generation fighter programme is a political statement. Whether we invest people and effort on a colossal project like the AMCA will have to be decided by the people who decide the country's futuristic foreign policies, being the PMO, MEA, MoD and MoF, with inputs from the Armed Forces. These has to be a very much careful assessment of the threats, their likely time scales with the Armed Forces going deeper into details such as potential targets, weapons likely to be sanctioned for use, tactics to be followed and the infrastructure to be put in place for training, manpower, logistics, basing and so on. A total 'system of systems' has to be evolved before development agencies are brought in to the picture. We know all too well what happened when the customer was side-tracked during the 'earlier' project.

What will the AMCA cost in time and money?

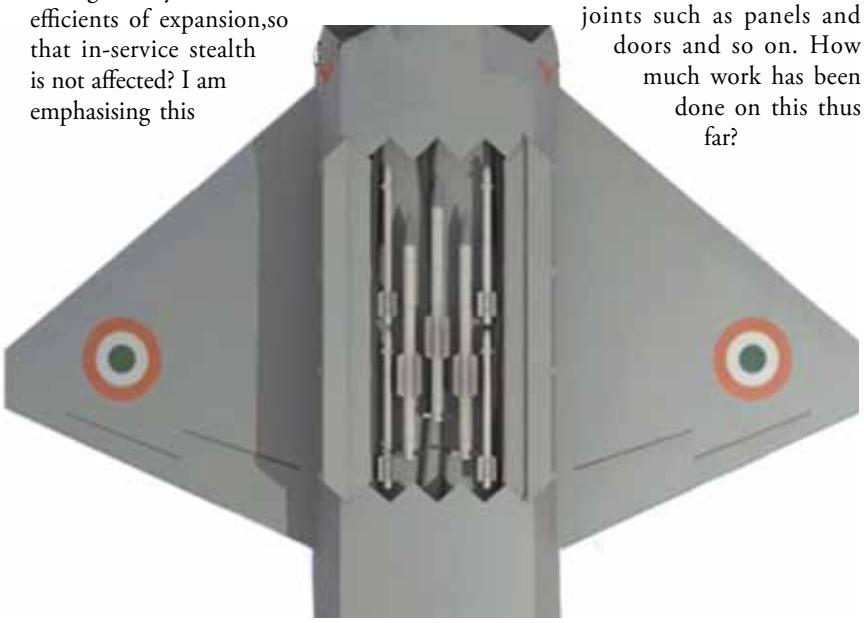
The earlier LCA has cost us Rs 40,000 crore - thus far. This was mainly owing to sheer mismanagement and it would be 'optimism'to assume that we have learnt from the earlier project. We certainly have learnt technical skills. which we always had, but there is no evidence, given the uncertainty about dates, of any improvement in project management. A budget for the AMCA should be around Rs 100,000 crore, not counting the powerplant. The Fifth Generation, being a political statement as much as it is a weapon, it makes little sense politically if we do not develop the powerplant. So we are looking at something in the order of Rs 150,000 crore.

The time for development can be hypothesised by reviewing the US timeline with the F-22 and I would doubt any target figure short of twenty years, or 2035 before IOC is achieved.' What will be India's political compulsions and priorities in 2035 ?

What is to be done

The Kaveri engine programme failed because the basic facilities required for carrying out the project were not available. As with the LCA, problems were compounded by not separating issues into details beforehand, and instead integrating them into the package. What a design agency must do is to identify the problems associated with development of the AMCA and then work on them in excruciating detail. There could be as many as 500 such 'problems' but I am listing some of the more obvious ones.

- Unlike existing supersonic aircraft, a super cruising fighter will 'soak.' Its skin will soak at 125 °C whilst the core structure may be at - 65° C. How does one *reliably* attach a composite skin to metal structure, with both having widely different co-efficients of expansion,so that in-service stealth is not affected? I am emphasising this because the LCA is supersonic for a few minutes at best and does not 'soak' as the AMCA's skin will.
- Because of the high skin temperatures of 125^0 C, stealthiness will be compromised to IR scans. The trick is to cool these areas using coolants or fuel. What is the standard of preparation on this as far as laboratory work is concerned? The same question applies to cooling of the jet efflux.
- Stealth requires radar anechoic chambers to confirm and refine the shape being chosen. Have we already got such chambers? What is the skill we have developed so far in validating theoretical studies with experimental testing?
- Stealth requires careful detail work: gold-flashing the canopy, minimising radar returns from joints such as panels and doors and so on. How much work has been done on this thus far?



- 'On simple things', like drain holes caused problems with stealth and corrosion damage on the Raptor will be needed to keep an eye on. These are typical of the many questions that must be asked - and solved - *before* taking up the AMCA programme.

Standard of Preparations regarding the sub-problems should be examined by an organisation independent of direct (and indirect) influence of controllers of the programme funding. From past experience it is the usual panel of 'eminent scientists and professors' but what is essentially needed is engineering common sense and experience.

There is also a somewhat naïve belief that CAE (computer-aided engineering) can replace an experimental approach. This is only partially true but with the tricky caveat that CAE is most useful to those who need it the least, that is, the seasoned engineer. CAE is very useful if one has identified and quantified a problem, because it then allows rapid 'optimisation.' Unfortunately, the computer is politely silent if the engineer does not focus on the problem. This is actually more common than one supposes. Just one example (from the public domain) in the HF-24 Marut the ballast weight was 134 kg. In the LCA, where with CAE one can compute CG at the push of a button, the ballast should ideally have been less than 50 kgs. If the rumoured 300 kg figure for ballast is true for the LCA, I rest my case !

Divide and Rule

To go eyes 'wide shut' into the AMCA programme would be to repeat the LCA story – an unfailing folly of introducing unproven technologies on an unproven platform. We should rather break up the task into technology modules, comprising stealth technology ; sensor fusion technology; supercruise.

Stealth technology and sensor fusion technology should take priority. Supercruise needs the most advanced engine technologies but is not available at a commercial level or else the enterprising Chinese would have had it by now. They are beavering away at their WS-15 Taihang engine whose super cruise attributes are unknown. The Kaveri programme showed we lacked the basics even as people rushed in with enthusiastic but impractical promises.

Stealth technology must incorporate features which include a hard chine fuselage, radar absorbent material (RAM), intake masking, DSI, internal weapons bay, serrated panels and covers, gold-flashed canopy, stealthy gun ports, AESA/conformal SLAR installation and IR sensors, design, production and maintenance of pressure cabins with angular exteriors and so on.

Since the IAF is luke warm on inducting the LCA Mk.I into frontline service, it may be possible to convert the last six airframes (of the 40 reluctantly ordered) to a 'LCA Stealth' model, incorporating some stealth features. These six can be built to an 'experimental' rather than be of 'combat' standard. For example, the internal weapons bay need not be capable of handling all the weapons planned for use, the airframe stress levels need not go to 9g, and so on. The idea is to give all those concerned – designers, planners, operators –much needed'hands on' stealth experience. Because such an aircraft is based on a'proven' design,a first flight by early 2018 and completion of field testing by early 2020 could reasonably be expected, particularly given the confident enthusiasm being proclaimed for the AMCA project.

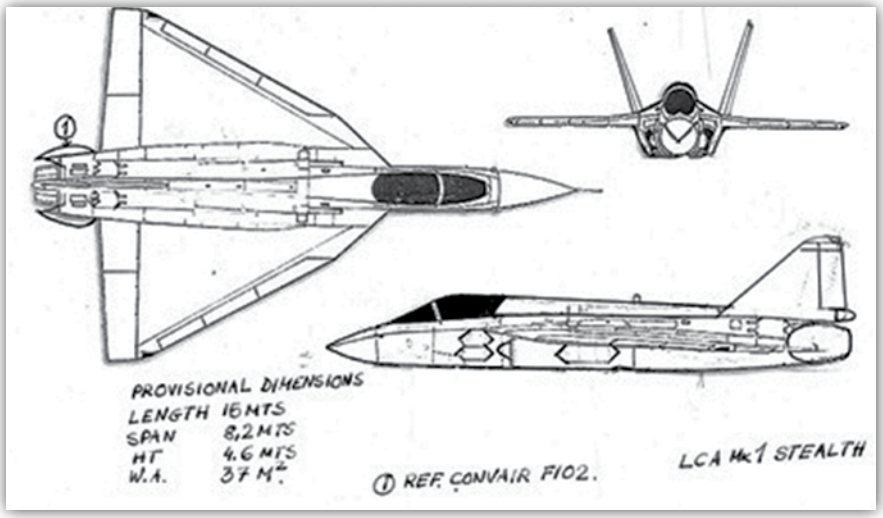
These 'experimental' LCAs will explore stealth effectiveness; stealth maintainability, particularly in humid and dusty conditions; manufacturing and airframe ageing effects on stealth deterioration; problems of stealth in LLXC profiles and so on.

The accompanying sketch shows a possible adaptation of the LCA Mk.I to a stealth research vehicle. The effort will be to confine the changes to the fuselage and see how some of the problems mentioned show up in actual conditions.

Similarly should be the approach for developing sensor fusion, which has applicability even in normal strike sorties and so has priority over supercruise. Such capability can be developed using Embraer145s or even our ubiquitous HAL-Dornier 228s. These are roomy aircraft and will allow much internal space for a 'bread board' approach to confirm the technology and its bugs before final packaging. CABS would be an obvious resource given the work they have done on the Embraer AWACS.

The obvious advantages of using a proven platform is that testing is not held up whilst the platform itself is being rid of its issues. as has happened with the LCA.

Assuming that we still feel that a fifth generation 'supercruiser' is essential, it would be much wiser to have a very careful 'engineer's' look at the tri-sonic MiG-25 and develop our own stealth aircraft based on the excellent proven high speed aerodynamics, systems and structure of that aircraft and then 'stealthifying' it. These are half a dozen long-retired IAF MiG-25s currently positioned as 'gate guardians' at various Air Force Stations.



Surprising even ourselves

Finally we must return to the problem mentioned in the techno-structure. Until this is energetically and drastically revised without the baggage of obsolete ideology, we will waste and fail. The socialist pattern of our society's early days chose to believe that only Government departments and the public sector were worthy and trusty repositories of public funds. The fact, as repeatedly demonstrated, is that money has no respect for which side of the economic

theory one is on. Suppose the Government had selected, say Tata or Mahindra or L&T, for the LCA project and they had turned in the very same results. What would have happened ? How would the ever vigilant Media and Parliament have reacted ? Why should performance which could be declared as a disaster, be accepted with some mild admonishment from the CAG if done by PSUs or Government? Given the proven disappointment with present arrangements, the Government should grasp the nettle firmly : *restructure drastically* !

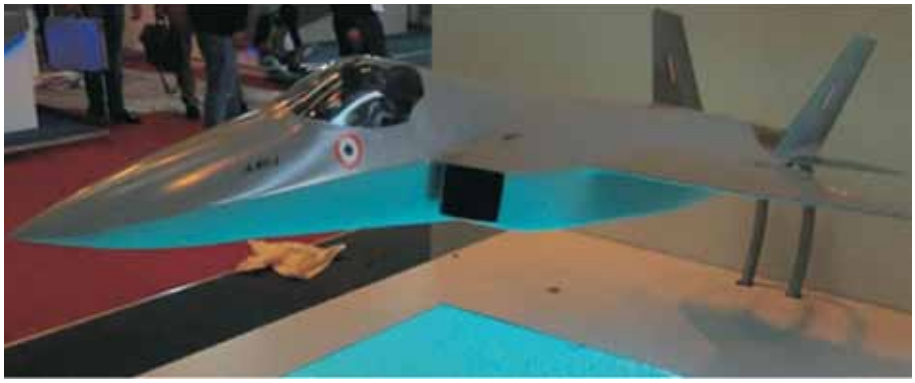
The Government must dismantle the 'Commanding Heights of the Economy' mind-set so beloved of theoretical economists of a certain hue. Commanding heights gained by decree rather than effort soon turn into toll gates. For weapons development all countries use the entire resources of the nation. By keeping the private sector out or emasculated we are denying our weapons industry the larger,more vibrant, and enterprising portion of our industrial strength.

I have mentioned enterprise : this is the difference between an Air India of the past under JRD Tata, and the present day Babu-run Air India. A 'command economy'cannot, by doctrine, have enterprise. We must welcome the private sector without bureaucratic caution. The Government must involve the Private sector as a valued resource rather than like convicts on parole. Allow FDI without limits. Indian Industry is the only one in the world where the domestic automobile industry has successfully fought out the challenges of well-established international giants. Why should they not also succeed in the field of aerospace and defence ? Those who raise the long dead ghost of the East India Company should be reminded of the several false 'bogeys' raised earlier: "computerisation will lead to loss of jobs", "mobile phones will lead to loss of sovereignty" (sic), "liberalising the automotive industry will result in a foreign exchange crisis" and so on !

Given this kind of prediction, the opposition to 100% FDI is short sighted or aimed at proving a certain economic theory rather than being at public service. Along with the big giants will come also the small brilliant firms like Scaled Composites, designers of the class of Burt Rutan and Stelio Frati and innovators like Edgley who would find that the canvas of India the ideal medium for their dreams. The Swiss ALR group in the 1980s was working on the interesting Piranha light fighter. In India, with the same funds, they could have progressed five times as far. The FDI policy must be particularly tuned for such enterprises and encouraged – at 100%.

The present Government's task is difficult enough because it must change the way people think. It must breakdown 'the narrow domestic walls' of our thinking, so that thoughts merge into broad urgent streams.

Once we do that, we may surprise even ourselves !



Model of the AMCA displayed at Aero India 2015

Key factors to determine the IAF's future fighter

- The fifth generation fighter aircraft is a political weapon and gives an aggressive message; is that our priority?
- It is a doubtful asset and requirements are too small to be an economic programme.
- The possession of such aircraft by our future adversaries cannot be countered by our possessing similar weapons.
- Our priority is not a fifth generation fighter, but countering that of the adversaries by:
  - development of stealth stripping techniques
  - development of techniques to confuse and degrade PGMs
  - development of suitable SAMs
  - development of structures capable of defeating bunker busters.

If after all this we still need a fifth generation fighter, we can go for a half house solution with emphasis on 'range/ payload capability' (i.e. a carrier for the Brahmos) as the priority rather than a Raptor-clone.

[AMCA images are computer-generated]

Rafales for Egypt being 'fast-tracked'

The first three Dassault Rafales for the Egyptian Air Force have already been rolled off the final assembly line at Bordeaux-Merignac and flown to Istres to be prepared for delivery. The Egyptian government had signed a contract on 16 February for 24 Rafales, under which the first three aircraft were to be diverted on the production line from aircraft already being built for the *Armee de l'Air*. The Egyptians hope to be able to take delivery of these first three Rafales in time for a flypast over the Suez Canal scheduled for early August 2015.

Rafales for Qatar

The State of Qatar has confirmed its intention to acquire 24 Dassault Rafales, the contract with Dassault Aviation being signed on 4 May 2015 in Doha in the presence of François Hollande, President of the French Republic. Following on from the Mirage F1, the Alpha Jet and the Mirage 2000, the Rafale will extend the relationship between Qatar, France and Dassault Aviation. "This new success for the French team demonstrates the Rafale's operational qualities and confirms the confidence that countries, that are already users of the Mirage 2000, have in our company", said Eric Trappier, Chairman and CEO of Dassault Aviation.

Netherlands orders eight F-35As

The Dutch Parliament has given approval to buy eight Lockheed Martin F-35A Lightning IIs for the Royal Netherlands Air Force (RNLAF), the clearance paving the way for the Dutch Ministry of Defence to sign a consolidated procurement request (CPR) during the spring meeting of the JSF Executive Steering Board. This year's acquisition is part of a total requirement for at least 37 F-35As for the RNLAF, which will have a further four CPRs covering the acquisition of 27 more F-35s by 2019. The RNLAF took delivery of its first two F-35As in 2013, both aircraft to operate from Edwards Air Force Base in California, for the next four years as part of the multi-national Operational Test and Evaluation (OT&E) programme.

The eight aircraft ordered will be produced as part of Low-Rate Initial Production Lot 11 and are scheduled for delivery in 2019. Current plans envisage that six F-35As from this batch will be assembled by Lockheed Martin in Fort Worth for initial delivery to the international Pilot Training Centre (PTC) at Luke Air Force Base, Arizona, while the other two should join 322 Squadron at Leeuwarden Air Base towards the end of 2019.

WZ-10 attack helicopters for Pakistan

Three Chinese-origin Changhe WZ-10 attack helicopters have been "donated as grants" to the Pakistan Army Aviation Corps "for assessment". Two of the three will be deployed to the Federally Administered Tribal Areas of Pakistan for battlefield assessment in actual combat conditions against militants in the region. The third helicopter to be used for training and testing. If cleared, the Pakistan Army may place "a large order" for the WZ-10, to replace its ageing AH-1 Cobra gunships.

RAAF trains on Reaper UAS

RAAF crews have commenced training on the General Atomics MQ-9 Reaper in the United States. Although the RAAF still does not have a formal project to acquire an armed UAS, the training programme is seen as a cost-effective method to increase the Australian Defence Force's understanding of complex UAS systems. "It would be remiss of Australia not to continue to develop our knowledge of this technology to ensure we are able to gain the greatest benefit from unmanned aerial systems and the best protection for our troops on future operations," according to Minister of Defence Darren Chester.

Ex-Portuguese F-16s for Romania

Romania's first F-16s will be delivered before the end of 2016, six of the 12 ex-Portuguese AF F-16s having already upgraded. Initial pilot and technician training was carried out in Portugal, while advanced training will take place in the USA even as infrastructure is being upgraded at Fetesti air base to accommodate the F-16s. Of the 12 aircraft, nine are being acquired from surplus Portuguese Air Force stocks, while the remaining three are former US Air Force examples.

Ghana orders Super Tucano and Z-9

The Ghana Air Force will receive four new Harbin Z-9 helicopters from China plus five new Embraer Super Tucano light attack and trainer aircraft from Brazil. President John Mahama has stated that the Z-9s would be delivered in June this year, the new aircraft to be used for training, peace-keeping support and combat operations, even as one of Ghana's current two C295s is being used on behalf of the United Nations-led Minusma mission in Mali.

Re-engining of B-52Hs

The USAF is planning on keeping its B-52H strategic bombers operational until about 2040, despite rising maintenance and per-hour flight costs. Following Globe Strike Command's announcement of the renewed interest, a range of options are being considered, which include a public-private ownership partnership that would allow the engines to pay for themselves with savings they generate. Previous proposals focused on re-engining the B-52H with four Rolls-Royce RB211 engines, while current suggestions are for a version of the Pratt & Whitney F117 engine.

SU-25SMs in Kyrgyzstan

Five upgraded Russian Air Force Sukhoi Su-25SM attack aircraft have been deployed to the Russian air base at Kant in the Krygyz Republic following enhancements made by the 121st Aviation Repair Factory at Kubinka. About 200 Su-25s equip 14 squadrons and will be brought up to Su-25SM configuration.

17 CH-47Fs for Netherlands

The sale of 17 Boeing CH-47F Chinook cargo helicopters to the Dutch Government is being mooted by the US Defence Security Co-operation Agency (DSCA). Apart from the helicopters, the contract would include 12 spare T55-GA-714A engines with hydro-mechanical assemblies, along with 41 embedded GPS/inertial navigation systems (EGIs), 54 AN/ARC-231 UHF/VHF radios, 21 AN/ARC-220 HF radios, 21 AN/APX-123A identification friend or foe (IFF) transponders and 41 AN/ARC-201D VHF radios. The CH-47Fs will supplement, and eventually supplant, the Royal Netherlands Air Force's 11 older model CH-47D helicopters.

JF-17s for Argentina?

Purchase of a batch of 14-20 JF-17 fighters for the Argentine Air Force was reportedly discussed during the visit to China by Argentina's President, Christina Fernandez de Kirchner and inter-governmental working groups have been set up to investigate the acquisition. The Chinese fighter types being considered are either Chengdu FC-1/JF-17 or J-10 fighters, but will probably be the former type. In this connection, an Argentine technical delegation will travel to China in the near future.

Final Saab JAS 39C/D for Swedish Air Force

According to Saab, production of the JAS 39C/D Gripen fighter for the *Flygvapnet* (Swedish Air Force) has been completed, the last one produced, a single-seat JAS 39C, leaving the factory at Linköping on 19 March. Production has switched to the new JAS 39E/F model, the first built to Gripen E specifications presently under manufacture and scheduled to make its maiden flight this year.

Turkish Air Force retires RF-4E Phantoms

The Turkish Air Force's RF-4E Phantom IIs will be withdrawn from service "with immediate effect" following the loss of two of the type, plus an F-4E in accidents in less than two weeks, killing all six aircrew. Operations with the last eight RF-4Es in Turkish service ended the very next day, their reconnaissance missions to be taken over by F-16s. It had already been planned to retire the RF-4Es in the near future, but the crashes prompted the Air Force to bring forward their withdrawal by several months.

Mexico seeks more UH-60Ms

Mexico has sought three Sikorsky UH-60M Black Hawks, the helicopters to be in standard US Government configuration, with designated unique equipment, embedded global positioning system/inertial navigation systems, six M134 7.62mm machine guns, three Star Safire III forward looking infrared radar systems, three aviation mission planning systems and 12 AN /AVS-9 night vision goggles. Mexico intends to use them to "modernise its armed forces and expand its existing naval/maritime support in its efforts to combat drug trafficking." The Black Hawk is already in service with the Mexican military, six S-70A-24s being flown by the *Fuerza Aérea Mexicana,* while the *Policía Federal de Mexixo* has six S-70As and six UH-60Ms. Mexico's *Fuerza Aeronayal* also has three UH-60Ms with five more on order.

HAL Chetaks for Surinam

Three HAL Chetak helicopters have been delivered to the *Surinaamese Lucthmacht* (Surinam Air Force) being formally handed over during a ceremony at Paramaribo-Zorg en Hoop Airport on 13 March 2015. They will operate from three locations: one each at the Air Force's main base at Zorg en Hoop, Abina and Nickerie.

Eight pilots and several technicians have been trained on the type in India, but for the first months Indian pilots will fly with their SAF counterparts to gain experience. The Chetaks will be armed and weapons for them have already been delivered, but details are not revealed. After being shipped from India, the three Chetaks were re-assembled in the SAF facility at Zorg en Hoop. The arrival of the Chetaks marks resurrection of the SAF, which is thought not to have had any air worthy assets for some years.

Egyptian F-16 deliveries re-commence

The USA has lifted the 'freeze' on weapons deliveries to Egypt that was imposed following the military-backed coup in the

country in 2013. This will enable deliveries to the Egyptian Air Force of the remaining 12 Lockheed Martin F-16C Block 52s. Deliveries of 20 Harpoon missiles and 125 M1A1 Abrams tank kits would also now commence. From Fiscal Year 2018, the US President said that US security assistance to Egypt would be chanelled into four categories: counter-terrorism, border security, Sinai security and maritime security, while also sustaining weapons systems that are already in Egypt's inventory.

L-159s for Iraq

Sale of 15 Aero L-159 Advanced Light Combat Aircraft to Iraq has been cleared by the Czech Government. Four of the aircraft will come from the current Czech Air Force inventory, the remaining 11 will be from those in storage for over a decade. The deal has been negotiated through Aero Vodochody, the aircraft's manufacturer and under negotiation for several years, with the numbers of aircraft involved constantly changing. Aero Vodochody was earlier to repurchase 13 single-seat L-159As and a pair of twin-seat L-159Ts from the Czech MoD, however it was planned at that time that only 12 operational aircraft (ten L-159As and two L-159Ts) would enter Iraqi Air Force service, the other two being used for spares.

Rafales demonstrated in Indonesia

Bidding for the *Tentara Nasional Indonesia-Angkatan Udara's* F-5E/F Tiger II replacement (16 aircraft), Dassault has demonstrated a Rafale B and Rafale C to Indonesia, which has put 'Transfer of Technology' and manufacturing new fighter components locally by PTDI as principal terms and conditions of any new fighter contest. The Indonesians had earlier stated that of the potential candidates to replace the F-5, the Russian Sukhoi Su-35 Flanker was on "top of the list", followed by the Saab Gripen C/D, Eurofighter Typhoon and Lockheed Martin F-16 Block 62.

Philippine AF C295M delivered

The first of three C295M transport aircraft to the island country's air force were handed over to the Philippine Air Force in mid-March, initially routing to Malta before arriving on 22 March at Clark Air Force Base. The type had been selected to meet the Philippine Air Force requirement for three new medium-lift transport aircraft, which will replace three surviving PAF Fokker F27 Friendships operated by the 221st Airlift Squadron, based at Villamor Air Base, Manila. The second and third C295Ms are scheduled for delivery in 2016.

Upgraded Tu-95MSM delivered

An upgraded Tupolev Tu-95MSM strategic bomber was handed over to the Russian Air Force during a ceremony in late January. The modernisation primarily involves replacing the avionics system to improve the efficiency of the aircraft's weapon aiming system and adds the GLONASS navigation system. The aircraft has the capability to launch the new Raduga Kh-101 long-range cruise missile, which has a conventional warhead, and also the Kh-102 nuclear variant of the weapon.

Su-35S with RuAF

The Sukhoi Su-35S multi-role fighter is to be formally commissioned into the Russian Air Force (RuAF) service later in 2015. The type has already been introduced into a trials unit at the 929th State Flight Test Centre at Akhtubinsk. During 2014, some 36 fighters were delivered to the Russian Air Force's Eastern Military District, which included 20 Sukhoi Su-35S aircraft for the 23rd Fighter Air Regiment at Dzemgi Air Base (co-located with the UAC factory at Komsomolsk-na-Amur), and two Su-35s for the 22nd Guards Fighter Air Regiment at Tsentrainaya Uglovaya airfield near Vladivostok.

Meanwhile, North Korea's People's Army Air Force is seeking to acquire a number of Sukhoi Su-35S multi-role fighter aircraft to modernise its fighter force. Choe Ryong-hae, a special envoy of North Korean leader Kim Jong-un, reportedly travelled to Moscow in November 2014 to discuss the request with Russian President Vladimir Putin.

USAF exercises in Bangladesh

Seen in the photo above are Bangladesh Air Force Chengdu F-7BG Airguards from the 5th Squadron based at BAF Base Bangabandhu (Dhaka-Kurmitola), Bangladesh with an US Air Force C-130H Hercules from the 374th Airlift Wing/36th Airlift Squadron at Yokota Air Base, Japan, during Exercise *Cope South* in Bangladesh. Three Yokota-based C-130Hs deployed to BAF Base Bangabandhu, for the exercise which took place during 24-30 January 2015.

First F-35A for USAF Weapons School

The US Air Force Weapons School has received its first Lockheed Martin F-35A Lightning II at Nellis Air Force Base, Nevada. It becomes the first of the type with the school's 16th Weapons Squadron, in conjunction with the US Air Force Warfare Centre and the 422nd Test and Evaluation Squadron both resident at Nellis. The school's first F-35A will be used for tactics development, the objective being to create curriculum for the first F-35 course.

KC-130Ts for the Philippines

Two former US Navy Lockheed C-130T Hercules are being acquired by the Philippine Air Force and a team of representatives from the PAF inspected the aircraft at Fort Worth in Texas during January. A Letter of Offer and Acceptance (LOA) has been signed, with cost of the two aircraft plus spares estimated to be US$55 million. These will be configured for maritime surveillance missions and will bring the PAF Hercules strength to five.

Ex-UAE Mirage 2000-9s for Iraq

Ten Mirage 2000-9 fighters have reportedly been "donated" by the United Arab Emirates (UAE) to Iraq, during UAE prime minister Haider al-Abadi's visit to Baghdad. The UAE Air Force and Air Defence has a mixed fleet of 65 Mirage 2000-9DAD/EAD/RAD aircraft, comprising both aircraft that have been upgraded from older Mirage 2000 models as also new production 2000-9s.

Iran's Thunderbolt

Iran has developed a new version of its HESA *Saeghe* (Thunderbolt) fighter, a twin-fin variant of the single seat Northrop F-SE Tiger II, the first of the new model, designated the *Saeghe* II and based on the two-seat F-5F, being unveiled recently at Tabriz-Shaheed Fakouri. The Islamic Republic of Iran Air Force's 23rd Tactical Fighter Squadron at Tabriz operates the earlier single-seat *Saeghe* I aircraft and it is presumed that the new variant will also join that unit. Iran's FARS News Agency has announced that several squadrons of the original *Saeghe* I version are operational with the IRIAF. All of the IRIAF's remaining F-5E/F aircraft are to be converted to one of the *Saeghe* variants by around 2030.

Israeli Thunders

Twenty-five Boeing F-15(I) *Ra'am* (Thunder) aircraft, operated by the Israeli Air Force's 69 Squadron at Hatzor Air Base are to be upgraded. This will include fitting a new radar system, most likely the US-built Raytheon APG-82(V)1 active electronically scanned array, together with other electronics. The F-15(I) has already previously been upgraded with conformal fuel tanks, Israeli-designed satellite communications and integrated with US and Israeli GPS/INS and other guilded weapons.

US Navy Ospreys

The US Navy is to procure the Bell Boeing V-22 Osprey for its carrier on-board delivery (COD) mission, with the first procurement dollars said to be included in the upcoming FY2016 budget request. The procurement decision includes four Ospreys that had been intended for the US Marine Corps in the FY 2018-2020. The US Navy has long expressed need for V-22s for the COD mission which is now included in the Department of Defence *Future Years Defence Plan*.

DARPA to speed up integration

The US Defence Advanced Research Projects Agency (DARPA) has launched a project to explore the quicker integration of new systems with existing techmology. The System of Systems Integration Technology and Experimentation (SoSITE) project will "develop and demonstrate concepts for maintaining air superiority via novel SoS architectures," combining aircraft, weapons, sensors and command and control systems with existing manned and unmanned aircraft.

"As advanced technologies become more readily available to adversaries on commercial markets, the nation's focus on ever-more complex weapons systems has become not just a strength but also a weakness," stated DARPA. Concept development contracts have been awarded to Boeing, General Dynamics, Lockheed Martin and Northrop Grumman, which are developing SoS architecture technology and flight experimentation plans. In addition, Apogee Research, BAE Systems and Rockwell Collins are developing tools to enhance current open-system architecture approaches.

15 AH-1Z Vipers for Pakistan

The US government has approved sale of 15 Bell Helicopter AH-1Z Viper attack helicopters to Pakistan, the package including 1,000 Lockheed Martin AGM-114R Hellfire II missiles. The $952 million package would be conducted under the US Foreign Military Sales programme, stating "by acquiring this capability, Pakistan will enhance its ability to conduct operations in North Waziristan Agency, the Federally Administered Tribal Areas, and other remote and mountainous areas in all-weather, day-and-night environments. Pakistan will have no difficulty absorbing these helicopters into its armed forces." In addition to the helicopters and missiles, the package includes mission computers, target sight systems, 20mm guns, spare engines and other equipment. The package also covers logistics, training and other support.

RFI for Turkish TF-X

A Request for Information (RFI) was issued on 13 March by Secretary for Defence Industries concerning the country's indigenous Turkish Fighter Aircraft (TF-X) programme. The RFI concerns an indigenous design, development and production of the TF-X to meet the Turkish Air Force's requirement for a next-generation fighter to replace the Turkish Air Force's current F-16 fleet in the 2030s. Preliminary design work is expected to cost in the region of $500 million, with the intention of completing the first prototype in 2023. Responses to the RFI will be followed by formal Request for Proposals which is expected to be issued in the third quarter of 2015. Around nine companies, including BAE Systems, Dassault, Lockheed Martin, Shenyang, Sukhoi and Saab are reportedly involved.

USAF T-X Requirements

Detailed requirements for the T-X trainer aircraft family of systems that will replace the T-38 Talon in USAF service have been released by the USAF director of plans, programmes and requirements, who stated, "The T-X requirements are being released approximately ten months earlier than under the normal acquisition process and is part of an ongoing effort for more deliberate and open engagement with industry." The initial draft requirements were released in 2012, allowing industry to make more informed, early design decisions, adding that "the T-38 is no longer a practical trainer to prepare USAF pilots for newer, more advanced aircraft."

12 of the 18 advanced pilot training tasks currently cannot be completed with the T-38, meaning fighter and bomber formal training units have to be relied on to complete the training at a much higher cost. "While the T-38 has been upgraded to a glass cockpit, the inability to upgrade the T-38's performance and simulated sensor capability presents a growing challenge each year to effectively teach the critical skills essential to today's military pilots."

The T-X requirements identify three key performance characteristics for the advanced pilot training mission: sustained G, simulator visual acuity and performance, and aircraft sustainment. The USAF plans to finalise contracts for 350 T-Xs to replace the 431 AETC T-38s from autumn 2017, with initial operational capability expected by the end of 2023. Five competitors have indicated their intent to offer a solution for the T-X requirement, including a Boeing-Saab team, developing a clean-sheet design (*see Vayu II/2015*). Northrop Grumman had initially proposed to offer a version of the BAE Systems Hawk T2/Mk 128, but is now also looking at a completely new design. Lockheed Martin will offer the KAI T-50 Golden Eagle. General Dynamics and Alenia Aermacchi have teamed to offer the T-100, which is based on the M-346.

KAI selected for KF-X programme

South Korea's Defence Acquisition Programme Administration (DAPA) has selected Korea Aerospace Industries (KAI) as the preferred lead bidder for the KF-X fighter programme on 30 March. KAI is partnered with Lockheed Martin as its foreign technical assistance company for the project. DAPA are to begin negotiations with KAI over details of the contract, expected to be finalised later in 2015. The contract, worth around $7.95 billion, will cover the development phase, including production of prototypes, until

2025. Purchase of 120 new indigenous fighters is planned to replace the Republic of Korea Air Force's fleet of F-4D/E Phantom IIs. Indonesia, which is funding 20% of the development programme, plans to acquire 80 of the type as well.

Saab and Embraer in MoU for Brazil's F-X2 Project

Following the July 2014 Memorandum of Understanding, Saab and Embraer have established a partnership for joint management of the F-X2 Project for the Brazilian Air Force as part of Saab's commitment to deliver industrial co-operation in relation to the F-X2 project. Under this agreement, Embraer will have a leading role in the overall programme performance of the programme. Embraer will also undertake an extensive share of work in the production and delivery of both the single- and two-seat versions of the Gripen NG, Brazil's next-generation fighter jet.

Embraer will be responsible for extensive work packages in systems development, integration, flight test, final assembly and aircraft deliveries and will also participate in the coordination of all development and production activities in Brazil. Furthermore, Embraer and Saab will be jointly responsible for the complete development of the two-seat version of the Gripen NG.

Beginning in the second half of 2015, a team of Embraer engineers and technicians will be based in Sweden to conduct initial training in the maintenance and development work for the Gripen NG.

Meteor fired from Rafale

The first guided firing of the long-range Meteor missile against an air target from a Rafale combat aircraft took place on 28 April 2015. The firing, prepared at the DGA's Cazaux Flight Test Centre (near Bordeaux) in France, proceeded successfully within the secured zone of the DGA *Essais de Missiles* (previously *Centre d'Essais des Landes*) in Biscarosse (also near Bordeaux). This firing is an important milestone in the integration of Meteor onto the Rafale progressing towards the F3-R standard.

With a throttleable ramjet motor and 'fire and forget' firing mode, Meteor is intended for very long BVR (Beyond Visual Range) air defence operations. Thanks to the performance of the RBE2 AESA (Active Electronically Scanned Array) radar which equips the Rafale (the only European combat aircraft currently equipped operationally with this kind of sensor), it is able to intercept targets at very long range thereby complementing the currently deployed MICA missile used for combat and self defence. The first Meteor missiles will be delivered as of 2018 to equip the Rafales of the French Air Force and Navy.

C-27J Spartan for Peruvian Air Force

The first C-27J Spartan has been handed over to the Peruvian Air Force at in a formal ceremony at Las Palmas base. This aircraft is part of the contract signed between AleniaAermacchi and the FAP in December 2013. In December 2014 a second contract was signed for two additional C-27Js bringing to four aircraft for the Peruvian Air Force (FAP). Deliveries will end in 2017.

100th Apache for US Army

The US Army has received the 100th AH-64E Apache helicopter. The 'Echo' model is a complete rebuild of the AH-64D model,

which includes an improved drive system, composite main rotor blades, a more powerful 701D GE engine, is fully digitised, and has level-4 manned-unmanned teaming, which allows pilots to control unmanned aerial systems - such as the Grey Eagle.

The AH-64E's has seen service in Afghanistan with the 1-229th Attack Reconnaissance Battalion, or ARB, the unit being the first with this aircraft.

Bell 412EPI helicopters for Canadian Coast Guard

Bell Helicopters will supply seven Bell 412EPI helicopters to the Canadian Coast Guard (CCG), to support maritime security and fisheries activities and will contribute to the safety, accessibility, sustainability and security of Canadian waters.

The contract was awarded to Bell Helicopter within the context of the Canadian Coast Guard's Fleet Renewal Plan. The first aircraft is expected to be delivered in June 2016, with one helicopter expected to be delivered every three months thereafter. This contract for Bell 412's follows a CCG contract announced in May 2014 for 15 Bell 429 helicopters. Bell Helicopter delivered the first of the 15 Bell 429s in late March..

CH-47F Chinook for Australia

The Royal Australian Air Force has commissioned their first two Boeing CH-47F Chinook advanced configuration aircraft, a major milestone in the updating of the Australian Army's cargo helicopter fleet.

The acquisition is part of an ongoing transformation which is allowing Australia to build one of the world's newest and most technologically advanced armed forces. Five additional new Chinooks will be delivered this year, eventually replacing an existing fleet of six older CH-47D Chinooks. Australia was among the Chinook's first international customers and now there are almost twenty countries operating the helicopter. The Australian Chinook fleet is flown by the Army's 5th Aviation Regiment, 16th Aviation Brigade.

Helibras contracts Sagem for modernisation of Brazil's Panther helicopters

Sagem (Safran) has signed an ITP (Intention to Proceed) agreement with Helibras for production of 30 autopilot systems for Brazil's Panther helicopters. This programme will be conducted by Optovac, a wholly-owned subsidiary of Sagem. Located in São José dos Campos, Optovac will produce the flight controls on Brazilian Panther and Caracal EC725 helicopters and will offer support capabilities. Sagem and Optovac have invested in the development of innovative avionics and optronics solutions since 2012 to meet the needs of Brazilian armed forces.

Sagem already contributes to several programmes in Brazil, including flight controls and navigation systems for the Caracal and Fennec helicopters, plus optronic masts for four *Scorpène* class submarines built by French naval shipyard DCNS. Sagem also makes the flight controls for all Airbus Helicopters rotorcraft deployed in Brazil, and provides the horizontal stabiliser trim system for Embraer's new KC-390 transport aircraft.

V-22B Block C Ospreys for Japan

The Government of Japan has requested purchase of 17 V-22B Block C Osprey aircraft, 40 AE1107C Rolls Royce engines, 40 AN/AAQ-27 forward looking infrared radars, 40 AN/AAR-47 missile warning systems, 40 AN/APR-39 radar warning receivers and 40 AN/ALE-47 countermeasure dispenser systems, apart from other items including 40 AN/ARN-147 VHF Omni-directional Range (VOR) Instrument Landing System (ILS).

UH-60M Black Hawk helicopter for Jordan

The Government of Jordan has requested purchase of one UH-60M Black Hawk helicopter, with two (2) T700-GE-701D engines, spare and repair parts, publications and technical data, support equipment, communication equipment, personnel training and training equipment, US Government and contractor

engineering, logistics, and technical support services, aircraft survivability equipment, aviation mission planning system, tools and test equipment, and other related elements of logistical and programme support. The estimated cost is $21 million.

Russia and China to co-develop AHL heavy helicopter

Russian Helicopters (part of State Corporation Rostec) and Aviation Industry Corporation of China (AVIC) will co-develop "an advanced heavy helicopter". The agreement was signed on 8 May 2015 at the Moscow Kremlin in the presence of Russian President Vladimir Putin and Chinese President Xi Jinping by the CEO of Russian Helicopters, Alexander MIkheev, and the Chairman of the Board of Directors of AVIC, Lin Zuoming.

The co-development and production of a heavy-lift helicopter in China is an important component of Russian-Chinese collaboration in the aviation industry. Under the agreement the parties will work on development and preparation to launch series production of the new aircraft, named the Advanced Heavy Lift (AHL).

It is estimated that requirement for the new helicopter in China could exceed 200 aircraft by 2040. The AHL is planned to have a take-off weight of 38 tons, and be able to carry 10 tons of cargo within the cabin or 15 tons on an external sling. The helicopter will be designed to operate in hot climates, mountainous terrain and all weather conditions, and will be able to fly a highly varied range of missions from transportation to medevac, firefighting and much more. Russian Helicopters and AVIC have prepared the preliminary technical specifications of the new helicopter and plan to sign a general contract later this year.

Arthur weapon locating system upgrade for Norway

Saab has received an order from the Norwegian Defence Logistic Organisation (NDLO) for a prototype of mid-life upgrade of their current Arthur weapon-location radar system. The order amounts to approximately SEK115 million.

Arthur (ARTillery HUnting Radar) is a radar system that locates enemy artillery fire and determines the weapon position with high accuracy. The Norwegian Army took Arthur into service in 1999 integrated on a Hägglunds BV-206 tracked vehicle designed to support light infantry brigades. The recent order includes upgrading the sensor to Saab's current production version of Arthur (ModC), development of new Command, Control and Communication functions and integration in a new 10ft container. The container has ISO corners for easy and flexible use on many vehicle types. The Norwegian Army will use M113F4 Armoured Tracked Vehicles as the main carrier for Arthur.

Sagem to upgrade French army's FELIN

The French defence procurement agency DGA (*Direction générale de l'armement*) has contracted with Sagem (Safran) for the FELIN V1.3 involving integration of several operational improvements in the FELIN infantry soldier modernisation system already in service with the French army.

FELIN V1.3 will feature a new configuration designed to optimise the system's observation and combat functions. Software upgrades will provide new services for specialised sharpshooter and mortar support units. It also offers a new carrying structure, along with lighter and more modular protective gear, thus improving soldier mobility while decreasing their visual signature.

Upgraded PS-05/A Radar for Gripen C/D

The PS-05/A fighter radar, designated Mk4, for the Gripen C/D with improved performance and operating range, significantly enhances the future capability of the Gripen C/D. The PS-05/A Mk4 is the most recent development of the renowned PS-05/A radar, originally developed for the Gripen fighter. Through continuous spiral development it has maintained its position as "one of the most competent fighter radars in the world."

A new hardware configuration with a complete new radar back-end gives significantly improved radar performance and operational range, enhances the Gripen Weapon System capabilities and offers full AMRAAM and Meteor integration. It also enables significant capability growth through software upgrades to successfully counter evolving threats in decades to come.

Raytheon AMRAAM variant key milestones

Raytheon has recently completed two milestones for the AIM-120D, its latest Advanced Medium Range Air-to-Air Missile (AMRAAM). Even as the US Air Force completed testing and fielded the AIM-120D, the US Navy achieved initial operational capability (IOC) on the weapon. With the Air Force, the new AMRAAM was subjected to several scenarios designed to represent realistic combat conditions. AIM-120D demonstrated outstanding capability against challenging targets, and it performed superbly in all regimes of flight. Airborne testing verified that AIM-120D is ready for overseas deployment.

Procured by 36 countries, the combat-proven AMRAAM has been integrated on the F-15, F-16, F/A-18, F-22, Typhoon, Gripen, Tornado, Harrier, F-4 and the Joint Strike Fighter aircraft. It is also the baseline missile for the NATO-approved National Advanced Surface-to-Air Missile System.

A321neo LR launched

Airbus has formally launched its A321neo LR with a memorandum of understanding for 90 examples from the Los Angeles-based Air Lease. Targeted at the Boeing 757-200W replacement market, the LR will have a 4,000nm (7,408km) range, enabling it to fly transcontinental and transatlantic routes currently operated by B-757s. Airbus has stated that the LR version will have a 97,000kg (213,848lb) maximum take-off weight, increased from the 93,000 kg (205,030lb) of the baseline A321 neo. The LR will be optimised for 206 passengers in a two-class layout (190 in economy, 16 in business class), up from the initial seating capacity of 164 as earlier suggested. The first deliveries are scheduled by 2019.

Eurowings long-haul services

The Lufthansa Group's new long-haul low-cost operation will start flights this autumn under the Eurowings brand. The fleet will consist of five Airbus A330-200s, the first routes to be from Cologne/Bonn to Dubai, Bangkok and Phuket in Thailand, Varadero in Cuba and Punta Cana in the Dominican Republic. The Lufthansa Group announced in 2014 that it would move into the low-cost long-haul market and is also reconfiguring 14 of the mainline Lufthansa's A340-300s with a revised cabin layout that includes 262 economy seats. The group is also expanding the Eurowings short-haul operation. Vienna will be its first hub outside Germany, with two A320s located there from start of the winter 2015/16 season.

Vietnam Airlines with A350 XWBs

The initial Airbus A350-900 for Vietnam Airlines is being leased from AerCap but the airline will eventually operate 14 examples of the new airliner (ten directly purchased from Airbus and four leased). The carrier will place the first A350 on its Hanoi-Paris CDG service from September, replacing a Boeing 777, after operating the aircraft on intra-Asia flights to build crew hours.

Finnair, which will be the third A350 operator, will start long-haul flights with the type in late October after a period of training flights to European destinations from Helsinki. The first long-haul route will be Shanghai, followed by Beijing and Bangkok with further destinations in 2016, in line with Finnair's focus on Asian routes.

Etihad and Darwin

Etihad Airways' one-third shareholding in Darwin Airline has reportedly been cleared. In January 2015, Darwin announced plans to terminate the majority of its European scheduled flights and concentrate on wet-lease operations for Air Berlin and Alitalia, both of which are partly-owned by Etihad. Darwin blamed "aggressive" competition from Lufthansa Group carrier Swiss International Air Lines for the change in its strategy. Swiss has wet-leased turboprops from group sibling Austrian Airlines to compete with Darwin on several routes.

China Airlines seeks 50 new jets

50 single-aisle airliners are being sought by China Airlines to meet needs of the carrier and its regional subsidiary Mandarin Airlines. Twenty of these jets will be for replacement, while the remaining 10 will be part of the airlines' expansion plans. Mandarin, an all-Embraer 190 operator, will phase out its eight regional jets, replacing them with narrow-bodies. Low-cost carrier Tigerair Taiwan, in which China Airlines has a 90% stake, will meanwhile require 20 narrow-bodies between 2018 and 2024. Tigerair Taiwan has three leased Airbus A320s in operation and will take three additional jets on lease this year.

Singapore UAVs achieve FOC

The Republic of Singapore Air Force's Elbit Systems Hermes 450 unmanned air vehicle fleet has reached full operational capability (FOC). RSAF's 116 Squadron including pilots, engineers and maintenance crew have undergone "intensive training" to allow them to operate the aircraft in line with RSAF procedures. The Hermes 450 was acquired to supplement the air force's Israel Aerospace Industries Searcher and Heron1 UAVs by providing a vehicle with longer endurance, advanced avionics and better sensors. The payload combines electro-optical, forward-looking infrared and a laser designator in one pod, allowing for target acquisition and designation, reconnaissance and battle damage assessment.

P&W's PurePower engine testing

Pratt & Whitney's PurePower engine family has completed more than 16,000 hours and 31,000 cycles of full engine testing, including 3,500 hours of flight time. The data includes flight testing information from eight aircraft with PurePower Geared Turbofan™ (GTF) engines. The PW1100G-JM engine is the only engine flying on the Airbus A320neo aircraft, with two aircraft flying and the PW1500G engine is powering flights on six Bombardier CSeries planes.

Rolls-Royce Trent 1000 engines selected by Air China

Air China has selected Rolls-Royce Trent 1000 engines and long-term TotalCare support for its 15 new Boeing 787-9 Dreamliner aircraft. The decision continues a strong relationship with the airline, which has 49 Trent 700-powered Airbus A330 aircraft in service, with four to be delivered, and ten Trent XWB-powered Airbus A350XWB aircraft on order.

Chinese leasing company and Sukhoi Superjet 100s

A framework agreement on establishment a leasing company to support sales of Sukhoi Superjet 100 (SSJ100) aircraft China and South-East Asia has been signed in Moscow. The parties to the agreement were the Russia-China Investment Fund (RCIF), Sukhoi Civil Aircraft Company (part of United Aircraft Corporation), Xixian New Area Administrative Committee and New Century International Leasing from China.

During the next three years, the Russia-China leasing company will reportedly purchase up to 100 SSJ 100 jets from Sukhoi Civil Aircraft Company worth some US$ 3 bn. The new leasing company will be headquartered in the Sino-Russia High-Tech Innovation Park (SHIP) in Xixian, Shaanxi, one of centres of China's aviation industry.

ShinMaywa awarded by Boeing

ShinMaywa Industries, Ltd. Japan has been awarded the coveted 'Boeing Supplier of the Year -2014' by the Boeing Company for a second year in succession. The company involved in design and production of products for Boeing aircraft for more than 30 years. *Boeing Supplier of the Year* is a highly prestigious award presented to suppliers recognised by the Boeing Company for exceptional performance in quality, on-time delivery, price etc. from among 13,000 suppliers from 47 countries around the world. ShinMaywa is responsible for the design and production of the wing-to-body fairing for the Boeing 777 and the main wing spar for the Boeing 787 Dreamliner.

CFM LEAP-1B engines to power Copa Airlines

Copa Airlines have ordered 122 CFM LEAP-1B engines to power 61 Boeing 737 MAX 8 & 9 aircraft, the engine order valued at more than $1.6 billion. Copa Airlines first became a CFM customer in 1999 with an order for eight CFM56-7B-powered 737s and today operates a fleet of 78 Next-Generation 737 in service or on order. This order will expand the airline's CFM engines fleet to 278 engines.

Rolls-Royce Trent 900 engines for Emirates

At $9.2bn, Rolls-Royce has won its largest ever order to provide Trent 900 engines and TotalCare service support to Emirates. The engines will power 50 Airbus A380 aircraft that will enter service from 2016, which confirms the Trent 900 as the "engine of choice" on the four-engine A380. It has now secured more than 50 per cent market share on the aircraft, in addition to being selected by the majority of A380 customers.

The Trent 900 powered the first commercial A380 in 2007 and is now used by eight operators on more than 70 aircraft, having logged over 4 million in-service flight hours. The engine offers the lowest lifetime fuel burn, with the latest version including technology developed for the Trent XWB and Trent 1000 engines.

PurePower Engines for ANZ A320neos

Air New Zealand has selected Pratt&Whitney's PurePower® PW1100G-JM engines for 13 firm A320neo family aircraft,

the agreement also providing fleet management support services for up to 16 years. Deliveries are scheduled to begin in 2017 and will continue through 2019. The PurePower Geared Turbofan™ (GTF) family of engines has completed more than 17,000 hours of testing, including 4,000 hours of flight time. Pratt & Whitney is a United Technologies Corp. company.

Raytheon's SM-6 full-rate production, SM-3 for USN

Raytheon's Standard Missile-6 programme has moved from low-rate to full-rate production, clearing the way for significantly increased production numbers and focus on further cost-reduction opportunities. SM-6 is a surface-to-air supersonic missile capable of successfully engaging manned and unmanned aerial vehicles and fixed- and rotary-wing aircraft. It also defends against land-attack and anti-ship cruise missiles in flight.

Also, the Missile Defence Agency has awarded Raytheon Company a contract for Standard Missile-3 Block IBs, which are guided missiles used by the US Navy to provide regional defence against short-to-intermediate-range ballistic missile threats.

Under this contract, Raytheon will deliver an initial quantity of 44 Standard Missile-3 Block IB all-up rounds and provide the work required to produce and deliver the third stage rocket motor reliability growth and design enhancements. The government expressed its intention to purchase additional missiles up to a total quantity of 52.

Raytheon Patriot ordered by "undisclosed" buyer

Raytheon has been awarded a contract worth over $2.0 billion to deliver the combat-proven Patriot Air and Missile Defence System to an "undisclosed international customer". Awarded on 2 April 2015 and booked in the second quarter as a direct commercial

sale, the contract includes fully digitised new-production Patriot fire units with the latest technology for improved threat detection, identification and engagement. The contract also includes a full training package and support equipment.

CFM LEAP-1B engine flight test programme

CFM International has initiated flight testing of the LEAP-1B engine on a modified 747 flying testbed at GE Aviation Flight Test Operations in Victorville, California. The testing is the next major milestone in a two-year programme that will culminate in engine certification in 2016 and delivery of the first Boeing 737 MAX in 2017. The engine "behaved well" and completed multiple aeromechanical test points at various altitudes during the five-hour, 30-minute first flight. The LEAP-1B engine is the exclusive powerplant for the Boeing 737 MAX family.

The flight test programme will encompass a comprehensive test schedule that will gauge engine operability, stall margin, performance, emissions and acoustics. It will also further validate the advanced technologies incorporated in the engine, including the woven carbon fibre composite fan, the Twin-Annular, Pre-Mixing Swirler (TAPS) combustor, ceramic matrix composite shrouds in the high-pressure turbine and titanium aluminide blades in the low-pressure turbine. There are currently a total of 26 LEAP engines (all three models) on test, with 10 additional engines in various stages of final assembly.

Russian Helicopters' financial results for 2014

Russian Helicopters, part of State Corporation Rostec, have announced their consolidated operating and audited financial results for the year ended 31 December 2014 under IFRS.

As CEO Alexander Mikheev stated, "we are pleased to once again report positive yearend results. We have seen significant growth in the key indicators of revenue and EBITDA, 23% and 79% respectively, despite the slight decline in the number of helicopters delivered. Russian Helicopters achieved a record EBITDA margin of 27.7%.The changing rouble rate and a more diversified supply portfolio, half of which is export contracts denominated in foreign currency, helped achieve these results. However, even leaving these external economic factors aside, we anticipated growth."

Helicopter deliveries in 2014 totaled 271 units, down 4 units or 1.5% compared to 2013. The Company delivered eight types of helicopters to clients from 11 countries during the year. The firm backlog reached 546 units, with an order value of more than RUB 396.1 billion in 2014. The delivery plan for 2015 is 100% secured with firm orders.

IAI results for 2014

Israel Aerospace Industries has issued its consolidated financial statements for the year ended 31 December 2014, which has sales in 2014 amounting to US$ 3,827 million compared to US$3,642 million in 2013, a 5% increase. The increase in sales is attributed to augmented activities of the majority of the Company's groups, particularly the activities of the Commercial Aircraft Group and the Elta Group. This increase was offset by a decrease in the System Missiles and Space Group after the launch of the Amos 4 Satellite in 2013.

At the end of the year, the order backlog totaled US$ 9.1 billion compared with US$ 10 billion at the end of 2013. 83% of the order backlog is designated for sales to overseas customers with a broad geographic dispersal. The order backlog is comprised of a diverse range of products and guarantees 2-3 years of operation.

Joseph Weiss, IAI President & CEO

Pilatus records a successful 2014

"2014 was Pilatus' most successful year ever in terms of sales revenue", recording at CHF 1,174 billion, a 16 percent increase from 2013. Pilatus built and delivered 127 aircraft during the year under review, 15 more than in 2013, half of these to civilian operators. The Government Aviation Business Unit recorded another 22 percent rise in sales revenue, with seventy percent of total Pilatus sales revenue generated by Government Aviation. The ongoing three major projects for India, Saudi Arabia and Qatar are progressing as planned with all deliveries to customers completed "on time so far."

In the USA, the slight recovery in the economic situation impacted positively during the year under review. Pilatus delivered a total of 66 PC-12 NGs to customers around the world, of which 50 were to the USA. Work to develop the market in China continues in parallel, and with good results: of the ten Pilatus Porter PC-6s sold during the past year, nine went to China.

Royal Malaysian Navy *Scorpene* submarines

The Malaysian government has signed with Boustead DCNS Naval Corporation for through-life support for its two 2000 type *Scorpene* submarines based at Kota Kinabalu, Sabah. This new agreement extends the through-life support time for the two 2000 type Scorpène submarines currently in service before the beginning of their first major maintenance campaign. The *Tunku Abdul Rahman* should start its period of unavailability for major repair and overhaul (ROH) in November 2015 and the *TunRazak* in June 2017. The contract also covers the operation and maintenance of the industrial infrastructures dedicated to the maintenance of submarines berthed at the Sepanggar naval base, Kota Kinabalu as well as part of the procurement required to carry out future ROHs.

Sagem's Blue*Naute* for US Coast Guard

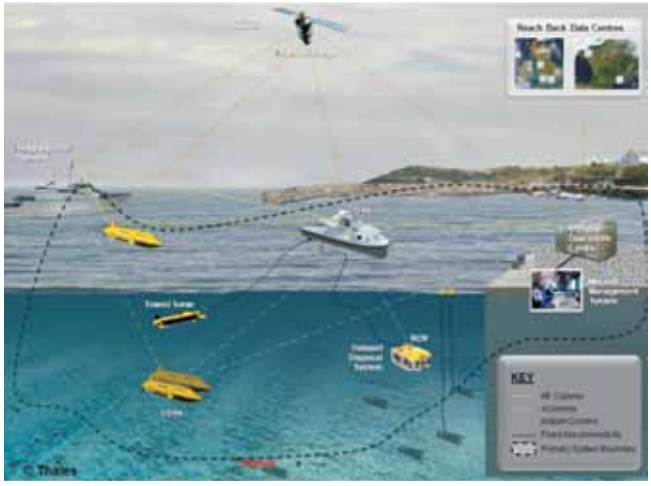
The US Coast Guard has chosen Sagem (Safran) 's new attitude and heading reference system, Blue*Naut*®, to modernise its Juniper WLB class ships. This is based on hemispherical resonator gyros (HRG), a proprietary Sagem technology that gives the Blue*Naute* very high reliability, coupled with extremely precise measurements. A disruptive navigation technology, the Blue*Naute*'s inertial core offers a competitive advantage in terms of total cost of ownership and performance, versus the previous generation of inertial technologies, especially fiber-optic and mechanical models.

Four Super Dvora Mk3s for an "African nation"

IAI recently received a contract worth tens millions of dollars to supply four Super Dvora Mk3 fast patrol boat to "an African

military customer". All four boats will be built at IAI Ramta's facilities in Israel and will be delivered during 2016. These newly ordered Super Dvorasare will be deployed for coastal defence, EEZ and HLS missions.

Thales contracted for French-UK mine countermeasures



On behalf of the French Defence Procurement Agency (DGA) in France and UK MOD's Defence Equipment & Support organisation, the Maritime Mine Counter Measures (MMCM) contract has been awarded to Thales, in collaboration with BAE Systems and their partners in France (ECA) and in the UK (ASV, Wood & Douglas, Saab). Initiated in 2012 under a cooperation agreement between France and the United Kingdom, the MMCM programme develops a prototype autonomous system for detection and neutralisation of sea mines and underwater improvised explosive devices (UWIEDs).

DCNS to maintain French nuclear attack submarines

Effective 1 April 2015, DCNS will provide through life support (TLS) until 2020 for the six nuclear attack submarines in service in the French National Navy and based in Toulon. The

contract covers the provision of through life support to the entire fleet of nuclear attack submarines, which comprises six *Rubis*-type ships as well as preliminary servicing for *Suffren*, the first of the *Barracuda*-class submarines. The contract also includes the operation of Toulon's nuclear infrastructures, the equipment as well as the simulators of the National school of submariners. Lastly, it covers the maintenance of infrastructures dedicated to the complete servicing of *Rubis*-type nuclear attack submarines and the future installations in the process of adaptation for the routine servicing of the first *Barracuda* nuclear attack submarines that will be commissioned progressively from 2018 onwards.

Options exercised for FREMM frigates

Orizzonte Sistemi Navali S.p.A., a joint venture between Fincantieri (51%) and Finmeccanica (49%), and prime contractor for Italy within the international Italian-French FREMM (Multi Mission European Frigates programme), have been notified by OCCAR (Organisation for Joint Armament Cooperation) of the option exercise for the construction of the ninth and tenth vessel, completing the supply of 10 vessels to the Italian Navy. These units to be delivered after 2020, will feature a high degree of flexibility as the previous ones, and will be able to operate in all tactical situations. The ships of the FREMM programme are state-of-the-art vessels of the European defence in the Mediterranean Sea and will replace the *Lupo* and *Maestrale* class frigates built by Fincantieri in the 1970s.

Falcon 2000 MSA for Japan Coast Guard

The Japan Coast Guard has selected the Dassault Falcon 2000 Maritime Surveillance Aircraft (MSA). Based on a Falcon 2000 LXS (range 4000 NM), this variant is designed for a broad range of missions including maritime surveillance, piracy control, drug interdiction, fishery patrol, law enforcement, search and rescue, intelligence and reconnaissance. It offers the best combination of size, payload, speed, range and acquisition and operating costs on the market.

Dassault Aviation will also provide the JCG with comprehensive maintenance support capabilities allowing the JCG to achieve a high level of aircraft availability. These support capabilities will enable the aircraft to efficiently meet the demanding operational requirements of the JCG.

Netherlands MoD partners with Thales

The Netherlands Ministry of Defence and Thales have partnered for four SMART-L Early Warning Capability (EWC) radars for the Royal Netherlands Navy, as well as service and delivery of two SMART-L EWC Ground Based systems (GB) for the Royal Netherlands Air Force. "These are unique contracts in which the services for both ground based and naval systems have been aligned and the MOD has involved a private party," stated Vice-Admiral Borsboom, Director of the Defense Materiel Organisation in The Netherlands.

Royal Netherlands Navy

As from 2018 maintenance services of the four SMART-L EWC radars for the Air Defence and Command Frigates will be carried out in cooperation with the Services and Maintenance Organisation of the Royal Netherlands Navy (DMI) for a period of 16 years.

Fincantieri and Finmeccanica units for Italian Navy

Fincantieri, one of the world's largest shipbuilding groups and reference player in the naval shipbuilding industry and Finmeccanica, has finalised a contract to build and equip the units set out in the renewal plan of the Italian Navy's fleet. Under this plan, OCCAR (*Organisation Conjointe de Cooperation sur l'Armement*, has ordered construction of six patrol vessels (PPA, or Multipurpose Offshore Patrol Ships), with four more in option, and for one logistic support unit (LSS or Logistic Support Ships) with the consortium (*Raggruppamento Temporaneo di Impresa* - RTI) consisting of Fincantieri and Finmeccanica, through its subsidiary Selex ES.

'TRULY IRON

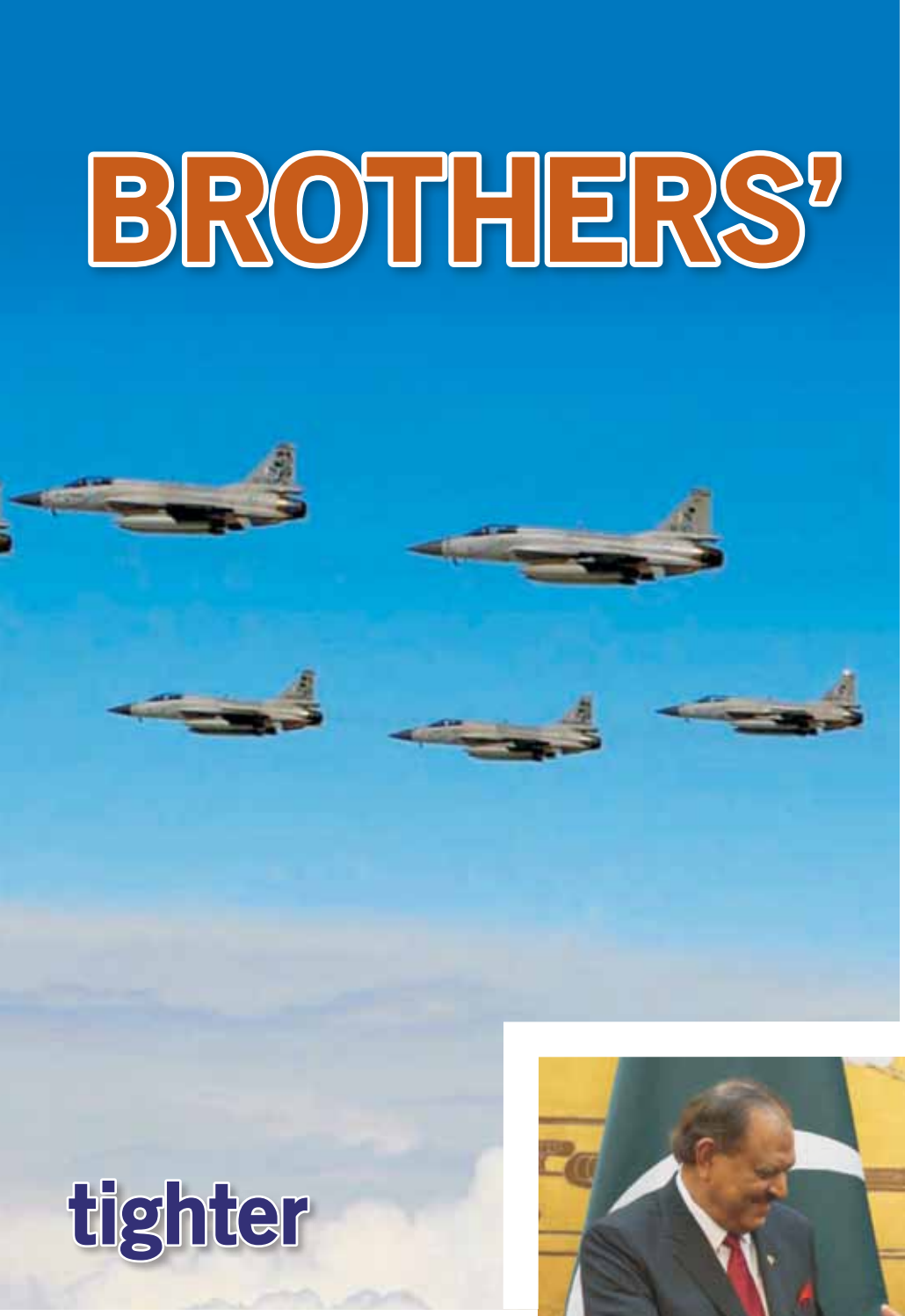
China and Pakistan ties get ever

Chinese President Xi Jinping's visit to Pakistan 20-21 April 2015 was arguably much more than awarding him the *Nishaan-e-Pakistan*, that country's highest civilian honour. Although Jinping did leave Islamabad with the award pinned to his chest, his arrival was perhaps more dramatic, with the Chinese President's VIP-configured Boeing 747-400 greeted by a formation of eight Sino-Pakistani JF-17 fighters as it entered Pakistan's airspace over the Karakorams, a move clearly intended to be symbolic of the two countries' ever closer military relationship.

While security matters are certainly dominant in the Sino-Pakistani relationship, with recent announcements regarding Chinese sales of additional fighter aircraft and submarines to Pakistan (viewed with usual dismay in India), the focus of Jinping's visit appeared to be more towards fostering economic growth and stability in the embattled nation. The Chinese President pledged a mammoth $46 billion investment toward Pakistan's infrastructure sector, having already signed agreements worth $28 billion before departing the Pakistani capital. China is moving forward with a modern day 'Silk Road', a land and sea trade route that will connect China to key markets in the West (read: Europe) via Pakistan and Central Asia. Central to this vision is the *China-Pakistan Economic Corridor* that is proposed to run from Gwadar Port in Baluchistan (suitably revitalised with Chinese funding) to Kashgar in China's Xinjiang province *(see 'Opinion' in this Issue)*.

Pakistani officials have confirmed that some $10 billion of the proposed investment will go towards establishing Gwadar as a modern deep - and warm - water port, as well as the actual land corridor

BROTHERS' tighter



from Baluchistan to Xinjiang. Another $37 billion will be spent on meeting Pakistan's growing energy needs through a mix of thermal, hydroelectric and solar power plants.

Even as China plays a leading role in Pakistan's military expansion, there are concerns about the security situation within the country, particularly in the restive Baluchistan province where Gwadar port is located. Chinese workers in Pakistan have also been subject to violence that pervades the nation, and indeed many have been killed, leading to a degree of discomfort between the two allies. In fact, Pakistani President Mamnoon Hussain met with Jinping during the latter's visit to personally reassure him of the safety of Chinese workers in the country, saying that Pakistan would even raise a special 10,000-man Division dedicated to the security of Chinese workers. This force will reportedly answer directly to the Pakistan Army HQ.

On matters Military

Even as China's largesse seems poised to affect a sea change in Pakistan's development landscape, the two countries have also taken major strides in military cooperation. While the re-development of Gwadar will no doubt result in a convenient warm-water port for Chinese PLAN vessels, particularly submarines, there has been significant movement in other areas. China is now comfortably ahead of the USA as Pakistan's largest arms supplier, meeting some 50 per cent of Pakistan's military procurement needs over the last five years while the USA supplied only 30 per cent.

Shortly before Xi Jinping's visit, talks were already underway for China to supply Pakistan eight diesel-electric submarines, either *Yuan*-class (Type 039A) or *Qing*-class (Type 032), in a $5 billion deal that would more than double Pakistan's submarine fleet size. Although a contract was expected during the Chinese President's

Chinese President Xi Jinping with Pakistan President Mamnoon Hussain

Yuan-class boat seen underway

visit, the procurement remains under consideration. It is important to note that while the *Yuan*-class is a conventional diesel-electric submarine along the lines of the Russian *Kilo*-class (operated in India as the *Sindhughosh*-class), the much larger *Qing*-class is reported to have a vertical launch system that will allow it to deploy nuclear or conventional long-range missiles.

Meanwhile, Pakistan has committed to acquiring another 110 JF-17 fighters from China, with the first batch of 50 Block II standard aircraft to be delivered in 3 years. The Pakistan Aeronautical Complex at Kamra has jointly developed the JF-17 with China's Chengdu Aircraft Corporation, and is capable of producing 25 JF-17 Block I per year in Pakistan, and indeed has already delivered 50 Block I aircraft to equip two frontline squadrons as well as the Combat Commanders' School at Sargodha. However, it is understood that the Block II rate of production at PAC (16 aircraft per year) is seen as insufficient to meet Pakistan's urgent need for frontline multirole fighters both to combat a vicious domestic insurgency as well as to replace legacy types that will be phased out from 2018 onwards. While the value of this 110-aircraft deal is unknown, an acquisition of this magnitude will comfortably allow the PAF to either retire their ageing fleet of strike-optimised Mirage 5s, or at least place them in reserve.

In December 2014, Air Marshal Javaid Ahmad, who heads PAC, stated that the JF-17 Block II, which incorporates a fixed refueling probe, new life support system, and improved EW systems, will be handed over to the PAF during 2015. The first JF-17 Block II made its maiden flight on 9 February this year.

Trio of JF-17 Thunders over Islamabad

Mission Impossible–is Possible

The Pilatus Porter PC-6 Still STOL-ing !

The ultra-short take-off and landing Pilatus Porter PC-6 first flew in 1959. In production since then and continuously updated, the PC-6 approaches a significant milestone with delivery of the 500th aircraft this year. It would be fair to surmise that the most famous workhorse from Pilatus' stable is witnessing what could be termed as a renaissance. Despite the advent of more sophisticated, powerful aircraft in the turboprop category from Pilatus itself, the PC-6 continues to hold its own.

Known around the world simply as "The Pilatus Porter", the aircraft is a model of simple but solid construction, proven systems and features, combined with precision Swiss workmanship and years of operating experience. Its unique Short Take-Off and Landing (STOL) capabilities, reliability and versatility in all weather and terrain conditions have established the reputation of the PC-6 as a rugged utility aircraft. The Pilatus Porter PC-6 is fully capable of operating from different types of unprepared, rough and short airstrips, in remote areas, at high altitudes and in all climates - in such diverse locales as the jungles of Southeast Asia, sands of the Sahara and glaciers of the Himalayas . It currently operates in over 50 countries, on all continents, especially where the environment is hostile and the access to traditional landing facilities is tough to non-existent. The Pilatus Porter's STOL performance is one of its key capabilities, providing a great deal of flexibility and allowing operation where access for other aircraft is impossible. The PC-6 is much cheaper to operate and maintain than any helicopter.

And now China too is emerging as a highly promising market for the PC-6. Pilatus annual report states that of the ten Pilatus Porter PC-6s sold during 2014, no fewer than nine went to China.

With minimum effort, the Pilatus Porter can be converted for various missions: having just operated as a paratrooper dropping parachutists, the aircraft can be airborne again in a matter of minutes. Whether as a workhorse, a platform for aerial surveillance equipped with cameras, air ambulance or as a parachuting or passenger aircraft, the Porter is extremely versatile.

In fact, Susi Air, which is a highly successful air charter service in Indonesia owned by the redoubtable lady entrepreneur Susi Pudjiastuti and currently Indonesia's Minister of Maritime Affairs and Fisheries,

has 9 Pilatus Porter PC-6 in her fleet. The website of Susi Air states "The PC-6 Turbo Porter – *Starts* where others *Stop*" - this describes in short the capability of this aircraft. The capability to land nearly anywhere (to be more exact, about 200 meters lengths of reasonably prepared surface) sets this aircraft apart from others. This short field capability, combined with about 1200 kg payload, is in high demand in Indonesia where more than 250 (out of 650) runways are shorter than 500 meters."

In India too, given that vast tracts of land continue to be remote and inaccessible, the PC-6 could well prove to be boon. Imagine being snowed under in Leh and the regular airport non-operational and rescue operations of marooned skiers need to be underway swiftly; or faced with the daunting task of needing to air drop cargo and supplies to some remote corner in the Western Ghats; or pressed into undertaking a aeromedical mission from a village in Assam to the nearest well equipped hospital - the PC-6 makes impossible missions possible!

With inputs from Pilatus

Enter, the Pilatus PC-24

The first ever PC-24 has made its maiden flight with just under 1800 Pilatus staff, all of whom are directly or indirectly involved in the PC-24 project, present to applaud the business jet as it taxied for takeoff. Prototype P01, call sign HB-VXA, flew across central Switzerland for a total of 55 minutes. The flight went exactly as planned with no problems whatsoever.

The PC-24 is capable of exceptional performance, and this maiden flight was a first opportunity to showcase some impressive credentials: the twin-engine business jet took off from runway 07 in just under 600 m and climbed to 10,000 feet (approx. 3000 m) in around three minutes, where the two pilots completed a series of meticulously planned tests. The maiden flight followed a route across central Switzerland – from Altdorf to Brünig via Engelberg.

Test pilot Paul Mulcahy, who has some 11,000 hours under his belt, flew the PC-24 as pilot in command. He has already test flown countless aircraft types and has acquired a wealth of experience on twin-engine business jets. "Everything looks great so far! Beautiful handling – the PC-24 flies just as expected – a real Pilatus aircraft!" reported the second experienced test pilot, Reto Aeschlimann, by radio from the cockpit.

Throughout the flight the PC-24 was accompanied and monitored by a PC-21. As is normal on maiden flights, the PC-24 landing gear was not retracted on this occasion. Twelve flight test engineers watched the flight from the ground as they kept an eye on a stream of real-time flight data received from the PC-24. Had the need arisen, these experts could have given the pilots crucial decision-making information: another means of ensuring the safest possible conditions for the entire maiden flight.

In recent months, the PC-24 handling characteristics had been trialled and refined during numerous tests using simulators and models placed in a wind tunnel. As part of the development team, these two pilots were involved in these tests; their role during the maiden flight was to verify the accuracy of the theoretical assumptions.

"It's an emotional moment for sure, and another major milestone in the Pilatus and Swiss aviation history", stated Oscar J Schwenk, Chairman of the Board of Directors. "Seeing our new business jet take off on its maiden flight is something we've worked very hard for, and dreamt about for a long time. Today, at last, that 'Swiss Dream' became a reality!" The onlookers burst into another round of applause as the wheels of the PC-24 gently came into contact with the tarmac. Paul Mulcahy earned more applause as he left the cockpit, saying to the crowd that this is "a real Pilatus aircraft!".

A total of three PC-24 prototypes will be built and used to complete a rigorous test programme of some 2,300 hours over the next two years. Fewer than half those hours will actually be flown in Switzerland, the remainder will be flown elsewhere. Certification and initial deliveries of the first aircraft to come off the production line are planned from 2017.

The PC-24 is the world's first business jet to be equipped with a cargo door as standard, with takeoff and landing performance that allows the use of very short and even unprepared runways. The jet also boasts a spacious cabin with an interior which can be customised to accommodate individual customer needs. This is indeed a "Super Versatile Jet" – an aircraft designed for a wide variety of missions in line with specific requirements.

(Courtesy : Pilatus)

Air Power and Armour at Red Square

Russia commemorated the 70th anniversary of V-E Day with the largest military parade in recent times, where they also unveiled a range of new generation armoured vehicles.

The 2015 Moscow Victory Day Parade took place in Red Square in Moscow on 9 May to commemorate the 70th anniversary of the surrender of Nazi Germany in 1945. Given the landmark anniversary of 70 years, the 2015 parade was the largest in Russian history. Colonel General Oleg Salyukov, Commander-in-Chief of the Russian Ground Forces, was parade commander while General of the Army Sergey Shoigu, Minister of Defence of the Russian Federation, was parade inspector. In addition to Russian troops, some 1,300 troops from 10 foreign countries also took part in the parade, including contingents from China, India, Serbia, and Mongolia, all four of which were making their first appearance at a Russian Victory Day parade. India was represented by a 71-man marching contingent from the Grenadiers Regiment, led by Captain Vikash Singh Suhag, with Captain DP Singh bearing the tricolour.

The last time the Indian military participated in an international parade of this kind was in 2009, when a tri-service contingent marched down Champs-Élysées during Bastille Day celebrations in France.

Russian military vehicles on the ground and in the air over Red Square included many familiar assets, such as the T-90 MBT, BMD-4 IFV, 9K720 Iskander tactical ballistic missile, S-400 SAM system, Mi-17, Mi-25, Mi-26, Mi-28 helicopters, MiG-29 and Su-27 fighters, Tu-95 and Tu-160 bombers, and An-124, Il-76 and An-22 heavy transport aircraft. However, the 2015 parade also featured a number of notable first appearances, including the public debut of a range of new armoured vehicles, long rumoured to have been under development but never officially confirmed until now.

The largest of the new armoured vehicles is the Armata Universal Combat Platform, based on which the T-14 battle tank and T-15 heavy IFV were on display at Red Square. The T-14 is a radical departure from past Soviet/Russian tanks, the most notable change being an entirely unmanned turret, with the commander located to the right of the driver. The turret receives a new 2A82 125mm smoothbore cannon and a remotely crewed secondary weapon station with a 12.7mm and a smaller calibre 7.62mm machinegun. The T-14 also incorporates an active-protection system (APS) as standard. The T-15 IFV is based on the same hull platform as the T-14, but reversed, so that the crew compartment is toward the rear of the vehicle. The T-15 also features a remote turret, with a 30mm autocannon, 7.62mm machine gun and four Kornet-EM ATGMs. All Armata family vehicles are understood to weigh less than 50 tonnes.

The Kurganets-25 is a new family of modular 25-tonne tracked vehicles that can be configured as IFVs or APCs, both capable of being equipped with remote turrets mounted with a range of weapons from 30mm autocannon, to 12.7mm and 7.62 machine guns to ATGMs.

The last major debut was the Bumerang 8x8 wheeled APC/IFV platform, displayed with a turret-mounted 30mm autocannon and Kornet-EM ATGMs. In yet another departure from traditional Russian designs, the Bumerang features a front-mounted engine, affording better protection to troops during ingress and egress from the rear hatch, instead of the side doors as used on older APCs such as the BTR-80.

In addition, the road-mobile RS-24 Yars ICBM, 2S35 Koalitsaya-SV self-propelled 152mm howitzer, and Ural

T-14 Armata MBT, displaying radical new profile, including unmanned turret, new track configuration, and commander seated in the hull (photo: Sokolrus)

Kurganets-25 APC (front) and IFV (rear) on parade (photo: kremlin.ru)

Typhoon mine-resistant vehicle were also displayed at Red Square for the first time.

In the air above Moscow, the Sukhoi Su-30SM (based on the Su-30MKI) and Su-35S 'Super Flanker' participated for the first time in a Victory Day parade, along with the Kazan Ansat light helicopter. A new four-aircraft Yak-130 aerobatic team called 'Crimean Wings' also debuted at the parade. The 'Russian Knights' and 'Swifts' display teams, flying the Su-27 and MiG-29 respectively, also performed a flypast.

Among the foreign dignitaries in attendance were Indian President Pranab Mukherjee, Chinese President Xi Jinping, South African President Jacob Zuma, the President of Vietnam, Trư'o'ng Tấ'n Sang, the President of Cuba, Raúl Castro, Egyptian President Abdel Fattah el-Sisi and United Nations Secretary General Ban Ki-Moon. Nicholas Soames, grandson of WWII British Prime Minister Winston Churchill, was also present.

MiG-29s of the Swifts and Su-27s of the Russian Knights in a dramatic flypast over Moscow (photo: kremlin.ru)

S-400 SAM system driving through the streets of Moscow (photo: Sokolrus)

Tu-160 and Il-78 simulate aerial refueling above Red Square (photo: kremlin.ru)

Boomerang 8x8 wheeled APC, showing remotely crewed turret with 30mm autocannon and Kornet-EM ATGMs (photo: Vitaly V Kuzmin)

Indian Army Grenadiers marching in Red Square (photo: kremlin.ru)

Su-30SMs of the Kazakhstan Air Force

Su-30SMs delivered to Kazakhstan

Irkut Corporation has delivered four Yak-130 combat trainers to the Republic of Belarus and four Su-30SM fighters to Kazakhstan. The newly-delivered Kazakh Su-30SMs participated in the Victory Day parade in Astana on 7 May 2015. Whereas in the past military aircraft were transferred to Kazakhstan in barter deals, this latest sale is significant in that it was a purely commercial transaction. Experts believe Kazakhstan needs a force of over 40 heavy fighters, so orders for more fighters are likely to follow.

In the present political scenario, any contract for combat aircraft has a political significance: a gesture of political confidence between customer and supplier nations. The supply of Su-30SMs to Kazakhstan should therefore be considered in the context of the relationship between Russia and Kazakhstan, who are both members of the Joint Treaty of Collective Security (JTCS). Kazakhstan is now the first JTCS-member to have acquired combat aircraft from Russia, and this signifies the importance of Astana as a leading ally of Moscow.

In view of increasing military tension in Asia, Kazakhstan has sufficient resources for necessary modernisation of its armed forces and is viewed as a significant arms market. Astana's acquisition policy is quite diversified: cooperation is maintained with Europe, Israel and Turkey. In the sphere of military aviation, there have been contracts for overhaul of MiG-29s and Su-25s in Ukraine and of Su-27s in Belarus. With the contract for supply of Su-30SMs to form the backbone of the Kazakhstan Air Force, Russia has stepped up its presence for future acquisitions by the Asian nation.

While the price of the contract remains unknown, a recent Russian Navy contract with Irkut for seven Su-30SMs was reported by Russian media as carrying a price tag of 12 billion Rubles ($240 million). On the other hand, it is clear that there are special 'JTCS prices' under which Russia supplies military hardware to JTCS member States, payable in Rubles and conducted in a so-called 'Inside-Russia Transaction' mode.

Konstantin Makienko, deputy director at the Centre of Analysis of Strategies and Technologies (CAST), a Moscow-based think tank, comments, "For some time, Kazakhstan has enjoyed quite a positive political situation. The country has no territorial disputes with its neighbours and its internal political situation is stable. Like Turkmenistan, Kazakhstan has been the only CIS country that has escaped any internal or external armed conflict. But recently, the situation has begun to change because of a general political scenario in Middle East and Central Asia, where the ISIL factor comes up with more certainty. The danger from Islamic extremism is becoming evident and a situation in neighboring Uzbekistan is potentially explosive as well. There, in Fergana valley, the concentration of Islamic radicals is huge. Not to forget about Afghanistan, which is not far away from Kazakhstan.

"The factor of China is also quite evident. The Bejing's economic and military power increases constantly and it a serious challenge to its neighbours. No matter what the actual strategies of Chinese leadership are in the long term, the military should keep in mind a 'balance of power' doctrine.

Strategists in Kazakhstan cannot exclude a possibility of regional conflict against Iran. The problem is the infrastructure of Kazakhstan's oil industries are located in the West, close to the Caspian Sea, and belong mainly to US companies. Under one possible scenario of the conflict, in case of any US aggression Iran may respond by attacking US industrial targets in Kazakhstan. Exactly this scenario was rehearsed in 'Center-2011,'a joint Russia-Kazakhstan military exercise."

Makienko further elaborates, "The Kazakhstan Air Force is in fact the most efficient instrument in meeting challenges of the present day. In case of any military conflict, it canleap into action rapidly. Secondly, its response will be the most efficient. The Su-30SM is actually the optimal option for Kazakhstan. It is an advanced fighter, developed from the Su-30MKI, with long range and a huge combat load. Its advantage is a two-pilot cockpit team, where the second pilot assists the first in piloting and weapons release. Kazakhstan has become the fifth country to acquire the Su-30MKI family after India, Malaysia, Algeria and Russia. Between these countries, they have ordered nearly 410 combat jets!"

In conclusion, he says, "Another circumstance is that with acquisition of the Su-30SM, the Kazakhstan Air Force has operational compatibility with the Russian Air Force. By now they have acquired 60 Su-30SMs, while the Russian Navy have got 12. In a scenario of any danger to Kazakhstan's integrity, under its obligations as an ally, Russia will provide Kazakhstan with assistance and in this situation a matter of technical compatibility will not be merely academic. Eurasian integration has become the main political concept of Putin's second term in power, and military-technical cooperation with Kazakhstan brings 'real' content into the idea of a Eurasian Union. Under a combination of political, economic, cultural and military factors, Kazakhstan is becoming the most important ally of Russia in the region and indeed in the post-Soviet area. Constant reinforcement of its relationship with Kazakhstan is a priority of Russia's foreign policy, and this sale of Su-30SMs to Kazakhstan speaks in favour of this concept."

Vayu on-the-spot report from Hamburg

Spoilt for Choice

The Aircraft Interiors Expo 2015

To use a cliché, the Aircraft Interiors Expo 2015 was the airline industry's "must attend" event of the year. The 16th edition opened at the Hamburg Messe in northern Germany on 14 April 2015 for two days and, organised by Reed Exhibitions, was touted as "the largest ever staged with over 530 exhibiting companies from 30 different countries spread over seven halls compared to the five in 2014, including a record size IFE Zone which has grown by 31%".

Aircraft Interiors Expo 2015 was a global event that showcased the entire range of interiors systems and services and over 58 new exhibiting companies were promoting ground-breaking new products and innovative technologies. Over 800 airline buyers as well as more than 530 suppliers and 13,800 visitors attended this year's most important event in the aircraft interiors calendar.

Prominent visitors from India were senior executives from Jet Airways and Vistara Airlines. Both these Indian carriers have formidable partnerships : Etihad Airways took a 24% equity stake in Jet Airways in November 2013 which airlines now combine their network of 130 destinations, with Jet Airways establishing a Gulf gateway in Abu Dhabi and expanding it's reach through Etihad Airways' growing global network.

Meanwhile the much awaited Tata-SIA Airlines Limited (TSAL) entity, with the name Vistara recently started scheduled services, their hub being Delhi. The name *Vistara* is derived from the Sanskrit word *vistaar*, which means 'limitless expanse', and draws inspiration from the brand's domain : the 'limitless' sky. Even as Vistara and Jet look to pamper their passengers, these airlines (and all others globally) are certainly spoilt for choice as traffic ever increases.

According to a recent report from the International Air Transport Association (IATA), global passenger traffic results for February 2015 showed a strengthening

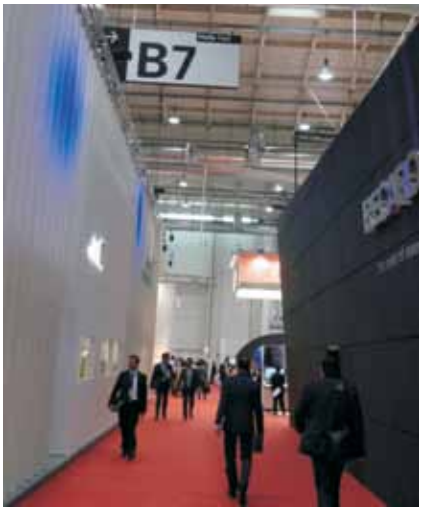
Top-down view of Recaro's display at AIX 2015

in demand growth compared to February 2014. Total revenue passenger kilometres rose 6.2%, which was an improvement on the January year-over-year increase of 4.5%. Available seat kilometres capacity in February 2015 increased by 5.6% with the load factor rising 0.5 percentage points to 78.5%.

IFEC and seating play a prominent role in enhancing the passenger experience and at Aircraft Interiors Expo 2015, the latest innovative technologies were displayed by 78 companies in the largest ever IFE Zone. These companies include Astronics, Blue Box Avionics, Gogo, Lumexis, Molex, Panasonic Avionics, TE Connectivity, Thales, Viasat and Zodiac as well as first-time exhibitors such as Axinom, Dicentia, DMD, In-Flight Dublin, TEAC and Wisscom Aerospace– to name a few.

With over 185 companies on the show floor from around the world displaying the latest in seating products and services, many visitors viewed a wide range of new seat launches on display incorporating the latest technological developments. At AIX 2015, a new and exclusively designed USA Pavilion provided a platform for a range of smaller and medium size companies to promote their products and services – many of which are new exhibitors.

Another new feature at Aircraft Interiors Expo 2015 was CabinSpace LIVE, a face-to-face platform which offered a dedicated area for the exchange of information and



Black & White : Zodiac to the left, facing Recaro on the right

best practices with direct access to airlines, operators, buyers and specifiers from the industry, which included companies such as Imeco, Lufthansa Technik, Recticel/ Soundcoat, Schott, Silentium, Solvay and STG Aerospace.

"With IATA's report confirming the rising trend in higher passenger numbers, the topic of passenger experience has never been higher on the agenda for the aircraft interiors industry. For attending visitors and airline representatives, Aircraft Interiors Expo 2015 is the largest edition ever staged, covering all aspects of the interiors spectrum on the show floor. We look forward to welcoming all our exhibiting companies and visitors from around the world to what will undoubtedly be a busy but important week at this year's *must attend* event for this innovative and vibrant industry," had said Katie Murphy, Senior Event Director of Aircraft Interiors Expo.

The Recaro–Airbus offer

There were certain high profile product launches and major policy announcements at AIX 2015, the most prominent being that by Airbus and Recaro Aircraft Seating who are uniquely offering a 'supplier-furnished-equipment' (SFE) Economy Class seat option for A320 Family operators. The proposed new seat, named '3530Swift, is based on Recaro's BL3530 already developed for the A320 Family and to be available later this year, both in line-fit and retrofit.

Till now, all economy-class seats for the A320 Family are supplied as "buyer-furnished-equipment" (BFE). Being SFE, rather than BFE, the new seat would be available in predefined, pre-qualified and pre-certified Airbus layouts and catalogue configurations which would save considerable time which is normally required for individual product approval. The new SFE option would sit alongside the existing Airbus BFE product offering and the A320 Family's BFE catalogue will continue to be updated.

Once it is fully available to order for the A320 Family, airlines would be able to customise the '3530Swift' with various catalogue options which include leather dress covers, comfort cushions, more stowage space and a six-way adjustable headrest. Customers would also be able to select a tablet PC holder and tablet PC stowage, as well as a power socket for USB and PC. Moreover, the seat would take full advantage of A320's wide cabin to offer a comfortable 18-inch width between armrests, while its excellent pitch efficiency will also enable airlines to install more rows in an aircraft whilst maintaining leg room.

Meanwhile, Vistara has selected BAE Systems' IntelliCabin™ in-flight entertainment (IFE) system, which provides inflight wireless streaming of preloaded content to customers' personal electronic devices across all three cabin classes in its fleet of A320 aircraft. The system also includes fully integrated Samsung Galaxy Tab S tablets for business class customers. With its state-of-the-art wireless technology and unique user interface,

the fully integrated IFE system provides travellers with entertainment options beyond those currently available aboard commercial flights. The entire Vistara fleet will incorporate the IFE system, expected to go live in another six months. In the interim, BAE Systems is providing Vistara's business class customers with customised Samsung Galaxy tablets with specially selected preloaded content. This interim solution will be available to Vistara's business class customers on flights of more than two hours duration beginning in March 2015.

Global technology leaders BAE Systems and Samsung have partnered to deliver the state-of-the-art IFE system, which can be experienced in business class using customised Samsung Galaxy tablets and on customers' personal electronic devices across all cabins. It delivers movies, TV shows, magazines, and games through a rich and responsive user interface.

The tablet-driven IFE system is one component of BAE Systems' IntelliCabin suite of products, which provides an integrated, scalable approach to aircraft cabin management through in-seat power, dynamic LED lighting, and a cabin crew interface.

Northern Avionics has introduced WAvES (Wireless Avionics Entertainment System) which is its latest line of wired and wireless IFE and Cabin Management Systems. WAvES is all about flexibility, customer customisation and ease of retrofit without any compromise in quality. It is designed to fit or retrofit any aircraft, from large airliners down to private jets and helicopters. Every part and every line of the WAvES software is produced in-house, which means that Northern Avionics can work with its customers to develop the system and the user interface exactly according to their requirements.

Panasonic Avionics Corporation (Panasonic) announced the acquisition of Tactel AB, a leading mobile app and software consultancy in Sweden that counts many prominent Scandinavian companies as its customers. The move is part of an ongoing strategy to enhance Panasonic Avionics' leadership and capabilities in software and design.

Panasonic also announced that China Southern Airlines, Asia's largest airline, will be launch customer for Panasonic Avionics' eXO system, the industry's most sophisticated overhead in-flight entertainment system. The eXO system is designed with single aisle aircraft in mind and China Southern has chosen it for its new narrow-bodied fleet of Airbus A320s and A321s being delivered from early in 2016.

Elsewhere in the exhibition, digECOR launched a new LED cabin lighting solution that gives airlines 4 billion colour and light intensity levels to maximise passenger comfort during flight. The system is fully integrated with digECOR's Glide seat-centric IFE solution and is available as a direct replacement for most aircraft common light fixtures in sidewall and ceiling use.

Thales staged a media briefing to announce the reshaping of its in-flight entertainment and connectivity (IFEC) activities into Thales InFlyt Experience. The company explained that this strategic shift focuses on the passenger experience which Thales enables airlines to offer, as well as the airline experience where customers engage with Thales to design, deliver and support their solutions.

According to writer John Hony, a new learning experience for visitors came in the shape of CabinSpace LIVE, a face to face arena for the presentation of new concepts and the exchange of information. Jan Schmidt from Lufthansa Technik and Klaus Portmanns from SCHOTT explained how the challenge of changing LEDs can be managed effectively with the unique HelioJet®technology. Nigel Duncan of STG Aerospace explored the importance of lighting to passengers' experience, brand

Mock up of Airbus A320 cabin with Recaro's BL3530Swift seats installed

Cabin interior of Austrian Airlines A320

Inflight entertainment is de rigueur for the business-class passenger and ever smarter systems are now on offer

identity, customer loyalty and optimisation of the cabin as a retail environment for airlines, while Dr Armin Klesing of Solvay gave an overview of current lightweight materials technologies, including his company's latest foams and sandwich designs for aircraft interior applications.

A new way to tackle noise pollution was described by Yoel Naor from Silentium. The quiet bubbles concept offers an alternative to ANR headphones by combining speakers in the seat shoulder and/or headrest to provide a significantly quiet environment. Another approach to sound reduction was presented by Werner Van Peteghem of Recticel/ Soundcoat who talked about the growing role of flexible foam products in replacing traditional materials and components.

The much awaited Crystal Cabin Awards, the 'Oscars' of the aircraft interiors industry, were congratulated by Katie Murphy,Senior Event Director of Aircraft Interiors Expo : this year, these were B/E Aerospace, Embraer, SABIC Innovative Plastics, SII Deutschland, ViaSat, Etihad Airways and Hamburg University of Applied Sciences, "all of whom had developed exciting new concepts".

As Katie Murphy summed up "We feel it's very appropriate that Aircraft Interiors Expo, which is itself a showcase of innovation, should have the opportunity to recognise the achievements of this year's Crystal Cabin Award winners. It is very encouraging how this industry continues to develop outstanding new ideas to meet the challenges facing the air transport sector."

Germany's Gateway to the World, the Port of Hamburg on the river Elbe, is located 110 kilometres from the North Sea. Hamburg is the site where A320 Family aircraft and the A380 are fitted with their cabin interiors, and painted for final delivery

"First Class is Dead, Long Live First-uh-Business-um-First Class!"

Speak to enough industry folks and there is general agreement that the section of the cabin allocated to 'First' is shrinking to oblivion. In fact, this is nothing new. We've predicted the end of First Class for as long as I can remember. That goes back a while now.

During this same time, as we've bemoaned the death of First, our industry has introduced never-before seen levels of comfort. Sure, many of those carriers are in regions accustomed to unrivalled luxury in all areas of life, and they are not representative of the majority of the flying public.

It is also true that carriers who cater to most passengers have slowly moved away from a three-class configuration, eliminating it entirely on certain routes.

Recaro's brand new CL6710 business class seat

But what is really behind that? Does it prove that First is finally dying, or is something else afoot?

When American Airlines announced their new 777-200 cabin this month, many pointed out: "They've eliminated first class!"

Marisa Garcia

Frisian Flag and EART 2015

A Dutch KDC-10 tanker returns from an EART mission

The annual *Frisian Flag* multi-national exercise was held 13-24 April at Leeuwarden air base in the Netherlands, with a mix of air-to-air and air-to-ground wartime scenarios executed by the participants. Realistic international cooperation is one of the key aims of this exercise, leveraging the lessons learned from recent operations such as those in Afghanistan and Libya. Many international operations are conducted by multinational taskforces, with a diverse range of aircraft, different tactics, doctrines and training, unique command-chains and varied mid-air refueling procedures and certifications. Exercises like *Frisian Flag* provide a cost-effective opportunity to train for multinational operations.

Two missions per aircraft were flown each day during the exercise, but different pilots operated each one. Over the course of the exercise, the missions became increasingly complex, to reflect the participants' growing familiarity with the assigned tasks. The missions included offensive and defensive air-to-air as well as air-to-ground sorties, with some 40 to 50 aircraft airborne each mission. All participating countries had a chance to play the role of mission-commander and all countries were able to bring in their tactics, doctrines and lessons learned from previous exercises as well as actual combat experiences.

French KC-135 taxis in front of a parked German A310 MRTT

The following fighter aircraft comprised the core of *Frisian Flag* 2015:

- Germany: 6/8 Eurofighter Typhoons (plus 4/2 spare) from 31 TLG at Nörvenich air base
- Poland: 4 F-16s (plus 2 spare) from 32 TAB at Lask air base
- Finland: 4 F/A-18s (plus 2 spare) from 31 Squadron at Rissala air base

Italian Air Force KC-767 tanker with refueling boom under the fuselage and hose pods under each wing

Spanish Air Force F/A-18A over Leeuwarden

- Spain: 4 F/A-18s (plus 2 spare) from the 12th Wing at Torrejon air base
- USA: 8 F-15Cs (plus 4 spare) from the 159th Expeditionary Fighter Squadron (aircraft from Florida Air National Guard and Oregon ANG)
- The Netherlands: 10 F-16s (plus 4 spare) from 312, 313, and 322 Squadrons at Volkel and Leeuwarden air bases. Besides the fighters, there were also several supporting aircraft:
- The Netherlands: One C-130 acting as a 'slow-mover' to be protected by the fighters
- Cobham Aviation Dassault Falcon 20 and Skyline Aviation L-39 for Electronic Warfare (EW)

EART 2015

In parallel with *Frisian Flag* 2015, the international tanker training exercise *EART15* was held at Eindhoven air base in the southern part of the Netherlands. Tankers from across Europe participated as refuellers for *Frisian Flag* aircraft. The Netherlands contributed a flying boom equipped McDonnell Douglas KDC-10, Germany provided a hose-and-drogue equipped Airbus A310MRTT, France sent a Boeing KC-135 with both boom and hose systems installed, while Italy provided a Boeing KC-767 also with boom and hose systems.

The European Air Transport Command, located at Eindhoven air base, coordinates and controls all cargo flights and refueling flights for the participating countries: France, Germany, the Netherlands, Belgium, Spain, Italy. EATC was started as an initiative of the European Air Group to use allied cargo aircraft more efficiently, resulting in a multi-national organisation that commands most of the aircraft of the participating countries.

Spanish Air Force F/A-18A preparing to take off on a Frisian Flag mission

German Eurofighter at touchdown

In 2014, the first *EART* was held at Eindhoven with the aim of getting tankers and tanker crews together in one place to support the parallel *Frisian Flag* exercise (see *Vayu III/2014*).

In 2015, the aim of the second *EART* at Eindhoven was once again to support *Frisian Flag* but also to incorporate elements from the European Airlift Tactical Training (EATT) and to lay the initial academic groundwork on air-to-air refueling.

During recent combat operations certain shortcomings in the European AAR capacity have been identified. First of these is the huge dependency on AAR capacity from the USAF. Among European tankers, not all receiver aircraft types could be refueled by any available tankers because the requisite certifications were not yet in place. This led to inefficient use of tankers in support of combat operations. In addition, not enough AAR planners are available to European air forces.

EART 2015 was therefore an excellent opportunity not only to support *Frisian Flag* but also to foster closer cooperation between tanker crews and their logistics crews. Participating tankers performed tasks from European Airlift Tactical Training, such as rendezvous procedures with other tankers

Joris van Boven/Sentry Aviation News (text and photos)

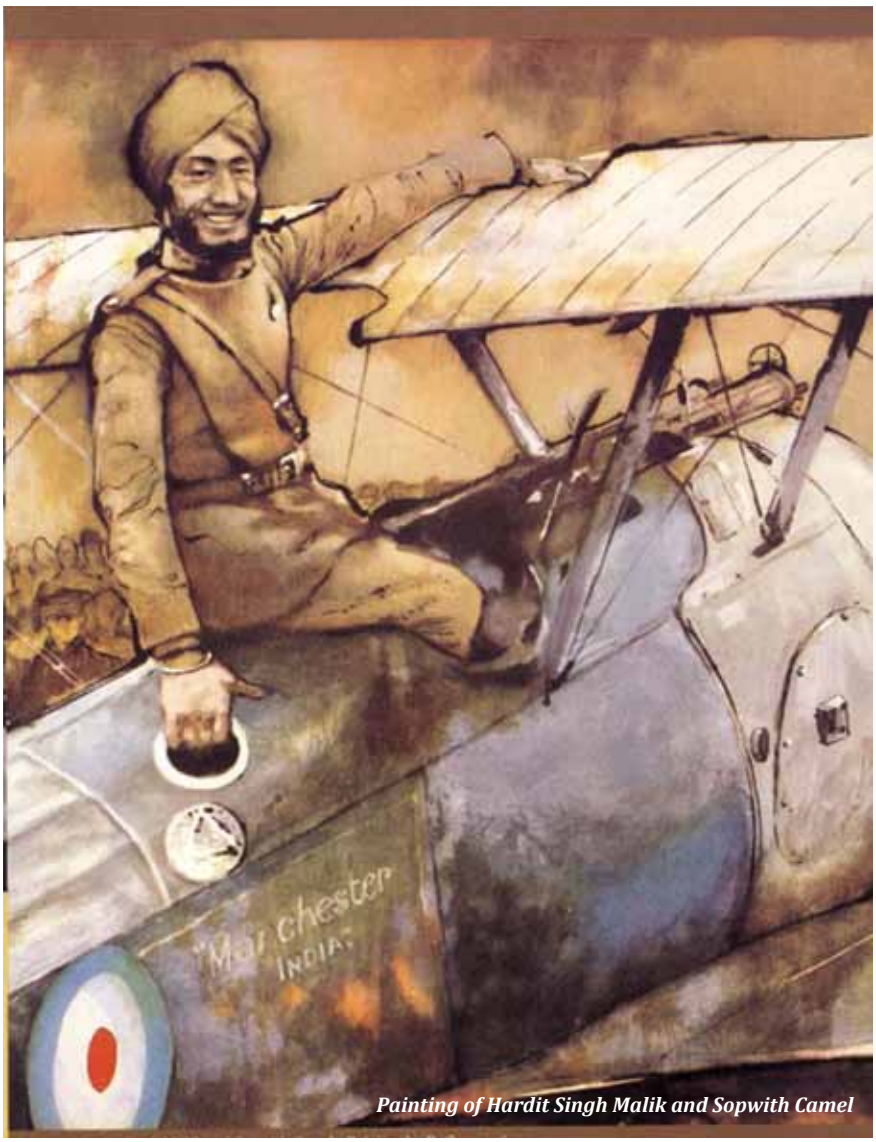
Royal Netherlands Air Force F-16 prior to touchdown

Florida ANG F-15C about to touch down at Leeuwarden

Centenary of World War I

Air Warrior Extraordinaire

This extraordinary story of India's first Air Warrior is published even as the Centenary of World War I is being commemorated. These excerpts are from the autobiography of Sardar Hardit Singh Malik CIE, OBE, ICS ('A Little Work, A Little Play') who joined the Royal Flying Corps (later RAF), saw operational service with the famous No.28 Squadron RAF shot down several German fighters and in turn was wounded in air combat over France. After the war, he entered the prestigious Indian Civil Service, later became the Prime Minister of Patiala State and continued to serve as India's High Commissioner to Canada and Ambassador to France. He was also one of the finest golfers in India.



Painting of Hardit Singh Malik and Sopwith Camel

When the First World War came in 1914 I was in my second year at Oxford. Practically all of my British colleagues who were physically fit volunteered to join the fighting services and it was not long before I also caught the fever. I had a strong feeling that this was going to be a unique adventure in which every young man should participate.

For an Indian student, however, getting into the war was not easy in the days. My attempts to get a commission in the fighting services as most of my British friends had done were not successful and all I was offered was a job as orderly in one of the hospitals in England where the wounded soldiers of the Indian Army who had joined the British Expeditionary Force were being looked after. This was not my idea of active service. Eventually, with the help of my tutor at Balliol, 'Sligger' Urquhart who was also a good friend I succeeded in getting out to France as an ambulance driver with the rank of an officer in the French Red Cross.

It was during this period of service on the Western Front that I made up my mind that I would be a fighting pilot. The exploits of Guynemer the famous French pilot who was worshipped by the French as a great national hero and who seemed to be like a Knight in shining armour of the days of my boyhood when I was fascinated by Henty's Tales of Chivalry and Romance, thrilled me and fired my imagination. I was determined to fly.

As luck would have it I was able, by pestering some of my French friends whom I got to know at that time, to arrange for admission to the French Air Force as a Volunteer. In the meantime I had kept up regular correspondence with 'Sligger' who had got me into the French Red Cross and when he heard of the possibility of my being taken into the French Air Force he called on General Sir David Henderson, who was commanding the Royal Flying Corps at that time and who was a friend of his, and expressed his indignation at the possibility of my being taken into the French Air Force when I, as a British subject should by all rights be in the Royal Flying Corps (RFC).

General Henderson was over and before long I was called to London for a personal interview with him. To my great delight and excitement the General, after a brief interview offered me a cadetship in the RFC as soon as I could secure my release from the French Red Cross. This did not take long and early in 1917 I joined the RFC, as a cadet. It seemed almost like a dream and I shall never forget the thrill of putting on the prestigious uniform — the famous old 'maternity jacket' — for the first time !

I have often been asked if as a Sikh - with my *keshas* and turban - I did not have .problems in the RFC. Well, on my very first parade the Sergeant Major in charge of

the parade pulled me out of the ranks and said "Why are you not wearing a hat ? You are not in uniform", I tried to explain that as a Sikh with my long hair I had to wear a turban and this was a part of *my* uniform. He would have none of it and would have ordered me off parade, but, fortunately for me, the Adjutant who was watching the parade, noticing the incident, came up. I explained the position to him and he told me and the Sergeant Major to carry on adding that the matter would have to be referred to the War Office. Presumably the War Office gave me a special dispensation as I heard no more about it.

The only other problem of this nature that cropped up was over the question of my flying helmet. This was very important in those days of open cockpits and l got over *this one* by having a specially large one made to fit over my turban.

I confess that while I thoroughly enjoyed the period of preliminary training, first at Aldershot - despite the physical discomfort already referred to - and later at Reading, learning all about the theory of flight and rigging etc. of the flying machines of those days which were mostly wood fabric and wire and about aero engines, and realised all this was basically essential, I was impatient actually to get into the air.

I did not have long to wait, for on the successful completion of my course at Reading I was posted to the Preliminary Flying Training Station at Vendome in central France which was run by the RNAS (the Royal Naval Air Service) but where both RFC and RNAS cadets did their preliminary flying.

It was here that the cadets were sorted out, those who were considered fit to fly the single seater fighters of those days, the Sopwith Camel, the Sopwith Pup, the SE.5 etc. which required a lighter touch and more skilful handling then the heavier mad lines the RES etc. mostly used for artillery observation and others. The heavier-handed pilots whose reflexes were supposed to be slower were put in this category while those who tailed in the various tests were declared unfit for flying relegated to ground duties. All these of course had their important roles to play in war but human nature being what it is, the fighter pilots were considered the elite in a Corps which itself was considered elite.

Great was my delight therefore when, after successfully going through the various tests I was put into the first category and picked for further training as a fighter pilot. I was fortunate in picking up a knack of flying an aeroplane very quickly – being allowed to go 'solo' after only 2 ½ hours 'dual' – and what a thrill, truly unforgettable, it was to be allowed to go up alone to pilot the Caudron in which I had received my dual instruction for the first time.

The time at Vendome was comparatively short, only a month or so, but very enjoyable as the Loire country in which Vendome lies is very beautiful and I was a member of a small group who became close friends as we had been together at Reading. Besides I thoroughly enjoyed the flying and happy that I had taken to it so easily.

A dapper Hardit Singh Malik with his RFC wings

I was fortunate in having as my Instructor a man who not only took a real interest in his pupils but became a good friend and it was due to his special interest that I learnt to pilot a plane so quickly. His name was Carr and he later came out to India as Air Officer Commanding the RAF there.

At my next posting which was at Filton near Bristol, well known as the location of the Bristol Aircraft Co. who brought out the well known Bristol Fighter, probably the best fighter aeroplane, on either side, in the closing months of the war and which I had the good luck to pilot in France in 1918 with No.11 Squadron. Again I was fortunate in having an excellent Instructor, a regular Army officer who had joined the RFC, Captain Chadwick who also became a good friend. Here at Filton we had our secondary flying and our preliminary training as fighter pilots. Starting with BE.2Cs which had a stationary engine and was a stable plane, we learnt to fly the unstable planes with rotary engines. Beginning with the Avro 504 which was the most popular training plane at that time for fighter pilots we moved on to planes like the Sopwith Pup the Nieuport and so on, ending up with the Sopwith Camel the most sophisticated fighter plane at that time—and the trickiest to fly.

At Filton we were taught aerobatics, the famous 'Immelmann' turn named after the renowned German ace, looping the loop, rolling, spinning, steep diving etc., all of which were so vital for the fighter pilot of those days whose life literally depended on his ability to manoeuvre his plane. Under Chadwick's expert and sympathetic instruction I soon got the knack of flying these sensitive planes and doing aerobatics in them and I won my 'wings' and became a full-fledged pilot inside a month of my posting at Filton.

From Filton I moved on to Yatesbury where after further flying various kinds of 'Scouts' as the single seater fighter planes were called we finally formed a Sopwith Camel Squadron, No. 28, and it was from here that we flew out to France. We were stationed at an airfield in Flanders near the village of Droglandt. This was wally a marsh as most of the land in Flanders is which had been made into an airfield by putting cinder tracks on it. As the field was comparatively small, landing on these cinder tracks was quite tricky, but most of us knew how to handle our Camels and had no difficulty. It was a different story however when a Squadron of DH.4s which were heavier, and ran more after landing than a Camel did. The first four planes ran into the hedge at the end of the runway and the plan to have the DH. 4 squadron stationed at Droglandt was abandoned.

In No. 28 Squadron the only pilot who had any active service was our CO. Major Glanville, a nice enough person but very shy and retiring, certainly not the man to command a fighter squadron. The role of leader in our Squadron was soon taken over by William Barker, a Canadian, who had served in the Infantry in France and then changed over to the RFC. Barker made it his business to master flying and particularly the business of aerial warfare. He became a first class pilot, complete master of his aeroplane and spent days and nights studying enemy planes, their performance, their manoeuvrability, the tactics of German fighter pilots like Immeleman and Richtofen. Realising the vital importance of shooting in the air, by sheer hard work and perseverance he made himself a first class shot. He ended up, I believe, as the most successful lighting pilot of all those who fought in the First World War either with the Allied Forces or the enemy, winning the Victoria Cross, the DSO with three Bars, the MC with three bars, the DFC and various foreign decorations.

'Billy' Barker was my flight commander and initiated me into the art of aerial combat. A great many pilots were shot down very early in their careers through sheer inexperience. Many never saw the enemy plane until they were hit and I was fortunate in being guided during my first flights over the lines by Barker who would fly close to me and often indicate by pre-arranged signals, as there was no such thing as aerial telephoning in those early days where enemy planes were and which direction they were coming from.

I recollect during one of these early flights that Barker signalled to me and before I realised what had happened, saw a Fokker diving on Barker and opening fire but before he got within shooting range Barker did a climbing turn and got on to the tail of the diving German shooting him down in flames. It all happened in a few seconds, almost before I realised what was going on.

On another occasion our Squadron joined up with two other squadrons to do a massive patrol against the German fighter squadrons posted across the lines not far from us including Richtofen's - the legendry Red Baron - who had been playing havoc with our artillery observation planes and balloons. It was an unforgettable sight when our three squadrons, 54 aircraft in all, Sopwith Camels, SE.5s, Sopwith two-seaters, assembled to cross over to the German lines. We soon ran into the enemy fighters and a regular dog fight ensued. In such a battle in those days each pilot had to look after himself and I soon found myself engaged in combat with a German Fokker. I was able to get into a position finally to dive on him and shoot him down. During the excitement of the combat, however, I had lost nearly 6000 ft of height without knowing it, and after the German went down I looked around for the rest of our formation. Not an aeroplane to be seen ! I became rather anxious, but then I looked up and saw a lot of our aeroplanes. Barker, after the battle, looked around for our aeroplanes, some of which had been shot down, and spotted me five or six thousand feet below. He brought the entire formation down to where I was, thus probably saving my life because alone in enemy country with plenty of German planes around, my chances of survival would have rather dim. This indeed was one of the ways in which the inexperienced lost their lives.

Barker who became a good friend, was associated with probably the most vital and unforgettable experience of my life. The incident is well worth describing in some detail.

We had had a spell of very bad weather, preventing all flying and as happens at such times we were all feeling rather bored and restless. In those days without any navigational aids except the compass and one's own sense of direction and observation we did no flying when the sky was completely clouded and visibility at 1000 ft or less was practically nil. Barker got particularly impatient and, weather or no weather, had made up his mind to fly. He told the CO that even in the prevailing bad

William George Barker and his Sopwith Camel on the Western Front. Malik's CO, 'Billy' Barker earned the VC, DSO and Bar, MC and Two Bars and was arguably the most highly decorated fighter pilot in aviation history.

In this painting, the legendary 'Red Baron' is seen making one of his 80 aerial 'kills'

weather he felt that he could find his way to Richtofen's Squadron who were just across the lines from us and his plan was to fly over there with three other pilots, who would volunteer to go with him, and shoot up the Germans. Glanville told Barker that he was crazy and categorically refused to give his permission. Barker, however, persisted and he was finally able to persuade Glanville to call up Headquarters and see if the General would give permission. The General who knew Barker said that he had no objection to Barker's plan.

Three of us, Fenton, Cooper and I volunteered to go with Barker and almost immediately on taking off in our respective Camels we flew into thick cloud and as planned started to fly a compass course to the German airfield. I kept as close as I dared to Barker but we lost touch both with Fenton and Cooper. Barker and I realised that we were lost when we suddenly flew into a clear patch of sky in the clouds. A large number of German aeroplanes had flown into the same gap and before we knew what had happened we were engaged in a dogfight. We were completely outnumbered of course and both of us, I am sure, felt that we had had it. However, there was no time for such thoughts as I saw a German coming straight for me with his machine guns blazing. I fired back at him but we both missed. At the same time I felt a sting in the lower part of my right leg and smelt petrol which meant that the main tank, which was below my seat, had been pierced. At the same time the German who had hit me continued in his dive - foolishly - and presented an easy target. I automatically pressed both the triggers of my Vickers guns and riddled him with bullets and he went down in flames. At the same time my engine began to splutter and I realised that there was no longer any petrol coming from my main tank which fed the engine by pressure and which had been shot through. (It was discovered later that the two bullets which had lodged in the lower part of my right leg must have come through the tank and it was a lucky break for me that they had come through the lower part which still had some petrol because if they had come through the petrol vapour in the upper part of the tank the plane would have caught fire and that of course would have been the end).

I realised immediately that my chances of survival were dim. I was about 40 miles over the lines in enemy territory, crippled, as without my pressure tank I could not do a climbing turn (so important in those days for aerial combat), completely isolated and exposed both to attack from the air and from the ground as I had to fly very low. At the same time I was not sure if I had enough fuel to be able to fly the distance to our lines. I felt sure that I would either be killed or taken prisoner. Almost immediately four German fighter aeroplanes caught up with

Scene of an aerial duel near Cambrai in France, November 1917 between a Bristol F.2b of No.11 Squadron RFC and German Albatross DVs (painting by Robert Taylor)

me and began shooting at my Sopwith Camel one after the other. They hit my aircraft several times but never hit me nor any vital part of my aeroplane (afterwards it was reported that my aeroplane had over 400 bullet marks on it!) I was scared at first but after the first few minutes when I felt the bullets hit the plane or ricochet over my head after hitting the wooden part of the plane immediately behind my head, I felt absolutely calm as if I was protected somehow and would not be shot down.

In due course the four German aeroplanes left me, having presumably exhausted their supply of ammunition and I continued my 'hedge hopping' westwards, being shot at and shooting such objects as I could spot on the ground, trucks, camps, groups of troops etc. Great was my relief when I saw the Zillebake Lake, a familiar landmark just on our side of the lines. And, just as I saw this, my engine began to splutter showing that my fuel supply had given up. I landed almost immediately and as that part of the front was nothing but craters and shell holes, the result of constant fighting in the same area over about three years, I crashed without, however, hurting myself. I must have fainted however because I had been bleeding from my leg wound for about 45 minutes and the only thing I remember after the crash was lying in a stretcher by the side of my plane along with some other wounded soldiers, mostly Canadians.

There was an amusing sequel to this incident because when I rejoined my Squadron about four months later, after recovering from my wounds, I saw the report that Barker, who had got back unhurt from this escapade, had submitted which was almost identical with the report I had sent in from hospital. Both reports, after describing the flight ended up "The last I saw of *Malik* (Barker' s report)/ *Barker (my report) was that he was surrounded by Huns, fighting like hell, but I did not think there was any chance of his getting back"!*

This miraculous escape (for I should have been killed a hundred times) had a profound effect on my subsequent life as it convinced me that we die only when our time has come and this bred in me a kind of fearlessness, a most valuable asset in dealing with such crisis as I had to often in my subsequent careers.

The RFC, later the RAF, were unique in one respect in those days among the fighting services. Discipline there was, of course, because without that no Service can survive but there was comparatively little "hot air" and "red tape" associated with the older fighting services and so long as one did one's job, much was overlooked.

The other example of getting away with a breach of discipline was after the armistice in November 1918 when I was posted with No.11 Squadron again a 'Bristol Fighter' Squadron at Nivelles near Brussels. As the war was over, flying was severely restricted and we were ordered to fly only when it was necessary for testing etc. We were all rather restless at this forced idleness and I got the brilliant idea of using this opportunity to visit an old friend of mine whom I had known in the old days at Eastbourne. She was the daughter of a great Alsatian patriot who died in a German prison during the war and she also had been persecuted by the Germans for her strong condemnation of German behaviour towards the Alsatians. For her courage she had been awarded the *Croix de Guerre*, a rare decoration for a civilian, particularly a woman, by the President of France.

When I asked my CO for leave to fly over to Colmar where my friend lived some two and a half hours flight from Nivelles, Heath said "No I can't let you fly, but you can have as much leave as you want and go by train".

As a journey by train from Nivelles to Colmar at that time was completely impracticable I foolishly made up my mind to fly, whatever the consequences. And, at the earliest opportunity, on the excuse of testing my aeroplane I took off and headed due south for Colmar! All would have been well if the flight had succeeded. I could have flown to Colmar and got back after seeing my friend, saying I had lost my way and nothing would have been said. Unfortunately however one of the oil pipes in my engine broke and I had to come down when I was only about half an hour from my destination. To cut a long story short I was able to hand over my damaged machine to the RAF at Nancy and so got back to my Squadron after about ten days absence without leave mainly by getting lifts from various people.

Hardit Singh Malik serving with No.151 Squadron RAF, flying Bristol Fighters from Biggin Hill in 1918

I fully expected to be court-martialled for having deliberately disobeyed the General orders and particularly my CO.'s instructions and was reconciled to this mentally as I knew I deserved to be punished. However, Heath, my CO was absolutely wonderful about it. He pretended to be very angry with me but no action was taken and I am sure that he must have persuaded the General to overlook this lapse on my part in the spirit 'Well the lad has done his bit in the war so what the hell, the war is over anyhow. Forget it !' Talk about being magnanimous!

Although I was determined more than ever to stay on in the Air Force but the war was soon over and after which I returned to India, got married and decided to get out of the RAF and got into the Indian Civil Service.

Epitome of a Test Pilot and Gentleman

Wing Commander Inder Mohan Chopra

On 30 March 2015, many test pilots and colleagues gathered in Bangalore to pay tribute to Wing Commander Inder Mohan Chopra ('Chopie'), former Chief Test Pilot (CTP) and later Chairman of HAL who had passed away a day earlier after a long illness, bravely borne.

As Air Marshal Philip Rajkumar writes, "I had an association with him lasting over forty years both professionally and socially. He was the epitome of integrity and gentlemanly conduct". He, the youngest child of Chet Ram Chopra and Susheila (nee Tandon), was born on 3 May 1932 at Jammu, his father was being a gazetted officer in the J&K State government. Young Chopie received his early education at the Presentation Convent in Srinagar and completed his schooling and college studies in J&K State. A good student, he stood first in the Matriculation examination and enrolled himself in the Mathematics (Honours) course at the Prince of Wales College at Jammu.

In his fourth year he captained the college cricket team but just before graduation, decided to join the Indian Air Force, which move was prompted by a difficult financial situation at home as his father was forced to leave state government service owing to the turbulence politics in the state following Partition in 1947. A gifted and natural flyer from the start he was awarded the Sword of Honour for standing first in order of merit in the Pilots Course. Upon commissioning, he was posted to No. 14 Squadron, then commanded by Sqn Ldr LRD Blunt VrC and equipped with the Spitfire Mk XIV (see photo).

Two years later he completed the flying instructor's course at the Flying Instructors School (FIS) at Tambaram, and was awarded the Majithia Trophy for standing first in the course. An instructional tenure at the No 2 Air Force Academy, was followed by a staff tenure at the FIS. While at FIS he, along with Flying Officer 'Babi' Dey, was selected to undergo the No.16 course at the Empire Test Pilots School (ETPS) at Farnborough,UK in 1957. Becoming an experimental test pilot was the dream come true for Chopie.

Wg Cdr Inder Mohan Chopra, when CO No.9 Squadron IAF, later to take over as Chairman of HAL in April 1989

At this time, the Government of India had signed a contract with Hawker Aircraft Ltd. for the supply of some 160 Hawker Hunter Mk.56 fighter bombers and as was the practice in those years, test pilots after completing the course at ETPS were attached to aircraft manufacturing companies to gain experience. Chopie and Babi were attached to the Hawker Aircraft factory at Dunsfold in Surrey to carry out production test flying of the IAF Hunters.

After three months Babi was deputed to the Folland Aircraft Company for development work on the Gnat light fighter and Chopie returned to India in June 1958 to be posted to No.1 Base Repair Depot at Kanpur for production testing of overhauled aircraft. At that time the Aircraft & Armament Testing Unit (A&ATU) at Kanpur was involved with hot weather and other proving trials of the Gnat Mk.1. Chopie converted on to this aircraft and had the unique honour of being in a three aircraft formation of Gnats which was the grand finale of the Republic Day flypast on 26 January 1960. Shortly thereafter he was sent on deputation to Hindustan Aircraft Limited, Bangalore.

Autographed by 'Chopie' : with a Spitfire Mk.XIV

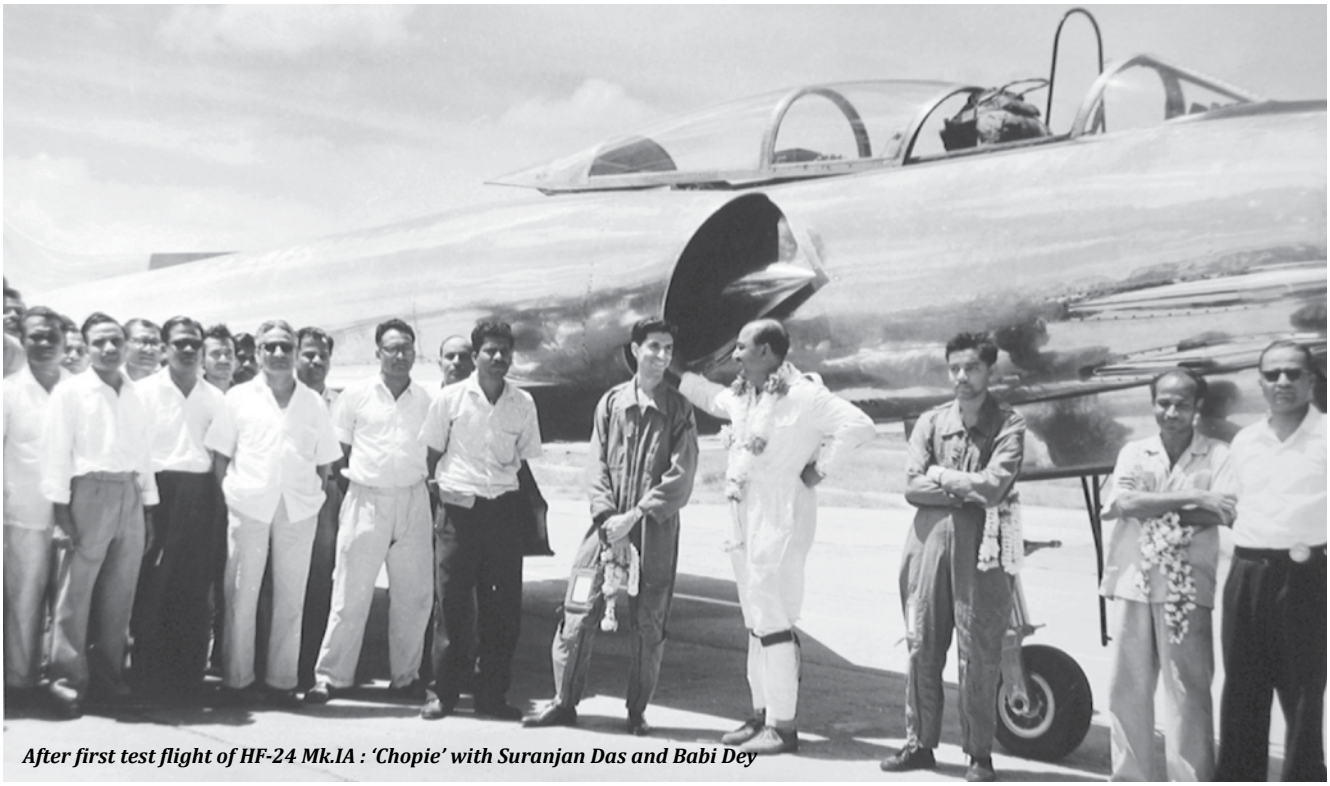
Over the next five and a half years, up to December 1965, Chopie carried out prototype flight testing of the HF-24 Marut and Krishak aircraft as well as production testing of overhauled Vampires, Canberras, Packets and Devons. The iconic photograph of a C-119G Packet flying with both engines feathered using only the Orpheus jet pack was taken when Chopie was at the controls. The Marut was underpowered with its Bristol Orpheus 703 engines and to overcome this problem, the Gas Turbine Research Establishment, a DRDO laboratory at Bangalore, developed a reheat system for the Orpheus. A HF-24 airframe was fitted with two reheated Orpheus engines and Chopie did the first flight of the HF-24 Mk. 1A in December 1965.

Autographed by 'Chopie' : entering the Marut

HAL went on to produce large numbers of the French Alouette III helicopter under licence from SudAviation. Chopie was selected to undergo helicopter conversion at the SudAviation plant at the Marignane plant at Marseille in France. After flying 35 hours with the company he was sent to EPNER, the French Test Pilots School at Istres for production testing of helicopters and he flew about 500 hours on helicopters.

terrible tragedy on 10 January 1970 when its legendary CTP, Gp Capt Suranjan Das, was killed in an accident involving the HF-24 Mk.IA reheat version. The reheat development was promptly cancelled ! Chopie was appointed the Chief Test Pilot in 1971 and after completing 20 years of service in the IAF he was permanently absorbed into the cadre of HAL. The Rashtrapati awarded him the Ati Vishisht Seva Medal for distinguished services.

As HAL's CTP, he was responsible for demonstrating the Gnat Mk.1 at the Farnborough Air Show in 1972 and later at the international air show at Sao Paulo in Brazil in 1973. However, his greatest satisfaction was to come when he single handedly flew a vintage B-24 from India to the UK. The American-origin B-24 Liberator heavy bomber of WW



After first test flight of HF-24 Mk.IA : 'Chopie' with Suranjan Das and Babi Dey

After this short interlude of rotary wing flying Chopie was selected to go to Egypt to work on the Egyptian programme for developing a new jet engine with German assistance. He was in Egypt for three years from June 1966 to June 1969 and carried out 140 flights in a Marut fitted with one Orpheus engine and one German Egyptian engine (the E300), this unique aircraft was designated the HF-24 Mk.IBX. Till then, no IAF test pilot had such an opportunity to work in an international engine development programme which sadly, owing to geopolitical reasons never attained fruition.

On his return to India, Chopie commanded No 9 Squadron equipped with the Gnat Mk.I at Halwara from September 1969 to June 1970 after which he moved to HAL Bangalore pending permanent absorption. HAL had suffered a

Wg Cdr Inder Mohan Chopra (centre, garlanded) after test flight of the HF-24 Mk.IBX at Helwan on 29 March 1967. He is flanked by Air Marshal Sidky Mehmood Chief of the Egyptian Air Force (in uniform) and Indian Ambassador Appa Pant

Rare picture of the HF-24 Mk.IBX

II fame had served in the IAF between 1948 and 1958 and on its retirement, the British government approached the Indian government to present one of these aircraft for the RAF Museum at Cosford. Thus one Liberator (HE 807) was overhauled and made airworthy by HAL and Chopie himself captained the aircraft on the long ferry to the UK in 1974.

During his CTP's tenure he made the maiden flight of the HA-31 Basant agricultural aircraft and later the HPT-32 basic flying training aircraft. A unique opportunity in 1978 was when he was selected to lead the HAL team to Germany which was tasked to prepare detailed feasibility studies on a futuristic light transport aircraft jointly with Dornier GmbH in Germany. This assignment in fact consolidated his considerable management skills, the studies becoming basis of the design & development of the Dornier 228 light transport aircraft which was, some years later, selected by the Government of India for comprehensive transfer of technologies and licence production by HAL and which continues three decades later.

After logging some 5412 hours on 75 types of aircraft, in 1980, Chopie was selected to move to the Management cadre of Hindustan Aeronautics Limited, his first posting being to HAL at Lucknow. After a year there he returned to Bangalore and became the General Manager, Overhaul Division. In 1984 he took over as Managing Director, Bangalore Complex where the Jaguar production was being carried out and Chopie ensured that the Darin-equipped Jaguars entered IAF service on time. In 1988, Wg Cdr Inder Mohan Chopra was selected by the Public Enterprises Selection Board to become the Chairman of HAL.

As Chairman, he ensured that the Advanced Light Helicopter development programme overcame numerous technical challenges and remained on track. His sincerity and integrity were appreciated by the Ministry of Defence, being given an extension of one year after the age of superannuation.

Chopie remained a bachelor, was a good golfer and enjoyed social evenings with his friends. A strict teetotaller and frugal eater, he adopted the children of his housekeeper and supported them through school and college and thereafter into their professions.

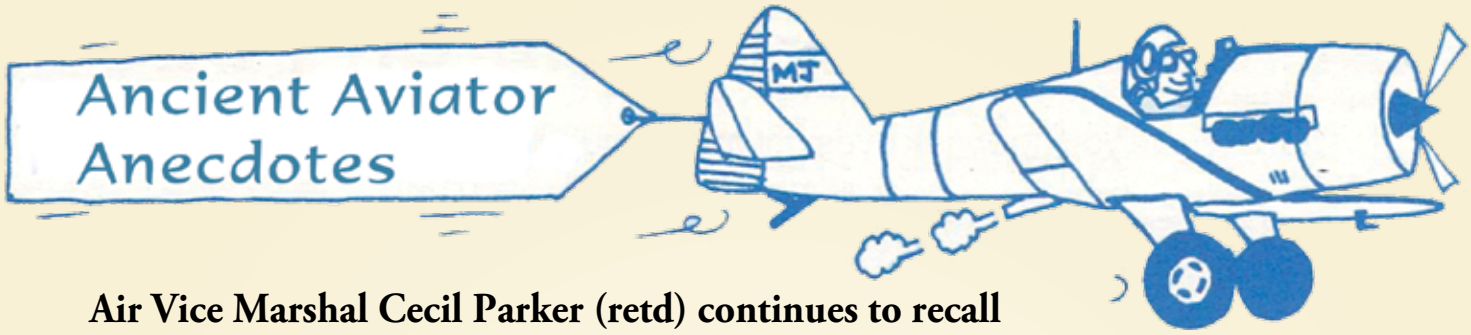
Two years after retirement, he was diagnosed with multiple myloma while in the USA. Doctors gave him six weeks but he survived for over 21 years which itself is a tribute to hisdetermination to fight the disease and the loving support he received from his close knit family of whom he was very fond.

Having known Chopie for such long time and having flown and interacted with him professionally on many occasions, I can only some up his distinguished life in saying that he was a very accomplished flier, a true flight testing professional, a manager par excellence and a gentleman to the core.

May his soul rest in peace.

At the ceremonial handing over of a B-24 Liberator to the Royal Air Force Museum in 1975. 'Chopie' is seen second to the right, along with Air Marshal SJ Dastur (Chairman HAL) and AVM AS Rikhye MD

Wg.Cdr Inder M. Chopra, as Chief Test Pilot HAL, in cockpit of the HPT-32 basic trainer before its maiden flight



Air Vice Marshal Cecil Parker (retd) continues to recall

From the log book

On reporting to the Air Force Academy in 1951, one of the first documents handed to each of us Flight Cadets, was a blank IAF F(AO) – 1266 soon to be familiarly known to us as the Pilots Log Book. Recent research for an article made me unearth my own. Most fliers carefully preserve this verified record of every single sortie flown. (For the uninitiated, a 'sortie' is the time in the air from initial take-off to full-stop landing). Normally the number of take-offs should equal the number of landings but in rare cases, there can be a difference. For example, on 28 October 1952 I took off in Tempest IIA (HA596) but 15 minutes later I had to bail out due to fire in the air and reached the ground by parachute. The detailed record in the log book is comprehensive covering as it does date, aircraft (ac) type / number, whether Pilot / Captain or 2nd Pilot / Pupil, duty (i.e. actual exercise carried out), flight time in single / multi – engine ac, day or night and dual or solo.

To the recorded data, most pilots endorse commemorative/significant occurrences against specific sorties, e.g. accidents, awards, war sorties and photographs. To illustrate: I have photographs of the very first Indian lady (an air force medical officer) to fly in a jet combat ac when I took her up in Hunter T.66D BA575 on 12 June 1970 for an air experience sortie. Another is of Hunter 56 A485 which brought me back safely from the very first sunrise gun-strike on the PAF air base at Peshawar on 4 December 1971 despite 22 bullet hits on its fuselage. Yet another is that of the Iskra trainer aircraft which I inducted into our air force in 1975. No two sorties are ever quite the same as a pilot is always on a learning curve due to the experience he/she gains in each sortie and applies in the next one. Quite a few sorties are linked with special incidents and perhaps some have stories that will never be told…..

As I went down memory lane, my log book reminded me that, as Captain/1st Pilot, I had flown the Tiger Moth, Harvard, Spitfire, Tempest, Vampire, Toofani, HT-2, Prentice, Devon, Dakota, Hunter, T-39 Sabreliner, Marut, Gnat, Kiran, Iskra, Chetak and MiG series. As a 2nd Pilot / Pupil, I had flown the BAe Hawk in the UK, RAF Harrier T.4 in Germany, USAF F–100 Sabre (*Ex Shiksha*) and our own Jaguar just before I left the Air Force in 1986. For the record, these added up to 22 aircraft types and 4261 flying hours of which 43% was on one aircraft type (the Hunter, which I flew continuously for 10 years) and 22 % was instructional as a QFI. I was also reminded that, outside India, I had taken off and landed on eight US airfields, four British and one each in France, Malta, Cyprus, Bahrain and Pakistan (yes, Karachi on 30 September 1969 ferrying Hunter 56A BA969 from UK to India and I believe the very first IAF Hunter to do so).

Hawker Tempest IIA

Dassault Ouragan (Toofani)

Hawker Hunter Mk.56A

MiG-21M

Mine was the generation that in 1952 transitted from piston–engined ac to jet aircraft and that too without the benefit of a trainer as the Vampire T 55 arrived long after we had been launched solo in the Vampire FB52. Perhaps the one sortie that gave me great joy cannot unfortunately be recorded in my log book. A decade after leaving the air force, and in my mid - 60s, I was invited to fly a sortie in a twin-seat microlight aircraft of the Harare Aero Club in Zimbabwe. It was great to be back in the air and, for a while, handling familiar controls in manual flying similar to the Tiger Moth where it all started! For an 'octopilot' his log book serves as a delightful memory box of the years spent in the air.

A PK from the past

Amir Khan's PK came from outer space; the PK of this story came from Kerala and I met him at an air force base. Unlike the saga of our Bollywood hero however, his is a story of the often unsung ground services provided by support personnel whose skills ensure effective air operations in the Indian Air Force (IAF).

On 1 October, 1966, as a brand new wing commander, I stood alone in an empty aircraft hangar at Air Force Station Jamnagar, contemplating my task of raising and commanding the IAF's first Operational Training Unit (OTU) with Hunters. A young corporal dismounted from his cycle, saluted and asked me as to where he could find the OTU. He gave his name as PK Soman, trade as Clk GD and was reporting on posting. I told him he had found OTU, introduced myself, bundled him into my jeep, and together we raided the station stationery stores where we begged, borrowed and stole a typewriter, stationery items and anything else we could lay our hands on. Back in the hangar, he helped me move three crates into the only room with a telephone, a big one for a table and two smaller ones for chairs as there was no furniture. Thus the HQ of OTU was established and a friendship now in its 50th year commenced.

In the next few weeks 20 Hunters, 28 officers, 380 airmen, families, ground equipment plus 16 trainee officers arrived and extensive flying commenced. Through all the initial interdependent activities of creating a new unit, PK was my Man Friday and right hand in setting up our own orderly room. He was virtually my SO, Adjutant and PA all combined till the posted incumbents reported. Through our professional relationship, a personal friendship developed. It was from him that I learnt about the significance of Onam which, along with all our other festivals, our unit celebrated. Unknown to him, I included his name in a list I recommended for a Commendation. However, my laudatory report on him resulted in his being whisked off on posting as PA to an air officer who kept him on his personal staff for a decade! We kept in touch and PK left the IAF in 1978 from HQ TC IAF Bengaluru. He joined the clerical cadre of the National Petroleum Construction Company in the UAE and independently opened a new office for them in Saudi Arabia before returning to Abu Dhabi. (I would like to think that his experience in OTU helped!). After I left the IAF myself in 1986, I travelled regularly to the UAE and met up again with him. Sometime after his return to Kerala in 1999, my wife and I were in Munnar on holiday; Soman and family took the trouble of driving from his home in Alapuzza to meet us in Kochi for lunch.

PK Soman is now a happily retired grandfather and, in the past near half century, I cannot recall a year when we did not exchange greetings cards for Christmas and Onam! Next year, when OTU (now at another base and operating another type of aircraft) celebrates it's Golden Jubilee on 1 October 2016, I trust that the then Commanding Officer will invite 71-year old No 259696 ex-Sgt PK Soman to the celebration as a founder member of the unit. This PK from the past can be reached at 098472 46275.

"He doesn't want glory – but please tell his story;
Spread a little of his fame around.
He's one of a few, so give him his due,
Three cheers for the man on the ground"
From: 'Ground Force' by LH Day

In clement days

In my student days, I was introduced to PG Wodehouse and of all the colourful cast of characters created by him, Jeeves was always my favourite. I did not know that in later years I was destined to meet a *desi* version of this 'gentleman's gentleman'. 63 years ago, on my very first squadron posting, I checked into the Officers Mess and shared the services of the room bearer with another bachelor officer. Clement, who was about my own age, was industrious, trustworthy and efficient. He not only looked after all our housekeeping needs and kept in safe custody our (very modest) salaries but in dire (financial) emergencies, even made a temporary 'loan' to his young masters who were generally insolvent long before the next pay day! He had some basic education, was a keen learner and had a flair for languages.

Our personal relationship bonded and, when my next posting came, I had no hesitation in agreeing to take him along. Clement thus entered my sole personal service and moved with me to various air bases, all up north. On a short visit to my parents in Kolkata, he accompanied me as he had never seen that city. As our own family retainer was himself on leave at that time, my mother was delighted with his culinary skills of which I knew nothing. He even picked up a smattering of Bengali to add to his communicative skills in Malayalam, Tamil, Hindi and English! Once, when I was briefly hospitalised in a remote Military Hospital and knew no one there, the matron surprised me by announcing a visitor. In walked a smartly dressed Clement, sporting one of my squadron ties and having ridden up on my motor cycle to visit me!

When I got married and while serving at a desert air base, my more senior and experienced colleagues cautioned me that bachelor-days Jeeves never survived post-marriage. On the other hand, my bride whose (then) sole culinary attributes comprised possession of a recipe book and a can opener, was more than relieved to have his experience in the kitchen and even suggested that we return the hospitality of my boss and his wife by asking them over for the very first meal we ever hosted. Just before dinner was to be served, Clement walked in and in a loud voice announced "Madam, fly has fallen in soup' which resulted in great activity behind closed doors! After serving dessert, he once again announced that 'there is no more French toast' to prevent anyone requesting a refill! Our guests laughed heartily at Clement's demonstration of the triumph of Trust over Tact!

Our landlord who lived upstairs had a young pahari maid who looked after his little daughters. Perhaps motivated by my change of marital status, Clement fell madly in love with the young lady upstairs who apparently reciprocated his ardour. Despite opposition from both families (plus the landlord) we were supportive and happy to see this unique Malayali-Himachali union take place when such nuptials were rare. On our next posting up north however, Clement requested me for help to relocate south where he felt he could better his prospects. I was more than happy to assist him financially and, with the help of good friends, admit him into a polytechnic down south for technical training.

Many years later I was in a staff car driving up to Wellington where I was posted when, at a traffic stop-light, a vaguely familiar face on a motor cycle pulled up, gestured to me and requested the driver to pull over. A very prosperous looking Clement (re)introduced himself and said he had been trying to catch up ever since he saw me emerge from Coimbatore airport. At the closest restaurant, we sat together and caught up with family news from both sides. He was now an Assistant Manager in a manufacturing company, had a son and daughter both of whom were in college and he added proudly that his wife and children were all trilingual. I doubt if the original Jeeves could have done any better!

25 Years Back

From Vayu Aerospace Review Issue III/1990

IAF Mirages without weapons

Two years after they had been inducted into squadron service, Indian Air Force Mirage 2000 fighters did not have their principal weapons, long range Super R.530D missile (designated as weapon 'A') and the BAP-100 runway penetration bomb (designated as weapon 'B'). The CAG in their report on the Air Force and Navy tabled in Parliament on 10 May has said that although the first squadron of the aircraft was formed in June 1985 and the second in January 1986, "the required weapons were not available for training as well as operational purposes till the end of 1987."

The contract for weapons 'A' and 'B' was signed in October 1984 'A' was received between July 1987 and February 1989 and 'B' between August 1986 and June 1987. In the intervening, period the squadrons were without weapons 'A' and 'B' required for "instructional, training and operational purposes".

Vayudoot expansion plans

With the objective of introducing new flights in several sectors to meet growing passenger demands, Vayudoot has plans to expand its aircraft fleet. Presently, negotiations are underway with the Romanian civil aviation authorities for 'wet lease' arrangement for two BAC 111 passenger aircraft which has a seating capacity equivalent to the Boeing 737. Purchase of several HAL-manufactured Dornier 228s is also being considered.

Pawan Hans flayed

The Comptroller and Auditor General (CAG) of India has strongly criticised Pawan Hans Ltd in the matter of purchase and operations of helicopters, especially those bought from Westland. Commenting on the huge losses of about Rs 22-45 crores chalked up in the last three years, the report states that in the original PIB proposal, the company has estimated a loss of Rs. 4.30 crores in the first year of its operations and profits thereafter. Against this, Pawan Hans incurred a loss of Rs. 7.12 crores in 1987-87, Rs 7.44 crores (provisional) in 1987-88 and is expected to suffer a loss of Rs 7.89 crores in 1988-89.

Four A320s to be sold and 14 leased

The proposal for sale of four A320 Airbus due to be delivered by Airbus Industrie to Indian Airlines has been cleared by the Union Cabinet. In addition the Cabinet has granted permission for lease of the 14 A320 aircraft presently grounded following the Bangalore accident. IA would shortly float global tenders for leasing and selling the fly-by-wire aircraft. The leasing arrangement is likely to be for a minimum period of an year, while the aircraft which cost Rs. 65 crore each, are to be sold at a premium. A five-member committee has been set up to negotiate with foreign parties keen or buying or leasing the high technology aircraft.

LAH Shows MBB influence

The first design drawings of the Indian Light Attack Helicopter (LAH) reflect a similarity to the Advanced Light Helicopter (ALH) designed with help from MBB of Germany. The tail rotor and tail fins appear to be identical to those of the LAH although to compensate for their high position the tailwheel assembly is unusually long for an attack helicopter. Also, with protection of cyclic and collective pitch controls, the LAH uses the same integrated dynamic system.

Pak orders ex-RAAF Mirages

In a deal worth $ 236 million, the Pakistan Air Force has ordered 50 ex-Royal Australian Air Force Dassault Mirage IIIOs. Pakistan's Chief of Air Staff, Air Chief Marshal Hakimullah has reportedly stated that the package deal also includes 45 additional new engines and spare parts which would help establish a Mirage plant at Karachi. The aircraft are scheduled to be shipped to Pakistan later this year but will not be available for immediate service.

The Indian Defence Report 1989-90

The Annual Report (for 1989-90) of the Ministry of Defence reviews Pakistan's biggest military exercise, 'Zarb-e-Momin', held in late 1989 which was obviously directed towards increasing the visible impact of its military capability and activity. Pakistan has adopted a more strident anti-India posture and despite repeated warnings has encouraged and aided terrorism and secessionism in Jammu & Kashmir. Pointing out that both the quantity and the level of sophistication of arms acquired by Pakistan are far beyond its legitimate security requirements, the Report expresses concern over Pakistan's nuclear weapons and allied delivery systems programme. Despite positive developments in the bilateral relations with China, the Report emphasises the need to watch over Chinese sale of arms to neighbouring countries and its programme of modernisation of the People's Liberation Army with special attention to the induction of advanced military technology.

PAC Mushaks for Iran

The Pakistan Aeronautical Complex (PAC) has secured an order for the supply of 25 Mushak piston-engined trainers to the Iranian Revolutionary Guard *(Pasadam)*. The Mushak is Pakistan's licence-built variant of the Swedish Saab MFI-17, and the PAC earns about US$ 10-million a year in supplying buy-back spares to Saab. So far PAC has built 92 Mushaks since 1975 and has also tested a new variant called the Shahbaz which has a higher rate of climb. PAC's Aeronautical Manufacturing Factory (AMF) is also co-developing the K-8 jet trainer with the People's Republic of China (PRC), estimated to cost US $ 2.2 million per unit which type is expected to compete with the $ 4.5 million CASA 101 in the world market.

Tale Spin

Squall on rail lines

"France will partner India in a study for upgrading the speed on the Delhi-Chandigarh rail track to 200 km per hour and help in re-development of Ambala and Ludhiana railway stations". This was amongst the statements made after Prime Minister Narendra Modi's meeting with President Francois Hollande in Paris on 10 April.

So, why was this sector identified when there are several other city-pair links that could well "qualify" for such TGV-type superfast train connections? Could this somehow be linked with the plan to base IAF Rafales at Ambala and Halwara (close to Ludhiana) when this long awaited aircraft ('squall' in French) sports the saffron-white-green roundels ? It would certainly make life easier for the French personnel seconded to these air bases !

Loch Ness Monster and *Jaguars*

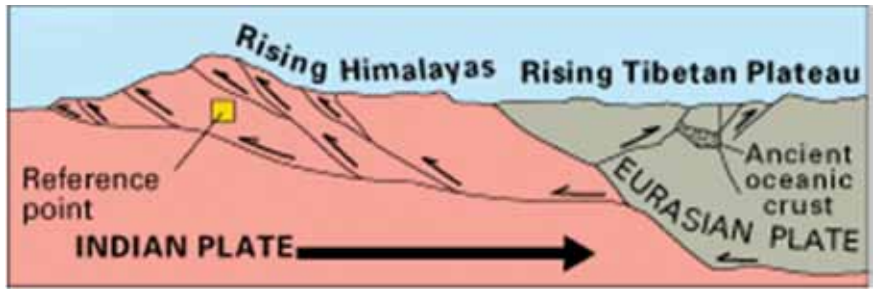
A photograph of the 'Loch Ness Monster' was allegedly taken by Colonel Robert Kenneth Wilson 81 years ago but was later exposed as a hoax. However, there are many tongue-in-cheek suggestions that should Scotland's voters push for 'independence', the elusive Nessie could well become the mascot for the Highland nation's Navy !

As for a future 'Scottish Air Force', one major airbase could be Lossiemouth on the North Sea, which is of nostalgic memory for many Indian Air Force pilots who carried out operational training on the Jaguar at this RAF station during the 1980s.

Indian moves into Tibet

Before this headline triggers off any alarm, since Indian troops face their Chinese counterparts all along the contentious Himalayan frontiers, this actually refers to a recent statement by a Professor of environmental geology at the JNU, that the Indian Plate is gradually moving northwards, to under the Tibetan Plateau. The 'Indian plate' has been moving by 5 cm every year towards the 'Eurasian plate'… so give and take 1000 years, the McMahon Line could look very different.

Hopefully, the proposed Mountain Strike Corps is taking these logistics into its account !



Rats - again !

Not for the first time, but with wincing regularity, an Air India airliner was grounded as rats were seen scurrying around in the cabin of an A320. This was at the high altitude airport of Leh, capital of Ladakh and the 11,000 ft asml conditions did not seem to faze the rodents. With the danger of electric wires being nibbled at, thus jeopardsing flight safety, Air India had to fly in special fumigation equipment to sanitise the aircraft.

Needless to add, the 90-odd passengers on-board had to wait breathlessly at the terminal while a 180-seater airliner from a private carrier came in from Delhi to fly them out of Leh.

Randi - and how !

A newly minted think-tank set up by Pakistan and China to mark the visit of Chinese President Xi Jinping to Islamabad has had the social media in stitches over its name that makes sense only to denizens of South Asia. It goes by the acronym, '*Randi*'.

Pakistanis were torn between helpless laughter and defensiveness. Indians reacted with glee. Strictly speaking, 'Research and Development International' should have been called *Radi* rather than *Randi*. But the creators were clearly inspired by the widely known US military think tank, *The Rand Corporation*. *Randi* may or may not have impressed Americans, but among Indians and Pakistanis, the acronym (which is slang for sex worker) was greeted with whoops. Within minutes, it had spawned a cottage industry in memes, cartoons and hashtags on Twitter.

Afterburner

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