

VAYU

V/2014

Aerospace & Defence Review



IAF at 82

Interview with the CAS
Air Power Imperatives
Himalayan Rescue Ops



IAF's Road to 2032
Need for Radical Reforms
MMRCA or FGFA ?

Dassault



Cover: IAF C-17 flanked by a pair of Su-30MKIs (photo: Angad Singh)

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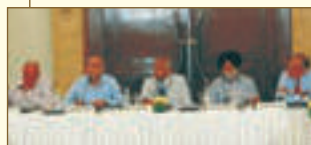
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40 "Capability Build Up in Phased Manner"

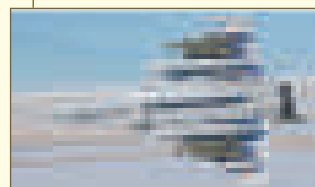
In his interview with Vayu on eve of the IAF's 82nd anniversary, Air Chief Marshal Arup Raha, CAS notes that in its capability build up roadmap, the IAF plans to induct additional fighters, transport and trainer aircraft plus helicopters, new generation weapons and EW Systems even as it progresses towards complete network centric operations capability. Status of the MMRCA, LCA, AMCA and FGFA programmes are also touched upon.



the participants which included an eclectic mix of former senior service officers, bureaucrats, defence analysts and observers. Many of the Air Officers in attendance had retired recently, and several have been closely associated with the MMRCA and LCA programmes.



configuration. The omnirole Rafale, with 14 hard points under fuselage and wings, is capable of carrying 1.5 times its own weight.



88 'More Su-30MKIs and FGFA's'!

A Russian view by Konstantin Makienko on increased cooperation between India and Russia in equipping the IAF with increased numbers of Su-30MKIs and the fifth generation T-50 fighter. He counters rumours on the FGFA programme concerning delays or the small work share of Indian industry.

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48 Herculean Relief Efforts

Floods in Kashmir during September 2014 had the Indian Armed Forces swinging into immediate action, with a major role played by the Indian Army and Air Force. By mid-September, some 2500 relief air sorties had been undertaken, thousands of tonnes of supplies dropped and lakhs of stranded people evacuated to safety. The combined relief operations involved over 80 aircraft, including helicopters.



78 Need for Radical Reforms

Air Marshal M Matheswaran examines the current crisis in India's aerospace industry and capability. Focusing on the importance of dominant technologies, if India is to rise to be a great power, he urges leapfrogging into a dominant position in the realm of aerospace and information systems.

82 Tejas Re-dux : The Israeli Touch

Sayan Majumdar looks at the increased Israeli touch in the Tejas LCA with the present airborne radar possibly to be supplanted by an AESA model. The light fighter's BVR missiles and CCMs are also sourced from the same country as are various sensors and targeting systems.

53 Imperatives of Indian Air Power

In July, 2014, even as the new government was settling in at helm of the nation and an air of change was permeating through the administration, Vayu Aerospace & Defence Review in association with defence and strategic affairs website StratPost hosted a day-long round table discussion on 'Air Power in India'. Candid views were expressed by

86 The Flying Battleship

Even as finalisation of the Dassault Rafale contract by the Indian Government is awaited, this new generation fighter's F3R variant has completed test flights in a new and heavily armed

92 'Get on with the Rafale'!

Abhijit Iyer Mitra on the other hand has clear views that 'hardware purchases are not translating into operational gains'. While the deeply confused nature of the MMRCA RFP indicates that the IAF, at least upto 2012, did not fully appreciate the technological challenges of systems integration, the reality is the Rafale will bring a seamlessly integrated system into play.

Also: 'Come, make in India!'; US strategic ties with India; 'US-2i heralds the future'; Mangalyaan's journey; interviews with Dr RK Tyagi; Jim Roche; Kishore Jayaraman; C-130 anniversary; 80th anniversary of French Air Force; 'Exercise Green Shield 2014'; on EJ-200; Honeywell; Globemaster III; Russian Helicopters; SRSAM; Thales; Sagem; Elettronica; Rockwell Collins; Sikorsky; Rheinmetall; Mirage F.1 final flight; Bavarian Tigers; India's Sentinel; Gnat Renaissance; The Great Indian Escape; Ancient Aviator Anecdotes; 'Q' Flight IAF.

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Mars mission success

After a journey of over 660 million kilometres that took 10 months, India's Mars Orbiter Mission has swept with effortless ease into orbit around the Red Planet, making this country the first to achieve such a feat in a maiden attempt. Probes despatched to Earth's sibling planet over the last half a century have often run into trouble of one kind or another, with less than half of those spacecraft ending the voyage successfully. Thus far, only the United States, the former Soviet Union and the European Space Agency have succeeded in doing so. India and its space agency, the Indian Space Research Organisation (ISRO), now proudly join their ranks. Although ISRO could draw on its experience with the lunar probe, Chandrayaan-1, launched six years back, the challenges involved in sending a spacecraft all the way to Mars are far greater. That includes propelling the spacecraft with sufficient velocity to escape Earth's gravitational grasp, guiding it along the proper trajectory over vast distances, and then slowing it down sufficiently to go into orbit around that planet. The spacecraft had to be capable of operating autonomously as communication signals to and from ground stations could take minutes to reach it. All of this has gone remarkably smoothly, including the orbit insertion manoeuvre with the spacecraft's main engine, which had lain idle for almost 300 days. It is a tribute to ISRO and the professionalism of its scientists and engineers that every minute detail for such a complex mission could be attended to in the course of a project completed in just one and a half years. India's Mars effort costs Rs.460 crore, an economical price tag by Western standards.

The Indian probe joins four spacecraft already circling Mars, including America's MAVEN (acronym for Mars Atmosphere and Volatile Evolution) that went into orbit just two days earlier, as well as two US rovers exploring the planet's surface. The Indian and US space agencies are holding discussions on possible scientific collaboration. Success with the Mars Orbiter will give ISRO the confidence and capability to undertake more challenging missions. However, if the country wants to send heavier and more powerful spacecraft to Mars, it cannot do so with the Polar Satellite Launch Vehicle (PSLV) that was used for the current mission. However, the Geosynchronous Satellite Launch Vehicle (GSLV) equipped with an indigenous cryogenic stage made its first successful flight only in January this year, and a few more flights will be necessary to establish its reliability. Further improvements to the rocket may also prove essential. ISRO has achieved much, and more will be expected of it in the years to come.

From *The Hindu*

Firing on all cylinders

A 'chalta hai' attitude won't do anymore. This was what Prime Minister Narendra Modi pointed out to the DRDO that has taken ages to conclude various weapon projects. Many of the projects that the DRDO has taken up over the years are 30 years old or even more. Akash, the medium-range surface-to-air missile, took about three decades. The same is true for Nag. The Tejas light combat aircraft, is ready for use but hasn't received operational clearance yet. As a result, the technology platforms that the DRDO had been using are becoming outdated and are being

overtaken by more sophisticated technologies. In addition, this opens the way for further imports, putting a spoke in the wheel of indigenisation and creating fears of a stoppage in supplies by foreign sellers.

Mr Modi also talked about having an interface between scientists working in the 52 laboratories of the DRDO and the defence forces. This is essential because often it is the military's objections that tilt the opinion of the Defence Acquisition Council in favour of importing. This is despite the fact that the previous PM, Manmohan Singh, had told the defence forces that the 15% hike in the procurement budget every year could not be forever assured. In view of this, it is all the more necessary that defence planning is streamlined. After taking charge as DRDO chief last year, Avinash Chander had said an expenditure model for R&D had not been developed. He talked about identifying a few focus areas such as the advanced medium combat aircraft and gun designing for the artillery. India spends about 5% of its defence budget on research and development, whereas the figure for China is 15%.

The DRDO in the meantime underwent restructuring last year. Seven top scientists, who were earlier chief controllers, were appointed director generals of various clusters. So they have now moved from an advisory role to that of a position where they would be in charge of execution. This has made it easier for the DRDO to be in a deal with Swedish company Saab to develop Tejas Mark II, which is expected to join the IAF by 2019. The new defence dispensation needs to review various pending proposals to see whether or not they are feasible. It also needs to smooth over some of the turf wars among the key ministries involved in research and development of new military technologies. But one thing is clear, the sort of inertia that had come to characterise the DRDO will have to change given the PM's push to show results in this field.

From *The Hindustan Times*

Closer to Tokyo

Prime Minister Narendra Modi's trip to Japan, his first bilateral visit outside the subcontinent, has laid the foundation for a new era in India-Japan ties. While Modi and his Japanese counterpart, Shinzo Abe, have developed a special rapport, the PM has built on his productive engagement with Japanese business as chief minister of Gujarat. The cultural connect between the two countries through old civilisational ties — illustrated by Modi's visit to Kyoto, Japan's ancient capital, and his tour of Buddhist temples — leverages the past in pursuit of New Delhi and Tokyo's current goals. The sister-city partnership between Kyoto and Varanasi ties in with the smart cities project.

In promoting a closer economic partnership, Modi has promised a more business-friendly India, with emphasis on non-discriminatory and speedy clearances as well as setting up a special team within the PMO to facilitate Japanese ventures. Modi's reference to the return of India's growth story and acknowledgement of Japan's role in India's infrastructural development assume significance given the target of doubling Japanese FDI in five years, during which Abe expects to see 3.5 trillion yen invested in India. But even as Tokyo offers support for building the high-speed Shinkansen railway system, Delhi cannot be happy that the big-ticket civil nuclear pact was not signed. Although the deal saw progress in the

Boeing

last few weeks — and Japan lifted export restrictions on six Indian defence and space entities during Modi's visit — Tokyo's staunchly non-proliferation bureaucracy put conditions that Delhi could not accept, and it is difficult to see Abe selling the deal at home in any other form.

The pending nuclear deal, however, does not take the shine off Modi's visit, which took place amid growing tensions between China and Japan. Modi's reference to "vistar vaad (expansionism)", in a speech to Japanese business leaders, seemed an indirect reference to China's aggressive tactics in its territorial dispute with Japan. But even as Delhi and Tokyo underscored closer defence and strategic cooperation with the "Tokyo Declaration for India-Japan Special Strategic and Global Partnership", Modi has signalled Delhi's eagerness to deepen economic and political cooperation with Beijing when Chinese President Xi Jinping visits India this month. Both Modi and Abe know that building on their bilateral synergies, the two countries could improve their relative weights against China. If the 21st century is to be an Asian century, its character will depend on India-Japan cooperation. For now, Modi and Abe's betting on each other is paying off.

From *The Indian Express*

Solid start on procurement

In a single stroke, the Narendra Modi administration has underscored its seriousness in taking indigenisation of military hardware to the next level, and signalled its intent to end the drought in military procurement, which had begun to affect defence preparedness. At a meeting of the Defence Acquisition Council (DAC) headed by Defence Minister Arun Jaitley (in late August), several decisions were taken to unclog the flow of equipment and technology to the three services. A thrust to produce domestically advanced weaponry was imparted by the decision to scrap the tendering process for the import of 197 light utility helicopters, eliminating the European Eurocopter and the Russian Kamov from contention. The tainted pitch by AgustaWestland for these choppers had boomeranged. Instead of seeking foreign suppliers, the DAC decided to go for 400 indigenously manufactured helicopters, which would become the lifeline for troops deployed on harsh border terrain. Despite initial hiccups, Hindustan Aeronautics Ltd. is producing the Advanced Light Helicopter, gaining experience that would come in handy in the new undertaking. The DAC directive could boost the Indian military aviation industry, which would do well to develop collaborative frameworks to absorb foreign technology to ensure quality, and reduce production time-frames.

The Defence Minister has also injected fresh energy into the indigenous Arjun project by clearing the way for the induction of 118 of the tanks. Simultaneously, the DAC cleared the production of self propelled guns mounted on the chassis of an Arjun tank. The move reveals a proactive doctrinal preference for swift battles, powered by mechanised forces, which would be especially relevant in the desert border zones in and around Rajasthan. The meeting also paid much-needed attention to India's ailing submarine arm by clearing a mid-life upgrade of six submarines. The clear message that emerges from the decisions is that India is ready to work with western partners, including

the United States, provided a pure buyer-seller relationship is jettisoned in preference to joint production partnerships. Consequently, it is likely that the joint production of Javelin missiles will be on the agenda of Indo-US defence ties. While the government seems to be firmly setting out the ground rules of procurement, it is important that the Modi administration walks the talk. Over the years many reports have emerged about dubious but politically well-connected agents involved in greasing their way through lucrative defence deals. Mr. Jaitley and his team now have a fine chance to clean up and impart much-needed transparency to the system of military procurement.

From *The Hindu*

Missing In Action

The Army's Operation *Megh Rahat* in Kashmir has opened up the possibility of a new reordering of perceptions between security forces and the people of Jammu & Kashmir. The army has transformed into a humanitarian agency and nearly a lakh marooned residents have been rescued. But seven days into the disaster, the utter collapse of the state government is deeply worrying. Chief Minister Omar Abdullah has personally airdropped relief material from choppers. But in district after district there is but one complaint: where has the government disappeared?

The anger on the streets has already led to some NDRF jawans being beaten up and forced the Air Force to scale back a few helicopter rescue operations after stone throwing incidents and unsubstantiated street whispers of a rescue bias in favour of VIPs. That the worst floods in a century in Kashmir would initially overwhelm those manning the state is understandable. But that they remain stunned and unable to formulate a coherent response even after a week is shocking incompetence. Abdullah has sought to put the onus on people, arguing that his government issued warnings from mosques and police vans a few hours before the Jhelum deluge but few listened. Even so, did the state government make any evacuation attempts? Did it have contingency plans? For a state that is used to dealing with almost daily emergencies of the terrorist kind, surely getting administrators ready for the flood battle should not have been impossible.

The deeper issue is that political discourse in Kashmir has for too long hinged on issues like 'Kashmiriyat' and separatism while daily *dal*, *roti* and *bijli* issues remained on the back burner. Political parties and government so internalised that limiting discourse that when faced with a humanitarian disaster that required real governance, they simply folded. This is un-pardonable especially when central funding to Kashmir far exceeded its population size for years. Kashmir received Rs 3,705 crore as grants-in-aid in 2012-13, for example. Only one state — Uttar Pradesh — received more.

As the discourse in Kashmir moves on to service delivery and accountability politicians must learn their lessons. The absence of a robust response so far has added to the unfolding human tragedy. It is also likely to have dire political consequences for Omar Abdullah and the ruling coalition government.

From *The Times of India*

Irkut

Former CNS Admiral Arun Prakash feels that



“Import dependence is impacting Indian Forces’ combat readiness”

The commissioning of INS *Kolkata* destroyer at Mazagon Docks Ltd (MDL) Mumbai, with due pomp and circumstance, on 16 August by Prime Minister Narendra Modi was an event of considerable significance for both the Indian Navy and the nation. So far the biggest Indian-built warship to join the navy, the size, firepower and advanced technologies incorporated in this 7,500-tonne guided-missile destroyer make it a formidable weapon platform.

What places the *Kolkata* many notches above most of its contemporaries is the advanced multi-function radar embedded in its mast and a long-range surface-to-air missile (LR-SAM) to be delivered shortly.

Two sister ships of this class will join the Indian Navy in due course, adding more punch to our navy which is rapidly approaching world-class status. While

the successful commissioning of this potent warship does call for celebrations, exaggerated claims about the levels of indigenisation and hyperbole about self-reliance also demand quiet introspection.

Excessive self-delusion can prove just as damaging as unnecessary self-denigration; and nothing proves this better than the sorry state of defence research and production that has pushed India to the No.1 position as an arms importer. *Kolkata*’s commissioning is an opportune juncture to strike a balance which may help us break out of the vicious circle of delayed indigenous projects and increasing import dependency.

On the positive side, the Directorate of Naval Design, which started in the 1960s with the modified *Leander*-class frigates, has over the years brought great credit to itself by creating a series of elegant, functional and combat-worthy warships

of the *Delhi*, *Shivalik* and now the *Kolkata* class. The *Kolkata*’s design claims ‘stealth’ features, which should render it difficult for the adversary to detect. The navy’s unique Weapon and Electronic Systems Engineering Establishment (WESEE), undertook the herculean task of integrating the melange of Russian, Israeli, Dutch, French, Italian, and Indian systems which went into this ship. Nowhere else in the world is such a complex undertaking being attempted, but WESEE’s endeavours have been invariably rewarded with success. WESEE also deserves huge credit for developing the electronic nerve-centre of the ship, its combat management system or CMS - again a unique achievement.

MDL, a public sector shipbuilding yard, deserves praise for having skillfully built and steadily delivered high quality warships and submarines to the Indian Navy for the past

Russian Helicopter

half-century. At the same time there is no denying the fact that every MDL project has been dogged by huge time delays (*Kolkata* took 11 years to build) and embarrassing cost overruns, which have had an adverse impact on the navy's force levels and fiscal planning. Warship building is supported by a network of dedicated ancillary industries which produce most of the systems required for 'domestic and hotel services' on board warships. It is their contribution, added to the steel hull of the ship, welded in MDL, which appears to underpin inflated claims of indigenous content (perhaps by weight or volume) made for all our warships - including the *Kolkata*.

However, we need to squarely face the fact that the ability of Indian built warships 'to move, to see and to fight' comes almost exclusively from high-technology systems imported from abroad. A media scan shows that the *Kolkata*'s gas-turbine engines, generators, propellers and shafting, gearbox, gun systems, the surface-to-surface and surface-to-air missiles, and radars are all imported. Most systems claimed as 'indigenous' have been assembled under licence - with minimal value-addition by Indian scientists. Thus, if the value of imported content is reckoned, it may come to as much as 70-80 percent of the ship's cost.

Here it is appropriate to cite two outstanding success stories related to the DRDO. One emanates from its Naval Physical and Oceanographic Laboratory (NPOL) which has provided a state-of-the-art 'Humsa' sonar, as well as other anti-submarine warfare (ASW) devices for the *Kolkata*. The provenance of Humsa sonar goes to 1975 when a brilliant naval electronic engineer, Lieutenant Arogyaswamy Paul Raj, led a NPOL team to develop an advanced panoramic sonar; then at the cutting edge of technology. Since then, the Indian Navy and NPOL have worked in close collaboration to successfully develop a series of ASW systems that equip our front-line ships today.

The second instance relates to an offer made by the Israeli Navy to the Indian Navy in 2004-05, on behalf of their industry, of a long-range missile with superior anti-aircraft and anti-missile defence capabilities. The 'cherry on the cake' was to be the new multi-function phased-array radar that accompanied it. There was no altruism behind this offer; the small numbers required by the Israelis made the project economically unviable for them,



and there were not many nations they could trust with such sensitive technology. Driving a hard bargain, the Indian Navy obtained Israeli agreement for joint development and co-production of systems.

Showing eminent good sense and pragmatism, the DRDO leadership agreed to the navy's proposal for a path-breaking tripartite collaborative arrangement with the Israelis for the development of the LR-SAM. The funding as well as manpower liabilities were shared by the Indian Navy and DRDO. The project, involving DRDO scientists, naval engineers and the defence-industry has rendered tremendous benefits to all three participants and, notwithstanding development delays, will bring the Indian Navy to the front ranks of navies, technologically.

Are there any lessons to be learnt from the *Kolkata* experience? Should we not replicate success stories? As the new government takes stock, the import dependence of our armed forces must figure on top of its national security agenda, because it extracts a huge toll in terms of combat-readiness and renders 'strategic autonomy' a meaningless nostrum.

Trapped in a time-warp, our defence research and production establishments are verging on dysfunctionality, but there is no one to either take responsibility or demand accountability. The PM's recent exhortation to DRDO scientists to accelerate research and produce timely results will remain rhetorical till a dedicated Raksha Mantri sits in South Block.



Elettronica



Air Marshal Brijesh D Jayal on A Question of Honour

Before the flicker of the last candle to commemorate those who laid down their lives for their motherland during the Kargil conflict dies out and memories of the 15th anniversary of Kargil Diwas begin to dim, it is perhaps time for the collective conscience of the nation to pause and reflect.

It is fair to say that this anniversary drew more public attention than have the previous ones. It is too early to judge whether this is a collective rekindling of the national conscience, the shadow of a new dispensation in South Block or some other factor, but if this shows a trend it is heartening. Because from the first time when the former Prime Minister, Atal Bihari Vajpayee, lit a candle in 2000, if anything, the celebrations have become *pro forma*

rather than events deserving a few moments of national remembrance of and reflection on the supreme sacrifice made by those who 'gave their today for our tomorrow'. The reflections are about what makes these sons and daughters of India so unique that self-sacrifice comes as naturally as a daily chore to them and, indeed, what part we, as a nation and a people, have played, if any, in contributing to their making.

But first a reality check. Over the years, neither the Supreme Commander nor the Prime Minister has led the event and it is left to the Defence Minister and the Service Chiefs. The event in the capital city itself attracts little attention. The Army, which lost 527 and had 1363 wounded (including gallant Indian Air Force officers and men), is left to commemorate the event at the

Dras War Memorial, a memorial built on the foothills of Tololing Hill where some of the severest fighting took place, built not by the nation, but the Indian army.

There are also similar functions spread across the country, invariably at small memorials built not by the nation, but through initiatives of enlightened citizens and veterans. One such is at Chandigarh built by a people's initiative backed by a national daily where, on the given day, schools send children to draw inspiration from and rub shoulders with veterans.

It is possible that the solemnity of the supreme sacrifice made by soldiers, sailors and airmen is being diluted by the multiple occasions when such commemorations are held: the others being Vijay Diwas, commemorating the victory in the 1971

war and the Prime Minister's homage to 'Amar Jawan' on Republic Day. Or is it that by periodic unburdening of our conscience we feel that we are paying our due to these martyrs, making up in frequency what we lack in the sheer depth of our emotions and what we do for their widows. A recent media report even indicated that India has 25,000 war widows.

That is why it is perhaps an opportune moment for the nation to take a call on whether enough blood has been shed by our armed forces for us to observe a day of national remembrance when we dedicate a few moments to pause, reflect and draw inspiration from the martyrs. A day when every student from every institution from across the country is exposed to the spirit of selflessness and sacrifice that is embodied in the feats of martyrs; a day where our veterans and those serving visit these institutions of learning where the moral values and character of tomorrow's leaders are being moulded; a day when our young learn not to take our freedom for granted and a day when no less than the supreme commander leads the nation in paying homage accompanied by his entire council of ministers. That is also a day when the solidarity of the nation is on full display to friends and foes alike. Above all else, a day when each proud citizen of this country vows to ensure that the sacrifice of martyrs has not been in vain.

But to sow the seeds of such idealism there is need for a place of worship and for preachers. Nearly every self-respecting nation that has seen its soldiers in battle has found this temple to be a national war memorial with the names of martyrs inscribed in stone. And it is these names that act as silent preachers in the periphery of this hallowed monument.

It is ironical that the British erected India Gate on the Central Vista in memory of those soldiers from our soil who fought their wars. That memorial is visible from the Rashtrapati Bhawan, Parliament House and the North and South Blocks housing the highest executive of our democracy. And yet there is no yearning in the largest democracy in the world to ask where in this magnificent Central Vista is our own memorial to those who have died fighting independent India's wars. Sadly, it is left to the armed forces to plead for a national war memorial on this Vista, but their pleas have elicited the weakest of responses.

The Ministry of Defence has never shown much enthusiasm to smoothen the inter-ministerial turf wars of which the national war memorial has become a victim. The last straw is the obduracy of the Ministry of Urban Development and the Delhi Urban Arts Commission which have vetoed the proposal supposedly because the 'ambience of the India Gate complex would be disturbed'. Seeing the continuing decay of our urban landscape one would have thought that this ministry had greater priorities than obstructing a project that symbolizes not just national solidarity, but supreme sacrifice. As for the *jholawallas* of the Delhi Urban Arts Commission, one wonders if this is the only way some self-importance can be extracted.

It was in 2009 that, on instructions of the then Prime Minister, a group of ministers under the then Finance Minister, Pranab Mukherjee, with the Defence and Urban Development ministers, considered the proposal for a national war memorial. It was then reported that they had recommended the memorial at the India Gate complex. To the objections of the upholders of ambience, the Ministry of Defence had indicated that, designed by the noted architect, Charles Correa, the memorial would only be a little higher than the ground and most portions of the marble slabs on which the 50,000 names would be etched would actually be below ground level. They would be in a circle around the canopy next to the India Gate. People could walk along the slabs, pay their respects and move to India Gate. Indeed, on Vijay Diwas in 2010, the then Defence Minister had assured the Armed Forces that this national war memorial would be a reality.

But there is no limit to busybodies in positions of authority who, in order to camouflage their own shortcomings, use their unfettered authority to play spoilsport. One such was the then Chief Minister of Delhi. A media report quoted the chief minister as saying, "It is a people's place. It is just like Marina beach and Chaupati. My point is that you can make a memorial anywhere else. Why spoil this beautiful place? Why become a hindrance to the people's enjoyment?" These are sacrilegious observations in the context of a national war memorial and as a veteran one can only hang one's head in shame.

The fact that in spite of the GoM's recommendations under Pranab Mukherjee

(now President and supreme commander) the process was halted makes one sadly conclude that this hopelessly frivolous view prevailed and more ominously continues to this day. So in the collective wisdom of those that govern us in the name of the people, building a national war memorial at the India Gate complex will spoil the ambience of a beautiful place and hinder people's enjoyment. If this is the attitude of our elected representatives and those in governance, it does not surprise one that the armed forces are desperately short of officers. What is worse, this attitude will slowly eat into the very fabric of our men and women in uniform, who must wonder why they should be serving in the remotest corners of the country risking life and limb when the national priority is enjoyment of their people over homage and respect to their dead comrades. We will then be staring at a hollow security edifice.

At the conclusion of the wreath-laying ceremony at Amar Jawan Jyoti the other day, the Defence Minister assured the people of the country that a war memorial would be built and that necessary funds had been earmarked. What, however, will not be music to the ears of the armed forces, the veterans and some 25,000 war widows is his statement that it will be centred on the Princess Park complex. This is tantamount to giving in to the 'Marina Beach, Chaupati syndrome' and will be a betrayal of our martyred soldiers, sailors and airmen and the entire veteran and armed forces fraternity and will be received with deep disappointment.

This writer, for one, strongly believes that no matter how grand and big the new complex at Princess Park, it will be soulless. Soulless because our worthy leaders did not deem it fit to accord it a place on the Central Vista in the company of India Gate which commemorates those of our countrymen who laid down their lives fighting for the Raj and it will be thus because the nation does not care.

Here is an appeal to the Prime Minister on behalf of those of our uniformed colleagues who gave their all and can speak no more :

"Honour us with a national war memorial on the Central Vista or leave us alone to be worshipped in our units and messes where at least we know our memories are treated with honour and dignity."

Brigadier Gurmeet Kanwal suggests An agenda for new Army Chief



A PIFFER as COAS : the new Indian Army Chief, General Dalbir Singh Suhag inspecting a guard of honour provided by the 8th Gorkha Rifles outside South Block in New Delhi. General Dalbir Singh is Colonel of the 5th Gorkha Rifles (Frontier Force)

ON taking over as the COAS from Gen Bikram Singh, Gen Dalbir Singh Suhag said his priorities would be to enhance operational preparedness and the effectiveness of the Indian Army. He also said that force modernisation, infrastructure development, optimisation of human resources and the

welfare of personnel are issues that are close to his heart.

Back in March 2012, Gen VK Singh, the then COAS, had written to the Prime Minister about 'critical hollowness' in the Army's operational preparedness. He had pointed out large-scale deficiencies in weapons systems, ammunition and

equipment in service and the fact that many of the weapons and equipment were obsolete or bordering on obsolescence. In particular, he had brought out that the artillery and air defence arms needed an infusion of modern guns, missiles and radars, and the aviation corps required new helicopters to replace the ageing fleet.

Two consecutive reports of the CAG in December 2011 and November 2012 brought out that the state of defence preparedness was a cause for serious anxiety. The Standing Committee on Defence (SCD) in Parliament has also noted these developments with concern several times. In an unprecedented move, the SCD insisted on meeting the three Chiefs to take stock of operational preparedness. The SCD has repeatedly urged the government to increase the defence budget to enable the armed forces to undertake meaningful modernisation.

Weapons, ammunition and equipment shortages have persisted for long and several Chiefs before Gen VK Singh had written to the PM and the Defence Minister for help to make up the shortfall. During the Kargil conflict the nation had heard Gen VP Malik, the COAS, make the chilling statement on national TV, "We will fight with what we have." Though the conflict was confined to Kargil district, 50,000 rounds of artillery ammunition had to be imported as an emergency measure because the stock holding was extremely low. If it had become necessary to open another front, the shortage of artillery ammunition would have seriously hampered operational planning.

Military modernisation has two major facets: the replacement of obsolete and obsolescent weapons and equipment with modern ones, which results in increasing combat effectiveness; and, the qualitative upgrade of combat capabilities through the acquisition and induction of force multipliers. General Suhag, like his predecessors, faces a major dilemma: Given the small budget, how can the Army improve operational preparedness while simultaneously making concerted efforts to modernise? Logically, operational preparedness takes precedence over modernisation. The art of military leadership lies in finding an optimum balance so that all efforts that are made to enhance operational preparedness also contribute substantively to modernisation.

The most critical operational deficiency is the inadequacy of artillery firepower due to the obsolescence of guns and mortars. No modernisation has taken place since the Bofors 155mm howitzer was purchased from Sweden in the mid-1980s. The 'night blindness' of the Army's mechanised forces needs to be rectified immediately. The F-INSAS (future infantry soldier as a



The Army needs new helicopters !

system) programme for the modernisation of infantry battalions must be implemented on an urgent basis.

Air defence guns and missiles and their radar systems are reported to be 97 per cent obsolescent. The Aviation Corps urgently needs 197 light helicopters. The old and inefficient intelligence, reconnaissance, surveillance and target acquisition systems available today adversely impact command and control and 'targeting' during war. Hence, the C4I2SR system needs a complete overhaul. The logistics support system also needs to be revamped, with the concept of 'just-in-time logistics' being implemented.

The new COAS will preside over the modernisation process during the remaining three years of the 12th Defence Plan, including raising of the 17 Corps for deployment on the border with China. This Corps, being raised as a 'strike corps' for the mountains, is expected to cost Rs 64,000 crore to raise and equip over a period of five to seven years. Approximately 90,000 new personnel will be added to the Army's manpower strength, including those in ancillary support and logistics units. New weapons and equipment will have to be procured for the divisions, brigades and battalions of this Corps. It will be a retrograde step to milk these from existing battalions to equip new raisings.

Recruiting additional manpower of the requisite qualifications has so far not posed any problems for the world's third largest volunteer army. However, finding officers for the new 17 Corps will be a major challenge as there is an ongoing deficiency of

approximately 10,000 officers. Transferring officers from existing battalions will further dilute their command and control and weaken them intrinsically. The methods for remedying this shortcoming are well known; it is for the NDA government to take appropriate action in an early time frame.

General Suhag wishes to ensure that relatively softer issues like human resources development and the welfare of serving personnel and veterans are not neglected. Morale is adversely affected if these issues are not appropriately handled. As a member of the Chiefs of Staff Committee, the General will help in the formulation of the recommendations of the armed forces for consideration by the Seventh Pay Commission. This has been a rather contentious issue in the past and will require sage handling. Finally, civil-military relations have not been good in the recent past and need to be improved.

If one may take the liberty of using a few well-known American buzzwords and catch-phrases, the 'revolution in military affairs' had whooshed by the Indian Army in the 1990s. The 'transformation' process that followed must be gradually implemented even though it is a decade late primarily due to budgetary constraints. The COAS will be responsible for the transformation of the Army to a 'network centric' force capable of executing 'effects-based operations' over the full spectrum of conflict. General Suhag must forge a light, lethal and wired Army that can fight and win India's wars on the battlefields of the 21st century, jointly with the Navy and the Air Force.

“Come, make in India!”



Prime Minister Narendra Modi's electrifying call to the World

Prime Minister Modi's speech on India's 68th Independence Day broadcast his invitation to companies across the world to “come, make in India”, reiterating his government's stand on promoting indigenous manufacturing and attracting foreign investment. “From electrical to electronics, automobiles to agro value addition, paper or plastic, satellites or submarines; come, make in India,” thundered the PM in this, his first ever speech from the ramparts of the Red Fort.

The PM laid particular emphasis on the creation of a ‘skilled India’, saying that development should be focused towards building a modern nation, and pointing out the need for research and innovative entrepreneurship. “They (the youth) should acquire skills which contribute towards making India a modern country,” he said.

The need to “serve the nation” by reaching global standards of industry

through a pool of young people who can “create jobs” was something that Modi stressed on, and in the same vein, he said that the country should look to its youth

to help lower the need for imports. He said that Indian manufactured products should have “zero defects and zero effect” i.e. the products should be flawlessly made and yet have no adverse impact on the environment.

Modi referenced the 2014 Union Budget while speaking about the changing nature of world economics, adding that in order to provide employment and capitalise on the skills of the youth, the Indian manufacturing sector must be promoted globally. In the budget, the hike in FDI supports this idea exhorted by the PM, but, analysts are quick to point out that India ranks extremely poorly on the World Bank's index of countries by “Ease of Doing Business”. Inflation in the recent past has also adversely affected the manufacturing sector. However, Modi laid stress on the government's commitment towards taking steps towards increasing indigenous production and foreign demand for said indigenous goods.

The reduction of dependence on imports is a big step for India's manufacturing industry, but the Modi-led NDA government seems determined to achieve this goal. As Modi put it in his open invite to the world, “Sell in any country of the world, but manufacture here. We have got the skill, talent, discipline and determination to do something.”

[The logo below was launched on 25 September]



Chosen for the Country's manufacturing endeavour, the “Make in India” campaign is depicted as an Indian lion, symbolic of the inherent strength and capability of the nation.

India-US Strategic Dialogue

“To improve strategic ties with India”



Air Chief Marshal Arup Raha, Chairman Chiefs of Staff Committee (COSC) and Chief of the Air Staff (CAS) meeting with United States Secretary of Defence, Chuck Hagel in New Delhi on 9 August.

Shortly after US Secretary of State John Kerry was in New Delhi for the 5th India-US Strategic Dialogue, US Secretary of Defence Chuck Hagel made a three-day visit to the capital in August, accompanied by key Pentagon figures such as Frank Kendall, defence under secretary for acquisition. Despite arriving with a host of proposals for Indo-US cooperation, Hagel left India with little of substance having been achieved, although he remained optimistic, noting that the two nations must be “results oriented” and be committed to doing more to “transform defence cooperation” between the countries. In a speech on 9 August, at an event organised by the Observer Research Foundation (ORF) as part of their 25th anniversary celebrations, the US Secretary of Defence said that he was confident that the United States and India would achieve the historical potential of their strategic partnership.

A key aspect of Hagel’s visit to India was an attempt to energise Indo-US defence

relations, particularly the Defence Trade and Technology Initiative (DTTI). While the DTTI is ostensibly the centrepiece of the Indo-US defence relationship, it was not leveraged by the previous government, in part owing to the lack of private sector participation in defence industry. With the Modi government determined to increase the role of the private sector and simultaneously slash import dependence, a revitalised DTTI offering joint development and production of weapons is likely to receive greater importance. The credibility of the DTTI, Hagel noted, is bolstered by the fact that the US has not established such a framework for cooperation with any country other than India. “We can do more to forge a defence industrial partnership—one that would transform our nations’ defence cooperation from simply buying and selling to co-production, co-development and freer exchange of technology. And we have no better opportunity than the

US-India Defence Trade and Technology Initiative,” Hagel said.

Apart from defence industrial collaboration, the Secretary of Defence also stated that a strong strategic partnership between the US and India “is a responsibility, not a slogan.” In fact, a key focus of his speech at the ORF anniversary event was the role of India not just in relation to the USA’s ‘Pacific Pivot’ but also as a net security provider in Asia, particularly in the wake of the withdrawal of the US military presence from Afghanistan by the end of this year.

Hagel hailed the steps already taken toward increasing Indo-US military cooperation, noting with appreciation Indian Navy participation in joint exercises such as *RIMPAC* and *Malabar* (see *Vayu* IV/2014), as well as the annual Indo-US *Yudh Abhyas* Army exercises. He also expressed hope that military cooperation would expand in size and frequency. “America’s future is tied to its sustained global engagement, and a stronger strategic partnership with India is an integral part of that future,” he said.

Hagel also stated that the US is committed to exercising its leadership to support India in its position as a global power. He emphasised the point that the US has worked to expand the role of the G-20, and called for India to become a permanent member of a reformed UN Security Council in the future.

After years of languor under the UPA government, Indo-US ties are in a position to be addressed with renewed vigour, and indeed it appears that the back to back visits of Kerry and Hagel have already begun to reap dividends, with 22 Boeing AH-64 Apache and 15 CH-47 Chinook helicopters cleared for purchase at the end of August.

Hagel ended his speech at the ORF anniversary event by reiterating his belief that the fundamentals of the US-India partnership are strong. “The question is whether India and the US can achieve the enormous potential of our partnership ... whether we can transform our potential into results,” he concluded.

Angad Singh

Windfall for India's Industry



Defence Minister Arun Jaitley seen striding through South Block

DAC clears key programmes

If the first Defence Acquisition Council (DAC) meeting under the new NDA government provided a windfall for indigenous industry (primarily domestic shipbuilding), the second did the same for certain key foreign purchases. On 29 August 2014, the Defence Minister cleared a number of key defence programmes after a day of deliberation with the DAC. However, even if the bulk of the value of cleared programmes involve foreign purchases, the second DAC continued to signal a commitment toward indigenisation.

The most crucial decision taken, one which has been pending for well over a year, was clearance to proceed with the purchase of 22 Boeing AH-64E Apache attack helicopters and 15 CH-47F Chinook heavy lift helicopters. The deal, valued at approximately Rs 15,000 crore and reportedly delayed by offset negotiations, was granted a waiver

and allowed to proceed to the Cabinet Committee on Security (CCS), which is expected to grant swift approval so that the contracts can be inked either just before or shortly after Prime Minister Narendra Modi's visit to the USA.

Indian Navy rotorcraft operations received a similar boost as the DAC permitted commercial bids to be opened for the urgently required Naval Multirole Helicopter (NMRH) programme, worth Rs 1,800 crore. This acquisition programme had also seen significant delays since the bids were submitted amid allegations of procedural irregularities. With one of the two competing helicopters, the NHI NH90, now coming under the MoD's new rules on dealing with Finmeccanica group companies, in this case AgustaWestland, the stage appears set for Sikorsky's S-70B to win the contract. The NMRH programme is meant to replace the Indian Navy's ageing

Sea King Mk.42B ASW helicopters which have been in service since the early 1980s.

Additionally, in a major boost to flight safety, Navy aircraft such as Tu-142MK-Es, Dornier 228s and Il-38SDs are to be fitted with TCAS (Traffic Collision Avoidance System). This requirement was reportedly brought to the fore in the wake of the Indian Navy's participation in the multinational search for the missing Malaysian Airlines flight MH370.

In an unusual turn of events, the DAC elected to scrap the decade-old 197 RSH (reconnaissance and surveillance helicopter) programme entirely, and announced that the programme would shortly be re-tendered, this time under the 'Buy and Make (Indian)' category. This could provide a unique opportunity for private sector firms to partner with foreign OEMs to establish production of light utility helicopters in India. The fate of the HAL



Light Utility Helicopter (LUH), a single-engine complement to the Dhruv ALH, remains unclear, although this programme is likely to also benefit from the MoD's push for indigenisation.

For the Army, the DAC renewed clearance to purchase 118 Arjun Mk.II main battle tanks in a deal worth some Rs. 6,600 crore, and also announced clearance to procure 40 Arjun Catapult 130mm self-propelled artillery guns worth Rs. 820 crore. While the previous UPA government had cleared the Arjun Mk.II proposal, the approval had expired over the course of lengthy user trials of the tank. The DAC's decision will now allow the Army to place orders for the Arjun Mk.II as soon as trials are complete.

In addition, the Army was cleared to create a dedicated mobile communications system for troops deployed in mountainous border areas that suffer from poor commercial cellular connectivity. The Army intends to establish its own cellular network along the borders, in a project estimated to cost Rs. 900 crore.

As DRDO development of an indigenous ASW suite, including towed array sonar (TAS), has left the Navy with a dire capability gap, the DAC has also elected

to acquire 11 such suites from abroad, so as to be able to commission the seven Project 17A frigates and four Project 15B destroyers with all systems integrated, unlike the recently-commissioned INS *Kolkata* and INS *Kamorta*, which had to be inducted without towed array sonars.

Finally, efforts appear to be underway to correct the Navy's most serious deficiency – submarines. While the Project-75(I) tender is yet to be floated, the DAC has cleared a total of 6 submarine refit projects, four

Sindhugosh-class (Project-877EKM *Kilo*-class) and two *Shishumar*-class (modified HDW *Type 209*). The refits will call for an outlay of approximately Rs. 4,800 crore, with both *Shishumar*-class boats to be overhauled by MDL, two *Kilo*-class boats to be overhauled by Russian shipyard Zvezdochka, and the remaining two *Kilo*-class submarines to be overhauled at the Naval Dockyard in Mumbai, with Russian technical assistance.

Angad Singh



Expecting a Great Deal



Sitting (L-R): Dr Dipankar Banerjee, Dr G Malakondaiah, DS & CC R&D (HR), Avinash Chander, Secretary Department of Defence R&D, DG R&D and SA to RM, Prime Minister Narendra Modi, Defence Minister Arun Jaitley, Raksha Rajya Mantri Rao Inderjit Singh, S Anantha Narayanan, Distinguished Scientist & Director NPOL
Standing First Row L-R: Dr S Guruprasad Scientist 'H', and Director, R&DE (E), Dr SC Sati Director, ADRDE, U Jeya Santhi, Dr K Tamilmani, PS Subramanyam, Dr Shashi Bala Singh Director DIPAS, K Jayaraman Director DRDL, Prof V Kamakoti, Emeritus Prof S Mohan
Standing Second Row L-R: RS Chandrasekhar, K Ravi Sankar, Rajeev Thaman, Dr Harsh Vardhan Batra Director DFRL, Ashwin Shah, R Sundar, JM Sundaresan

The PM's directives for DRDO

At a DRDO awards ceremony held on 20 August, Prime Minister Modi laid repeated emphasis on India's need to keep up with the evolution of defence technology. He remarked that the biggest challenge for DRDO was to defy time through effective management of its resources. He said that DRDO lacked neither talent nor resources, but in spite of what it had already achieved, the organisation needed to get rid of its '*chalta hai attitude*' with regard to time management.

The performance of DRDO has lately been under much public scrutiny, with ten key projects experiencing long delays, including the Tejas LCA, Naval LCA, Astra air-to-air missile, Kaveri aero engine and the Airborne Early Warning and Control Systems. However, with an increase in budgetary allocations and stress on indigenous production, there are hopes for speedy completion of pending programmes.

Modi began his address by comparing the work of a scientist to that of a sage or

'rishi', lauding the dedication of DRDO scientists; however, he added that there was a gap between the organisation and the soldiers that it seeks to serve. He called for greater interaction between the armed forces and DRDO, saying that it was the former who would offer perspective which would aid further innovations. An important point he raised was the need for constant evolution of existing systems so as to maximise productivity.

Another suggestion made by the PM was that it was in DRDO's interest to start recruiting younger scientists. He said, "Of the 52 laboratories under DRDO, there should be at least five which are directed by scientists that are less than 35 years old," further adding that cyber security in particular is a sphere to which those in the 20-25 age group would be best qualified to contribute.

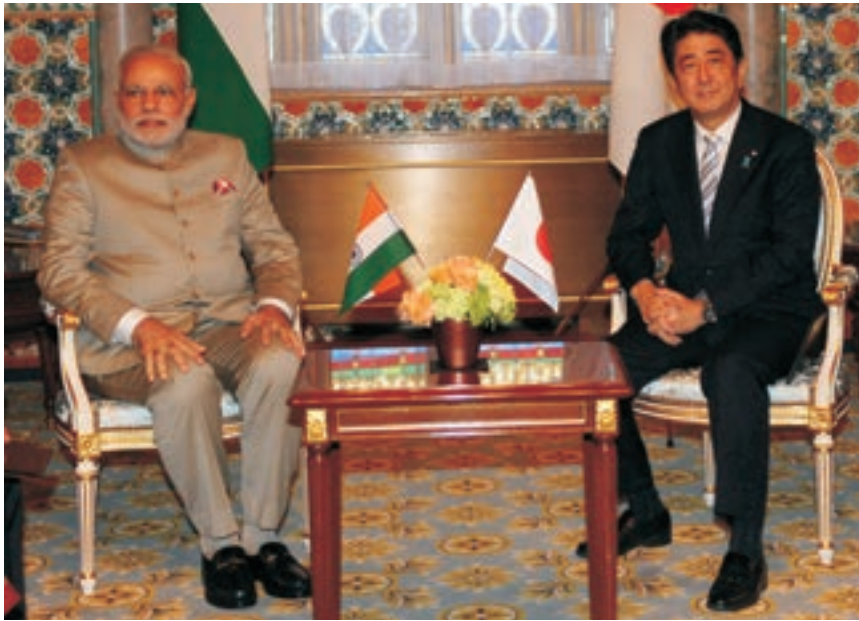
Addressing the issue of time lags that DRDO has been struggling with, the PM suggested the requirement was to develop

advanced technology so as to surge ahead. "For instance, if the rest of the world produces something in 2020, we should aim to have it ready by 2018," he said, observing that this would require DRDO to be proactive. "If a project is conceived in 1992, in 2014 we should not be asking for a few more days."

Moreover, he also pointed out a need for increased interaction between technical universities and scientists in order to inspire the youth to engage with defence security. He insisted that an increase in dialogue could only benefit all parties involved as it would increase the pool of ideas and by engaging the youth, it would serve to set a foundation for the future of the country.

The Prime Minister concluded his speech with the idea that one expects great results only from those that have untapped potential and that DRDO is thus an organisation that he expects a great deal from!

India-Japan Relationship



US-2i heralds the future

Prime Minister Narendra Modi's four-day state visit to Japan in September focused on the growing ties between Japan and India as the two Asian powers turn to each other to bolster their economies and balance the security environment of the continent. Former PM Dr Manmohan Singh had earlier described Japan as the focus of India's 'Look East Policy' and his successor PM Modi certainly has carried this forward, with his trip to Japan being his first extended state visit to any country since he took office as Prime Minister of India in May 2014.

Japanese Prime Minister Shinzo Abe pledged a massive \$34 billion investment in India over the five years as Modi in return promised to implement a special mechanism to 'fast track' Japanese investment in India. While the two leaders did not make any headway on the much-awaited civil nuclear agreement, their summit was productive in multiple other ways.

Undoubtedly the most dramatic among these was the path breaking deal for ShinMaywa US-2i amphibian aircraft for the Indian Navy, the first Japanese overseas sale of military hardware in over 50 years. This acquisition would mean that Japan will transfer critical aerospace technologies to India, and assist India in setting up

assembly as well as maintenance, repair and overhaul (MRO) facilities for the US-2i. In addition, this would assist Indian industry in furthering its aerospace manufacturing capability by integrating Indian partners into the Japanese aerostructures industry, which provides parts to a host of major global manufacturers including Boeing and Bombardier. This would have the added benefit of having India and Japan working together to support future sales of the aircraft to other countries.

The ShinMaywa US-2i is a unique aircraft in that it is capable of taking off and landing within dramatically short distances and in very rough weather (up to sea state 5). As a platform, it provide versatility for

a wide range of missions, from logistics support of island territories that lack land-based runways and other infrastructure, to high-speed search and rescue on the high seas, to monitoring territorial waters and EEZs. With India reportedly considering 15 or more US-2s, initially, the operational environment in the Indian Ocean Region (IOR) would be radically altered once these are inducted and operational.

Along with the US-2i agreement, the two leaders agreed to a series of other pacts. Japan lifted bans that had been imposed on HAL and five other Indian firms in the aftermath of the 1998 nuclear tests, which will enable these companies to seek cooperation with Japanese firms, including transfer of technology.

Modi reiterated his 'Make in India' slogan, inviting Japanese firms to make India their manufacturing hub, and saying that India offers the three essential 'Ds' for businesses to thrive, namely: Democracy, Demography and Demand. Japan also expressed willingness to provide financial, technical and operational support toward the introduction of bullet trains in the Indian subcontinent, beginning with the proposed 300km/h Mumbai-Ahmedabad sector. Modi also took the unprecedented step of announcing that a special management team would be set up directly under the PMO to facilitate investment proposals from Japan, and that this team would include two members nominated by Japan.

Prime Minister Modi concluded his first trip to Japan with a commitment to friendship and partnership between the two nations, summarising his view on the relationships with a humorous quip: "Yeh Fevicol se bhi zyada mazboot jod hai (this bond is stronger than that of Fevicol)."

[Comprehensive article in Vayu's next edition, Vayu Issue 6 Nov/Dec 2014.]



The ShinMaywa US-2 amphibian aircraft

“Good morning MOM !”



The 'Mangalyaan' orbiter seen prior to integration with the payload shroud (photo: ISRO)

‘Mangalyaan’ completes incredible interplanetary journey

At 7.41 am IST on 24 September 2014, shortly after a perfectly choreographed insertion into orbit around Mars, ISRO's Mars Orbiter Mission (MOM) exited the 'dark side' of the Martian planet and sent its first transmission towards Earth. A nerve-wracking twelve-and-a-half minutes later, the Spacecraft Control Centre at ISRO Telemetry, Tracking and Command Network (ISTRAC) in Bangalore received the transmission. Shortly thereafter, the mission's most crucial phase was declared successful amid raucous cheering at the Control Centre. In a room occupied mostly by jubilant scientists was Prime Minister Narendra Modi, who had

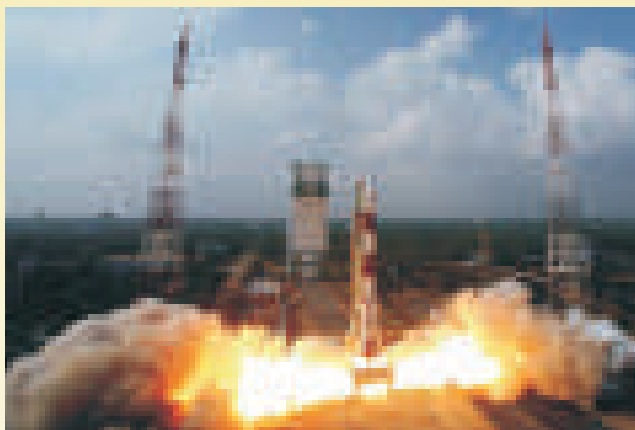
arrived early in the morning to follow this historic event.

Achievement of such Mars orbit insertion makes India the very first country in the history of spaceflight to have successfully sent a spacecraft to Mars on its first attempt. In the past, only NASA, the European Space Agency (ESA), and the former Soviet Union succeeded in placing spacecraft in orbit around Mars. The PM was keen to highlight this feat, saying, "History has been created today. We have achieved the near impossible. I congratulate all ISRO scientists and all my fellow Indians on this historic achievement. The odds were stacked against us. Of the 51 missions

attempted across the world so far, a mere 21 had succeeded. But we have prevailed!"

At a total programme outlay of about Rs 450 crore (\$74 million), the Mars Orbiter Mission is one of the most cost-effective spaceflight missions ever conducted. The programme began with a feasibility study conducted in 2010, shortly after the launch of ISRO's 'Chandrayaan' lunar satellite. Formal sanction to proceed was granted in August 2012, making the project's 15-month journey to launch one of the most rapid of recent spaceflight endeavours around the world.

The orbiter, nicknamed 'Mangalyaan' (Marscraft), began its extraordinary journey aboard an ISRO PSLV-XL launch vehicle on



Launch of the PSLV-XL rocket on 5 November 2013 (photo: ISRO)

5 November 2013. The rocket placed the satellite in Earth orbit, where it spent a little over three weeks. During this time, ISRO progressively tested the spacecraft systems and performed a series of 'orbit raising manoeuvres' using the orbiter's own thrusters. On 30 November, a 23-minute engine firing initiated the spacecraft's transfer away from Earth, sending it on a nine-month journey through outer space toward Mars.

Four trajectory correction manoeuvres were planned for the journey to Mars, but the spacecraft followed its planned path so closely that one of the correction operations, planned for April 2014, was deemed as superfluous. Once within range of the red planet, orbit insertion was carried out smoothly, and Mangalyaan entered Martian orbit with a velocity of 1099 m/s against a target of 1098.7 m/s.

The orbiter's dry mass is 500 kg and it carried 852 kg of propellant at launch, for a total launch weight of 1,352 kg. As of orbit insertion on 24 September, the orbiter had around 40 kg of propellant remaining for minor orbital adjustments. The mission's primary technological objective is to demonstrate and validate ISRO's ability to conduct deep-space missions, particularly aspects such as deep-space communication, navigation, mission planning and management, as well as implementation of autonomous features to handle contingency situations. The scientific objective is to explore Mars' surface features, morphology, mineralogy and Martian atmosphere using indigenous scientific instruments.

For this, the 'Mangalyaan' orbiter has a number of scientific instruments on board. These include a Lyman-Alpha Photometer (LAP) that will provide an estimation of the amount of water loss to outer space, a Methane Sensor for Mars (MSM) to measure atmospheric methane and map its sources, Mars Exospheric Neutral Composition Analyser (MENCA) for the analysis of the neutral composition of particles in the Martian exosphere, a Thermal Infrared Imaging Spectrometer (TIS) for measurement of the temperature and emissivity of the Martian surface to allow for mapping of surface composition and mineralogy of Mars, and a Mars Colour Camera (MCC) that will provide 4-megapixel images in the visual spectrum, providing context for the other instruments.

The mission is expected to last for at least 160 days but may, in fact go on for much longer, being limited only by onboard propellant required for adjustments to the path and orientation of the orbiter. Communications with the orbiter are primarily carried out by ISRO's Telemetry, Tracking and Command Network (ISTRAC),

HAL-ISRO partnership to expand with the ICMF

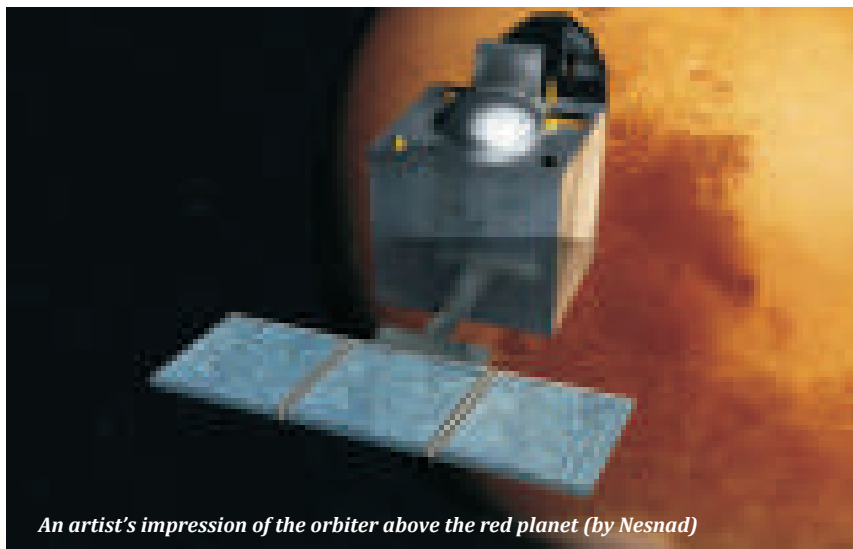
HAL Chairman Dr RK Tyagi congratulated ISRO for the success of the Mars Orbiter Mission, and said that "the HAL-ISRO partnership will be further strengthened in the years to come." An Integrated Cryogenic Engine Manufacturing Facility (ICMF) will be set-up at HAL's Aerospace Division in Bangalore to manufacture cryogenic and semi-cryogenic engines for ISRO.

Discussions with ISRO are already underway for assembly integration and testing of IRNSS satellites and for production of propulsion sub-systems for spacecraft and launch vehicle projects. Work packages for the Chandrayaan-2 and Reusable Launch Vehicle (RLV) projects are also on the anvil.

HAL has partnered and supported ISRO over the years by providing parts for satellites as well as the SLV, ASLV, PSLV, GSLV Mk.II and GSLV Mk.III launch vehicles. HAL's association with India's space programme goes back to the early 1970s, when HAL provided technical input and manufacturing support to ISRO with light alloy structural assemblies for satellites and launch vehicles. HAL built the structural assembly of India's first satellite 'Aryabhata' which was launched on 19 April 1975. The growing collaboration between HAL and ISRO led to the inception of HAL's Aerospace Division, with an MoU signed by ISRO Chairman Prof Satish Dhawan and HAL Chairman Air Marshal LM Katre in May 1983. "Since then, HAL has been a vital partner in ISRO's journey to becoming a globally renowned space agency."

with NASA's Deep Space Network providing position data through its three stations located in Australia, Spain and California, USA. The South African National Space Agency's (SANSA) Hartebeesthoek ground station is also providing satellite tracking, telemetry and command services.

Angad Singh



An artist's impression of the orbiter above the red planet (by Nesnad)

DAC clears procurement of Boeing Apaches and Chinooks

On 29 August 2014, the Government's Defence Acquisition Council (DAC) approved the procurement of 22 Boeing AH-64E Apaches and 15 CH-47F Chinooks, for an estimated US\$ 2 billion. Deliveries of the Apaches would take place during the 2016-2020 period while the Chinooks would be delivered by 2018. As learnt by *Vayu Aerospace Review*, the Apache order has an option clause for another 11 helicopters while another 7 Chinooks could follow the initial purchase.



Boeing CH-47 Chinook of the US Army with lightweight howitzer (photo: US Army)

However there remains some uncertainty on which Service would operate these helicopters as the previous Defence Minister had, in fact, announced that all attack helicopters would in future be operated by the Indian Army's Aviation Corps.

RSH tender withdrawn

The Indian Army's long pending requirement for a suitable reconnaissance and surveillance helicopter (RSH) to replace its ageing Cheetahs and Chetak is to be revisited after the Defence Acquisition Council (DAC) 'scrapped' the original tender for 197 helicopters. Of these, 133 were for the Indian Army and 64 for the IAF, the process having begun in 2003. Various light helicopters have been evaluated over the years and the recent shortlisted types were the Airbus Helicopters AS550 C3 Fennec and Russian Helicopters Kamov Ka-226T.

The tender will be reissued in the 'Buy & Make (Indian)' category which requires Indian companies to identify foreign OEMs as partners and then build the selected type in India. The DAC decision will certainly affect HAL's ongoing Light Utility Helicopter (LUH) development programme of which 187 numbers would be ordered subject to clearance by 2017. Combining the total, some 384 LUHs will be required for the Indian Armed Forces (*see details in this Issue*).

ShinMaywa US-2i amphibians for Indian Navy

A major announcement made during Indian Prime Minister Modi's state visit to Japan from 30 August to 3 September 2014 was the decision to acquire ShinMaywa US-2i amphibian aircraft for the Indian Navy and build the type in India. According to reports around 15 such aircraft are to be acquired, the bulk of which will be manufactured by the private sector, with final assembly and integration carried out in India. Following contract, the first aircraft would be delivered around 2017 with two aircraft delivered each year, the programme at an estimated cost of \$3 billion and an offset amount worth \$900 million.



The Indian Navy will employ the US-2i for a number of roles, which are in effect 'force multipliers', including replenishment of key stores to warships at sea, rotation of personnel, long range surveillance, search and rescue and casualty evacuation (*see details in this Issue*).

5th Boeing P-8I MPA delivered

On 9 September 2014, Boeing delivered the fifth P-8I aircraft to India, on schedule, as part of a contract for eight aircraft to fulfil the Indian Navy's maritime patrol requirements. The aircraft was flown to INS *Rajali* from Seattle's Boeing Field and joined the four previously delivered P-8Is at the station.

Boeing is building Indian Navy P-8Is through a contract awarded in 2009. Based on the Boeing 737 commercial airliner,



the P-8I is an Indian-specific variant of the P-8A Poseidon operated by the US Navy. The P-8I incorporates a host of features unique to Indian requirements and also integrates Indian-built subsystems that are tailored to meet the Indian Navy maritime patrol requirements.

In order to maximise programme efficiency, Boeing uses a unique, in-line production process that draws on the company's 737 production system. P-8I aircraft are built by a Boeing-led team of companies that include CFM International, Northrop Grumman, Raytheon, Spirit AeroSystems, BAE Systems and GE Aviation.

Indian Army & Air Force in Kashmir relief operations

During the first fortnight of September 2014, the Indian Army and Air Force carried out relief operations on a virtual 'war footing' in the Kashmir Valley and parts of Jammu which were affected by unprecedented floods. The combined relief operation involved over 80 service aircraft, which included twelve An-32s, four Il-76s, five C-130Js and two C-17 Globemaster IIIs transport aircraft, along with Mi-17-V5, Mi-17-1V and Mi-8 medium-lift helicopters of the IAF as also HAL Cheetahs and Dhruv ALHs of the Indian Army. In addition, the sole remaining airworthy Mi-26 operated by No. 126 Helicopter Flight in Chandigarh was also pressed into service, carrying fuel, medicine, generator sets, and engineering equipment to Avantipur.



IAF Lockheed Martin C-130J Super Hercules of No.77 Squadron taxis out as a C-17 of No.81 Squadron takes off from Srinagar

By 15 September, the involved military helicopters and aircraft had made a combined 2,451 sorties, delivering 3,435 tonnes of relief materials. It is estimated that by the close of rescue operations, the total number sorties would be well over 2,500 and nearly 4,000 tonnes of aid material will have been airdropped (*see details in this Issue*).

"IAF can't afford delay in Rafale deal"

Air Chief Marshal Arup Raha has said that it is crucial to keep the Dassault Rafale deal, valued at some \$25 billion, on schedule, as the IAF "cannot afford any more delays."

His comments came in the wake of the Eurofighter consortium submitting a new and unsolicited bid for the MMRCA requirement, reportedly at discounted cost. While the Air Chief did not mention any deadlines, he noted that "it would not be appropriate to make any changes in the process" that is already ongoing. The Rafale was selected as the lowest bidder for the MMRCA tender in January 2012.

Additional Arjun Mk.II MBTs ordered

Additional orders for the indigenous Arjun main battle tank have been sanctioned by the Government, with the DAC renewing a Rs 6,600 crore clearance for 118 Arjun Mk.II tanks. This will equip two armoured regiments, complementing an earlier order for 124 Arjun Mk.I tanks which presently equip two regiments. In addition, 40 self-propelled artillery guns (130mm), termed as the 'Catapult' have been cleared for procurement worth Rs 820 crores. The Catapult, which was displayed at DefExpo 2014, is being developed by the Combat Vehicle R&D Establishment in Chennai (CVRDE).



Indian Navy NMRH requirement

The Indian Navy's urgent requirement for Naval Multi Role Helicopters (NMRH), long pending, will now progress



with the DAC “permitting” commercial bids to be opened in the Rs 1,800 crore tender for 16 helicopters, to be operated from decks of warships in the ASW role. The shortlisted types are Sikorsky’s S-70 Seahawk and the NH-90 produced by NHIndustries, for replacement of ageing Westland Sea Kings in service with the IN since the early 1970s.

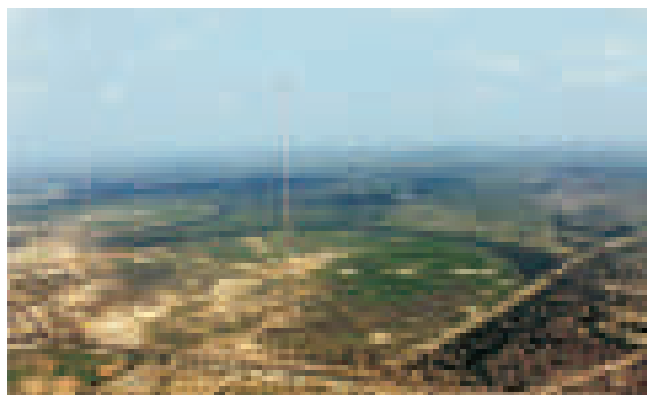
Refurbishing of Indian Navy submarines

The Indian Navy’s conventional submarines, essentially four Russian-origin *Kilo*-class, and two German-origin HDW submarines are to be refurbished under the Medium Refit and Life Certificate (MRLC) programme costing Rs 4,800 crores. This is a two year process that involves major maintenance and repair as also replacement of worn out parts. While the two *Kilo*-class submarines will be refitted in Russia, the balance two plus the HDW submarines will be refurbished by Mazagon Dock Ltd Mumbai.



New IN communication facility

With the Indian Navy planning to induct strategic nuclear-powered ballistic-missile submarines, a new facility to



communicate with the ‘silent’ vessels has been commissioned. Installing equipment constructed by Larsen & Turbo divisions in Chennai and Bengaluru, the new facility will have the highest mast structures in India, as well as several other unique engineering features.

Navy Chief Admiral RK Dhowan commissioned a very low frequency (VLF) transmitting station at INS *Kattabomman* in Tirunelveli (Tamil Nadu) on 31 July 2014. VLF radio waves (3–30 kHz) can penetrate seawater to a depth of approximately 20 metres, allowing submarines to remain submerged while trailing a long wire antenna to receive messages from shore. VLF messages are only sent from shore, since the broadcast equipment is much too large to fit in submarines. Additionally, the limited bandwidth of VLF radio signals cannot carry voice transmissions, and are limited to text.

HAL’s IJT programme “critical”

In a written reply to Lok Sabha, Defence Minister Arun Jaitley confirmed that the HAL HJT-36 ‘Sitara’ Intermediate Jet Trainer (IJT) programme has hit critical roadblocks and that efforts are underway by the IAF to look for alternate IJT aircraft from elsewhere. “The IAF conducts intermediate stage of flying training for ab-initio pilots on the Kiran aircraft. These aircraft will complete their technical life over the next couple of years. HAL, which has been developing the Intermediate Jet Trainer (IJT), as a replacement for the Kiran aircraft, has not so far been able to resolve critical wing and airframe design and development issues related to stall and spin. In order to meet the emergent situation created due to inordinate delay in the IJT project, IAF has already begun the process for extending the technical life of the Kiran aircraft. The IAF has also initiated action to look for alternate options for the IJT.”



Indo-Russian Air Exercise Avia Indra 2014

The Indian and Russian Air Forces carried out a ten-day joint exercise ‘Avia Indra 2014’ from 25 August 2014 in the Astrakhan region, concluding on 5 September 2014.

Avia Indra is the first such exercise between the two Air Forces, with participation of fighter and helicopter pilots, missile combat



Su-30SM in distinctive Russian Air Force paint scheme

crews, as well as engineers from the Indian Air Force, along with their counterparts from the Russian Air Force. During the exercise, fighter and helicopter pilots of the IAF operated Russian Air Force aircraft and participated in missions alongside their Russian counterparts. Russian aircraft flown by Indian crews included the Sukhoi Su-30SM fighter, along with Mi-17 and Mi-35 helicopters. Missile combat crews interacted with their counterparts from the Russian Air Force and took part in air defence exercises.

“The exercise provided an opportunity to both the forces for exchange of operational best practices and is intended to cement the foundation for more professional interaction and growth in the future.”

Exercise Surya Kiran VII

As part of ongoing military co-operation with Nepal, an Indo-Nepal combined Army training exercise, *Surya Kiran VII*, was conducted from 18 to 31 August 2014, in the mountainous region of Pithoragarh under aegis of the Army’s *Garud* Division.

Following the 7th Indo-Nepal Bilateral Consultative Group on Security, the two countries had commenced combined training at the platoon level in 2011, enhanced to company level in 2012 and have currently upgraded this to battalion level.

The aim of *Surya Kiran VII* is to hone sub unit-level tactics and develop interoperability between the Indian and Nepalese Armies in jungle warfare, counter terrorism operations in mountainous terrain, as also to provide working knowledge of disaster management.

LCA programme 'stakeholders' meeting

During the 'Indigenous Strategic Partners' Meet' organised by HAL in Bangalore on 11 August 2014, some 50 business partners involved in the Light Combat Aircraft (LCA) programme “have resolved to ensure that indigenous content of components used in the aircraft reaches 80 per cent over the course of the next three years.”

According to SAtORM, Avinash Chander, “it is possible to achieve such a goal since 165 out of 344 Line Replaceable Units (LRUs) are already made in India.” Dr RK Tyagi, Chairman HAL stated that production of the LCA “is on track” with the creation of a dedicated



Avinash Chander and Dr RK Tyagi reviewing indigenous LCA components

production Division at HAL Bangalore, and announced that HAL will produce 16 LCAs every year. T Suvarna Raju, Director Design and Development HAL, said that the coming together of stakeholders was necessary “to understand and share knowledge.”



Dr RK Tyagi at the Indigenous Strategic Partners' Meet, along with Avinash Chander, PS Subramanyam, Dr K Tamilmani and T. Suvarna Raju

Afghan Army Chief meets General Dalbir Singh Suhag



General Sher Mohammad Karimi, Chief of General Staff, Afghan National Army, seen with General Dalbir Singh Suhag, COAS, on 21 August 2014.

Cabinet approves 49% FDI in defence

In keeping with announced economic reforms, the Cabinet has cleared a long-mooted proposal to raise the FDI limit in defence to 49 per cent, from the previous 26 per cent. The hike is aimed at inviting greater participation from foreign companies and “boosting domestic industry and reducing import reliance.”

Shortly after the announcement, the government issued clarifications on the FDI structure, stating that the mandated minimum 51 per cent holding “does not need to be held by a single Indian company.” Multiple Indian firms may cumulatively own at least 51 per cent of any joint venture, allowing a foreign shareholder with 49 per cent stake to be the largest shareholder. In addition to adding an incentive for foreign investment, this move makes it easier for smaller Indian firms to secure shareholding in larger ventures. Management control, however, would remain an Indian majority, with the Government also mandating that certain executives, including the chief security officer, must be Indian nationals. Additionally, the Government has allowed FIIs to acquire up to 24% in Indian defence firms without requiring FIPB approval.

In September 2014, the FIPB granted the first set of approvals to new FDI applications, clearing 21 of 35 proposals under consideration, with the approvals reportedly worth nearly Rs 1,000 crore. Among the approved defence related projects were Bharti Shipyard, Solar Industries and Kinco Kaman Composites, along with Hatsoff Helicopter Training, which involved both the Civil Aviation as well as the Defence Ministry.

COAS and PM in Ladakh

General Dalbir Singh Suhag, Chief of Army Staff, visited Army formations in Ladakh during August 2014. The COAS was accompanied by Lt Gen DS Hooda, GOC-in-C Northern Command and was received at Leh Airport by Lt Gen BS Negi, GOC 14 Corps.



The Army Chief reportedly held detailed interactions on the prevailing security environment, infrastructure development projects and various initiatives undertaken by the Army in the Ladakh Region, and also reviewed the logistical infrastructure available to soldiers.

Thereafter, he flew to the Siachen Glacier and also visited forward posts in Eastern Ladakh to review the Army's defence preparedness in that sector.

Prime Minister Narendra Modi also visited the Ladakh sector on 12 August 2014, where he said that he was aware “of the aspirations of the soldiers and the challenges being faced by them.” The Prime Minister reiterated the Government's commitment to the ‘One Rank, One Pension’ scheme and the construction of a National War Memorial in New Delhi.



PM on the Siachen glacier 'standoff'

In Leh on 12 August, Prime Minister Narendra Modi ended all ambiguity about the Siachen glacier, and touched upon various issues that the state of Jammu and Kashmir has been facing. “There will be no compromise on Siachen,” said the Prime Minister, upholding the government's policy over the past thirty years. The Indian Army has stressed the strategic importance of the glacier that India has occupied since 1984, even as Pakistan had suggested demilitarisation in the past.

The PM announced a Rs 8,000 crore package to build better roads connecting cities in the state. He also laid the foundation of the



The COAS General Dalbir Singh with PM Narendra Modi at Leh

Leh-Kargil-Srinagar power grid, set to be completed by 2017 at a cost of Rs. 1800 crore, with the Centre funding 95 per cent of the cost.

ITBP raises 13 new battalions

The Indo-Tibetan Border Police's total strength is now close to 90,000 troops after four new battalions were raised this year, completing the expansion and restructuring programme that was started three years ago. 35 new border outposts have also been established to guard the international border with China.

With four battalions raised last year, and five in the year before that, the number of new battalions in the ITBP is 13. Each battalion comprises 22 officers and 1,355 men. The existing 20 battalions have also been restructured, increasing the establishment strength of the Headquarters at the Directorate General, Frontier and Sector level in order to augment the ITBP's logistical functions. One Frontier Headquarters, three Sector Headquarters, seven specialised training centres and three recruit training centres have also been formed to cater for the increased strength.

DRDO to work on export of weapons

The Defence Research and Development Organisation is working on a weapons export plan and has identified 15 weapon systems for the same. These include the Astra, Prahar, Akash and Brahmos missiles, Tejas light combat aircraft, sonars, battlefield radars, Arjun Mk.2 MBTs, airborne early warning and control systems and a number of unmanned aerial vehicles.

Advanced missile defence system to be deployed by 2016

DRDO Chief Avinash Chander has said that the organisation is speeding up its ballistic missile defence (BMD) programme, with eight more tests remaining before the capability is deployed by end 2016. The BMD programme was started 15 years ago and

the DRDO has so far carried out nine tests, including one that was aborted.

In this advanced programme, two intercept systems have been integrated so as to provide a hit-to-kill probability of 99.8%. The upcoming trials include three exo-atmospheric and five endo-atmospheric tests to intercept incoming hostile missiles, both within and outside the earth's atmosphere.

'Project Mausam'

Suggested by some observers as being India's response to China's 'Silk Route' Project and to counter that country's growing influence in the Indian Ocean Region, *Project Mausam* is shaping up to become a significant foreign policy initiative for the Modi government.

Foreign secretary Sujatha Singh has reportedly met with culture secretary Ravindra Singh to discuss the project that focuses on the phenomenon of winds, especially monsoon winds used by sailors in ancient times for maritime trade that shaped exchanges between countries and communities connected by the Indian Ocean.

India's naval presence is being strengthened through joint naval exercises, even as China is building ports in Sri Lanka and Pakistan. While the project ostensibly aims to explore cultural linkages in the IOR, it is seen as a reaction to intensifying Chinese naval activities in the region.

BRO developing roads along China border

Chinese incursions along the Line of Actual Control are an increasing cause for concern in India, and the building of border roads is considered vital for the deployment of troops and creation of the security infrastructure. In addition, employment opportunities and economic development for the locals could rise significantly.

Even though ecologists have raised doubts about the impact this could have on the fragile Himalayan ecosystem, the environment ministry has eased green rules to develop 6,000km of roads along the border with China. Under the new guidelines, rules have been relaxed in order to develop the region. The Border Roads Organisation is developing nearly 80 roads along the 4,056km China border from Arunachal Pradesh to Jammu and Kashmir, including widening of existing roads. Work is to start within the next few months, and will take around 8-10 years to complete.



'Honour of Excellence' Award for HAL Chairman

President Pranab Mukherji bestowed the 'Honour of Excellence' award to seven industrial leaders including Dr RK Tyagi, Chairman of HAL, on 24 August 2014. The award recognises Dr Tyagi's contribution "in building a self-reliant India."

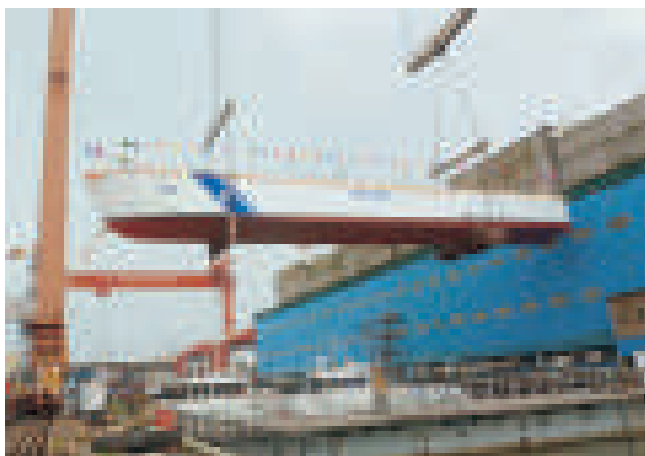


Dr RK Tyagi with his award and model of the LCA

Cochin Shipyard launches tenth FPV

Cochin Shipyard has launched the tenth of twenty Fast Patrol Vessels being built for the Indian Coast Guard. The vessel was launched by Mrs Ranjana Singh, wife of RK Singh, IDAS, IFA to DGCG, in a simple ceremony at Cochin Shipyard. On the same day, RK Singh also laid the keel of BY-511, the eleventh FPV.

CSL has so far delivered seven of the twenty vessels on order, with the eighth vessel currently readying for sea trials. The most recently delivered FPV, ICGS *Amal*, was handed over to the Coast Guard on 18 July 2014.



Defence Minister visits the Eastern Theatre

On 24 August 2014 Defence Minister Arun Jaitley visited the country's Eastern Theatre and was briefed on the upcoming Behrampore Military Station in the Murshidabad District of West Bengal. General Dalbir Singh Suhag, COAS, and Lt Gen MMS Rai, Eastern Army Commander, were present during the thirty-minute briefing held near the campsite whose foundation plaque had been laid by President Pranab Mukherjee in February.



The Defence Minister and COAS at Behrampore

Located about mid-way between Kolkata and Siliguri, the Rs 600 crore project covering 250 acres is set to be an eco-friendly 'model military camp' that will be replicated in all future infrastructural developments of similar military stations wherever feasible.

Earlier, General Suhag had visited the Panagarh Military Camp where he took stock of ongoing preparations for raising of the Army's XVII Corps (Mountain Strike Corps).

Exercise Yudh Abhyas 2014

The tenth edition of the joint Indo-US training exercise *Yudh Abhyas* 2014 commenced at Chaubattia in Uttarakhand on 17 September 2014. The US contingent was represented by Company and Brigade Headquarters from an Infantry Division of the US Army while the Indian Army was represented by an equivalent strength from a Mountain Brigade of the *Garud* Division.

Focus of the exercise is to carry out counter insurgency and counter terrorist operations in mountainous terrain under a United Nations (UN) charter. The two-week long event will see the contingents hone their tactical and technical skills in countering insurgency and terrorism in a UN peacekeeping scenario. State of the art equipment for surveillance and tracking, specialist weapons for close quarter battle with terrorists, explosives and IED detectors, as well as the latest communication equipment are being fielded by



The opening ceremony of Yudh Abhyas 2014

both sides, who will train, plan and execute a series of combined tactical drills for “neutralisation of likely threats that may be encountered in UN peacekeeping operations.”
(Detailed report in *Vayu* VI/2014)

New Indian defence export strategy

The NDA government has developed a new strategy for export of defence products, aimed at encouraging sales of military equipment to foreign nations. The ‘Strategy for Defence Exports,’ issued by the Ministry of Defence, is accompanied by a new set of rules for obtaining clearances for export of military products by both private and public sector enterprises. The strategy also outlines a structure for India to finance purchase of domestically-manufactured arms by other countries. This new export strategy is part of a raft of measures implemented or proposed by the new government to promote domestic defence industry.

Highlighting India’s strategy for leveraging defence exports for both commercial opportunity and military diplomacy, the document notes that a new Defence Export Steering Committee (DESC) will be set up by the end of the year, along with a national defence export facilitation body. The document also states that within six months, India is to become a part of the *Wassenaar Arrangement on Export Controls*, and will establish a detailed list of military equipment that can be exported.

MoD eschews ‘blacklisting’

In a welcome departure from the UPA regime’s policy of ‘blacklisting’ defence contractors, often on flimsy evidential grounds, the NDA government has elected not to ban Finmeccanica and AgustaWestland from doing business with the Government of India. However, it has introduced a set of conditions that penalise a company “for its transgressions”, whilst ensuring that needs of national security are met.

The decision highlights a significant difference from the previous government, which became notorious for banning foreign

suppliers, often at the cost of readiness and modernisation of the Armed Forces.

There are several terms and conditions, including that all ongoing contracts with the Finmeccanica group and its subsidiaries will continue, all contracts related to spares and maintenance will continue, contracts with Russian manufacturers where the Finmeccanica group is involved as a third-party supplier will continue, Finmeccanica will be allowed to bid for all contracts, but if multiple companies submit bids, the Finmeccanica group will not be considered regardless of competitiveness of their offer. Where the group is a ‘single vendor’ with no other company providing options, the government is empowered to go ahead with the deal.

New Indian Navy base at Rambilli

In addition to a new VLF transmission facility, the Indian Navy is implementing major base infrastructure programmes on the eastern coast of the country. Among these are plans for a new warship base, named INS *Varsha*, that will come up at the coastal town of Rambilli, some 50 km south-west of Visakhapatnam. The new facility will house conventional as well as nuclear-powered vessels, and is expected to be operational by 2020.



The Navy’s MiG-29K/KUB multirole fighters will also have an Eastern base. Preparations have begun to deploy a squadron of these fighters to the eastern seaboard, the Naval air station INS *Dega* at Visakhapatnam housing the aircraft, for which an initial sanction of Rs. 450 crore has been granted to establish related technical support and infrastructure facilities.

Navy to get new Headquarters

The Indian Navy is finally to get a consolidated headquarters in the national capital, after operating from six scattered



Foundation stone laid by Defence Minister Arun Jaitley on 20 August 2014

locations across New Delhi for several decades. The building is to be constructed next to DRDO Bhawan, opposite South Block. The new NHQ will have 17,000 sq ft of office space and was sanctioned at a cost of around Rs 353 crore in December 2013.

The foundation stone of the 5.4 acre plot was laid by Defence Minister Arun Jaitley on 20 August 2014, when he joked that “it takes less time to get a nuclear submarine than this land !”

Heavy weaponry along Indo-China border

To counter the build up of Chinese infrastructure along the Line of Actual Control (LAC), the Indian Army is reportedly bolstering land forces to the Ladakh sector of Jammu and Kashmir. This includes an armoured brigade, comprising approximately 150 tanks, along with a large number of BM-30 ‘Smerch’ heavy multiple rocket launcher systems.

The armoured brigade will be directly under the control of Leh-based 14 Corps and co-located with existing units, crucial because although the area is suitable for armoured operations, access is limited and vulnerable.

India to reinforce trade and defence ties with Vietnam

External Affairs Minister Sushma Swaraj, leading a delegation to Vietnam in August, has stated that India is keen to bolster bilateral ties with Vietnam. She met with key Vietnamese officials in Hanoi conducting discussions focused on connectivity, trade, defence and security cooperation.

This visit came a few days after Hanoi renewed India’s lease of two oil blocks in the South China Sea for another year, in a pointed move aimed at China, which has a discordant relationship with Vietnam over the hydrocarbon-rich region. Vietnam has been turning to India for deeper defence cooperation, which includes possible procurement of weaponry in addition to training. India has also extended lines of credit worth some \$100 million to Vietnam for infrastructure and defence procurement.

Hawk AJT file goes “missing”

In a bizarre development, a file connected with the procurement of twenty additional BAE Hawk advanced jet trainers “has gone missing from the Ministry of Defence.” These twenty Hawks were intended to equip the IAF’s *Surya Kiran* aerobatic display team,



(photo: Angad Singh)

which used to fly HAL HJT-16 Kirans but was disbanded three years ago. The MoD says it has ordered an inquiry into how exactly this file was lost, and the officials found guilty of “acts of omission or commission will be suitably dealt with.”

The Government of India had initially ordered 66 Hawk AJTs in March 2004 and then another 57 in July 2010, at a combined project cost of Rs 16,000 crore. The overall AJT project, with the first 24 trainers supplied directly by BAE Systems and the remaining 119 being progressively manufactured under licence by HAL in Bangalore, will cost well over Rs 20,000 crore when completed in 2017-2018.

INS Kolkata commissioned

On 16 August, Prime Minister Narendra Modi dedicated the indigenously-designed and built destroyer INS *Kolkata* to the nation. The PM hailed the commissioning of the vessel as proof of India’s “*Buddhi bal* (intellectual strength).” He also emphasised that with changing times, scientific and technical prowess are as important for the armed forces as physical capability. The Prime Minister went on to acknowledge the high indigenous content of the vessel, and said that India would soon be self-reliant in defence production.



The PM, Defence Minister, CNS and others at the commissioning ceremony

Nick Clegg visits HAL

Nick Clegg, Deputy Prime Minister of the UK, visited HAL’s aircraft division in Bangalore with a business delegation on 27 August 2014, where he appreciated the sustained efforts of HAL on “the success of the Hawk AJT project.”



Nick Clegg, UK Deputy PM (right), at HAL facilities in Bangalore along with Ian Felton (left), British Deputy High Commissioner and K Naresh Babu, Managing Director of HAL Bangalore Complex (photo: HAL)

INS Kamorta commissioned

Defence Minister Arun Jaitley commissioned the first indigenously-built stealthy anti-submarine warfare (ASW) corvette, INS *Kamorta*, at the Naval dockyard, Visakhapatnam on 23 August, a week after the indigenous destroyer INS *Kolkata* was commissioned by the PM in Mumbai.



Kamorta, a frontline warship with an array of anti-submarine warfare, anti-air and anti-surface weapons and sensors, is the first of four indigenous ASW stealth corvettes designed by the Indian Navy's Directorate of Naval Design (DND), which celebrated its 50th year in September 2014. *Kamorta*-class vessels can be equipped with short-range Surface-to-Air Missiles (SAMs) and Active Towed Array Decoy System (ATDS), in addition to an integral ASW helicopter.

INS Sumitra commissioned

Admiral RK Dhowan commissioned the fourth and final *Saryu*-class patrol vessel, INS *Sumitra*, in Chennai on 4 September 2014. The CNS said that the Indian Navy's plans for the future are centred on self-reliance and indigenisation and as many as 41 ships and submarines are under construction in various public and private shipyards of the country. He said that over the years the Navy had progressively designed and built scores of warships and submarines, transforming from a 'Buyer's Navy' to a 'Builder's Navy.'



Upon commissioning, INS *Sumitra* became the first major ship based at Chennai in view of the growing importance of the region. The command has the task of countering maritime challenges in the Bay of Bengal and the waters of the adjoining Eastern Indian Ocean region. Built by Goa Shipyard Limited, INS *Sumitra* will

have a major role to play in patrolling the Eastern seaboard and "will be an important component under the Eastern Naval Command." The primary role of the vessel is to undertake surveillance of the country's exclusive economic zone (EEZ) besides anti-piracy patrols, fleet support operations, maritime security and escort operations.

ICGS Abhiraj commissioned

Indian Coast Guard Ship *Abhiraj*, the fourth in a series of 20 Fast Patrol Vessels (FPVs) designed and built by Cochin Shipyard Limited, was commissioned on 2 September 2014 at Tuticorin by Vice Admiral SPS Cheema, FOC-in-C Southern Naval Command.



The 50-metre indigenous FPV displaces 290 tonnes, can achieve a maximum speed of 33 knots, and has an endurance of 1,500 nautical miles when cruising at an economical speed of 13 knots. The ship is equipped with state-of-the-art weaponry and advanced communication and navigational equipment, making the vessel an ideal platform for a range of missions such as surveillance, interdiction, search and rescue and medical evacuation. The special features of the ship include an Integrated Bridge Management System (IBMS), Integrated Machinery Control System (IMCS) and an integrated gun mount with indigenous Fire Control System (FCS).

ICGS *Abhiraj* will be based at Tuticorin under administrative and operational control of the Commander, Coast Guard Region (East).

Navy's Project 75-India revitalised

In order to accelerate clearance to issue tenders for the long-delayed Project-75I (India) submarine programme, it is reported that the Navy has elected to drop a clause stating that two of six vessels will be built in a foreign shipyard. This key change dovetails into the Modi government's push for indigenisation, and is expected to expedite clearance to proceed with the selection. RFPs for the programme were to have gone out in late-2012 or early 2013, with Acceptance of Necessity (AoN) having been granted at Rs 50,000 crore in November 2007. With the Indian Navy reduced to a handful of diesel electric submarines, and the *Scorpene* programme suffering repeated setbacks, the urgency for a new submarine acquisition programme has never been higher.

National War Memorial to be at India Gate

The National War Memorial, a highlight of this year's union budget, as well as a priority of the new government, is set to be located at the India Gate complex in New Delhi, with a War Museum to be located at the nearby Princess Park. The decision was finalised at a meeting held by Defence Minister Arun Jaitley, with the three service chiefs, Air Chief Marshal Arup Raha, Admiral RK Dhowan and General Dalbir Singh Suhag, as well as Defence Secretary RK Mathur in attendance.

The project is expected to cost Rs 400 crore, "but awaits final clearance from the Cabinet."

Singapore requests MoD review

Singapore has communicated a formal request to New Delhi to review its 2012 decision to blacklist defence firm ST Kinetics for ten years. The firm was one of four foreign companies barred from competing for Indian defence contracts in the wake of a scandal that came to light in 2009.

With the NDA government making a series of unprecedented (but welcome) steps in dealing with foreign firms in the interest of national security and defence readiness, Singapore is hoping that its request for a review will be looked upon "favourably."

IAF to equip QRTs with bulletproof vehicles

The Indian Air Force has stated a need for 200 high performance bulletproof vehicles to equip its quick reaction teams (QRTs). QRTs are the first responders in the case of any attack on an IAF installation, and will employ these vehicles for rapid movement in reaction to ground assaults.

The IAF has specified that it is seeking an air-conditioned vehicle no longer than 5 metres in length, with a turbocharged diesel engine, automatic transmission and 'run flat' tyres. It is also expected to be equipped with a roof-mounted machinegun turret, multiple firing ports, bulletproof glazing, and a high degree of blast and damage resistance against contemporary weapons.

Agni-1 successfully test fired

The Strategic Forces Command (SFC) test launched the short-range Agni-1 ballistic missile, powered by a solid rocket propellant system with a range of over 700 km, from Wheeler Island on 11 September 2014.

The launch was undertaken as a part of periodic training activity by the Strategic Forces Command to further consolidate operational readiness. A battery of sophisticated radars, telemetry observation stations, electro-optic instruments and Indian Navy ships tracked the trajectory of the missile from launch until it impacted its target.

Dalai Lama visits Zaskar

The Dalai Lama, supreme spiritual leader of the Tibetan people, made his annual visit to Ladakh in June 2014. He arrived at Padum, in the Zaskar Valley, aboard an IAF Mi-17V5 helicopter where he was received by throngs of supporters before driving to his residence at nearby Photang.



Advanced US weapon systems and technologies for India

On the eve of Prime Minister Modi's visit to the USA, from 25 September, it was reported that the Pentagon has offered to jointly develop/manufacture 34 state-of-the-art weapon systems and technologies with India. The imminence of such offers was made by US Secretary for Defence Chuck Hagel during his visit to India in early August, where *Vayu* editors were present (see article in this issue). An Indian MoD team, led by defence production secretary G Mohan Kumar, met with US under secretary for acquisition and technologies Frank Kendall on 22-25 September in preparation of the PM's visit.

Amongst the key weapon systems involved is the FGM-148 Javelin, a man-portable fire and forget anti-tank missile manufactured by Raytheon and Lockheed Martin. The Javelin deal would include full transfer of technology, including software that allows the missile to track and destroy AFVs. The infra-red guided missile has a range of nearly 5 km, and according to South Block officials, Bharat Dynamics Ltd. will be involved in co-production of the missile as well as the co-development of the next generation.



FGM-148 Javelin anti-tank missile on launch.
(Photo: US Marine Corps)

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Systems



Munitions



Equipment

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Tata-AW venture 'cleared'

Security clearance for a joint venture between AugustaWestland and the Tata group, pending for some time, has finally been given. The clearance came shortly after prosecutors in Italy agreed to settle legal proceedings with Finmeccanica, AugustaWestland's parent company.

In 2009 AugustaWestland had signed an MoU with the Tata Group for assembly of AW119 helicopters. *Indian Rotorcraft Limited* (IRL), the proposed joint venture, was to begin assembling helicopters in early-2014.



Home Ministry officials stated that such clearance was due for some time and the Ministry of Defence was not opposed to it, since the JV between AugustaWestland and Tata does not involve any defence-related deals. Tata has maintained that at a future date, IRL may sell helicopters in the Indian domestic market for civilian usage, in line with the JV's stated intent to operate only in the civilian market.

MEHAIR begins seaplane service from Mumbai

Maritime Energy Heli Air Services Pvt Ltd (MEHAIR) and the Maharashtra Tourism Development Corporation (MTDC) launched the first commercial amphibian aircraft flight from Mumbai to Pawana dam (near Lonavala) on 25 August 2014. MEHAIR's amphibian aircraft will eventually connect Mumbai with multiple state tourist destinations adjacent to four suitable water bodies, which will save time for travellers, given that aircraft take far less time to connect two points as opposed to road or rail journeys.

The floatplane service is being launched with Cessna 208 and Cessna 206 amphibians. MEHAIR pioneered seaplane operations in India in January 2011, in the Andaman and Nicobar Islands.



Pilatus partnership with Tata Advanced Systems

Pilatus Aircraft Limited has announced a ten-year partnership with Tata Advanced Systems Limited (TASL), for the assembly of PC-12 aero structures at its facility in Hyderabad, India. This provides for delivery of the first complete PC-12 NG aero structure during the second half of 2016, and includes tooling, jigs and training of TASL personnel at Pilatus facilities in Switzerland. The training will enable TASL to supply PC-12 NG aero structures for the Pilatus global supply chain.



MKU introduces 6th generation ballistic protection technology

MKU has introduced new 6th generation ballistic protection technology, Ammoflex-6 and Polyshield-6, which reduce the weight and thickness of personal body armour by 40 per cent. This not only increases the agility and speed of soldiers but also reduces stress and enhances their endurance.

A personal ballistic vest manufactured using 6th generation Ammoflex-6 technology, which conforms to the stringent norms of NIJ 0101.06 Level II, weighs 1.5 kg, while a vest compliant with Level 3 of VPAM BSW 2006 norms weighs only 1.3 kg. An armour insert for rifle protection made using 6th generation Polyshield-6 technology weighs less than 850 g. Body armour made using Ammoflex-6 and Polyshield-6 offers multi-hit protection at lowest possible weights, whilst conforming to international standards such as NIJ 0101.06 and VPAM. Providing soldiers with unrestricted movement, flexibility and comfort, such solutions are ideal for Special Forces that need to carry out rapid action.

These 6th generation protection solutions were showcased at a series of defence trade shows around the world—SMM in Hamburg, Germany (9-12 September), GPEC in Germany (9-11 September) and ADEX in Azerbaijan (11-13 September)—where “they were received with great interest.”

LCA development teams feted by PM

DR K Tamilmani, DG (Aero) at DRDO and former CE, CEMILAC plus PS Subramanyam, Director ADA, and their respective teams were recognised by Prime Minister Narendra Modi on 29 August 2014 for their “unique contributions to the development and certification of the Tejas fighter aircraft.”



In a function also attended by DRDO DG Avinash Chander, Defence Minister Arun Jaitley and MoS for Defence Rao Inderjit Singh, the pair was presented the *DRDO Award for Performance Excellence 2013* by the Prime Minister.

An Indian Aeronautics Commission?

During his keynote address delivered at the 9th International Conference on ‘Energising Indian Aerospace Industry,’ organised by the Confederation of Indian Industry (CII) in association with the Centre for Air Power Studies (CAPS), HAL Chairman Dr RK Tyagi recommended formation of an Indian Aeronautics Commission to combine various organisations and institutes currently functioning under different ministries under one umbrella.

He also said that it is important to exploit FDI and joint venture opportunities for development of indigenous industry in India’s defence and aerospace sector. Dr Tyagi touched upon other issues such as supply chain management and strategic investments in defence and aeronautics sector.



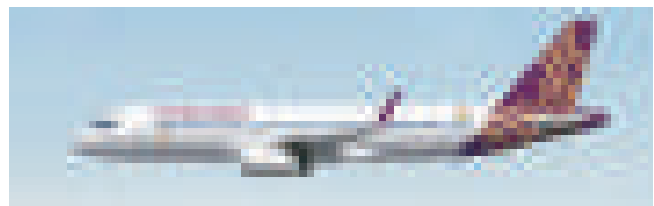
HAL Chairman Dr RK Tyagi addresses an International Conference on Indian Aerospace Industry in Delhi on 10 September 2014

Tata-SIA airline ‘Vistara’ to launch in October

The Tata-SIA joint venture airline has revealed its long-awaited name, announced as *Vistara*, a Sanskrit word meaning “limitless expanse.” The full-service airline, offering a three-class service, is due to start operations in October, subject to approval by the Directorate General of Civil Aviation (DGCA). This marks the return of Tata in the airline industry after 1953, when Air India was nationalised. Singapore Airlines owns 49 per cent of the venture, while Mumbai-based Tata controls 51 per cent.

Vistara’s chief executive, Phee Teik Yeoh, has projected a strong future for the new carrier thanks to India’s fast-growing middle class, noting that compared to developed countries, there is tremendous growth potential in the Indian market.

Vistara will take delivery of its first aircraft, an Airbus A320-200, in September 2014, and will have five aircraft by December. The airline plans to expand its fleet to 20 aircraft by the end of its fifth year in business.



Indian air traffic statistics



(photo : Angad Singh)

In August 2014, the Directorate General of Civil Aviation (DGCA) released data showing that India's domestic air traffic has dropped by ten per cent since June. There has, however, been an increase in passengers on domestic airlines since the previous year, with 52.16 lakh in July this year as against 48.66 lakh in the same period last year.

IndiGo's market share is the highest, at 30.7 per cent, however in spite of being the largest low cost carrier in India; the flight occupancy rate was down to 67 per cent even as the number of passengers it carried was the highest at 16 lakh. Spice Jet's market share is at 20.9 per cent, while its flight occupancy rate is the highest at 79.4 per cent with 10.92 lakh passengers.

Jet Airways' market share is at 19.6 per cent, with an occupancy rate of 64.2 per cent and 10.21 lakh passengers (between Jet Airways and JetLite) while Air India is at 18 per cent, with 9.40 passengers and an occupancy rate of 69.6 per cent. Go Air's market share is at 9.3 per cent with an occupancy rate of 69.7 per cent and 4.80 lakh customers.

Two new airlines, AirAsia India and Air Costa are also included in the domestic air scene with a market share of 0.5 per cent and 1.1 per cent respectively. Flight occupancy at Air Asia for July was 69.8 per cent with 58,000 passengers and Air Costa flew 25,000 passengers at an occupancy rate of 65.5 per cent. The new Tata-SIA airline Vistara will launch in October 2014, even as six other airlines have been cleared for scheduled services by the new government.



(photo : Angad Singh)

Aviation ministry to review second airport restrictions

The restriction on having a second airport within 150 km radius will come under review by the Ministry of Civil Aviation in order to consider the possibility of setting up multiple airports in Indian cities. A lowered figure of 100 km is being examined so as to achieve this.

Minister of State for Civil Aviation Ashok Gajapati Raju has issued instructions for the setting up of public-private models in which all stakeholders are considered, given that existing public-private partnerships in the airports at Delhi, Hyderabad and Bangalore may have private stakeholders preventing airports being built in the vicinity. Moreover, the minister has asked authorities to ensure that airports streamline activities by providing three separate terminals for full service airlines, budget carriers and business jets.

Dassault Systemes introduces Solidworks 2015

Dassault Systemes, considered world leaders in Product Lifecycle Management (PLM) solutions, launched their 'Solidworks 2015' CAD software at Bengaluru on 22 September. With this latest release of 3D design software applications, users would gain access to cloud based capabilities and also benefit from improved productivity, work processes and operating costs.

Bertrand Sicot, CEO of Solidworks, speaking on the occasion stated that more than 90% of the functionality in Solidworks 2015 has been based on customer inputs, which ensures that the rapidly expanding design needs of customers are adequately addressed. "Users can now connect their existing Solidworks desktop applications to the cloud and begin developing new business processes," which he averred, was "a testament to their ongoing commitment to users."

Solidworks 2015 covers all comprehensive aspects of product development, including 3D design, simulation, electrical design, product data management and technical communication. Designers and engineers can now span multiple disciplines with ease, shortening the design cycles, increasing productivity and delivering innovative products to the markets faster.

Besides delivering key enhancements requested by the user base, it also provides solutions to a wide range of industries and markets such as enhancing the aesthetics of products and building infrastructure and machine tools better than ever before. With Solidworks Model Based Definition, the 3-D model itself holds all the dimensional data necessary to make the part. This means less documentation creation, fewer emails flying around, and fewer files to sustain when the project is complete.

Dassault

"Capability Build Up in Phased Manner"

VAYU Interview with

Air Chief Marshal Arup Raha, Chief of the Air Staff IAF

VAYU : *The IAF is in the midst of a comprehensive modernisation plan, which will enable it to acquire niche operational capabilities essential for meeting India's security contingencies. Deliberating on a balanced force structure, what are the IAF's priorities in terms of new acquisitions so that limited resources can be allocated affectively?*

CAS : The capability building roadmap of the IAF is laid down in the Long Term Perspective Plan (LTTP). Over the next five-year period, the IAF plans to induct additional fighters, transport aircraft, trainer aircraft, force enhancers, helicopters and RPA's. The IAF is also in the process of procuring new generation AD radars, weapons and state-of-the-art Electronic Warfare Systems to complement these platforms while progressing towards acquiring complete Network Centric Operations capability.

The capability build up is processed in a phased manner, catering for the inherent gestation period, and schemes are processed

accordingly to achieve the desired capability over each Five-Year Plan period. Each of the schemes mentioned is very high on our priority and integral to this capability development process. Hence, there is no inter-se prioritisation, and the IAF aims to acquire the mentioned assets and the capability by the end of the 12th Plan period. We are also focusing equally on comprehensive infrastructure development with an objective to create matching operational and maintenance facilities, which enhances the overall capability of the IAF.

VAYU : *The IAF's MMRCA requirement remains unfulfilled and there are contradictory reports in this regard. What is the present situation and are there any alternatives being considered should the programme be further delayed?*

CAS : The timely induction of 126 MMRCA in the IAF is of critical importance to arrest the drawdown in strength of fighter squadrons due to phasing out of older aircraft. Any deferment of the MMRCA



The Air Chief (photo: IAF)

procurement will adversely affect the fighting capability of the IAF and therein impact national security. Three CNC Sub-Committees negotiating 'Maintenance', 'Offset' and 'Transfer of Technology' have completed their negotiations and submitted their report to the CNC. The 'Contract' Sub-Committee has completed most of the contractual aspects with the representatives of the vendor and HAL. IAF hopes that pending issues will be resolved soon and the contract will be signed after obtaining CCS approval. No alternatives are being considered as MMRCA induction is part of IAF's Long Term Perspective Plan based on the envisaged capabilities, technology drivers and threat scenarios.

VAYU : *There is some confusion about phase out of the MiG-21 fleet from frontline service. Has there been a further extension of life in service of the Type?*

CAS : The MiG-21 fleet is being phased out from frontline service as per envisaged timelines. The oldest version of MiG-21s, the MiG-21 Type 77, have already been phased out. Some MiG-21 aircraft were upgraded and will be phased out in a planned manner. The last squadron of the upgraded version of MiG-21 will be phased out by 2025.

VAYU : *The Tejas LCA Mk.I received its IOC (2) in December 2013 but establishment of the first trials unit in the IAF has still not taken place and FOC of the LCA Mk. I will also be affected. How will this impact on operational deployment of this indigenous fighter?*



The IAF's strike force : Su-30MKI with two Jaguar Maritimes

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Tejas LCA LSP-2 (KH2012) during a display flight at Aero India 2013 (photo: Angad Singh)

CAS : The first squadron to receive the LCA has already been earmarked and the squadron would be made operational as soon as the initial batch of LCA is delivered to the IAF. The full complement of aircraft for the first squadron of LCA is likely to be delivered by 2017 subject to adherence to the production schedule by HAL. During the initial period of operationalisation of the aircraft, there are bound to be certain teething issues, but with the required hand-holding between IAF and HAL, we are sure to overcome them. The necessity of expediting the production of the LCA in order to meet the operational capability of the IAF has been addressed by HAL.

VAYU : *Should the follow on LCA Mk. II not meet the IAF's requirement in terms of performance and availability, what are the options that may be considered?*

CAS : A lot of lessons have been learnt from the LCA Mk.I project and the same have been taken into account for the development of the LCA Mk.II, currently at the Preliminary Design phase. Issues like the provision of a single point entity for addressing the major design and development issues, maintainability and ground support and ramping up of production capability are some of the areas where the IAF has made certain recommendations. 'Other Options' are not being considered at this stage since we are confident that the LCA Mk.II will be able to bridge the gap between the LCA Mk.I and the Air Staff Requirements.

VAYU : *The Advanced Medium Combat Aircraft (AMCA) is at the preliminary design phase at the Aeronautical Development Agency. This 5th Generation fighter aircraft is required to go into*

service from about 2030 onwards, but we believe that the IAF should be in 'the driver's seat'. Your views please!

CAS : The AMCA is being developed as a multirole medium weight and twin engine fifth generation fighter. Exploiting the concept of stealth, super cruise, high manoeuvrability, advanced avionics and sensor fusion, the aircraft shall be capable of performing a multitude of air-to-air and air-to-ground missions. The IAF is actively involved in the Preliminary Design programme. Top level Operational Requirements for the AMCA have already been released by the IAF to Aeronautical Development Agency (ADA), the lead designer for this project. The IAF is an active participant in the feasibility study that is presently underway, rendering support and guidance to ADA at every step of the design process.

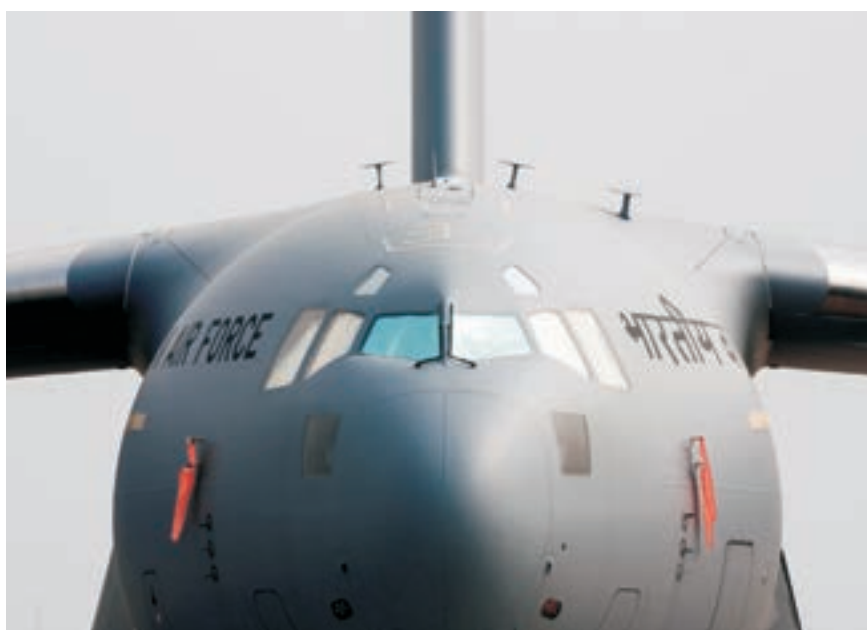
VAYU : *In this context, the Indo-Russian FGFA programme has also been underway for several years but again there are reports of major delays. Could you kindly comment on its status?*

CAS : The Inter-Governmental Agreement (IGA) for development and production of FGFA was signed between India and Russia. The Preliminary Design phase was completed in Jun 2013. Presently, contract negotiations for R&D Phase are in progress. FGFA is a very large project in terms of technical complexities, work-share and the costs involved, therefore, the CNC is studying these aspects critically.

VAYU : *The IAF is steadily inducting the C-17 Globemaster III strategic air lifter and these are being well employed on various major tasks. Is the option for additional aircraft likely to be exercised?*

CAS : Seven of the 10 contracted C-17 aircraft have already been delivered. The remaining aircraft will be delivered by the end of 2014. The IAF is planning to procure additional aircraft in the Very Heavy Transport Aircraft Category (VHETAC) and the process for the same has been initiated.

VAYU : *There are disquieting reports, confirmed in Parliament, on critical design and performance problems with the HJT-36 intermediate jet trainer. Will the IAF be forced to extend technical life of the Kiran and also look for alternative options for the IJT?*



The C-17 has greatly improved IAF air transport capability (photo: Angad Singh)



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C-130J of No.77 Sqn taking off from Srinagar AFS during one of many relief missions conducted in J&K (photo: IAF)

CAS : The IJT is being developed by HAL for the past 14 years and is striving hard to achieve its Initial Operational Clearance (IOC). This delay in IJT and the grounding of the HPT-32 fleet from 31 July 2009 had adversely affected IAF's pilot training. The delay in IJT's induction has forced IAF to explore for other options from the global market. Kiran fleet is likely to remain in service for a few more years. However, our aim would be that the IJT project succeeds.

VAYU : *With employment of the Pilatus PC-7 Mk.II basic turboprop trainer, the stage I flying training needs are being met. After delivery of the first 75 aircraft from Switzerland, will the IAF insist on receiving the balance 106 from abroad or await emergence of the HAL HTT-40?*

CAS : HAL was supposed to make 106 Basic Trainer Aircraft (BTA) i.e. HTT-40 for the IAF. However, MoD declined to accept the Detailed Project Report of HAL due to techno-commercial reasons. In effect, the proposal still remains on the drawing board. Meanwhile, Air HQ has been directed to submit a proposal for a 'Buy & Make (Indian)' case for 106 PC-7 Mk.IIs. Response to an RFI issued for this project to the Indian industry has evoked encouraging response from several companies. Air HQ expects to get final approval for the project in the next few months.

VAYU : *The IAF has so far placed comparatively little emphasis on simulators as training aids. Given the emerging budgetary constraints, would it not be cost effective to increasingly utilise advanced flight simulators?*

CAS : Emphasis on simulators has increased several fold. The IAF is aware of the important role of simulators as training aids and procurement of simulators is built

into the contracts of all aircraft that the IAF is in the process of procuring. Availability of adequate number of simulators would assist in enhancing skill levels of aircrew and of maintenance personnel in the IAF. I agree that enhanced use of simulators as a training aid would be in keeping with the need for realistic and cost effective training; nevertheless, the importance of operational training in the cockpit will retain its significance and cannot be replaced. The IAF has also initiated a case for acquiring Virtual Training System (VTS) towards more cost-effective training for transition to advanced combat aircraft.

VAYU : *Networked air warfare is vital and the IAF is certainly enhancing capability in this regard. The few Phalcon AWACS in service are to be joined by EMB-145s with indigenous AEW&C radar. Is the IAF planning to augment this force multiplier?*

CAS : To ensure the requisite degree of air surveillance in our area of interest, IAF has already taken the first step of operationalising three AWACS, procured from Israel. Indigenous development of AEW&C by DRDO is in the developmental flight trials stage. Two AEW&C platforms would be inducted in the IAF after successful completion of trials. To leverage the experience and expertise gained in

the Design & Development of AEW&C, a project for indigenous development of AWACS was initiated. The project is envisaged in two phases.

Phase I, which has already been approved, envisages development of prototype AWACS (India) followed by a mid-term review by a National Review Committee. Based on the success of the Phase I, Phase II for production of additional AWACS (India) will be initiated. This programme of indigenous development of AWACS by DRDO is yet to commence and delivery of the first indigenous AWACS is expected in a decade from now. In order to bolster our air defence requirements in the near future, IAF has initiated a proposal to procure two additional IL-76 based AWACS from Israel. The contract is likely to be signed during the current financial year.

VAYU : *IAF has stressed that cyber security is the new critical dimension in conflict between nations? What is the broad planning for the IAF in meeting this new threat?*

CAS : IAF has adopted a proactive approach towards cyber security through continuous awareness, auditing of networks and strengthening of cyber security for its Critical Information Infrastructure. A comprehensive roadmap for strengthening cyber security in IAF is being implemented. Formation of tri-Services cyber command is under active consideration.

VAYU : *What is the current situation with IAF's requirement for additional mid-air refuelling aircraft? What is the status of the A330 MRTT contract?*

CAS : The IAF took up the case for six additional Flight Refuelling Aircraft (FRA) mainly to meet the requirement of air-to-air refuelling in respect of IAF as well as Indian Ms EADS (Spain) with Airbus 330 MRTT has emerged as the L1 vendor. Presently, the project is at Contract Negotiation (CNC) stage.



IAF MiG-29s escorting A-50I AWACS aircraft (photo: IAF)

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VAYU : *The IAF has in recent times expressed concerns about adequate availability of talented personnel. Could you share any new recruitment measures undertaken over the past year to rectify this, and also whether the problem has lessened in severity?*

CAS : The IAF vision statement 'People First-Mission Always' underscores the fact that the air-warrior behind the machine is the 'pivot factor' that will eventually decide the outcome of any operational endeavour. IAF has adopted a multi-pronged approach to attract the best talent in the country in desired numbers. These include optimum utilisation of electronic, radio and print media, rallies and campus interactions and research study at the university level for understanding the aspirations of youth who soon would be looking at various career options.

In order to absorb the increased induction of trainees we have created two additional Air Force Selection Boards (AFSB), and necessary infrastructure in our training establishments to absorb the enhanced intake. We are extending our reach to a larger section of the youth. Our aim is to create 'Brand IAF,' which will be sought by the youth as a favoured career option. Our initiatives have ensured that the quality and quantity of candidates opting for Air Force as a career has gone up significantly. It is expected that the Seventh Central Pay Commission would address the issues submitted by the three Services to make the 'Profession of Arms' an attractive one for the youth.

VAYU : *The Air Force has had women pilots in the helicopter and transport streams while the Navy/Coast guard also has women aircrew on maritime patrol aircraft. Are there plans to induct women in the fighter streams in the near future?*

CAS : The IAF has played a leading role in giving opportunity to women and considerable progress has been made since their induction commenced in 1992. Today, a large number of talented and industrious women officers are undertaking a variety of tasks in all branches of the IAF except the fighter stream. The IAF is complying with all extant policies of the GoI in order to ensure that fighting efficiency, combat effectiveness and functionality is maintained at all times. Moreover, maritime patrol aircraft of the

Indian Navy you mentioned fall under the broad category of transport aircraft. The probability of inducting women in the fighter stream in the near future is high.

VAYU : *The 'Avro replacement' programme has been resurrected: in which role would the selected aircraft type be employed considering that the Avro fleet are currently engaged in staff communication, navigator training, multi-engine conversion training and light logistic air support.*

CAS : The replacement aircraft as of now is planned to undertake the tasks that were being undertaken by the Avro i.e. air transport operations, communication, type-training of transport aircrew and ab-initio training of Navigators. However, any modern military transport aircraft of this class also has the capability of transportation of troops and cargo.

VAYU : *New Mi-17V5 helicopters have been remarkably successful, particularly in disaster relief and aid operations,*

playing a vital role in last year's Operation Rahat and in numerous relief operations since. Does the IAF foresee an expansion in its role as a key facilitator in disaster management operations?

CAS : IAF has always been at the forefront during HADR missions. With the induction of the new Mi-17V5 helicopters, the availability of medium lift helicopters has improved, both with respect to number of assets and bases. Thus, they can be available for disaster relief in a faster time frame and in higher numbers.

These are multi-role helicopters equipped with state-of-the-art avionics and can carry more payload over longer distances. The V5 also has a higher ceiling of operation. These helicopters recently undertook the additional role of fighting forest fires at Mount Japfu near Kohima and in the Tirumala Hills this year. Their employability in the ongoing Op Megh Rahat in J&K is testimony to the versatility of these platforms, especially for HADR missions.



Pair of Mi-17V5s, bearing the IAF ensign, at an Air Force Day parade (photo: Angad Singh)



Air Chief Marshal Raha prior to a sortie in a MiG-23 trainer (photo: IAF)

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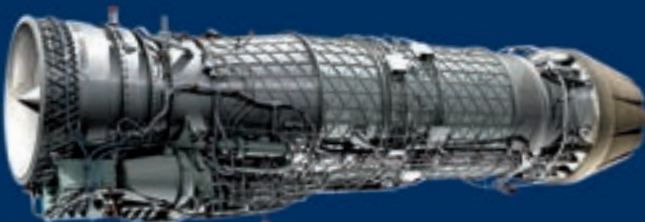
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Floods in Kashmir, September 2014

IAF Boeing C-17 Globemaster III of No.81 Squadron comes into land at Srinagar

In scenes unfortunately reminiscent of the devastation wreaked on the state of Uttarakhand in June 2013, the Indian armed forces swung into action in early September this year to conduct another massive relief mission, this time in the flood-ravaged state of Jammu and Kashmir. In early September 2014, the Jammu and Kashmir region was hit by torrential rainfall that caused widespread flooding and landslides, which, by 10 September had claimed some 200 lives. According to the Home Ministry, several thousand villages across the state had been affected and 350 villages were submerged. Many parts of Srinagar, including the Border Security Force (BSF) HQ in Santnagar and the Army cantonment in Badami Bagh were inundated, and vital roads submerged.

Shortly after the flooding and landslides on 3 September, military units (initially Army and Air Force) took over the task of conducting rescue and assistance operations



Indian Army Cheetah rescuing stranded people from a rooftop in downtown Srinagar



Flood victims being airlifted out of the Valley in IAF C-17 aircraft



Jawans of the Army load relief supplies in IAF Mi-17 V5 at Srinagar

from courageous locals who had made commendable efforts when the disaster first struck. The paramilitary National Disaster Response Force (NDRF) was caught unprepared by the suddenness of the flooding and only began to arrive in the state from 6 September onward. They were followed a few days later by teams from the Indian Navy's elite Marine Commandos, whose expertise in maritime operations proved invaluable to the relief efforts. The Army gave their relief efforts the code 'Operation Megh Rahat' ('relief from the clouds') while the Air Force dubbed their task 'Operation Rahat-II,' naming it after their sterling performance in *Operation Rahat* during the 2013 floods in Uttarakhand (see *Vayu IV*/2013).

By 7 September, rescue efforts were in full swing, and the IAF had airlifted a total of 850 military and paramilitary personnel to the flood-affected regions, and sent a RAMT (Rapid Action Medical Team) with



Jawan helping families evacuated by Mi-17



IAF Dhruv ALH comes into land with Mi-17 V5 in the background

medical supplies, blankets, tents and boats to Srinagar to aid relief efforts. Some twelve An-32s, four Il-76s, five C-130Js and two C-17 Globemaster III transport aircraft of the IAF were initially involved in the operation, along with twenty-six helicopters of various types.

The Army carried out rescue operations around the clock, working through the night and inclement weather and despite the Army cantonment in Badami Bagh itself being severely affected by floodwaters. General Dalbir Singh Suhag, the COAS,

directed that despite difficulties of the operation, “The Indian Army will not move back to the barracks till the last person is brought to safety.”

The Army employed the Internet and social media networks to improve effectiveness of their rescue operations. In addition to online tools such as Google’s People Finder, which has been purpose-built for disaster relief scenarios, the Army monitored social media networks including Facebook and Twitter to direct rescuers to stranded civilians. Mobile messaging

service Whatsapp was also reportedly used to coordinate efforts on the ground.

By 11 September, over 96,000 people had been rescued from flood-afflicted areas, and the total number of Army Aviation and IAF aircraft involved in the relief effort had increased to 84. The number of Army troops deployed reached 30,000, of which 21,000 were deployed in Srinagar and 9,000 in the Jammu region. With food and water shortages becoming dire, airdropping of supplies was conducted on a massive scale, with 224,000 litres of water, 2.6 tonnes of



With the Pir Panjal mountain ranges as backdrop, Mi-17 and Cheetah get airborne



Mi-17 evacuating stranded tourists



Air Chief Marshal Arup Raha, CAS, carrying out aerial survey over the Valley

biscuits, 7 tonnes of baby food and 31,500 MRE (Meal, Ready-to-Eat) packets being provided. The helicopters and aircraft had undertaken 930 sorties, delivering over a thousand tonnes of relief material. By midday on 11 September, 80 medical teams of the Armed Forces Medical Services were in place and had already treated more than 21,500 patients. The Armed Forces also established 19 relief camps in the Srinagar and Jammu region, where thousands of rescued people were sheltered and provided with food, water and other basic amenities.

With boats fast becoming the crucial factor in rescue operations, the Army

pressed its BAUTs (Boat Assault Universal Type) and OBM (Out Board Motor) into service to augment the NDRF boats already being used.

Relief operations continued at high tempo over the next few days and by 15 September over 226,000 persons had been rescued from different parts of Jammu & Kashmir. As the floodwaters began to recede, sanitation and hydration became the most pressing concerns, and twenty RO (reverse osmosis) water purification plants with a capacity to filter 400,000 litres per day and four RO plants with a 100,000 litre per day capacity were put in place

at Srinagar. Heavy-duty suction pumps were airlifted in from Jodhpur and Raipur, while sewage pumps from Delhi were also dispatched to the Valley. To address power shortages, thirty generator sets with capacity between 3 to 5 kVA each were sent to Srinagar along with communication equipment from BSNL.

By mid-September, 2,451 relief sorties had been undertaken, with over 3,000 tonnes of relief materials dropped. A total of 224 Army and 148 NDRF boats were actively involved in the rescue operation. Meanwhile, four Army Field Hospitals were established in Avantipur, Pattan,



Ilyushin Il-76 of No.44 Squadron before flight out of the Valley

Airlines lend a hand to rescue efforts

Indian carriers, including Air India, played a vital role in assisting relief and rescue efforts in the wake of the disaster. Civil carriers airlifted over 35,000 stranded passengers and flew over 100 tonnes of relief material to the flood-ravaged state.

Air India flew several trips between Jammu, Srinagar and Leh to transport security and paramilitary personnel, and also carried inflatable boats from the United States to J&K in aid of relief and rehabilitation measures. While Air India permanently stationed two aircraft to fly stranded people and patients free of cost out of Srinagar and Leh, private airlines, non-scheduled and charter operators also mounted additional flights to evacuate affected people. Additionally, Pawan Hans Helicopters Limited (PHHL) deployed four helicopters, with five more kept on standby to meet emergency situations.



HAL Cheetah at dusk with HAL Dhruv in the background

Leveraging social media and the internet

In a first for disaster relief operations in India, the Army employed the Internet and social media networks to improve effectiveness of their rescue operations. In addition to online tools such as Google's People Finder, which has been purpose-built for disaster relief scenarios, the Army monitored social media networks such as Facebook and Twitter to direct rescuers to stranded civilians. Mobile messaging service Whatsapp was also reportedly used to coordinate efforts on the ground.

Major General Shokin Chauhan, head of the Army's



Air Vice Marshal Upkarjit Singh, AOC J&K, with Gp Capt Gerard Galway speaking to the media

public information office said that a dedicated team of young officers was monitoring social media websites "practically around the clock." According to Maj Gen Chauhan, an estimated 12,000 people were assisted on the basis of reports received over the Internet.

Anantnag as also the old airfield where medical aid was provided to more than 60,000 patients.

To restore road connectivity in the state, five task forces of the Border Roads Organisation, comprising some 5,700 personnel, were deployed to Srinagar, Rajouri and Akhnoor. They rapidly restored road connectivity between key towns, notably repairing the Srinagar-Sonamarg route, which was opened to traffic by 15 September.

On 16 September 2014, Air Chief Marshal Arup Raha, Chief of the Air Staff (CAS), visited flood-affected areas of the state to oversee and assess relief operations, meeting Lieutenant General Subrata Saha, Commander 15 Corps at Badami Bagh. The CAS carried out an aerial survey of both north and south Kashmir, and was "extremely satisfied with the team work and joint operations being carried out by Army, Navy, Air Force and NDRF" and pledged that the Armed Forces were trying their best to restore conditions back to normal.

With the most pressing rescue work complete by 16 September, the focus shifted to restoring road connectivity and telecommunications to the region. By 17 September, Army Engineers, after successfully opening the national highway between Jammu and Srinagar, restored connectivity between Rajouri and Budhal as well, by constructing a 180-foot Bailey bridge over the river Ans, to ensure that relief and rehabilitation support could reach the most remote parts of the state. Approximately 10,000 personnel from the Army Engineer Corps and Border Roads Organisation (BRO), equipped with over 400 bulldozers, excavators and earthmovers, were involved in the mammoth reconstruction efforts.

As the pace of military operations in the region slowed, the Army declared in the evening of 19 September that the *Megh Rahat* rescue operations were complete but relief and medical assistance in the region would continue. Restoration of road networks was largely completed, and efforts were underway to improve the condition of recently restored roads. "Troops of the Army's Northern Command remain committed to providing support in close synergy with the civil administration and the police."

Angad Singh

Imperatives of Indian Air Power



The Vayu-StratPost Round Table Discussion in New Delhi

In July 2014, even as the new government led by Prime Minister Narendra Modi was settling in at helm of the nation and an air of change was permeating through the administration,

Vayu Aerospace & Defence Review in association with defence and strategic affairs website *StratPost* hosted a day-long round table discussion on 'Air Power in India' at New Delhi.

Held on 4 July 2014, the discussion was meant to review how the combat fleet structure of the Indian Air Force (IAF) is expected to evolve over the coming decade, particularly in the context of on-going

IAF Fixed Wing Combat Force Levels: 2012-2032



• Figures above are based on various public-domain sources.

• Any future projections will be affected by amended phase-out schedules as has happened with the MiG-21 Bison fleet, which was originally supposed to have gone by 2017, now 2025.

• Projections for 2022 are based on a "best case" scenario assuming that LCA Mk.I production is at least 8 aircraft per year from 2015, that the MMRCA contract is completed in 2014 -15 with deliveries taking place as envisaged, and that FGFA development and production is not delayed any further.

developments and acquisition programmes such as the LCA, MMRCA, FGFA and AMCA.

Invited were an eclectic mix of former senior service officers, bureaucrats, defence analysts and observers. Many of the Air Officers in attendance had retired recently, and several have been closely associated with the MMRCA and LCA programmes.

Moderated by Inderjit Badhwar of *India Legal*, the six-part discussion was initiated by *Vayu's* Pushpinder Singh giving an overview of Indian air power today and then exploring how it balanced against 'opposing' forces of neighbouring countries.

The IAF is, at present, smaller than its sanctioned strength of 42 combat squadrons and at no point in the next 20 years will the force levels actually meet sanctioned requirements. Compared with this, Chinese air power is several times larger in quantitative terms and relentlessly improving its qualitative aspects. Pakistan is struggling with a host of domestic problems, but the PAF's future force mix appears to be well mapped out, with upgraded F-16s to form the qualitative edge while large numbers of JF-17s would make up the quantitative aspect.

An overview presented stark realities of the IAF's present force composition and suggested that the near future was not going to be entirely free from problems either.

The status of the LCA programme was reviewed, in that the aircraft in present form is not able to meet the IAF's qualitative requirements, even as it remains far from FOC, with the first series production (SP) aircraft yet to be delivered. The follow-on

Tejas Mk.II is still on the drawing board, and it is indicated by designers that little of value can be accomplished within constraints of the present airframe. At the same time, the MMRCA negotiations are floundering, the FGFA has suffered a setback during testing in Russia and the AMCA has not had its configuration frozen as yet and remains without a designated engine. Underlining all this is the fact that 'finances' are fundamental to the future. The nation simply does not have the kind of resources needed to fund future fighter programmes which are expensive to acquire and prohibitive to operate.

Having set the tone for the day, Pushpinder Singh was followed by eminent geo-political analyst B. George Verghese, who spoke on the imperatives of expansion and modernisation of the armed forces, "The previous emphasis on the Army has to change. I think the air and the naval aspects are going to be growing in importance," he said.

He also referred to the sorry state of indigenous defence manufacture, succinctly stating that we had "missed opportunities for becoming more self-sufficient on our own, because of the timidity in taking bold decisions."

State of the IAF 2014-2032

The follow-on session dealt primarily with air power in India and fulfilling the requirements of this role. The discussion revolved around the background on how the Indian Air Force's requirement for 126 Medium Multi Role Combat Aircraft (MMRCA) had originated and proceeded towards its current stage.

Discussions on the state of air power centred on qualitative and quantitative aspects and application at the strategic level which remain areas of great concern.

Former CAS Air Chief Marshal SP Tyagi noted these strategic concerns by highlighting the outdated schools of thought that remain prevalent in India. He said, "When we discuss air power, we basically have a continental mindset. Everything is land-based. And we just don't realise how much the world has changed." He also addressed the reactionary nature of the move to institute a new manpower-heavy mountain strike corps in the east, noting that "mountains eat troops" and that "this business of getting more and more and more corps and more divisions needs a re-look." The former Air Chief stressed on the need to recognise the crucial importance of air power in mountainous terrain, given the fact that air power "to a large extent does not recognise terrain" and is free from most burdens that hamper ground-based operations in the particularly difficult mountainous frontiers of the subcontinent.

Air Chief Marshal Tyagi continued to clarify his views on the role of air power in an overall sense, saying that the Air Force is not only an offensive or defensive force but also a deterrent force. Air power, therefore, plays a crucial part in maintaining the regional balance of power. "The moment you're weak, someone will come and kick sand in your face," he warned.

Former Chief of Naval Staff Admiral Arun Prakash seized ACM Tyagi's point regarding the balance of power, bemoaning



B. George Verghese



Air Chief Marshal SP Tyagi



Admiral Arun Prakash

the sorry state of Indian strategic vision. He was blunt in noting, “The unfortunate fact is that as a state, India has failed to articulate any national aims, objectives and so on.”

This lack of strategic clarity, stressed Admiral Prakash, has led to misgivings regarding the efficacy of increased defence spending. “I have serious doubts about how well that money is going to be spent and how much national security it will buy for us because we fail to articulate aims, objectives, national interest et cetera.” He also noted that with large portions of capital allocations earmarked for committed liabilities (contracts that are already signed), the actual scope for modernisation and expansion is limited because funding simply does not extend to adequately cover all these. “Since the state has failed to do its job,” he said, “the Services are floundering.”

The former CNS and Chairman, Chiefs of Staff Committee was candid in stating that the “guardian of air power in India,” the Indian Air Force, appeared to be suffering from a lack of clarity similar to that which has afflicted the national leadership. “Take the MMRCA,” he said. “If we go by the Air Force’s choice which is [estimated at] 85 million dollars apiece, then buying 126 copies of that aircraft is going to cost 120 lakh crore [Rupees], which is almost half the country’s defence budget. Was that a wise decision? At the same time we’re also continuously criticising our indigenous industry — for good reason. But the big question is for how long are we going to be able to afford buying from abroad?”

Admiral Arun Prakash said, therefore, there is a need to “temper our vision” considering the fact that “anything that we imagine is going to be unaffordable.”

Former Deputy Chief of Air Staff, Air Marshal Nirdosh Tyagi attempted to steer discussions back toward the role and



Air Marshal Nirdosh Tyagi

IAF in 2014	
Aircraft Type	No. of Combat Squadrons
Jaguar 16/18	6
MiG-29/35/49	4
Mirage 2000/18	3
Su-30/49	18
MiG-21/18/49	6
MiG-21 Intelligence	11
TOTAL	38

• Su-30MKIs have been inducted steadily and now make up both of the IAF's combat force. This type will remain backbone of the combat fleet for decades to come, but is yet to be complemented by a lower-end fourth-generation type.
 • A large number of IAF fighters are still past their service life and are approaching conclusion of their structural life. Withdrawal of these aircraft is no longer a matter of choice but a matter of necessity and ability.
 • The Indian Navy is to have 2-3 fighter squadrons by 2017-18. The LCA Navy is the best indication.

relevance of air power, commenting on the future size and structure of the Indian Air Force: “From a Pak-centric force, we have to look at our strategic imperatives, look at energy security requirements, trade-route security, out-of-area contingencies and also make sure that there is conventional deterrence in place. So for all such reasons, the force-mix for the future has to be different.”

“Traditionally, the Indian Air Force combat aircraft mix was that of light and medium-type aircraft. The Su-30 was the first heavy aircraft and initially 190 were to be acquired. The number has now grown to 272. This, plus the MMRCA, and all other future inductions, will take the mix leaning towards the medium and heavy end. Its implication is that revenue expenditure—operational expenditure—will progressively increase. It has already started going up, our ATF requirement is far more today, and we’re consuming more fuel for the same flying hours.”

He also queried *Vayu*'s squadron strength statistics, both present and future, noting that there are probably fewer operational fighter squadrons at full strength today. “I think the actual strength is a little lower. Just going by the figure stated in the media, it would be closer to 35. A large part of force will also not be available because of upgrade requirements. A certain number of

Mirage 2000s, MiG-29s and Jaguars will be undergoing upgrades so actually the force availability will be even lower.”

While the pressing need for modernisation and expansion of the IAF was endorsed by those present, the focus frequently segued toward the financial constraints faced by the IAF. As the discussion began on the MMRCA, the discussion became livelier and a host of interesting aspects, were considered. Defence analyst Vishal Thapar critiqued the complicated and ever-changing origins of the MMRCA programme, noting that the aircraft originally under consideration by the IAF were all essentially medium-light fighters but “by the time the [MMRCA] RFP was issued, the contenders had turned around completely in favour of



Vishal Thapar

twin-engined, heavier aircraft.” Thapar asked whether it was possible that the IAF had allowed “the market to define its requirement” as a consequence of being entirely import-reliant.

On a related note, Thapar recalled the ad-hoc nature of IAF acquisitions, calling this an “open-ended process, where there are no timelines, no fixed costs and no accountability,” calling into question the capability and competence of the Ministry of Defence in handling key acquisitions.

NC Bipindra echoed Thapar, highlighting the need for strict timelines during acquisitions, and criticised the defence establishment’s inability to manage such time efficiently. He also called into



NC Bipindra

question the increasingly common practice of complaints addressed to the MoD as employed to derail acquisition processes.

Handling of the MMRCA programme and indeed its very rationale came under more criticism, with former Indian Army Colonel Ajai Shukla suggesting that the



Colonel Ajai Shukla

IAF was wary of re-doing or revising the MMRCA case from its present structure owing to a belief that any changes at this stage would result in the programme being set “back by ten more years” in qualitative and quantitative terms.

The common thread emerging from discussions seemed to be that Indian air power continued to be reliant primarily on acquisition of capability from abroad, leaving it vulnerable to a wide range of potential disruptions.

Admiral Arun Prakash developed on this line of thought and offered a solution. “I think it’s time for the Indian Air Force to take ownership of its programmes; they need a basic trainer, they need a jet trainer, they need a multi-role combat aircraft, they need a multi-role transport aircraft, it’s time they took ownership of all these projects,” he said. “If you start today, in thirty years you may well have a few of these. If you never start, you’ll keep importing. If you keep criticising and rejecting everything that comes out of Bangalore, we’ll keep running at the same spot. And we are doomed if we do that. Full stop!”

At this juncture, Air Marshal Harish Masand went back to the squadron statistics provided by *Vayu*, combined with the future acquisition of the MMRCA and FGFA,



Air Marshal Harish Masand

saying that “By 2032, we will have a force of 38 combat squadrons out of which 36 will be heavy. Is that the kind of force-mix that you’re talking about? Is that what

you want? Is that what you can afford and sustain? And with that kind of force what you intend to do – if you know the roles and missions – the way you fight? We need a severe re-examination of our doctrines and the way we intend to fight future air battles.”

In side discussions, Air Marshal Masand felt that the IAF planners should also be considering raising a force of highly agile, light attack aircraft for operating in the narrow valleys and high mountainous terrain of northern India.

In response to criticisms on the MMRCA, Air Marshal Muthumanikam Matheswaran, who was a key figure in gestation of the programme, candidly laid out some key facts. “With respect to the MMRCA, the RFI was sent out in November 2004 under my signature,” he said. “The first four [aircraft types] involved and in consideration, except for the Gripen, were thirty-year-old technologies, and we were going to induct an aircraft which would be frontline for the next forty years. We then raised the question whether it was worth looking at three of the contenders – F-16, Mirage 2000 and the MiG-29 — which are dated technologies? This rationale was accepted by the MoD, and so the 20-ton ‘limitation’ was removed. However, the light, medium and heavy aircraft consideration needs to be revisited in context. Weight is irrelevant today, and that’s the argument I put on the file and that was accepted at that point of time. You cannot categorise aircraft any longer by weight. Categorisation can only be differentiated in terms of cost considerations and in terms of usage and quick turnaround capabilities.”

Having declared this long-overlooked rationale, Air Marshal Matheswaran blamed procurement delays for “boxing” the IAF into a situation where suddenly a massive amount of both qualitative and quantitative accretions were required, imposing a sudden and sharp pressure on available finances. He argued that if the MMRCA had been operational by 2008, as it should have, the MoD would not have found itself in the position where it has today to decide between the FGFA and MMRCA, both programmes demanding tens of billions from a thinly spread defence budget. The problem, he argued, was ‘systemic’, and therefore it is the system that really to be examined more closely.

UAC

However, some other panellists were not content to simply accept these assertions and Vishal Thapar, for one, queried the apparent lack of cost consciousness displayed by the air force through the MMRCA programme. “In acquisition processes across the world, you seek capabilities at a particular cost,” he stated. “My point is that there’s no cost-consciousness; has the Air Force, by ‘over-specing,’ made it [the MMRCA programme] the Air Force’s Mountain Strike Corps?”

Admiral Arun Prakash added to the number of dubious voices in asking, “What is the significance of the term ‘medium’? Is it weight, is it performance, is it range, or is it endurance? And how did you [the IAF] end up with a bunch of aircraft from single-engine to twin-engine, from 15 tonnes to 30 tonnes — I mean why did you stand for it? Make up your mind whether it is performance or weight. So I think this mess has been self-inflicted!”



Admiral Arun Prakash

Air Marshal Matheswaran responded, once again providing an insight into the evolution of MMRCA programme. He revealed that the crux of the ‘weight’ issue was a need to keep even more Su-30MKIs, by then already on contract in massive numbers, out of the competition, claiming that had the Su-30 not been excluded by the ASRs, the MoD would have simply asked the IAF to procure more of this gargantuan fighter. “Now you can’t put all your eggs in one basket – strategically, it’s unwise. That’s one of the primary reasons.” The ASRs were tailored to include newer generation

European fighters such as the Rafale and Typhoon, thus assuring the qualitative aspect of the RFP, whilst also excluding much larger aircraft, including the Su-30MKI. Of course, this process also meant a wide swath of costs had been opened, from the ‘lighter’ Gripens and F-16s to the much ‘heavier’ and thus expensive Typhoons and Rafales.

Challenge of Neighbouring Air Forces

The next focus was on the balance of air power in India’s immediate vicinity, essentially challenges posed by the air forces of China and Pakistan.

Air Marshal PK Barbora, former VCAS, firmly stated that the primary challenge was not, in fact, numerical or qualitative strengths of neighbouring forces, but India’s own financial constraints. He also echoed some points made in the previous session regarding the lack of strategic clarity and



Air Marshal PK Barbora

vision in the defence establishment, noting that in some ways India remained fixated on the strictly regional concept of a ‘two-front’ war (with China and Pakistan) even as the government pursued the development of strategic capabilities for the Air Force and the Navy.

The same lack of strategic clarity has affected assessment of ‘nuclear factor’ in regional conflict, according to Air Marshal Barbora. With nuclear deterrence in place, force structures cannot be examined “in a vacuum”. However, he also questioned the value of having a variety of nuclear systems,

contending that a few reliable delivery methods “were deterrent enough”.

The Air Marshal admitted that while opacity of the Chinese military made it difficult to precisely ascertain their capabilities, Pakistan was certainly “moving rapidly” with high-tech acquisitions. “Unfortunately we have not moved,” he concluded, referring to the qualitative aspects of air power.

Back on the MMRCA issue, he dismissed the idea of any re-thinking on the programme, stating “We’re already a decade and a half behind time. If we have to rethink our whole *kahani* (story), I’m sorry; we’ll go another decade and a half behind time.”

Air Marshal VK ‘Jimmy’ Bhatia, former AOC-in-C Western Air Command, continued on the theme, noting that China and Pakistan together had an edge over the IAF in quantitative terms. In order to counter such combined capability of these two nations, he suggested that the Indian Air Force would require more than 42 sanctioned combat squadrons, and we “should think of ultimately going up to somewhere close to 50 combat squadrons” so as to maintain the balance of air power in the region.

Brigadier Gurmeet Kanwal, former Director of CLAWS, noted that while the probability of state-on-state conflict is low in the subcontinent, future conflicts would most likely arise in and remain confined to the mountains, where the bulk of territorial and boundary disputes with both China and Pakistan remain. The geographical realities of conventional conflict in the mountains, therefore, place a priority on airborne firepower. “In order to achieve the required military aims in a future conventional



Brigadier Gurmeet Kanwal



Nitin Gokhale

conflict with either China or Pakistan, since I'm saying it's going to be confined to the mountains ... you cannot manoeuvre in the mountains... we will need massive air symmetries of firepower."

NDTV's Nitin Gokhale felt that, "The first priority should be to redress that balance [of air power]." He also pointed out that while doing so, the future force must be composed of "aircraft which are relevant," considering the IAF's decision to continue extending service lives of aircraft such as the MiG-27 and MiG-21, as a stop gap.

Major General Ashok Mehta referred to Kargil 1999 when "the greatest critique against the Air Force was that it was not ready to fight the war in the mountains. In Kargil, the Air Force was not prepared."

On this aspect, Air Marshal Barbora admitted "When we had initially worked out our QRs et cetera, there were certain aircraft types that couldn't fire a weapon system beyond a certain altitude. So we were not fully prepared. But we were ready

to take on—and we did innovate some things—otherwise Kargil wouldn't have stopped when it did."

Air Marshal Barbora also raised the vital issue of the future fighter force mix, remarking on the vastly more capable platforms in service now as compared to the past. He suggested that the force size and mix could be reviewed keeping in mind various contemporary factors including nuclear deterrence and highly versatile multirole aircraft. "We must keep in mind the nuclear factor .I don't think we can go beyond 30 squadrons with the kind of pricing that is talked of, Rs. 1200 crores per aircraft!" He said, regardless of the IAF's sanctioned strength, the "cost factor" would make it difficult to achieve both qualitative and quantitative goals. "We just cannot do it," he concluded.

Concerning this assessment, Admiral Arun Prakash expressed his views on the IAF's ability to handle a two-front conflict with China and Pakistan. "I think the armed forces must be prepared for a two front war because if you go to war with one country the other one will definitely take advantage," he said. "They don't even have to fight. They just have to move a few formations forward for us to be absolutely side-tracked."

Air Marshal Harish Masand, Colonel Ajai Shukla and Air Commodore Suren Tyagi echoed the Admiral's point, with Masand stating, "Two-front deterrence, at least, is required. We may not fight a two-front war, but two-front deterrence is required. That is really what you have got to consider."

The MMRCA Matter

Discussions then inexorably moved on to the MMRCA matter, to meet which requirement the IAF has selected the Dassault Rafale. The question posed by moderator Inderjit Badhwar was : how does the MMRCA meet the IAF's future air power needs, considering the large costs and desirable squadron strength?

Air Chief Marshal Tyagi replied with a forceful statement in response to what he characterised as "endless debates" on the issue, "We have debated enough. Let's just do it." Addressing cost concerns, he pointed out that it was possible to spread deliveries over an extended period, so as to soften the financial impact of such a massive acquisition. "So you need ten squadrons in ten years, if you don't have the money now, maybe it'll take fifteen years to get to the same strength."

Former AOC-in-C SWAC, Air Marshal SR Deshpande agreed, saying, "Time is running out and a decision has to be taken in the next few months, if not less than



Air Marshal SR Deshpande



Major General Ashok Mehta



Moderating the discussions ...

that, for the simple reason that costs will keep escalating and more importantly, any other opportunities that we had in terms of affordability will be lost.”

Air Commodore Suren Tyagi admitted that while costs were a serious obstacle, there was no escaping the import option since indigenous alternatives had all fallen through. “There is no accountability,” he reflected, referring to HAL’s inability to deliver what the Air Force asked for. “If we can fix their accountability, half our problems will be solved.”



Air Commodore Suren Tyagi

He also referred to the continually high costs of production at the state-owned aeronautical firm, saying, “Everyone else in the world is setting up plants in our country because we have cheap manpower – everything works out cost effective for them. But anything that we produce for ourselves becomes one and half times the cost of an imported item.”

The MMRCA, stated Air Marshal Nirdosh Tyagi bluntly, “was needed when the procurement process was started, is needed now and will be needed till it is inducted.” The Air Force will require large numbers of medium and light aircraft types to bolster the Su-30MKI and FGFA fleets once legacy types are retired, making “the MMRCA an absolute necessity.”

At this juncture, Vinod Mishra, former Secretary for Defence Finance, brought out an interesting fact about the MMRCA trials and selection process with regard to cost consciousness. “It was apparent from the very beginning that some of the contenders have a single engine, that some of them have twin engines. There would be inherent disadvantages in a like-to-like evaluation,”



Mr. Vinod Mishra

he said. “But we thought we would go through the technical evaluation process and then confront this as we come to that stage. As it turns out, the Air Force shortlisted, after that technical evaluation, two of the most expensive aircraft. The others got eliminated on technical grounds because if they had passed muster at that point in time, then costs would have taken over and then it would have been an L1 situation.”

However, while the aircraft selection may have appeared to favour a ‘capability at any cost’ approach, Mr. Mishra was keen to point out that there were also a number of unique aspects of the RFP that were intended to ensure cost-effectiveness, from life cycle cost (LCC) evaluation, to a performance-based logistics arrangement to ensure high readiness levels of the aircraft, along with the ubiquitous offset obligation to bolster indigenous manufacturing capabilities. However, he admitted to inherent shortcomings in the LCC calculations, since they relied on vendor-supplied facts and figures, which were difficult to verify until the aircraft was actually fielded in service.

Mr. Mishra also endorsed Air Marshal Matheswaran’s earlier defence of the manner in which the RFI was structured, insisting that keeping older and cheaper aircraft “in the reckoning till the last stages of the technical evaluation process ensured that the commercial bids which eventually came from Dassault and the Eurofighter consortium remained somewhat competitive.”

Air Chief Marshal SP Tyagi also commented on the life cycle cost aspects of the acquisition, pointing out that the MMRCA programme was the first time that armed forces considered life cycle costs. This was a new approach for the IAF and the former CAS said a broad spectrum of

experts had to be consulted to rationally form a framework to assess life cycle costs. This was necessary because the Air Force in the past had “lots of cheap aeroplanes which occupy a lot of ground but never get airborne.”

Colonel Ajai Shukla was blunt in his response. “I think the MMRCA should be scrapped. I think that it will be a death blow to Indian defence finance. Acceptance of Necessity (AoN) was initially agreed to at Rs. 42,000 crores, today it is more than double of that. And on those grounds alone the programme should be reconsidered. We have to function within the limits of our budget.”

He then addressed the lack of transparency in the procurement process, pointing out that life cycle costs of the MMRCA had never been made public by the IAF or the MoD. Citing the F-35 programme as an example, he said that the enormous multi-trillion dollar figures that are so often criticised in the media are openly available for examination and involve comprehensive development, procurement and life cycle costs of the entire programme. The MMRCA life cycle calculations remain, on the other hand, ‘secret’ and are not open to any scrutiny.

StratPost’s Saurabh Joshi recalled that at DefExpo 2014, then defence minister AK Antony had made a curious statement, admitting that there were “some issues” with life cycle costs in the MMRCA negotiations. The LCC was supposed to be part of the commercial bids, thus to admit that there was an issue after the L1 bidder



Saurabh Joshi

had been selected called the entire LCC calculation process into serious question. Joshi also referenced French government statistics on availability and costs of the French Rafale fleet. The MMRCA programme was necessary, but questioned the low availability numbers reported by the French Air Force. He also said that any two-front deterrence, as brought out by Air Marshal VK Bhatia, would be impossible to achieve if the Air Force consisted entirely of aircraft that were expensive to buy and operate.

Air Marshal Matheswaran brought his considerable expertise to bear on the issue, providing new perspective on the MMRCA procurement process. First, he admitted that the project was expensive no matter how one approached it. However, he stressed that the programme had two components, and that observers often forget the second part, one that, in his view, is larger and more important.

The first part is the basic operational requirement of the user, in this case the Air Force. The larger interest is the national perspective. He argued that spending huge sums of money should require an examination of how the indigenous industrial capability could evolve post-MMRCA acquisition. This factor should be strategised and calibrated for through the course of the acquisition process. Whether this will be applied in the MMRCA programme remains to be seen, but the Air Marshal stated that it has never worked with past acquisitions because development of national capabilities via acquisitions was never considered a priority, only acquiring capability at the lowest possible cost was. "I dare say the L1 system has ruined the entire approach towards self-reliance and development in the country," he said. "You go to the industries—the DPSUs—the L1 system has ruined them completely. We need to get out of that L1 mindset."

He warned that the refusal to link acquisitions with actual indigenous development was being repeated with the FGFA programme. On the FGFA, he predicted, "we will end up being what we've been for seventy years — once again global-trotters, buying from the global market. And nothing, no self-reliance will ever be achieved."

Brigadier Gurmeet Kanwal agreed with Air Marshal Matheswaran, and concluded the session with a suggestion for the future. "We lack the technical tools for evaluations

such as the life cycle costs. Officers who serve in tenure for one-and-a-half to a maximum of two-and-a-half years just can't acquire such expertise on the job. The Americans have a Defence Acquisitions University. We at least need a Defence Acquisitions Institute."

The LCA Programme

The roundtable conference thereafter moved on to discuss the Tejas Light Combat Aircraft (LCA) programme with serious concerns being raised on the impact of its possible failure.

With the Indian Navy having been a key stakeholder in the programme, Admiral Arun Prakash began the discussion. Incisive as always, the Admiral swiftly pinpointed to what he felt was the IAF's biggest failing. "Why," he asked, "has the air force not taken ownership of the LCA?"

He gave the Indian Navy's example, which has allocated Rs 900 crore for development of naval variant of the Tejas. "So if the Air Force had done it right at the beginning," he suggested, "perhaps this situation may well not have arisen."

Supporting Air Marshal Matheswaran's stance on the FGFA, the Admiral noted that the Russian PAK-FA project had already been well underway and tailored for Russian requirements by the time India got involved. With hundreds of millions already invested and billions more set for investment, he said it was unclear why the Indian Air Force had allowed the FGFA project to so proceed while remaining unwilling to back the LCA. He strongly felt that the LCA should not be allowed to fail, but used as a springboard for future development programmes such as the LCA Mk.II and AMCA. This approach would eventually allow the industry to gather

strength and thereby deliver the required products, from new generation aircraft to advanced aero engines.

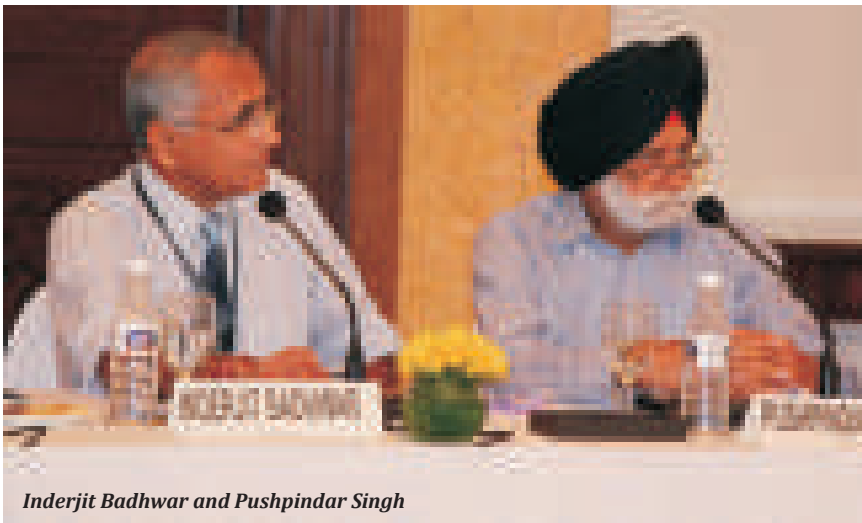
Air Marshal Matheswaran came back to review the problems that have dogged the LCA. "In the context of Indian capability development," he said, "there is nothing more important than such a programme which must be taken up and moved in full earnest." He gave the example of the HAL HF-24 Marut, an aircraft that never achieved its potential owing to a short-sighted decision to abandon all development work as soon as it entered initial service. The Air Marshal advocated the 'block approach' of gradually increasing capability of a basic aircraft design as technological and production advances were realised, "That's how you build national capability."

He criticised the often-unrealistic costs and timeframes put forth by the organisations responsible for the LCA, but also insisted that the Government be taken to task for simply accepting these improbable schedule commitments at face value. As an example, the Cabinet Committee on Security (CCS) had sanctioned development of the LCA's slated *Kaveri* engine in 1989, with funding of Rs 450 crores. The engine was ambitious even by the standards of established Western firms with decades of experience, yet the state-controlled industry stated it would be in production and ready for operational service by 1996, which position was accepted by the government of the day. A quarter century later, the *Kaveri* prototypes are not even close to meeting their projected specifications, and there are no plans for such an engine to enter production in the foreseeable future.

Regarding the LCA itself, Matheswaran was clear, "It is the time to close it. What you have achieved is what you will get. The



Air Marshals Matheswaran and Jimmy Bhatia with Vice Admiral Shekar Sinha and NC Bipindra



Inderjit Badhwar and Pushpindar Singh

first choice of the design was wrong and that design can give you only this capability, which, I've said, is something akin to the Bison's capability. This is an opportunity to adopt the 'block approach,' address the shortcomings of the Tejas, and develop different models."

Vayu's Pushpindar Singh, who had earlier authored a definitive book on the HF-24 Marut, recalled those heady days under leadership of Pandit Nehru, calling that "a very brave attempt from absolutely scratch to develop a multi-role supersonic fighter-bomber." He had a resigned sense of *déjà vu* concerning the LCA programme, because as with the HF-24, it was the lack of suitable powerplant that eventually led to foreclosure of the programme. In the LCA's case, the aircraft originally projected in 1986-87, "would have not only met the LCA requirement, it would have been a world leader." However, when technical assistance was switched from German consultants to the French, the LCA virtually mimicked the Mirage, without assessing the state of technologies available at that time. "The Air Force doesn't 'own' the programme because the Air Force saw the writing on the wall," referring to then DCAS Air Marshal Brijesh Jayal's clear directive on 'technology demonstrators' first proving performance before taking the next steps.

Admiral Arun Prakash clarified his earlier stance in response to the views of Pushpindar Singh and Air Marshal Matheswaran "When I say 'take ownership,' I mean Air Headquarters should establish a Directorate of Aircraft and Aero-engine design, assume leadership of HAL, march to the PMO and state that India cannot have

an aerospace industry without the key user being in charge!"

Colonel Ajai Shukla agreed wholeheartedly, pointing out that foreign consultancy could well be sought to take a fresh look at meeting the LCA requirement and noting that many firms had, in fact, already expressed interest in becoming involved.

At this point, Air Marshal Barbora eviscerated the LCA programme. He laid total blame for the IAF's incoherent force structure squarely on the LCA mess, saying that the IAF's problems started when it accepted the 'promise' that the LCA would, on time, replace the massive fleet of MiG-21s. He attacked management of the

programme, calling it "very poor." He even recalled when during his tenure as VCAS, the stage seemed set for a serving Air Vice Marshal to take charge of the entire LCA programme and bring it back on track. However, this proposal was stymied by the 'system.' "Frankly," he concluded, "we must pick up the good and move towards the future possibilities."

Air Marshal Matheswaran interjected in giving certain clarifications. In wake of the jubilation surrounding the near-farcical 'IOC-II' ceremony for the LCA in December 2013, some misconceptions had taken root that the LCA could now replace the MMRCA and obviate the need for a large foreign purchase. This, he insisted, was an egregious fallacy, probably as a result of DPSU's penchant for publicity events. "You keep announcing things: 'we are the fourth country to achieve this,' or 'we are the third country to achieve this.' Where is the final product? When is it going to see operational utility? Where are the timelines? Where is the cost accountability? How about questioning that?!"

There then was the issue of programme management itself. The lack of cohesion between the stakeholders had led to a situation where it is perhaps too late for the IAF to make changes with so much programme development already completed. Nowhere in the world is the user excluded from the management of a programme so vital to its needs.



Air Marshals Matheswaran and Deshpande

HAL

“There’s a problem in our service culture and service mind-set. We don’t want to put people with professional competencies as experts on a programme for any length of time. Our personnel staff will cry hoarse and say ‘No, this guy cannot be in Bangalore for so many years.’ So we keep breaking up the expertise and it’s like the monkey climbing up and then coming down- we are always at the perpetual start point.”

“The problem lies in the system and the methodology of controls we exercise in making those systems run. It’s remote-controlled from the Ministry of Defence, from the Department of Defence Production. There is no professionalism involved—one can put the best persons there but the fact is none of these organisations have the spirit of innovation, no dynamism. They don’t even start their own research and development programmes.”

Air Marshal Matheswaran also replied on the oft-repeated canard that the IAF repeatedly amended its QRs, consequently ‘shifting the goalposts’ for the LCA programme management. “The ASR was approved with everybody involved in 1985 and there were two concessions given in 1989 — no other change has ever been made. It is their inability to conform to the ASR, for a variety of reasons,” he said candidly.

On the inordinate and continuing LCA delays, Air Marshal Harish Masand slammed the notion that the LCA programme was thrown out of gear by US sanctions in 1998. He recalled his involvement in the MiG-21bis upgrade programme (which was to result in the MiG-21 Bison), where as early as 1993, the IAF anticipated a vulnerability to sanctions and consequently steered clear of US origin equipment. With one arm of the DRDO working in the LCA programme and another involved in developing nuclear weapons, Air Marshal Masand expressed incredulity that nobody foresaw the possibility of US sanctions.

Air Chief Marshal SP Tyagi addressed the issue of ‘ownership,’ detailing the various procedural hurdles that had hobbled all attempts by the IAF to have at least some say in how the LCA programme was being managed. He mentioned how difficult it was to arrange project review meetings even once or twice a year, and how repeated requests for an Air Officer to take over as Chairman of HAL were always denied. He described the entire process as “lessons learned on

how *not* to manage a project,” suggesting that if the LCA programme was to be closed and the technology leveraged afresh, it must certainly be under an entirely new management structure.

Air Marshal Nirdosh Tyagi concluded this session with a few key facts. First, he noted that amongst various technologies being developed indigenously, some have seen good progress whereas others have not. The issue was that where progress had not been made, the scientific establishment refused to admit they had any problem and rejected any external assistance.

On the topic of financial support to the LCA programme, Air Marshal Tyagi pointed out that the IAF had ordered two batches of twenty Mk.1’s each, even with little “mutual admiration” between the supplier and the customer. “At least on this front the Air Force has not been found wanting,” he exclaimed.

The last issue the Air Marshal raised was cost-related. The LCA and MMRCAs cannot be compared on cost because comprehensive ancillary equipment is included in the case of the latter. With the LCA, orders for the first 20 only covered ‘flyaway’ aircraft, with no support equipment. The addition of support equipment became a major issue with HAL and additional funding had to be earmarked for this at a later stage. Therefore, the figures used to compare the two aircraft tend to “create a distorted picture” while the truth is that the LCA, with all elements of a typical contract which included Manufacturer Recommended List of Spares (MRLS), warranty, product support for a certain period (usually eight years), training infrastructure, ground-based equipment and so on, will cost many times more than the relatively low figures often quoted in various forums.

The Cost of Air Power

Final session of the roundtable discussions dealt with the cost of air power, both at present and in the future.

Appropriately enough, this ‘front’ was opened by Vinod Mishra, former Secretary Defence Finance, who first addressed the very understanding of ‘affordable air power’. He reminded those present that the issue of affordability had always been keenly appreciated by the Air Force, which is, in fact, how aircraft upgrade programmes came into being. The logic, which he described as “quite sensible,” has been to concentrate

on longer-lived platforms and then execute upgrades of sensors and weaponry.

He also explored the ‘sanctioned strength’ metric, pointing out that the decision for 42 combat squadrons was taken in the 1960s, but that a two-front war is a reality which now “stares us in the face.” Therefore an optimal force mix and size of combat aircraft has to be determined afresh, depending on force level comparisons with both Pakistan and China. Technological advances would also have to be considered, with systems such as PGMs and combat drones likely to have far-reaching effects on the future battlespace.

With all that, he also stated that reliability and availability of combat assets needs to be brought up and maintained at high levels. If availability levels are improved from the recently reported force-wide figure of 40-50 per cent, virtually two additional squadrons could become available from within the present inventory. “The IAF needs “numbers as well as capability. That is well recognised. But a professional exercise to determine that optimal number has yet to take place.”

Air Marshal Nirdosh Tyagi queried the uncertain nature of defence funding. In recent years the defence budget has seen almost constant increases in monetary terms, but owing to inflation and depreciation versus foreign currencies, the increases are often negated in real terms. These factors coupled with the reduced economic growth rates seen over the last few years had led to a funding ‘crunch.’ However, he was optimistic that the economy, which is already rebounding, would see higher growth levels in the future and a stabilised Rupee would see the military’s spending power improve, even if the defence budget remains below 2 per cent of GDP.

Addressing short term needs of the Air Force, Air Marshal Tyagi said that the IAF “has now met most of its requirements in terms of force multipliers and some other assets and the future numbers required is now lower.” He felt that induction of the MMRCAs and the LCA plus many others could take place without any great strain on the budget.

He also addressed the point raised earlier regarding AoN for the MMRCAs. “There is no bar in the Ministry of Defence that if the AoN figure is low and the contracted figure is high then it has to be redone,” he said. Initial budgeting is done via estimations,

and all acquisition programmes experience a degree of cost escalation.

Air Marshal VK Bhatia agreed with Air Marshal Tyagi, pointing out that funding required for the MMRCA is indeed daunting, but then this will not be spent “all at once. Money will be disbursed over the delivery period of the contract, spreading the financial burden over a longer period of time.” He also pointed out the value of direct offsets linked to the contract, which would at least ensure that a significant portion of the money is spent within the country.



Air Marshal VK Bhatia

He also raised an interesting point on the defence modernisation ‘hedge fund’, and claimed that during the previous NDA government a fund had been created to collect the money that was budgeted but not spent during that financial year. This had been created solely for the defence establishment, and was capped at a sizable Rs 25,000 crore. Brigadier Gurmeet Kanwal recalled this fund, noting with regret that it had been allowed to lapse following the UPA’s ascension to power in May 2004. During his tenure as Defence Minister, Pranab Mukherjee (now President of the Republic) had attempted to see the fund restored but this was stymied by UPA Finance Minister P Chidambaram.

Air Marshal Harish Masand once again raised the issue of “strategically aware leadership,” saying that all plans for numbers, force structures and doctrines stem from the country’s leadership and without a clearly articulated national security policy,

the requirements for capability cannot be adequately defined.

Without directly referencing the MMRCA, the Air Marshal stated that the Air Force has to ‘cut its coat according to its cloth.’ Once the civilian administration and military establishment have defined clear goals and policy, from which required warfighting capability requirements would be defined, a force mix should be decided based on affordability. This clearly hasn’t happened in the case of the MMRCA.

To address short-term capability gaps, Air Marshal Masand echoed Vinod Mishra’s point on aircraft availability. “Just imagine if you were to take the utilisation [availability in numbers] to 75 or 80 per cent... at least for the short term... we can fill the gaps,” he said. He insisted that the Air Force should not be complacent with the present peacetime attrition rate. Working towards this goal will at least ensure the problem does not get worse.

He however disagreed with Air Marshal Barbora’s comment that the IAF’s size could be revised downward with induction of more capable multirole aircraft. While accepting that multirole capability is indeed of great value, he contended that even “with all the capability in the world... one aircraft can’t do what ten others can do at different places at different times.” He insisted that there must be a balance between capability and numbers, and that quantity cannot be sacrificed for capability.

Once again recalling the example of the MiG-21bis upgrade project, he pointed out

that the upgrade requirement was for an improved air defence capability. However, with a sophisticated radar and inertial navigation system, the MiG-21 Bisons entered service with a potent secondary ground attack ability as well. This additional capability, said Air Marshal Masand, did not change the fact that the IAF still needed as many MiG-21 Bisons as previously envisioned, because the air defence role regardless needed to be fulfilled by a certain number of aircraft.

Air Marshal Matheswaran agreed with Air Marshal Masand, adding that in the Indian environment, one cannot rule out the possibility of a major two-front war, however remote. Therefore numbers count and the logic of reducing force size in proportion with increased capability does not apply to Indian air power.

Continuing on the theme of force size and affordability, Pushpinder Singh made two interlinked points. First, he drove home the absolute necessity for the Indian Air Force to balance its force structure with capable yet affordable lighter fighters. Heavier twin-engine aircraft, no matter how advanced or capable, would impose a financial burden through operating costs, and so as to maintain an adequate force size, the future has to hinge on a rational high-low mix.

He then addressed the vexed issue of the LCA. The Mark I variant was ‘done’, with forty aircraft ordered. This, however, hasn’t changed the fact that several hundred additional fighters are required to meet the IAF’s quantitative requirements. “The LCA



Nitin Gokhale and Colonel Ajai Shukla

class is really generic, as it is centred on a role with a set of requirements, not any particular aircraft type.” By 2032, with fifteen Su-30MKI squadrons, (hopefully) six MMRCA squadrons and six FGFA squadrons in service, a massive ‘gap’ of about 400 aircraft would still exist, which would have to be filled by fighters of the LCA-class. “Where would these come from?” he wondered.

Air Marshal Nirdosh Tyagi agreed, saying, “We should now concentrate on identifying these 400 light fighters and the LCA, as far as indications are today, is a non-starter. We would somehow like to make it work but unless we can find that method, there should be some alternate to make good this deficiency.”

Back to the essential aspect of the cost of air power, Air Marshal Matheswaran took a piercing look at relevant issues, by comparing the inefficiency of DPSUs against the high cost of imported equipment, saying “It is not enough to look at the cost of imports alone. How much does it cost us for producing these within the country? Why does it cost more? That’s one important issue we need to look at. Then, how much do we leverage in terms of technologies?”

Citing the 2011-12 balance sheet of Hindustan Aeronautics Limited, he pointed out that of expenditure close to Rs 14,000 crore, a gargantuan 96 percent was spent on raw materials and imported components. This, he said, implies a value addition across HAL’s operations of less than four percent, which is an indication of how much HAL has really absorbed.

Air Marshal Matheswaran referred to a well-known transfer-of-technology failure at HAL as part of the Su-30MKI technology transfer agreement (ToT). In 2007, single crystal turbine blade technology was transferred to HAL, yet even today such capability has not been absorbed. “That, really, speaks volumes about the DPSUs. Obviously, of course, failure to absorb technology is a waste of money, because all such agreements cost the nation large sums.” On the issue of imported raw materials, he stated that there was little point to absorbing new technology when it could not be used to make products from domestic materials. “We must recognise the fact that we are not getting value for the money that we spend. We are not getting control over critical technology. We are so import-dependent, we better recognise that fact and then change our policies accordingly.”

Such inability, or unwillingness, on part of the DPSUs to maximise use of indigenous processes and materials, he noted, has led to the present situation where the LCA is virtually entirely import-dependent. Thus the cost of ToT versus its absorption and effective utilisation was a key facet in the overall affordability of air power.

The issue is that of a largely public sector system. “You need to move away from that,” he said bluntly. “You need to wind up the DDP (Department of Defence Production), you need to create a Ministry of Aerospace Industries and you need to encourage privatisation of most of the DPSUs in the pattern of the corporate model.”

“That is where a national strategy comes into the picture,” he said. “Unless you have an aerospace strategy or aeronautics strategy, which looks into how you get control over critical technologies and how you develop the eco-system, and then have a national policy that addresses the overall contract-signing, procurement, acquisitions and indigenous development, you will never get to where you want to reach.”

This proposal for a ‘National Aeronautics Commission’ was first raised by the C. Subramaniam Committee in 1969, and the MoD has always objected to establishing such an entity. “I don’t know why,” he lamented.

Vice Admiral Shekhar Sinha, former FOC-in-C Western Naval Command and the Navy’s ‘Grey Eagle’ till his recent retirement, also addressed the DPP and the offset policy, elegantly explaining why vital aerospace technology cannot

be secured from abroad without paying massive sums of money. “The key”, he said, “was not direct offsets (workshare) but instead to apply an offset multiplier to obtain strategically important know-how. This would provide an incentive for foreign suppliers to share knowledge on areas of interest to the Indian defence establishment. To implement this, however, would require a team of technology experts and professionals involved in the framing of high value contracts, to evaluate the relevance of technology under consideration and assign appropriate multipliers.”

Speaking on budgetary constraints, the Vice Admiral referred to the gap between defence planning and financial allocations. The MoD’s Long Term Integrated Perspective Plan (LTIPP) takes inputs from all three Services and then maps out a combined capability-building programme over the course of fifteen years. It does not, however, cover the financial aspects of this capability-building exercise. The combination of planning and funding, which includes both capital and revenue expenditure, is dealt within five-year plans. The problem with this approach, therefore, is that capability enhancement decisions are planned in a ‘financial vacuum’ and invariably sets goals in excess of what funding will allow. As Air Marshal Nirdosh Tyagi had noted earlier in the session, the five-year plans are heavily reliant on accurate economic forecasting and should actual growth fall short of predictions, as has happened subsequently, all the



Vice Admiral Shekhar Sinha

number crunching goes to waste and service headquarters have to re-adjust in real time. “So there is a gap between the perspective plan and the five year plan because the perspective plan is only a capability build up,” noted Vice Admiral Sinha.

To address the inevitable dichotomy between planning and funding, the Vice Admiral suggested: “don’t match tank to tank, ship to ship, aircraft to aircraft. Please identify vulnerabilities [of the opposing forces] and create a capability to puncture that vulnerability.” He also addressed aspects of the revenue budget, warning that “a time will come when revenue expenditure will exceed allocation.” Once capability building, force expansion and modernisation is complete, however far in the future that may be, he said it was imperative that the budget then be readjusted to cater for the inevitably higher revenue costs.

Those present at the discussion agreed with Vice Admiral Sinha on the limited efficacy of the offset policy. “I was a member of the first offset committee and we fought to create a holistic offset policy,” Air Marshal Matheswaran recalled. “Somehow we got into the mindset that we are stepping into offsets for the first time, so let’s not look at it in a big way, and let us only look at the direct offsets.”

This timidity, he said, reflects two mindsets. First, that the administration hasn’t appreciated its weaknesses, and has therefore missed the opportunity to devise a policy to address those. Secondly, it reflects “a fair amount of ignorance” on the part of people who are supposed to be in charge of policies aimed at plugging technological gaps. “If we had conceived that offset policy well,” said the Air Marshal, “then it would have two components — direct and indirect offsets. The multiplication factor that he [Vice Admiral Shekhar Sinha] explained is the one that comes into the domain of indirect offsets.”

These indirect offsets are what would have been instrumental in addressing technology shortfalls, skill deficiencies, education infrastructure and so on. “We’ve become huge importers,” the Air Marshal rued, before adding, “That’s not a thing to be proud of. But at least when you spend that kind of money in imports, how about leveraging that? If you don’t leverage, air power will always remain very expensive.”

Air Marshal Nirdosh Tyagi added to the offsets discussion, reminding those present that while the multiplier for technology



B. George Verghese

exists, it is only applied in the case of transfer of technology to the DRDO. “So DRDO, instead of developing technology is now a recipient of technology. There is no multiplier for transfer of technology elsewhere!” he said.

The astute views of George Verghese summed up discussions of the day:

“I don’t have the last word but the least word. I think it was mentioned—and I would agree with what ACM Tyagi said—we don’t have a national security doctrine, it’s very fuzzy and it’s not shared. I don’t know the last time when parliament discussed defence, maybe twenty years ago. It simply doesn’t happen, [but] it needs to be there.”

“And I don’t know how well or how effectively the National Security Council functions. It is an ad hoc emergency body. So there’s no larger thinking there within which defence policy, production, et cetera has to be framed.”

“Second, we’ve talked about all the procurements we are making—those are very important—but I would emphasise

the need for indigenous production by including the private sector, which is now being allowed, but grudgingly. Why not 100 per cent? We say ‘it’s a secret,’ but when you import things from outside, it’s 100 per cent given away. The secret is kept from us.”

“There’s an old saying: we are fearful doing this because we don’t have the experience, and bad judgment will cost us the earth. But good judgment comes from experience and experience comes from bad judgment. Having contracted the rest of the world to build for us, they have learnt through bad judgment on Indian contracts, the experience that has given them the expertise, which we go back to. I think the world and many of our major suppliers have learnt at India’s expense and have made mistakes and mid-course corrections, which we have paid for. We are not prepared to do that ourselves, so I think that is, to my mind, a very important factor.”

“So I think we need to emphasise indigenous production including private participation and this would then figure out the kind of research and development effort which can be drawn from all over the world, so that we don’t have to go outside and the world doesn’t learn at our cost and gains experience but we develop our own expertise. Other countries might partner with us, for example, Israel, Japan, whosoever, with the necessary expertise and the same needs, broadly speaking, in terms of their defence doctrines, their worldview and so on. I think we must exploit those opportunities.”

For complete video coverage of the day’s proceedings, readers may visit: <http://goo.gl/mKtTmZ>

The Stark Reality

- ❖ IAF force levels are reducing alarmingly even as rivals are expanding and modernising.
- ❖ The LCA programme has dragged on for three decades.
- ❖ Acquisition of an MMRCA to plug the ‘capability gap’ is floundering.
- ❖ By 2017, there will be a shortfall of 10 fighter squadrons, forcing at least 6 MiG-21 Bison squadrons to remain in service till 2025.
- ❖ Indian Armed Forces need to be more proactive in engaging administration and industry.
- ❖ The Administration itself must streamline acquisitions while focusing on the broader strategic picture as well as economic realities.

Striving for Greater Capability



The IAF's Road to 2032

Mirage 2000TH in afterburner takeoff (photo: Angad Singh)

As it moves towards its first centenary in 2032, the Indian Air Force is in the process of enhancing its capabilities in a major manner. Most of this enhancement is being obtained through induction of advanced equipment such as the C-130J Super Hercules and C-17 Globemaster III strategic airlift types, with the Rafale chosen as the IAF's Medium Multi-Role Combat Aircraft (MMRCA), alongside the Indo-Russian Fifth Generation Fighter Aircraft (FGFA) to name the more prominent inductions underway. A common characteristic of these inductions is that they are sourced from foreign vendors. To be a truly effective and independent force, the IAF also requires full control over its technology. Thus, technology ownership is an issue of importance to the IAF. Likewise, with increasing networking of its forces, the IAF requires to put in place effective cyber warfare capabilities. With the likely expectation of future military operations

requiring close cooperation between the different military arms of the government, effective jointness requires to be planned for and implemented on the ground. Further, ensuring deep imbibing of acceptable organisational values and modes of behaviour amongst its cadre is important for internal cohesion and operational effectiveness. This article dwells on these issues from the point of view of enhancing the IAF's effectiveness in the near and medium term future out to 2032 when the IAF completes one hundred years of existence.

Issues for Greater Capability

Technology

The IAF by its very nature is technology intensive. Owing to the constraints of domestically available scientific and technological capabilities, the IAF has, since its formation, been a technology importer, adapting its doctrine, strategy and tactics to the technology available from foreign sources.



IAF Sukhoi Su-30MKI in dissimilar formation with Jaguar trainer and maritime strike aircraft

Despite the constraint imposed by the need to import equipment, the IAF has proven its innovativeness and technical acumen since the early years of its existence. For instance, IAF technicians, during World War II, modified tail skid units of the British-origin Lysander aircraft which was then in IAF service, to increase controllability of the aircraft during take-off and landing as well as to increase reliability of the aircraft's undercarriage. Modifications carried out by IAF technicians were examined by the manufacturer of the aircraft and subsequently implemented on the entire global fleet of Lysanders by the British. The same aircraft type was thereafter modified to carry bombs on external weapon stations, a capability the designers had not conceived.

After World War II, IAF technicians with the assistance of personnel from Hindustan Aircraft Limited (HAL) were able to recover as many as 37 B-24 Liberator bombers from the aircraft graveyard at Chakeri airfield, Kanpur. At the time of independence, the British authorities had deliberately damaged the B-24s to make them unflightworthy and unrecoverable to prevent them being employed by the Indian Air Force used by any party apart from US and British forces, and dumped these in a 'graveyard'. These 37 rebuilt B-24 Liberators were to serve with the IAF for another 20 years, till 1968.

During the Kashmir operations of 1947-48, the IAF again displayed innovativeness and technical acumen using C-47 Dakota transport aircraft as improvised bombers and also utilising Tempest fighters to deliver essential food and ammunition supplies to the state forces besieged at Skardu fort when it was impossible for the Dakotas to operate at those altitudes. In this "incredible" war, when Srinagar airfield lacked replenishment facilities for IAF fighters, the IAF improvised by decanting fuel from Dakotas landing at Srinagar, and using this fuel for Harvard trainers, Spitfire and Tempest fighters, effectively converting the Dakotas into mobile refuelling posts while on the ground at Srinagar airfield. The IAF also exceeded manufacturer's specifications by landing on the improvised airstrip at Leh, doing this repeatedly for ferrying troops and supplies to build up defences against enemy attack.

The IAF has continued to regularly display its technical skills in the years since

then. The Jaguar's Display Attack Ranging Inertial Navigation (DARIN) system, an indigenously integrated navigation and attack system with performance superior to many foreign systems of the same era (1970s-1980s), was integrated with IAF participation, albeit using imported components, and used to upgrade the IAF's Jaguars. The system is currently in its third iteration as the DARIN-III.

This brief recall of some innovations and demonstrated instances of technical skills by

seeking to impose external political and/or military will, and detrimental to our national interest. Thus, it is important for India to build the ability to develop and field its own weaponry. For success in this endeavour, involvement of the IAF, the primary end user of aerial weaponry, is required to give direction, ownership and suitable oversight on the design and development process. Such an involvement would be beneficial in removing the end user's tendency to demand unrealistic



Jaguar DARIN II trainer comes into land (photo: Angad Singh)

the IAF over the decades since 1932 clearly proves that IAF personnel have the 'right stuff' in possessing, and, more importantly, in being able to exercise, their technical skills in an innovative manner so as to address practical problems.

Dependence on Foreign Sources

Reliance on critical military technology that is not itself controlled by a nation can prove dangerous. Any nation that the technology was sourced from, can impose control on the recipient's policies and available military options through denial, or restricted supply of spares and other essential support. India has faced such instances in the past. Indian Navy Sea King helicopters and Sea Harrier fighters faced severe shortage of spare parts subsequent to the US led sanctions imposed on India post the 1998 Pokhran-II nuclear tests,

performance parameters from domestic manufacturers who may be undertaking such an effort for the very first time as well as to give tighter control over the activities of the designer, developer and manufacturer.



The first batch of IAF cadets trained on the PC-7 Mk II graduated last year

The Indian Navy's system wherein the Service at its Headquarters has an entire directorate dealing with warship design and development (Department of Naval Design), leading on to interaction with the concerned domestic shipyards entrusted with the actual manufacture, deserves serious consideration. The IN, through this system, ensures end user involvement at every stage, from initial design through manufacture till commissioning into service of indigenous warships. This is further enhanced with serving or retired naval officers in the upper echelons of the warship building shipyards. This model displays comprehensive integration and appears to have worked fairly well (despite primarily public sector shipyards being involved in warship building) and we have an increasing number of indigenous frontline warships entering the Indian Navy.

Solution for the IAF

The IAF could well adapt and use the IN's approach through setting up a separate Directorate of Aircraft Design and Development (Dte of ADD) at Air HQ, tasked with developing aircraft and weapon system designs to meet the IAF's future operational requirements. This new directorate could be manned by a mix of specially chosen engineers with design acumen and operational aircrew with test pilot and operational, experience. Some suitably qualified representatives of Research and Development (R&D) laboratories under the Defence Research and Development Organisation (DRDO) could also be assigned to the Directorate

which would ensure that the designs are practical, meet requirements of the IAF while staying within the bounds of indigenous technical capabilities.

In addition, Air Headquarters could encourage many of the IAF's highly qualified engineers to undertake higher, educational qualifications, in India as well as foreign institutions of higher education, for specialising in aspects of aerospace technology. The IAF could certainly interact with institutions such as the Indian Institute of Science (IISc), Bangalore, to reserve seats in aeronautical disciplines for its personnel to be seconded there. These officers could then be posted to specific DRDO laboratories as well as to 'upgraded' Base Repair Depots (BRDs) of the IAF to undertake programmes to meet the IAF's long-term requirements. Other batches of

IAF engineers could be deputed to work in aircraft manufacturing agencies, both in the public and private sector. Such a body of personnel would ensure that there is seamless linkage from the apex at Air Headquarters, through R&D centres to manufacturing locations, till delivery of the required equipment. The IAF would have unprecedented oversight over the entire domestic design, development and production chain in addition to involvement and ownership of the process. Such an integrated structure could be reasonably expected to deliver far better than has the current system.

The IAF has several BRDs which today only act as storage locations for spares while undertaking limited maintenance work on equipment. These BRDs could well be upgraded to become full capability R&D



Klimov RD-33 engine of a MiG-29 fighter seen under maintenance at an Air Force station



Senior IAF officers at a recent Air Force Commanders' Conference

centres specialising in different aspects of required aerospace technologies. If manned by a mix of qualified and 'motivated' IAF engineers and scientists from DRDO, these could well develop into centres of excellence in their respective fields.

Such a system is likely to ease many of the problems that exist in today's sub-optimal deployment of skilled manpower as well as in indigenous production of aviation equipment. Total ownership and development of technology to address the IAF's actual problems in operations could, through such a change in structure, be within the IAF's grasp. Engineers should be made to keep in touch with realities in the field through innovative posting policies. Engineers may spend a few years at a junior level in operational units and later at suitable intervals, say, for six months every 10 years, rotate through tenures in field units in order to retain a feel for actual issues and problems in operational field units.

Manpower planning and career progression issues obviously would be heavily involved in this approach as is suggested. Manning and personnel issues are involved in other aspects of IAF development too and are thus intentionally not expanded upon in this article.

Choosing the Right Technology

Even as the ability of indigenous design and manufacture organisations has increased manifold in several different areas, some problem areas do remain.

As the IAF plans ahead, it needs to decide upon the type and nature of technology it should invest in for the future. The IAF must be certain about the capabilities it would require by the 2032 timeframe and in subsequent further timeframes. This process should not be based upon just following the path earlier trod by more advanced countries of the West (such blind copying of the West may lead to commitment of resources towards very high end 'gold plated' weapon systems such as the F-22 Raptor of which even the US found it could not afford more than 187), but should be an independent exercise with no pre-conceived notions about what future technologies can deliver. The IAF should dispassionately analyse available options, realise the practicability of real world new technologies. This would help it take informed decisions about the research and development efforts it should invest in for the future.

For instance, while assured penetration of hostile airspace would be the desired capability required, this could possibly be achieved through the use of stealth aircraft or through hypersonic space planes or even launching attacks from platforms orbiting in outer space. This simple example brings out the fact that in most cases, there will be more than one way to achieve an operational task. Of course, such choices between alternatives will carry an element of risk. The challenge for the IAF with respect to technology selection will be to arrive at reasoned decisions with adequate risk alleviation strategies built into its plans. Such technology identification and selection is best done at Air HQ within a specialised cell of the new Dte of ADD, in order to integrate operational needs with technical feasibility. Long-Term Perspective Plans (LTPP s) at the Directorate of ADD could give direction to long-term R&D into enabling technologies for futuristic LTPP projects. In the USA, the Defence Advanced Research Projects Agency (DARPA) carries out this function for the US armed forces. Concepts accepted by the organisation and government are contracted out by DARPA to private and public sector agencies for further development and 'proof of concept' before being developed into operational systems. The Directorate of ADD could set up a department to serve a similar function as served by DARPA in the US till all three Services and the MoD can set up a combined central agency for this important task.

Aeronautical Engineer branch officers:

Most modern equipment, whether for civil or military use, comes with exhaustive documentation that includes fault identification and rectification checklists and flowcharts. These two aspects are most often covered as a series of block diagrams with the sequence of progression clearly defined. Availability of such documentation means that maintenance personnel in units do not require very advanced academic knowledge to carry out routine maintenance especially with Line Replaceable Units (LRUs) becoming the standard design aspect of most modern weapon systems. The IAF's substantial number of highly qualified AE branch officers require effective deployment for tasks that are suitably challenging for them and which utilise their capabilities for the greater good.

Weapon Inductions for Effectiveness

The IAF would definitely also require development and induction of appropriate technologies for effective air-to-ground attack in the mountains given that India's disputed territories for the most part lie in the Himalayas; in the 1999 Kargil War, effective attack against targets in the mountains was a major challenge for the IAF. Widespread induction of Precision Guided Munitions (PGMs) should be planned for use in mountainous terrain as well as in the plains. Increased availability of PGMs could make Battlefield Air Strike



Griffin LGB on IAF Jaguar

(BAS) less prone to fratricide apart from making it more effective. The IAF will need to identify leapfrogging technologies to counter, for instance, the People's Liberation Army Air Force (PLAAF). The IAF's highly qualified AE officers could be deployed to address such challenges of technology and equipment development.

Cyber warfare

The IAF is making rapid strides towards becoming a fully networked force, able to execute networked operations through the cyber domain. It is putting in place its Air Force Network (AFNET), which is a fibre optic based high bandwidth connectivity backbone between all IAF ground locations, which is able to provide high bandwidth voice, data and video streaming facilities to its users. The IAF's Integrated Air Command and Control System (IACCS) enables near real-time information sharing and combat decision support and operates on the AFNET backbone. AFNET also enables Internet Protocol (IP) based communications amongst its users.

IACCS nodes are rapidly expanding over the IAF, with a total of ten nodes planned to cover the entire country.

While the AFNET architecture provides seamless connectivity between ground locations, aircraft and satellites for real-time voice and data amongst users, the IAF is progressing towards greater connectivity through a wideband Code Division Multiple Access (CDMA) 3G portable wireless network. This network is meant to ensure complete connectivity among more than 80,000 IAF personnel and their bases, for which high end smart phones manufactured by HCL are to be issued to all officers. The IAF is well on its way towards achieving a fully networked and integrated organisation able to share relevant information rapidly, achieving significant force multiplication effects. Networking can achieve significant force multiplication effects through near instantaneous sharing of information amongst all war-fighters, thus significantly reducing the 'fog of war' and making the IAF's networked forces significantly more effective.

New capabilities also bring new vulnerabilities. In a situation where war plans are based upon availability of the network, its absence could well throw plans into disarray. Reversion to non-networked operations could be resorted to, but this

could lead to a significant decrease in efficiency. Therefore, along with induction of cutting edge technology, it is important for the IAF to devise effective means of insulating itself from the new vulnerabilities that accompany the new technology inducted.

The IAF is relying upon a dedicated self-owned fibre optic cable network for high bandwidth data transfer. Fibre optic cables provide a degree of safety from leakages as intercepting the 'on fibre' data would require a relatively difficult direct tapping into the network through cutting into fibre optic cables or access to AFNET linked computers, both of which can be protected physically. India's Computer Emergency Response Team (IN -CERT) set up by the central government is already hard-pressed in dealing with the many attacks on Indian computer systems. The need to extend the IAF's ground-based network while the sensors and war-fighters are in the air means that wireless data-links are also needed from the secure ground network (net) to the airborne net. The CDMA-based 3G wideband wireless network could also be tapped into by malicious elements, apart from the real

Cyber attacks

The growth of Information Technology (IT) in today's world has opened up the sharing of data, but has also led to the emergence of a growing threat to security in the form of cyber attacks. Given the dynamic nature of the cyberspace, and the fact that it is difficult to identify accountability, defence networks require regular development and constant modernisation in order to combat cyber attacks.

In September 2011, news emerged that the US Air Force's drone control stations were infected with malware recording pilots' keystrokes. Earlier the same year Lockheed Martin Corp came under attack from a cyber source, however, its sophisticated Cyber Kill Chain framework prevented any data from being compromised. Instances like these show the increasing vulnerability to cyber aggression due to the dependence on technology. At the NATO summit 2014, held in Wales on 4th and 5th September, world leaders recognised cyber attacks as being at par with extremists and regional conflicts when it comes to national security. A number of NATO members have been building up their cyber warfare capabilities, after various cyber breaches that have occurred over the past few years.

India's armed forces, too, have been subject to a number of cyber security breaches. The Indian Navy faced a major breach in 2012, in its Eastern Command at Visakhapatnam, when sensitive fleet deployment information was passed on to IP addresses in China owing to malware in a pen drive. Soon after, the Indian Navy became the first to create a cyber security cadre. Similarly, in an attempt to control instances of hacking by third parties, the Indian Air Force now requires officers to sign a declaration that they will not save or view any official document on personal computers.

Measures such as these are steps in the right direction; however, there is a perennial danger with the cyberspace, as pointed out by Mikko Hyppönen, Chief Research Officer for F-Secure, "There is no 100 per cent security. You can compare computer security to a lock. There are different kinds of locks. Some are easy to pick. Others are hard to pick. If we put lots of effort, can we create a lock that could never, ever be picked by anyone? No we couldn't. Even the most secure lock can be picked, because it's built by humans. What one man can build, another man can break apart."

danger of some of the 80,000 handsets issued to personnel falling into hostile hands. These handsets could be configured to require a frequent authentication through biometric means tied to the authorised user to continue to have access to the AFNET. Securing of wireless data-links requires technological means such as a combination of advanced encryption to defend against eavesdropping and spread spectrum ultra wideband transmission characteristics to defend against jamming.

It should be borne in mind that a static system, if attacked continuously by hostile elements, is likely to finally succumb. Therefore, the defence of a network requires being dynamic in nature and continuously evolving to deal with ever more complex threats as these, in turn, evolve. In view of the numerous attacks continually taking place on Indian computer networks and IN-CERT involved in dealing with these, it would be prudent and even necessary for the IAF to have its own cyber security personnel.

on a permanent basis who could be tasked by the IAF to continually probe the IAF's network to identify potential weaknesses. Such identification of 'weaknesses' should lead, in turn, to development of suitable patches to secure the potential weaknesses identified. A purely defensive approach is unlikely to be adequate, and so the IAF may need to develop Offensive Cyber Warfare (OCW) capability to supplement its Defensive Cyber Warfare (DCW) capability. This OCW capability should comprise the ability to trace back the path of cyber attacks (from hacking, denial of access attacks to virus insertions) to their source and then counter attacking such sources, once identified, with "overwhelming, but precise, retaliation". Merely training regular IAF personnel by putting them through computer skills courses may not suffice in building up highly skilled manpower for OCW and DCW, as the IAF may require personnel who have both the aptitude for cyber technology and already possess advanced cyber skills.

the IAF as 'cyber combatants' for DCW and OCW tasks. Similarly, selection of specific people could be carried out for manning cyber forces aligned towards other potential adversaries. In this manner, a suitable Cyber Warfare (CW) capability specialised towards potential adversaries could be built up. The IAF would, thus, also be able to leverage the diversity in India's population to its advantage. CW personnel would require deployment at levels from the highest at Air HQ down to the field units to ensure total integrity of the AFNET, wideband wireless 3G mobile network, and IACCS. At Air HQ, Air Command and air base levels, CW personnel would interface with the cyber personnel of the army, navy and other government organisations [such as IN-CERT and National Technical Research Organisation (NTRO)] involved in CW. At lower levels, CW personnel would need to interact with their counterparts in the other two Services and elements of the civil administration in their vicinity.

Joint Operations

Future wars are likely to require joint operations of a much greater magnitude than those in the past. Thus, the IAF must synergise with the army and navy when planning new inductions to ensure that the capability for joint operations becomes seamless. The challenge arises in developing a model of jointness most suitable for India's current and future needs. The tendency to copy models developed by other armed forces is strong but should be avoided with effort being expended towards developing a specific model suitable for India.

The need for change in India's current methods for jointness is brought out most clearly by an assessment of the US' defence organisation post the Cold War by the renowned management and organisational development guru Peter F Drucker, who wrote of each headquarters staff in the Pentagon that, "...the office of the secretary of defense (OSD), Joint Staff, service secretariats, and military staffs is organised along traditional lines with manpower, intelligence, logistics and other functional activities. The input nature of defense budget categories reinforces this functional orientation. Although this structure provided the needed stability during the Cold War, it does not adjust well to new missions." Peter Drucker's assessment is relevant not only to the Pentagon but also to India's defence organisation which in many respects, is patterned in a way



A dynamic cyber defence option would require highly skilled teams of experts continually working to identify weaknesses in the network, analysing the state and sophistication of attackers and, in turn, dynamically updating / upgrading the network to deny hostile elements access to it. The IAF could achieve this through entering into contracts with the parties that designed the AFNET and IACCS. In addition, it could hire 'ethical hackers'

Selection of personnel with basic language skills aligned towards the likely adversaries may be beneficial. For forces aligned towards China, for instance, suitable personnel from northeast India may be inducted as early as school level and put through intensive Chinese language courses along with advanced computer skills courses. Those who show the aptitude and skills required in language and computers could then be offered permanent commission in



'Special operations' aircraft such as the C-130J already play a significant role in joint operations, which are lately receiving much more attention from military and political leadership (photo: Angad Singh)

similar to the Pentagon's organisation. In order to determine the most suitable model of jointness for India, models put forth by various experts must be examined.

De-confliction across the environment

Such a model is characterised more by a lack of jointness than actual jointness. In this, three single Service campaigns are apparently planned and executed, with de-confliction being carried out in order to reduce mutual interference, rather than plans aimed at achievement of synergy. In the past, the Indian armed forces have mostly followed this model. The most outstanding example of success within this model is the 1971 Indo-Pak War on the eastern front where there was an early achievement of objectives on achieving total air superiority over East Pakistan and cooperative action taken at the tactical or field level which resulted in 'outstanding success'. While this model has delivered a degree of success in specific circumstances, it remains an obsolete model, not worthy of being pursued further, as it does not strive for synergy.

Joint HQ

The 'Joint HQ' model is characterised by top-down joint campaign planning, leading to single Service planning. The Integrated Defence Staff (IDS) and Strategic Forces Command (SFC) in India could, to an extent, be said to be modelled on this concept of jointness. The same model appears to form the basis for the demands for 'Theatre Command' by some sections of India's armed forces. This model, although at first glance quite appealing, has some major lacunae. Expert advisors notwithstanding, owing to lack of knowledge of the intricacies of specific force utilisation, there is very real danger in this model of smothering the core competencies of technologically intensive forces in the overall plan. 'Groupthink' becomes a very real danger in such an approach. Moreover, in this model, once the overall plan is decided, the individual planning is still left to the individual Services, thus, reverting to effectively single Service war plans with the required de-confliction. Hence, this model too is felt to be unsuitable for adoption by India's armed forces.

Integrated Organisation

In the 'Integrated Organisation' model of jointness, a single organisation is formed by subsuming the individual Services into an all encompassing combined defence force. There are no longer any individual Services but a combined defence force with branches such as the "air" branch, "maritime branch," etc. This model has most famously been tried in Canada where the Royal Canadian Army (RCA), Royal Canadian Air Force (RCAF) and Royal Canadian Navy (RCN) were merged to form the Canadian Defence Forces (CDF); all in one common uniform and answering to a common hierarchical chain of command. Contrary to expectations, it was found that the loss of individual Service culture and traditions led to a loss of domain specific core capabilities and competencies. Soldiers, sailors and aviators who had earlier fought tenaciously for the pride and honour of their individual units and Services were found to have lost that intangible '*josh*' which is a vital ingredient of battle success in combat. Additionally, in the Gulf War of 1991, of all the participants in the US-

led 'Coalition of the Willing', the CDF was found to suffer from a surprisingly excessive lack of jointness in comparison to the armed forces of nations which followed more 'obsolete' organisational models. The Canadian experience clearly brings out that, especially in view of the traditions and history that our three Services possess, the 'Integrated Organisation' model of jointness is unsuitable for India.

A model of jointness for India

In the ultimate analysis, jointness matters most at the sharp end in the actual battle where synergistic joint application of military power should overwhelm the enemy at least cost to friendly forces. However, for this to be achieved, it is essential that all arms of the military work together and, without any jingoism, strive to develop a joint approach for synergy. This envisions true joint planning from the weapon systems development and induction phases on to development of the war plan and its actual execution.

Such an 'Integrated Systems' model of jointness addresses this need as it envisages true interoperability among the equipment used by the three Services through compatible Operational Data-Link (ODL) systems so that all combatants operate with full information, optimising force utilisation in time and space. Such transparency would deliver true networking down to the battle space. Beyond initial joint planning, it is reasonable to expect that a synergistic joint plan would flow down to lower execution levels that are empowered to do this efficiently while continuing to enhance jointness through information empowerment across Service boundaries.

This model requires a coordinated systems approach to development and induction of new weapon systems as well as upgrades. In new weapon development and induction, interoperability needs to take pride of place. This model has the potential to deliver true jointness in several disparate scenarios and, thus, should form a starting point in development of an Indian model of jointness, especially relevant today as the three Services stand poised to upgrade in Service equipment and induct new equipment. The IAF's AFNET hosted IACCS aims to deliver such transparency down to the lowest levels, including at interfaces with Army and Naval forces.

The 'Integrated systems' model of jointness, due to its merits, should form the foundation of jointness for India's armed forces. Once this basic model has been implemented at the field level, on the basis of hands-on experience gained in the current scenarios of operation from Low Intensity Conflict (LIC) to anti-piracy, the model could be fine-tuned further.

It is opined that the 'integrated systems' model of jointness, later leading to a 'hierarchical command, networked control and empowered field commanders' model of jointness would be able to address the jointness needs of the Indian armed forces for all envisaged scenarios, from LIC conventional war and Out of Area Contingency Operations (OOACO), in the foreseeable future. In this model, through availability of real-time and complete fused information on the actual progress of all activities at the battlefield, the higher hierarchical command levels could well exercise far more effective control on operations than they have thus far. A major advantage in this model is that unlike today, wherein if the higher commander controlling the operations is made ineffective or communications fail, and thus operations suffer due to incomplete information at the field level, the availability of information at all levels would permit continuation of effective battles till higher commanders are operational again. It is opined that this basic model should be adopted by Indian authorities for further

development to deliver truly synergistic application of military power.

Eventually, the IAF must work together with the other organs of state security to ensure that the most appropriate model of jointness for our situation is implemented effectively, while also building up the required capabilities for scenarios that require single force (aerospace force, land force or naval alone) missions.

Optimal utilisation of resources

The IAF, being a technology intensive Service, requires investment in expensive equipment on a regular basis. Towards the end of the 1980s and in the early 1990s, India was facing a major economic crisis, and funds were largely unavailable for procurement of new equipment. Subsequent to economic liberalisation and the faster growth of the economy, lack of funds was no longer an issue; while, at the same time, the earlier reluctance of some Western nations to export technology to India was reduced. Taking advantage of the situation, the IAF embarked upon a major re-equipment plan to overcome obsolescence and deficiencies endured during the 'lean' period. New combat aircraft and force multipliers were sought to be obtained from various sources, while also upgrading most of the existing aircraft types. The issue of possible sanctions adversely affecting force availability has been discussed earlier as has the need to control and own one's technology. These issues apart, import of equipment, even



Various IAF transport types seen in formation flight over Hindan : in the lead is an An-32, followed by pairs of Avro 748s and Dornier 228s (photo : Angad Singh)

with licensed manufacture, is at best, an immediate solution.

Licensed manufacture brings 'knowhow' level technology but replacement requires foreign involvement again. Each time the equipment is replaced or upgraded; there is significant foreign exchange outflow. However, availability of specific technology may well be restricted by the exporters. A more cost effective, albeit slower process, is to invest in a planned

imported for locally-built aircraft or by increasing the final contract price by an amount sufficient to recover these losses. For instance, until its production line was shut down, the MiG-21, built in different variants in India since 1967, and till the very end even aircraft "built from raw materials" by HAL continued to incorporate a few critical parts directly imported. The supplier naturally recovered some of his costs through very high prices

for these parts. Only through indigenous design and comprehensive manufacturing can a nation free itself from such external constraints and exploitation. This, in turn, can only be achieved through the growth of a viable aircraft sub-components ancillary industry to support large public and private sector full system integrators.

Resources, if utilised in such judicious manner, although after an inevitable period caused by challenges in design, development and procurement, will certainly lead to better utilisation of the available resources.

Acceptable organisational values

The IAF necessarily draws its personnel from the Indian populace. While military socialisation has always endeavoured to insulate military personnel from the turbulence of civil society, over time, there is bound to be some effect. The IAF needs to enforce a strict code of conduct from the initial induction stage itself. Such socialisation could include a set of hard and fast 'Acceptable Organisation Values' that all entrants must understand fully and live by at all times. Such a code of values could be modelled on the 'Honour Code' system used by the US Marine Corps, emphasising that every air warrior is a warrior first and member of his branch later. From the basics of human behaviour, it is well known that subordinates in all walks of life will do as the leaders do and not as they say.

Gp Capt Vivek Kapur

Senior Fellow at CAPS, New Delhi.



MiG-21 Bisons seen departing the apron at a fighter base (photo: Simon Watson)

manner in developing indigenous design and manufacture capabilities. In the short term, of course, this is likely to lead to delays and development of equipment that falls below global specifications. However, in the long-term, it should lead to equipment equal to, or exceeding, globally available equipment. The funds spent on such indigenous equipment, would, in the long-term, contribute to the economy and thus to the nation's power.

It is often brought out that making, say, a Jaguar aircraft in India costs more than the same product bought from the Original Equipment Manufacturer (OEM). This, as we are seeing in press releases on the current MMRCA deal and in discussions on the offsets clause of the current Defence Procurement Policy (DPP) is primarily because the foreign supplier compensates by increasing the costs of critical parts that may still be



Key to the future lies in the training, management and motivation of IAF personnel

UAV conference

Need for radical reforms



Air Marshal (retd) M Matheswaran on the Crisis in India's Aerospace Industry and Capability

Computer generated image of a future generation fighter

Role of the aerospace and defence industry - and the larger defence economy - is crucial in making a country powerful in real terms. The implication of this is that a meaningful defence industry can only exist when the country pursues a national strategy to ensure it has control over critical technologies. This would ensure that the country is free

from technological dependence on others. Supremacy in defence technology can be achieved only through dynamic policies that aim to acquire advanced technologies, create competitive domestic environment for the industry, create a competitive environment for innovation, research and development, and focus on developing an economically viable defence industrial eco-system. This

would create an active defence economy that would plug itself into the global supply chain. A defence industry that generates globally competitive products would become a huge money-spinner through exports. More importantly, exports would drive the industry to constantly innovate and improve, thus creating a self-sustaining research and development cycle.



Importance of Dominant Technologies

An aerospace and defence industry is characterised by cutting edge technologies. Ever since the onset of the industrial revolution, technology has continued to develop at an increasingly exponential rate. Over the last three centuries of technological growth and subsequent

technology explosion, technologies have tended to cluster around one or two dominant technologies in a cycle of approximately 60 years. These dominant technologies resulted in a plethora of inventions in various applications in both civil and military sectors. The impact has been stupendous. Dominant technologies determined the markets, which in turn determined trade and wealth creation. Thus it was important for a nation to be a leader in dominant technologies in order to dominate world markets for its economic growth and creation of wealth. Dominant technologies were also instrumental in creating advanced military technologies, thus leading to creation of powerful military capability for the leading technology powers. The history of Britain, France, USA, Russia, Japan, Germany, Sweden and lately, China are clear examples of countries that have gained enormous wealth and power on the strength of their control over dominant technologies, and hence control over world markets.

In the current environment, the world is undergoing a cycle of dominant technologies, specifically in aerospace and Information Technologies (IT). If India is to rise as a great power it must leapfrog into a dominant position in the realm of aerospace and information technologies. This is easier said than done! Over the last 60 years or so, India has enacted policies and systems that are actually detrimental and counter-productive to India's national interests.

Great Power in the making?

There are many elements – political, strategic, economic, social, technological, military, cultural, etc – that go into the complex process of the rise of a great power. India has many positive aspects in some of these elements that make it a vibrant emerging power. But there are also serious weaknesses that hamper its growth. These lie in the critical domains of national strategy, technology, and most importantly realistic military power. Critical weaknesses in these domains have a cascading negative impact on our economic growth, diplomatic leverage, and our standing or our ability to have our say in the international system.

Military Power

India is seen as a major military power. While this is true in terms of size - we have the second largest army, fourth largest air force, and seventh largest navy - the narrative conceals more than it reveals. For

a country to be powerful in the real sense (this means an ability to impose its will on any adversary in the international system diplomatically or militarily) its military power must be rooted in national strength and national capability. Simply put, most of our technological requirements must be met by own national capability. Otherwise, we are vulnerable to international pressures and leveraging by outside parties.

90% of India's military power is import - dependent. India's control of cutting edge military technology is negligible. The combat capability of the three armed forces, the Indian Air Force in particular, is completely dependent on imported weapons and systems. For too long we have had the unique reputation of being the largest importer of military equipment. What does that mean? It implies that we actually support defence industries in other countries, which means we also end up supporting their jobs, their research and so on. None of that contributes to India's strength. Our defence industry is almost entirely in the public sector. It is dependent on licence production. There is very little meaningful research, little incentive for innovation, and complete lack of any coherent national strategy.

Lack of competitiveness stems from lack of export orientation, production inefficiency, lack of accountability, and lack of effective decision-making. Besides, heavy bureaucratic oversight, with little professional experience, has ensured complete lack of initiative and innovation. The middle level managers, some of whom are brilliant and keen on innovation, are hampered by the constant threat of vigilance. This leads to good managers becoming reluctant to take effective decisions. More critically, the Indian defence industry has been the victim of the 'L1 system' in its tendering process, which patronises mediocrity and punishes excellence.

Policy Paralysis

Indian policies with respect to defence industry have been lopsided to say the least. No meaningful private sector exists as Government policies originally restricted private sector firms from defence manufacture. Even though this policy has been revised since 1991, there has been no level playing field. The DPSUs have been the beneficiary of almost all defence contracts. This has resulted in DPSUs functioning

in a non-competitive environment, which is detrimental to innovation and research orientation.

India did not permit defence exports for the first fifty years due to a lop-sided policy. The net result has been lack of a vibrant defence industry based on export orientation and economic well-being.

Technology acquisition strategies have been seriously flawed. In fact, there has been no strategy ! The outcome is an industry that is entirely dependent on licence production. Joint ventures and FDI policies have been ineffective in translating into business. Contrast this with the many Chinese successes.

What should India do?

The cutting edge defence technologies lie in the areas of aerospace and IT. India is now at the crossroads of having to decide to take the route to great power achievement or remain the mediocre survivor that it has been through the last 800 years of foreign domination.

The following should be the agenda to revamp India's technological capability, national power and national security :

- Create a National Aeronautical Commission that should oversee and implement a cohesive national aerospace strategy. The need for such a commission and a national aeronautics strategy has been articulated by various studies over the last fifty years. For some strange reason the government has not acceded to this requirement. The need is now very acute, as without such a body it is impossible to develop an aerospace industrial ecosystem. The commission must report to the PM through the NSA. The commission should be headed by a technocrat and be manned by professionals in the subject.
- Aerospace strategy should address the fundamental need for creation of a vibrant aerospace industrial eco-system. The strategy should address this through four verticals : Industry, Education, Research & Development, and most importantly the User (military and civil).
- The strategy should aim to create a large, vibrant, competitive aerospace industrial ecosystem of thousands of small and medium enterprises that become the source of component manufacturer and spares support. The country does not have any meaningful Tier 1 or Tier 2 suppliers nor do we have any share in the important Maintenance, Repair and Overhaul (MRO) market. Unless we plug in to the global aerospace supply chain, and garner significant share of the global MRO market as well as aerospace components and spares manufacture, our aerospace strength will continue to remain weak.
- Aerospace industrial policies must become comprehensive, with a focus on competition and the private sector, along with government funding for research in private sector.
- DPSUs have long been patronised by the government at the cost of the private sector. Over the years they have become inefficient, lack any spirit of innovation, and are a drain on the national economy. The primary problem stems from the fact that DPSUs are governed by articles 12 and 14 of the Indian Constitution; by considering them as part of the State, the PSUs and DPSUs have enormous negative constraints that militate against the highly technical skill and quality requirements of the aerospace sector. It is time the DPSUs are freed from these constraints by corporatising them as well as by divesting a significant level of government control/shares and changing it into a vibrant PPP model. Brazil's Embraer is the best model to emulate here.
- HAL (Hindustan Aeronautics Limited) is too huge and unwieldy. It needs to be restructured into a format of a holding company with many independent industries. Bring in private capital, infuse private entrepreneurship, and minimise government role. Let the market determine its success or failure. HAL must focus on exports as its major revenue basis. Currently its export performance is abysmal – its quality control and production efficiency are poor.
- Defence export policies should be overhauled completely. Export should become the main focus. This will drive and energise innovation and research in the industry. All JV and licence production contracts must incorporate our freedom to export and be part of the global supply chain.
- While FDI in defence industry has been hiked to 49%, in selective cases where our need for high technology is involved we must permit greater levels of FDI.
- FDI will bring in advanced technologies, production methods and technologies, increase training of our human resource in highly skilled sectors, and create many jobs. The technology diffusion effect that accrues would be hugely beneficial to our research efforts.
- R&D and reverse engineering must be actively encouraged.
- Review the policy that limits production of missiles and military explosives only to DPSUs. The result has been severe constraints on weapon supplies to the defence forces. The manufacture, research and production of missiles and explosives should be opened to the private sector.
- DRDO should be pruned down to focus its research efforts only to high-end strategic domain. Most other research should be encouraged in the private sector and academic institutions. This process should be done through adoption of the DARPA model.
- The military must create its research cadre, who would then advise on the research efforts. Most weapon related research labs should be controlled by the military.
- The government must create a Ministry of Defence and Aerospace industry. It should replace the current DDP and be outside the ambit of the MoD.
- The Office of the SA to RM should be separated from that of the Secretary, DRDO. Instead, a Scientific Advisory Board should replace the SA to RM.



Air Marshal M Matheswaran was the Deputy Chief of Integrated Defence Staff (DCIDS) at HQ IDS until his retirement on 31 March 2014 and was responsible for Policy, Perspective Plans and Force Development (PP & FD).

Hindustan University

Tejas Redux : The Israeli Touch



During Aero India 2013, the Aeronautical Development Agency (ADA)- developed Tejas Light Combat Aircraft project signalled the long due transition to its primary role : that of an “uncompromising multi-role fighter”, being lavishly aided by Israeli munitions and Fire-Control Radar (FCR). This primary sensor, mounted in a Kevlar radome, was initially presumed to be an upgraded version of the Israel Aerospace Industries (IAI) Elta EL/M-2032 (with mechanically scanned antenna) with India’s Electronics Research & Development Establishment (LRDE) separately working on an Active Electronic Scanned Array (AESA) antenna.

However, also during Aero India 2013, to this *Vayu* writer, the FCR destined for integration with Tejas actually appeared to be an ‘enigmatic’ scalable Elta EL/M-2052 AESA FCR based on fully solid-state active phased array technology. The inherently enhanced detection and tracking ranges (which should be well beyond 200 km against a fighter-sized target) remain classified although the Pulse Doppler FCR is officially confirmed as being capable of

tracking up to 64 targets and engaging them in Look-Down/Shoot-Down (LD/SD) mode. In the air-to-ground mode the high resolution Synthetic Aperture Radar (SAR) is highly effective against static targets while the Ground Moving Target Indicator (GMTI) on Real Beam Map (RBM), Doppler Beam Sharpening (DBS) and SAR are invaluable assets. In the air-to-sea mode the Inverse Synthetic Aperture Radar (ISAR) mode assists target classification. The radar is known for high Electronic Counter Measures (ECM) immunity, ultra-low side-lobe antennae and high mission reliability.

The Tejas will naturally remain beyond hostile detection to a considerable degree, thanks to the considerably reduced visual signature in terms of physical dimensions and high percentage (45 per cent by weight,

95 per cent
by surface area)
of Carbon-Fibre-

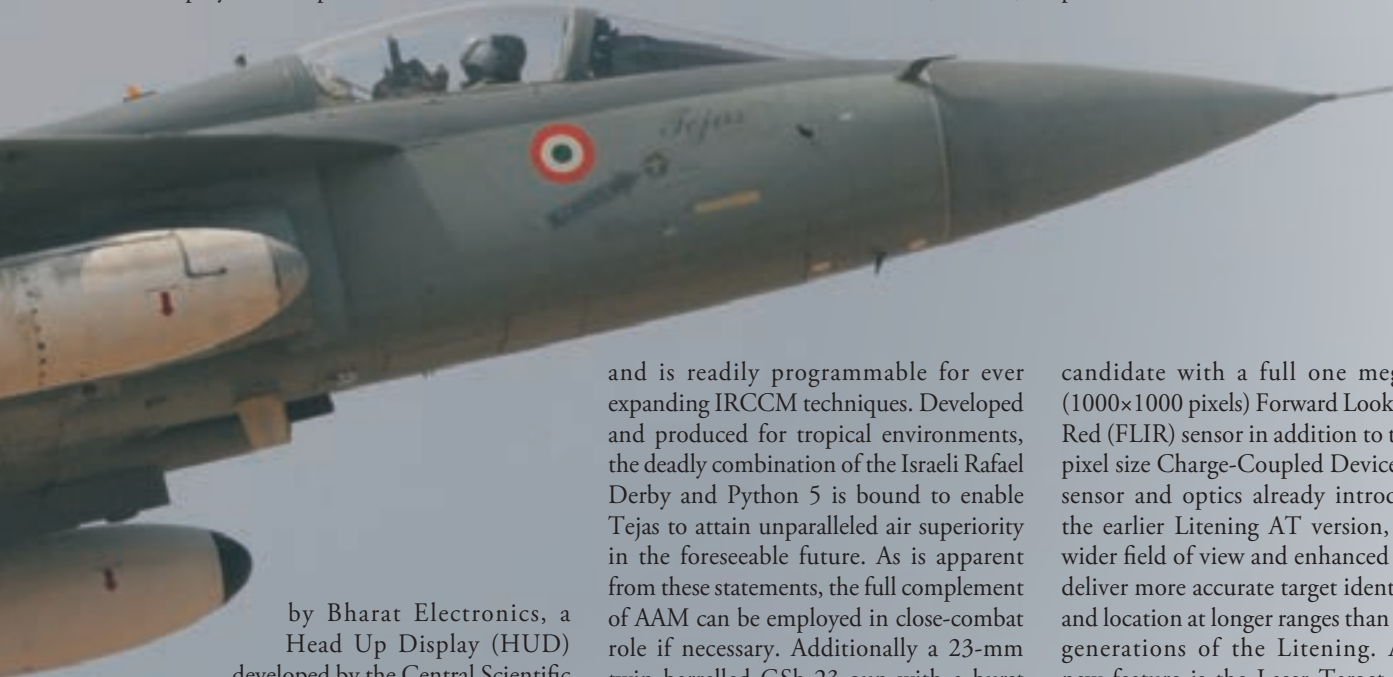
Composites (CFC) in the

airframe, while the bifurcated Y-duct intake design specifically developed to reduce Radar Cross Section (RCS) effectively masks the engine face. The Tejas also has a lower Infra Red (IR) signature and will be further adorned with radar absorbent paint. The RCS is bound to recede even sharply if Beyond Visual Range Air-to-Air Missiles (BVRAAM) can be accommodated in stealthy pods on the inner wing pylons. Self protection is further enhanced by the aircraft’s state-of-the-art electronic warfare suite, developed by the Advanced Systems Integration and Evaluation Organisation (ASIEO) of Bengaluru, that includes a Radar Warning Receiver (RWR) and Self Protection Jammer (SPJ), laser warning receiver, Missile Approach Warning System (MAWS) and chaff and flare dispensers. The programme is termed *Mayavi* (Illusionist) and is receiving considerable inputs from Elisra of Israel. (A similar system is also

projected to equip F-35 Lightning II in Israeli Defence Force-Air Force service). Test pilots have praised the advanced night vision goggle compatible glass cockpit with two 76 × 76 mm colour LCD multifunction displays developed

AF) philosophy of a visual identification pass coupled with a close-in High Off-Boresight Angle (HOBA) shot, the missile uses staring Focal Plane Array (FPA) seeker technology that has inherently better Infra-Red Counter Counter Measures (IRCCM)

navigation system with an integrated global positioning system. For nocturnal surface strike across international borders and especially against hostile rolling armour, the Israeli Rafael Litening G4 targeting pod, offered to the IAF, is an excellent



by Bharat Electronics, a Head Up Display (HUD) developed by the Central Scientific Instruments Organisation (CSIO) and a liquid crystal return-to-home-base panel with keyboard.

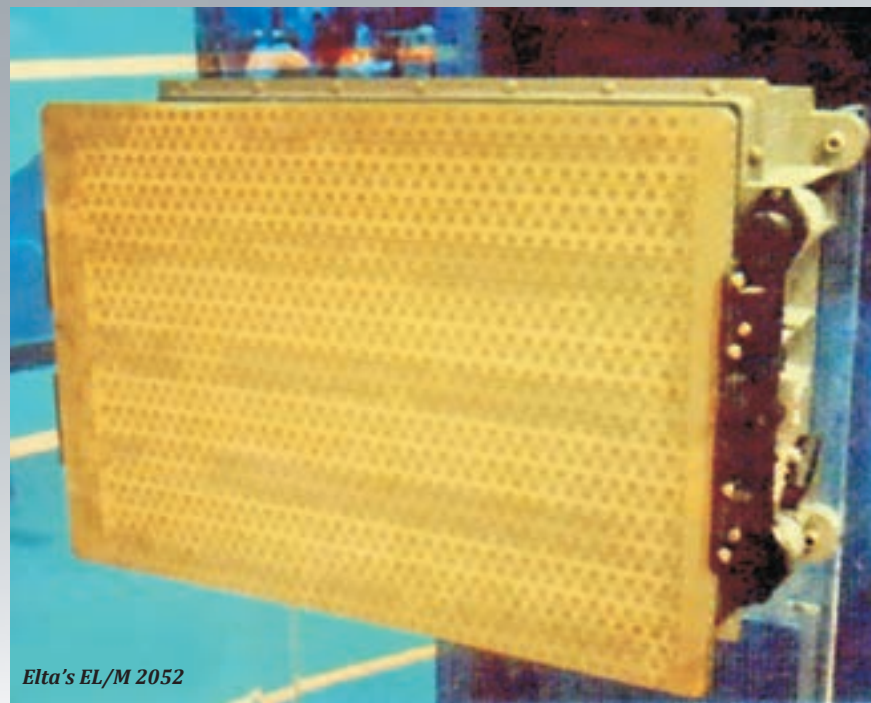
For Tejas, at least initially, the Rafael active-radar homing Derby has been selected to fulfil the role of BVRAAM until the indigenous Astra BVRAAM or an entirely new BVRAAM (confirmed to this *Vayu* writer during the Defexpo 2012) enters mass production. According to Rafael, the 'multi-shot capable' Derby in Lock-On After Launch (LOAL) mode has a range in excess of 63-km if launched at Mach 0.9 at 25,000 ft against a head-on target, although its maximum range, or its effective seeker range, remain highly classified. Derby also has a very low minimum range and an option for Lock-On Before Launch (LOBL) mode thus also capable of being employed for short-range engagements in tight dogfights with Derby's seeker slaved to the aircraft's radar or the pilot's DASH helmet mounted cueing system.

To complement the Derby BVRAAM, the fifth-generation Rafael Python 5 CCM, a progressive development of the Python 4, with numerous canard control surfaces, destabilisers and powerful 6-inch diameter rocket motor is selected. Designed around an Israeli Defence Force-Air Force (IDF-

and is readily programmable for ever expanding IRCCM techniques. Developed and produced for tropical environments, the deadly combination of the Israeli Rafael Derby and Python 5 is bound to enable Tejas to attain unparalleled air superiority in the foreseeable future. As is apparent from these statements, the full complement of AAM can be employed in close-combat role if necessary. Additionally a 23-mm twin barrelled GSh-23 gun with a burst firing rate of 50 rounds per second and muzzle velocity of 715 metres per second is to be installed in a blister fairing under the starboard air intake.

The navigation suite includes the Sagem SIGMA 95N ring laser gyroscope inertial

candidate with a full one mega pixel (1000×1000 pixels) Forward Looking Infra Red (FLIR) sensor in addition to the mega pixel size Charge-Coupled Device (CCD) sensor and optics already introduced in the earlier Litening AT version, offering wider field of view and enhanced zoom to deliver more accurate target identification and location at longer ranges than previous generations of the Litening. Another new feature is the Laser Target Imaging Programme (LTIP), employing a Short-Wave Infra Red (SWIR) laser augmented imaging, to enhance the targeting system's capability to capture images in situations where Medium-Wave Infra Red (MWIR), FLIR and CCD are ineffective. In addition,



Elta's EL/M 2052



Tejas LCA before participation in IRON FIST 2013 (photo : Simon Watson)

the Litening G4 employs an integral digital two-way data link, facilitating encrypted data communications with compatible land-based or airborne digital datalink devices.

The Litening G4 will facilitate employment of a broad spectrum of Israeli and United States-origin Precision Guided Munitions (PGM) effective even in high altitude and urban environment with minimum collateral damage. Spice guidance kits likely to be chosen by IAF will convert 1000-lb and 2000-lb general purpose and penetration warheads into precision (CEP less than 3 metres) stand-off (range over 60 km) strike weapons (Spice-1000 and Spice-2000). While the dual Charged Coupled Device/Imaging Infra Red (CCD/IIR) seeker facilitates day, night and adverse weather capabilities, the automatic target acquisition capability is implemented by a unique scene-matching technology that is robust to scenery changes, countermeasures, navigation errors and Target Location Errors (TLE). Spice navigates autonomously by means of Inertial Navigation System and Global Positioning System (INS/

GPS) and its seeker provides positive target identification.

From an Indian defence standpoint, success of the Tejas programme is critical and obligatory to enable the IAF to attain quantitative parity against the combined fleet of potential adversaries in the neighbourhood, namely the Chinese People's Liberation Army Air Force (PLAAF) and Pakistan Air Force (PAF). This 'flamboyant lightweight', with its shoulder mounted highly adapted compound delta wing design with extensive wing-body blending and an optimised area ruled fuselage endowed with relaxed static stability with full authority quadruplex digital Fly-By-Wire (FBW) controls appears well capable of protecting India's national airspace besides performing limited precision strikes with appropriate munitions. The aircraft's aerial display during Aero India 2013 was most impressive.

The proposed LCA Mk.II is to have the General Electric F414-GE-INS6 engine producing 98-kN reheated thrust and Full Authority Digital Electronic Control (FADEC) fed by enlarged intake ducts to cater to the increased airflow requirements

to boost the performance spectrum. With a target price tag of \$45 to 50 million per aircraft, this aircraft is a candidate to be inducted in considerable numbers.

Looking ahead, in the most optimum scenario, the IAF would likely be best equipped if progressively transformed into a 'two-tier' fighter force with, say, twenty squadrons of heavyweight air dominance fighters like the Sukhoi Su-30MKI and the Indo-Russian Fifth Generation Fighter Aircraft (FGFA) complemented by another twenty squadrons or so Tejas-class fighters. With advent of the projected Advanced Medium Combat Aircraft (AMCA) complemented by an Unmanned Aerial Combat Vehicles (UACV), the Indian military industrial complex should necessarily concentrate on progressively developing aircraft to approach the fifth generation. The 'two-tier' fighter force (alongside 'stopgap' medium weight companions) will be well suited for the diverse concept of 'Cooperative Fighter Operations' or Mixed Fighter Force Concept (MFFC).

Sayan Majumdar



DISCOVER THE **RAFAEL EDGE**



IRON DOME
Air Defense Against
Short Range
Artillery Rockets



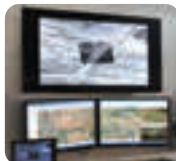
SPICE-1000
Autonomous
Stand-Off Guidance
Kit



RECCELITE
Tactical
Reconnaissance
System



SPYDER
Air Defense System



IMILITE
Imint for Airborne
Missions



LITENING
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The Flying Battleship



Rafale F3R launched

Dassault's Rafale has successfully completed its first test flights in a new heavily-armed configuration, comprising six air-to-ground precision AASM *Hammer* bombs four medium and long range air-to-air missiles from the MICA family, two very long range Meteor missiles, as well as three 2,000 litre fuel tanks. This preliminary work, self-funded by Dassault Aviation was conducted in collaboration with the *Direction Générale de l'Armement* (the French Defense Procurement Agency) and will eventually lead to complete clearance of the flight envelope.

"By increasing the capabilities of its fourteen hard points, including eight under the wings, the Rafale is the only fighter aircraft in the world capable of carrying 1.5 times its own weight. Its omnirole capability responds to the needs of countries requiring, at a controlled cost, an operational and versatile system capable of fulfilling all missions more effectively, whilst mobilising fewer resources." Two Rafales represent the same potential as six Mirage 2000 class aircraft, according to company officials.

"This new configuration, in versatility and firepower it represents, has been made

possible thanks to the open architecture of the aircraft, designed from the outset to perform all of the missions previously assigned to seven different types of aircraft in France. This new development, which combines great autonomy with the versatility of the weapons system, demonstrates the power and operational superiority of the aircraft, which already has a unique range of configurations, including the unique ability to strike deeply, with two Scalp cruise missiles and three 2,000 litre fuel tanks, as used by the French armed forces during Operation

Harmattan in Libya in 2011”, stated officials.

The Rafale has been designed to perform the full spectrum of combat aircraft missions such as interception and air-to-air combat using a 30mm gun, Mica IR/EM missiles and Meteor missiles (as of 2018); close air support using a 30mm gun, GBU-12/24 laser-guided bombs, AASM and GBU-49 GPS-guided bombs (used in Afghanistan, Libya and Mali); deep strike using Scalp-Storm Shadow cruise missiles (used in Libya); maritime strike using the Exocet AM39 Block 2 missile and other air-to-surface weapons; real-time tactical and strategic reconnaissance using the Areos pod (used in Afghanistan, Libya and Mali); buddy-buddy in-flight refuelling and nuclear deterrence using the ASMP-A missile.

The Rafale entered service with the French Navy in 2004 and with the French Air Force in 2006, gradually replacing the seven types of previous-generation combat aircraft. Since mid-2013, production Rafale aircraft are equipped with an active array RBE2 AESA radar from Thales.

Earlier in 2014, Mr Jean-Yves le Drian, Minister for Defence, handed Mr Eric Trappier, Chairman and CEO of Dassault Aviation, the ‘F3 R’ standard development contract for the Rafale combat aircraft. The F3 R standard is an evolution of the Rafale ‘F3’ standard, part of the ongoing process to continuously improve the aircraft in line with operational requirements. It will enable Dassault Aviation to integrate the following equipment and weapons onto the Rafale: MBDA Meteor long-range air-to-air missile, which will achieve maximum

effectiveness thanks to the ‘active array’ radar which equips all production Rafale aircraft delivered since mid-2013; Thales PDL-NG new-generation laser designator pod. Primarily used for air-to-ground strikes, in daylight or darkness, this pod will further enhance the high degree of precision that the Rafale has achieved since its first engagements (in 2007 in the Afghan theatre) and the laser homing version of the Sagem AASM air-to-ground modular weapon. It was used during operations in Libya (2011) to destroy targets at ranges of several tens of kilometres with metric precision. The laser homing version is particularly adapted to moving targets.

The F3R will also include upgrades to Rafale sensors and to systems ensuring total interoperability. Validation of the F3R standard is scheduled for 2018.



(Photos from Dassault)

**“Lets get more Su-30MKIs
and FGFA’s!”**



Su-30MKI of the IAF (photo: Angad Singh)

A Russian view on continued cooperation between India and Russia

The Indian Air Force has always been regarded by Russian industrial communities as one of the most potent, powerful, professional and dynamically developing air forces in the world. The utmost respect is afforded to the IAF's constant pursuit of technical excellence, openness towards transfer of experience from other countries' air forces and the ability to access different

side and would support closer ties between the two countries in general.

For post-Soviet Russia, India has become a unique client and partner in military cooperation. The question here is not only of numbers, although they are rather important – New Delhi has been Russia's biggest arms buyer for the last ten years. In 2007, the volume of shipments to India outnumbered those to China,

development and serial licensed production. Perhaps for the first time in aviation history, a fighter was developed to meet specific requirements of the future client. Moreover, Indian Air Force specialists, designers and the industry were all involved in the creation process from the very beginning. Up to now, orders for the type have exceeded 400 aircraft, which is an optimum number for such a heavy and sophisticated fighter.



technologies, not only Russian, but European, Israeli and, lately, American. Practical cooperation between the Russian aviation industry and the IAF has existed for decades. The cooperation continues and, undoubtedly, will last longer with realisation of the FGFA project. Unfortunately, the tradition of cooperation between our two countries' air forces is somewhat weaker than that of industrial or military-technical cooperation. The cause lies, I think, in the situation with the Russian AF, which is largely closed to any international relationships. Meanwhile, intensification of such relationships with the IAF which, among other things, has experience of joint training exercises with other leading air forces would be beneficial to the Russian

and since then India has continued in that vein. Perhaps more important is the quality of the relationship, which is based upon similarity in the two countries' geopolitical interests that are in perfect harmony with mutual commercial interests. The erstwhile USSR, and now Russia, has always been interested in an increase of India's military and political powers and, as a consequence, had minimum internal limitations on technology transfer, unbound by any international obligations. India, for instance, has become the first and the only country that has leased a nuclear submarine from the USSR, and later from Russia, which country is also helping India to create its own indigenous nuclear submarines. An unprecedented level of cooperation was achieved in the aviation industry as well. As early as in the 1960s India received the technology and licence to produce the 2nd generation of Soviet fighters – the MiG-21 – followed by the MiG-27 third generation fighter-bomber. This gave India the ability to independently produce military aircraft – the level of localisation achieved exceeded 75% and India only received raw materials.

The Su-30MKI has been another programme of high importance both for Russia and India, both in terms of its

Rapid changes are occurring in the world power balance, in which China is gaining swiftly; Russia is becoming stronger while Europe seems to be demonstrating dependence on the USA. This is creating new risks, but at the same time opening new opportunities for activating Russian-Indian ties.

While India has recently shown good results among large developing economies (except for China) it is clear that the growth rates will be lower than of those before the crisis and far from double-digit figures. In this context priorities may be set as follows: external acquisitions, cost control, concentration on finishing existing programmes, a conservative approach to ambitious but expensive programmes and a search for more affordable and realistic alternatives that are technically suitable.

The imperative of ensuring affordability of imported munitions is dictating a more responsible approach to the diversity of aircraft types. The IAF has, for a long time, been noted to possess excessive fleet heterogeneity. Arguably, IAF is the only air force in the world that has heavy (Su-30MKI), medium (MiG-29), light (Mirage 2000) and superlight (Tejas) fighters. The platform suppliers are Russia,



Fourth prototype of the T-50 fifth generation fighter aircraft

France, Great Britain and, lately, the USA. Apart from this, Israel is a large provider of electronic equipment and weaponry. During the period of rapid economic growth, diversifying sources had its advantages, providing India access to maximum number of technologies on the market but in today's financial situation, this approach is starting to look archaic and irrational from the budgetary point of view.

In the new economic (slower growth) and political and military (rapid growth of the Chinese qualitative and quantitative military potential) situation, the most vulnerable and susceptible to criticism is the expensive MMRCAs programme. This project, growing from the fast 'non-tender' acquisition of Mirage 2000 fighters has developed into an endless tender and, further, endless talks with the selected winner.

Even if this contract is signed in the near future, the first Rafale fighters will arrive in India in the second half of 2015 at the earliest. The first squadron will be established in 2016 and another year/year-and-a-half will be needed to achieve initial operational clearance. The weapons system

is modern but will not give any advantages over the systems and technologies that India will get through acquisition of the T-50 FGFA and Su-30MKI upgradation programmes.

In fact, acquisition of the Rafale, in a military sense, is 'excessive' in terms of countering the PAF and does not provide IAF parity with the PLAAF, which is working on creating its own 5th generation fighters.

In my opinion, the alternative should be a binary approach that would consist of technically conservative but swift measures aimed at keeping the quantitative parameters of the IAF on the one hand and more active work on the FGFA programme on the other. An interim solution in this strategy would include a Su-30MKI upgrade. Such a conservative method could be used in adding to any type of existing in-service aircraft in the IAF fleet.

The Su-30MKI deep modernisation programme can actually be part of conservative and fast decisions, as well as of measures to obtain 5th generation competencies. The need to upgrade these advanced but ageing machines is obvious,

as their concept was developed nearly 20 years back. Obviously, access to 5th generation technology is mandatory in order to ensure technical superiority of the IAF over the PLAAF and PAF in the strategic perspective. China is actively, and, as far as can be told, more or less successfully, developing such fighters, including lighter types that can later be sold to Pakistan.

Contrary to what some sections of the media in India are reporting, the Russian T-50 project, which is the basis of the FGFA is progressing successfully. Sources in Sukhoi report that they are well within the limits of stealth parameters requested by the Russian AF. Moreover the discussion over the stealth 'fetish' resembles 80's intellectual fashion, instead of today's understanding that vitality is more important. Nonetheless, Sukhoi sources state a very low optical and infrared visibility of the aircraft. The effective radar cross section is as low as 0.5 sq.m. (versus 20 sq.m. of the Su-30MKI).

The T-50 widely uses composite materials whose share in the empty weight is about 25% and 70% of the surface area. Increased composite usage allows for lower

weight and substantially eases production preparation. The number of components has decreased by four times in comparison, for instance with the Su-27.

Even the current engine allows for super cruise with the second stage engine that should be ready by 2020, providing all 5th generation prerequisites. Undoubtedly, technical risks remain, as always, but there are no doubts about the programme's success. Moreover, Russian AF pilots that have flown the fighter hold a very high opinion of the systems and handling characteristics and other air force sources strongly believe in the programme's success as well.

According to Alexey Komyakov, General Director of NPP 'Polyot' that creates some of the T-50's radio systems, these are very advanced – for instance the integrated antenna feed system for the fighter is very different from all other existing ones – and allows for a new level of aircraft awareness and information exchange speed in all combat types. The quality and distance of communications is increased owing to digital packet data transfer, wide-band radio channels, and new counter jamming measures, among others.

Currently, all aircraft systems have their own antennas and the number on a

given aircraft can reach double digit figures. This greatly increases radar visibility, cost and complexity of the aircraft. A new generation antenna feed system allows combined antennas for communications, navigation, identification, etc. It is built into the fuselage skin and covered by a radio transparent cover allowing for smaller drag and visibility.

It must be admitted that India has initiated the FGFA programme in timely manner, giving Russia enough time to overcome initial technical risks and make sure the programme is feasible and at the same time early enough to allow for Indian engineers to get fully engaged in developing their version of the aircraft and receive the necessary experience of developing such a sophisticated aviation system. The last flown prototype is already a fully fledged 5th generation fighter. It is now important to maintain the tempo and not repeat mistakes of the MMRCAs, not get caught in the 'time trap'. Any prolongation in the programme's development will decrease the number of competences that Indian engineers will benefit from.

Also, from a financial point of view, the current R&D phase does not require excessive expenditure. Financing it will

require about US\$2-3 billion with half of the money being invested inside India. The most expensive stage involving series production will fall into the 2018-2020 timeframe when the macro-economic situation, hopefully, will allow for allocation of necessary resources.

Generally speaking, rumours about the small work share of Indian industry are a problem with the industry itself. It should be remembered that creation of such an advanced fighter cannot come only with Sukhoi's investment: colossal finance and effort are put into fundamental and applied research by the Russian academy of sciences and other research institutions such as TsAGI, VIAM, and others.

With the FGFA project, India will join the exclusive club of countries capable of not only producing under licence, but also developing weapon systems using the latest technologies available.

And I firmly believe that India more than deserves this status, rather than being merely a buyer of expensive European models.

Konstantin Makienko

Centre for Analysis of Strategies and Technologies (CAST), Russia



Formation flight of T-50s during MAKS 2013

“Let’s get on with the Rafale!”



Hardware Purchases not translating into operational gains

India and the West hold very different views about what constitutes escalation. As a general observation it can be stated that India’s security establishment, for a variety of reasons, holds boots on the ground to be *least* escalatory while considering air strikes to be a significant escalation. The West, on the other hand (as evidenced from the wars it has fought in the past decade or so), views boots on the ground to be the most escalatory option while air power — grading up slowly from drones to cruise missiles to a full-scale air campaign — is perceived to be among the least escalatory options.

While this is a product of some very complex factors — this article focuses specifically on what the Indian Air Force has learnt (or not) from its western acquisitions thus far. The picture is quite sobering in that it would seem the IAF is without a 4.5+ gen aircraft. Consequently many of the doctrinal and warfighting changes brought

about as a result of the technological progression within the 4th generation are yet to be imbibed by the IAF. This is not to suggest that it does not understand what these 4.5+ gen gains are, but rather that the key decision makers within the Air Force and the scientific bureaucracy have drawn different lessons from different episodes, and that while they understand the end-product or “western qualitative superiority” in the air quite well, the component lessons have not been integrated into an actionable and organic whole. What this translates into in practical terms is that hardware purchases are not translating into operational gains; the classic case being the Sukhoi Su-30MKI which as this article shows has turned into a nightmare because of the different lessons and lack of standardisation of knowledge, or in some cases wrong knowledge.

The Indian Air Force’s perception of technology has likely been shaped by three

factors. The first is that the IAF has not fought a full-scale war since 1971. The second is that in these 43 years the IAF has transitioned from a 1st and 2nd generation fighter force in combat to 3rd and 4th generation fighters without engaging in an all out war. As a result the combat testing of 3rd and 4th generation tactics has never happened and Kargil 1999 was in fact a highly limited engagement.

The third, and perhaps most important factor is that the electronics revolution has happened “under the skin” within the 4th generation. While this revolution did not improve range or kinematics, it certainly freed fighters almost completely from ground control and overcame many of the technology blocks to true beyond visual range combat as well as massive improvements in sensor and counter-measures technology. These components, synergised into a whole, have given 4.5+ gen pilots the ability to focus



MiG-21 firing conventional rockets during 'Iron Fist 2013'

entirely on fighting and the tactical situation at hand, rather than with the aircraft.

The easiest way to understand this is to look at the corollary upgrades in consumer electronics. In 1996 when India contracted for the Su-30MKI, a Compaq Presario PC took up much of one's desk, with 5 gigabytes of total memory that was considered unusably large, connected to dial-up internet which transmitted data at rates considered lightspeed by the standards of time. In 2014 however an iPhone 6 has more processing and graphics power than 50 1996 era PCs, 128 gigabytes of memory all integrated into a package that fits on one's palm. In its entirety, one person equipped with a smartphone has more productivity and connectivity and situational awareness on the move than a small industrial office did in 1996.

However while the French performed the inter-generational upgrades on their Mirage 2000, the IAF never did. Consequently when the IAF went in for its big 4th generation type the Su-30MKI, it did so with a baseline that existed in the very first model Mirage 2000s rather than the Mirage 2000-5.

Much of this had to do with the fact that the 'H' model which India purchased with

its older, "pre-revolution" electronics was not that much different or better than the MiG-29 and the latter's superior kinematics were prized more. However while the IAF learnt from *Desert Storm*, Bosnian and Kosovo operations, these were distant theoretic absorption of knowledge rather than an organically developed expertise. The French themselves experienced this learning bottom up, as AdA pilots learnt to do much more with successive upgrades and their learning filtered through to the high command. With India this option did not exist. Consequently what came about with the Sukhoi was a top down hybrid approach that combined eastern kinematic superiority with western electronic superiority, without understanding the philosophical, operational, logistical, or integrational difficulties that would ensue.

Contrary to popular belief on the Su-30 being "India's two front ace" owing to the confusion and lack of intra generational learning, this type has in fact become an albatross around the IAF's neck. While this situation was perhaps brought about by the lack of experience and organic learning, it has been perpetuated by myths of political problems. Consequently "arms

lobbies" and "technology denial regimes" are being blamed across the scientific bureaucracy and air force, for what is in effect a stubborn refusal of both to absorb technological lessons.

To be fair there is a political problem, but it was one that was believed to be surmountable. Russian officials interviewed for this article were emphatic that the Israelis or French would not be given access to the core electronics of the Sukhoi. Similarly the Israelis have no intention of offering up their jamming algorithms and technology to the Russians under the guise of 'integration'. For commercial purposes, the American are equally adamant that Israel will not be allowed to sell India stand-alone AESA radars and that if India wants these, it will have to buy a complete US system.

However the problem seems to be that we still do not understand the technological element of the problem, preferring instead to scapegoat the political aspect. On the other hand, in acknowledging significant problems, a take on the issue is that the problem is not technological but a political one, with the Russians and Western suppliers mutually suspicious of each other and refusing to grant full access. As a result, the institutional view appears to be that political barriers have prevented India's scientific establishment from optimising full potential of the aircraft. The writer however, chooses to stick with his assessment of negative synergies at play as opposed to the view of mere under-optimisation or lack of political will.

The Rafale procurement under the MMRCA banner has been criticised by some sections of the strategic community, including this writer based on the belief



*Mirage 2000TH : the type is under major upgradation
(photo : Angad Singh)*



Dassault Rafale conducting mid-air refueling

that the Rafale was superfluous in that this brought capacity duplication at many times the cost of the Su-30. Clearly this assessment was wrong. The reality is that the Rafale—and indeed the MMRCA contest at some point—mutated into a ‘failure fall back’ for the Sukhoi. Much of the confusion surrounding the MMRCA contest, be it the deeply contradictory and confusing statements regarding weight, cost, numbers, effects and especially the implied nuclear delivery role for the Rafales indicate they are not complementary to the Sukhoi but rather a gap filler faced with the reality of the Su-30’s handicaps.

While the deeply confused nature of the MMRCA RFP indicates that the IAF, at least upto 2012, did not fully appreciate the technological challenges of systems integration, the reality is the Rafale will bring a seamlessly integrated system into play that will further be able to integrate into a ‘system of systems’ with India’s other ISTAR platforms like the Phalcon and P-8s should the need arise. However the persistent refusal of the IAF or the DRDO to internalise the political or technological dimensions of integration is a concern and may impact on the Rafale as well. The clearest sign of this is the rejection by the IAF of the Rafale’s organic SEAD solution based on the AASM glide bomb. After naively soliciting the American AGM-88 HARM for the role (which the Americans obviously refused), the IAF is now insisting Dassault integrate the Kh-31A ‘Krypton’. This points to significant knowledge bottlenecks in the system where lessons supposedly learnt from the Sukhoi are simply not being absorbed or internalised. Much of this has to do with the far simpler integration of the French Top-Sight helmets with the Vypel R-73, and previous successes with integrating the Matra Magic onto the MiG-21.

While the Rafale may very well solve most of the current problems of reliability,

availability and vulnerability the Su-30 faces, its costs – both procurement and support—will create problems of a very different kind for the Air Force. Ultimately one cannot maintain first world capabilities at third world budgets and yet this is exactly what the Air Force hopes to do. Advanced countries like France are able to do this because of their reliance on NATO alliance ISR assets or massive hidden spending on their own intelligence gathering networks, none of which India can afford or has the technological capacity for. For example much of the recent French power projection in Libya and Mali were dependent on alliance assets like refueling. This is not an option open to India.

The implications are profound. The first is that the 4.5+ generation revolution is yet to happen in India. This will start quite possibly with all this the upgraded Mirage 2000s when they arrive later this year. The second is that all this confusion has basically created an artificial dilemma, that either we are faced with severe cost consequences should the Rafale purchase eventuate, or a huge capability gap given

the disappointment with the Su-30. Consequently the IAF cannot ‘downsize’ in the near future or transit to a purely qualitative air force to counter the Chinese quantitative threat. India will therefore continue for the next 15 years resort to quantity compensation in some manner.

On a strategic level this would mean that India will not in the foreseeable future, be able to wage the kind of aerial blitz warfare that has been the style of western campaigns. Clearly such options will not be available to the political leadership, given the complications of a high quality low quality mix (as opposed to a high-low *capability* mix the west emphasises). Corollary to this is the fact that Army-centrism in India will continue for a few decades yet and the Air Force will not be prioritised as it will be unable to deliver the sort of finely calibrated options that a true 4.5+ generation air force should.

Ominously, as a result of a presidential decree last year, Xi Jinping dictated an end to army-centrism and a focus on the air force in 2013. Such a political top-down decision unleashes its own dynamics which will see a far more air-focused Chinese posture, facing off against a dangerously land-focused Indian force posture. That is something we will have to ponder long and hard if this is a risk worth accepting for the next decade and a half.

Abhijit Iyer-Mitra,
Research Fellow, ORF

(Based on a longer study “Technology and Escalation in South Asia” by the author for Sandia National Laboratories, Albuquerque, New Mexico).



Dassault Rafale B at Aero India 2013, with Su-30MKI in the background

In conversation with

Dr. RK Tyagi, Chairman HAL



Some excerpts

VAYU : *Kindly give an update on LCA series production.*

RKT : The Tejas LCA received Initial Operational Clearance (IOC-2) on 20 December 2013 and HAL is committed to producing these aircraft. I am pleased to inform you that comprehensive performance ground runs have been completed and maiden flight of the first series production aircraft (SP-1) will commence shortly. HAL is on the right path.

Within few months of the IOC, HAL's LCA Project Group has been upgraded to become a full-fledged Division to look after production in a systematic way with more investments. The new initiative will help in an enhanced rate of production, reduced production cycle-times by incorporating several advanced defence aerospace technologies. We have drawn up ambitious plans to revamp our capabilities and capacity and are confident about



Dr. R K Tyagi welcomes Air Chief Marshal Arup Raha, CAS at Nasik.

meeting all the challenges on the production front. The company has already processed approvals of the government to ramp up production capacity to 16 LCAs every year, doubling the initial target of eight per year.

VAYU : *The Government has categorised the light utility helicopter (LUH) requirement under the 'buy and make' category. Your comments please !*

RKT : HAL welcomes the recent decision of the Government to scrap the tender for buying 197 LUH from the global market. As per some media reports, LUH now falls in 'buy



Light utility Helicopter (LUH) mock up

and make' category which means Indian companies will have to produce the LUH in India. This will create manufacturing jobs and help Indian industry sustain the project for long time. It is an important step in indigenising aerospace capabilities.

As far as the progress of HAL's LUH is concerned, I wish to inform you that detailed design activities have been completed. The selection of engine and other critical LRUs have been completed. The Ground Test Vehicle has also been built. Building of the prototype is under progress and we are expecting the first LUH to fly in 2017.

VAYU : What about the light combat helicopter (LCH) ?

RKT : The LCH is at an advanced stage of certification and the third prototype has completed its first ground run. Essential flight tests have been carried out to evaluate performance parameters. Sea level trials have been successfully completed covering the helicopter's performance, loads measurement and handling qualities for various all up weights with external stores installed, bank turns and spot turns, low speed handling, single engine performance and auto-rotation. The Detailed Project Report (DPR) for productionisation of the LCH is also ready.

VAYU : Research and Development is a critical area, how is HAL coping with challenges on this front ?

RKT : HAL believes that the key differentiator in today's warfare is going to be indigenous platforms. In line with this, we continue to give thrust on R&D by making increased funds allocation. We have filed over 300 patents till date to protect its intellectual property developed with large investments and efforts.



HAL's light combat helicopter (LCH) (photo : Angad Singh)



Strategising at the AGM of the Aeronautical Society of India in Hyderabad, 16 September 2014

We have constituted a Committee of Institutions Network (COIN) to bring in synergy among the R&D centres of HAL spread across the country. The company has created R&D corpus, earmarking 10% of Operational Profit after Tax, to promote technology development in HAL. We have identified 111 technologies that we can concentrate on and funding will be taken care of by us. HAL has gone ahead with harnessing the expertise available with leading academic institutions such as IITs by way of establishing Chairs at these institutions of repute, so as to facilitate

well structured framework for research and development.

VAYU : What are HAL's future plans ?

RKT : HAL has effective action plans for a number of projects including the HTT-40, FGFA, MTA, MMRCAs, UAVs and 25 kN aero-engines.

We have taken a slew of measures to diversify into new business segments and have started a new Strategic Business Unit (SBU) for Unmanned Aerial Vehicles (UAVs) to meet national and international requirements.

Another major area in which our company is diversifying is Civil Aerospace. We have made significant progress towards

formation of a special purpose vehicle (SPV) along with NAL for the design, development and manufacture of 70 to 100 seater regional civil airliners. Regarding FGFA and MTA, they are co-development projects where HAL is involved with Russian agencies.

Some years from now, HAL will have the LCH, LUH, IJT, LCA and the BTA fully certified in its product profile. HAL would be in a position to deliver indigenously developed products to the Indian Armed forces as well as for export in significant numbers against competition from global OEMs.



Saab IDAS on HAL's ALH Dhruv

Saab's Integrated Defence Aid Suite (IDAS) is now fitted on the Dhruv ALH. The IDAS system is designed to provide self-protection for airborne platforms in sophisticated, diverse and dense threat environments. IDAS is a fully integrated multi spectral warning and self-protection system for airborne platforms consisting of multi sensor warning systems (MSWS), countermeasures dispensing system (CMDS), multiple chaff and flare dispensers and the threat library management systems (TLMS) that can be configured for radar warning, laser-warning, missile-approach-warning. The system is fully integrated with the BOP-L countermeasures dispensing system. Development and production of the IDAS system takes place at Saab in Centurion, South Africa (Saab Grintek Defence).

IDAS has also achieved operational success with a growing list of customers in Europe, Asia, Africa and the Middle East. The product has been ordered/installed on helicopters, commercial transport aircraft as well as fighters. Some of the platforms where systems/components have been installed include Oryx, Puma, Cougar/Super Puma, Rooivalk, A109, Super Lynx 300, Dhruv, Chinook, Hawk, C-130, C-130H, Su-30,

NH-90, Mi-17, Embraer 120, Gripen, Saab 2000 & ERIEYE, Dash-8 and Tornado.

Although IDAS has been designed as an integrated system from the onset, its modular system architecture allows the system to be configured in any combination of the three sensor-system types as user requirements may dictate. An optional digital receiver (DRx) is available to enhance the radar warning performance of the system. IDAS systems offer effective defensive aids, providing performance in a lightweight form for rotary winged, fixed wing and fighter aircraft. IDAS also comes in a compact version configured with only electro-optic sensors and CMD system, designed specifically for the protection of aircraft against man-portable air-defence systems (MANPADS) and laser-based threats.

The system facilitates user-definable threat symbology along with a flight-line software upload/download via external data-loader interfaces. It has configurable secure modes of operation in terms of operational software and libraries.

The radar-warning function features a compact, wide-band, high-sensitivity solution with high probability of intercept (POI). The addition of an optional digital

receiver (DRx) transforms the radar-warning functionality into a full-fledged ESM system. The laser-warning functionality is achieved by using four LWS-310 sensors and a processor card in the electronic-warfare controller (EWC). It features high sensitivity, broad threat coverage and probability of intercept (POI) for both single and multi-pulse emissions.

An optical design ensures high sensitivity equating to long detection range. Each sensor uses a dedicated digital signal processor making use of a distributed, hierarchical data-processing architecture to ensure optimal utilisation of information in real time. The BOP-L dispensers are controlled via a fully integrated chaff-and-flare dispenser controller that resides in the EWC. This allows for automatic dispensing under the control of the EWC upon threat-identification. The system can handle mixed payloads per dispenser, i.e. chaff and flares mixed in each dispenser.

IDAS is supported by appropriate flight-line stimulators for each type of sensor and chaff-and-flare test blocks (CFTB) for the dispensers. The flight-line test equipment is used to verify system serviceability prior to missions.

Courtesy: Saab

United Colours of Russian



850th Mi-171 series helicopter produced

The Ulan-Ude Aviation Plant (UUAP) of Russian Helicopters, a subsidiary of Oboronprom and part of State Corporation Rostec, has produced its 850th Mi-171 series helicopter. The landmark aircraft was a Mi-171A1 built for Brazilian commercial operator Atlas Taxi Aereo. In August 2013, UUAP produced its 750th Mi-8AMT/Mi-171 helicopter – a Mi-8AMTSh for the Russian Defence Ministry. This model (export designation Mi-171Sh) was designed by

the Mil Moscow Helicopter Plant, another Russian Helicopters company. The Russian designers have created a helicopter with high operational efficiency that is capable of flying a wide range of missions in real operational conditions.

In its 70 years of existence, Ulan-Ude Aviation plant has produced over 8,000 helicopters and presently specialises in producing the Mi-8AMT (Mi-171) multirole helicopter and the Mi-8AMTSh (Mi-171Sh), while also being involved in developing and preparing for series production on the latest Mi-171A2 medium helicopter.

Rostvertol celebrates 75th anniversary

2014 marks the 75th anniversary of Rostvertol. "75 years is a significant milestone and an important celebration for the company, the success and achievements of which we are rightfully proud today are a credit to the company's staff," stated Russian Helicopters CEO Alexander Mikheev. "Rostvertol's place and significance in Russia's helicopter industry, its role in its rich and complex history, and in the success we see today cannot be overstated. From everyone at Russian Helicopters, I

Helicopters



congratulate Rostvertol on this anniversary, and wish everyone there good health, optimism, unending energy and future successes."

Rostvertol's foundation can be traced to 1939, with the Ryazan plant producing wooden aircraft propellers. The plant initially started producing gliders, light aircraft and the Polikarpov Po-2 biplane. It later moved into the production of helicopters such as the revolutionary Mi-1 and Mi-6 heavy transport helicopter, the Mi-24 and Mi-35M military helicopters, the Mi-26 heavy lift helicopter, and the latest Mi-28N(E) Night Hunter.



Mi-28N Night Hunter

Mi-26TS to China ...

Russian Helicopters and China's Lectern Aviation Supplies have signed a contract for the Mi-26TS heavy transport helicopter, under which the helicopter will be delivered in 2015 for operations concerning forestry management in China's Shandong province. "The Mi-26TS is an unrivalled helicopter, widely used and highly rated by Chinese operators," noted Russian Helicopters' Deputy CEO for Sales and Marketing Grigory Kozlov. "This model is already operated successfully across China – where it is used both for complex transport missions and for fire-fighting and emergency response duties. The new Mi-26TS will prove an effective addition to our Chinese partners' fleet of helicopters, opening up new business opportunities."



... and Ka-32A11BC helicopters

Russian Helicopters has delivered two multirole commercial Ka-32A11BC helicopters to Sino-Russian Helicopter Technology Company, based in Qingdao, China. The Ka-32A11BCs were built by Kumertau Aviation Production Enterprise, part of Russian Helicopters. The helicopters will be operated for commercial purposes by Citic General Aviation. A contract for 20 helicopters for Sino-Russian Helicopter Technology Company was signed in 2011, with the first two helicopters delivered and operating successfully in China. Another four Ka-32A11BCs are planned for delivery by the end of the year under the contract.



First upgraded Mi-8AMTSh

Russian Helicopters has delivered the first consignment of four upgraded Mi-8AMTSh transport helicopters to Russia's Defence Ministry. The helicopters were built at Ulan-Ude Aviation Plant (UUAP), as part of the state defence order, and have flown to their new operational stations. These helicopters are fitted with enhanced VK-2500 engines and an upgraded and strengthened transmission to provide independent control of hours logged in service and improve the aircraft's operational

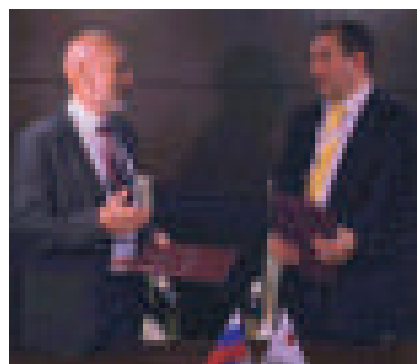
and support the Industry Controlled Other Party (ICOP) quality-assurance process in Russia. The MoU was signed at Oboronexpo 2014 and the Engineering Technologies 2014 international forum. ICOP is an industry controlled system that accredits and certifies quality management systems (QMS) across the aviation industry. It was developed and is overseen by the International Aerospace Quality Group (IAQG) to harmonise certification schemes, and is recognised by leading aerospace and defence companies.



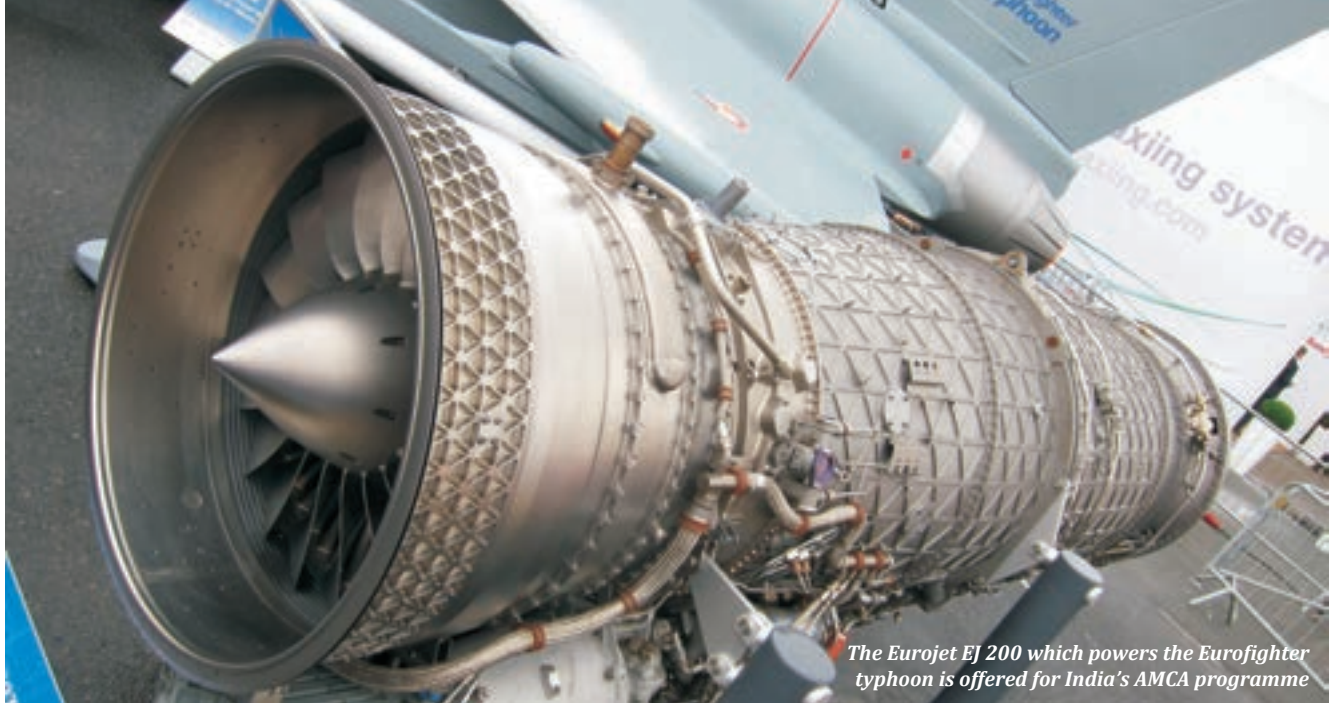
efficiency in mountainous terrain and hot climates. They also come with new TA-14 auxiliary power plants that generate improved thrust and power output, as well as modern weapons systems. Increased lightweight metal cladding protects the crew and essential support systems, while batteries with enhanced capacities mean electrical systems can function autonomously for longer periods.

Russian Helicopters and UAC to collaborate

Russian Helicopters and United Aircraft Corporation have signed a memorandum of understanding (MoU) to develop



Russian Helicopters Deputy CEO for Production Andrey Shibitov (on the right) with UAC's Head of Department of Quality and Standardisation Anatoly Kolosov



The Eurojet EJ 200 which powers the Eurofighter typhoon is offered for India's AMCA programme

Make (and further develop) in India!

In his Independence Day address to the nation on 15 August 2014, Prime Minister of India Narendra Modi stressed his Government's objectives in promoting manufacture in India and attracting foreign investments : "Make in India !"

Amongst futuristic defence development programmes in India is the advanced medium combat aircraft (AMCA) presently at the definition phase at the Aeronautical Development Agency (ADA) at Bangalore. The AMCA endeavours to provide the Indian Air Force with superlative fighter aircraft capability of the next generation.

Perhaps the most critical requirement is that of the AMCA's power plant and the Indian Air Force is well aware of the need to identify an appropriate engine that will not only power the AMCA but have the potential to 'grow' in the times to come. Among the shortlisted engines is Eurojet's EJ200, which currently powers the Eurofighter Typhoon, a contemporary multirole fighter in service around the world. "The EJ200 offers unrivalled technology—with reliability."

Eurojet is keenly following initiatives of the Indian Government to not only modernise the Indian Air Force but also take advantage of modern technology to further develop indigenous systems. In fact, Eurojet has expressed willingness to build a long-lasting relationship with not only the Indian Air Force but also with India's aeronautical industry. Eurojet is a proven partnership consortium whose long-

standing partnership practices could bring several advantages to the Indian industry in creating and sustaining viable defence solutions. Eurojet has had an enviable record of delivering customer solutions working in partnership not only within the four core nations (UK, Germany, Spain and Italy) but also with the export operators which include Austria, Saudi Arabia and the latest, Oman, the 7 nations involved in the current programme for the Typhoon.

One of the challenges facing the Indian Government 'from Eurojet's point of view' is the need for investment in increased technology across India's defence forces and the necessity of balancing the budget over simultaneous requirements. In order to make funds available for a number of projects consecutively, the Indian Air Force is undoubtedly best served by a mature product that is ready to operate, effective and trusted but still has full capability for growth. With over 500,000 engine flying hours achieved over 10 years and over 1,000 production engines delivered, the EJ200 still offers opportunity for maximum growth as, having outperformed the specifications from day one, it has remained relatively unchanged. In this context, having the opportunity to modify and adapt the EJ200 for the Indian Air Force's particular needs, the IAF can benefit from an engine that is available today while achieving a solution that fully supports the unique defence requirements for India.

The EJ200 offers a level of technology that is second to none. The engine's average

time on wing is 1,120 engine flying hours with the lead engine achieving an excess of 1,700 engine flying hours on wing which demonstrates its unbeatable and proven reliability. The unique modular construction allows for a quick engine repair by modular exchange, with a low engine turn around time and high level of weapon system availability. It offers a low maintenance burden at O-Level, easy access boroscope, LRI change and Maintenance Data Panel check. The 'Executive Lifting' approach measures the actual usage rather than planned mission profiles, which can achieve considerable Life Cycle Cost (LCC) savings compared to other engines without this advantage. In other words, the EJ200 offers India the most advanced technology currently available on the market in a fourth generation engine.

The unrivalled expertise of four partner companies (Rolls-Royce, MTU Aero Engines, ITP and Avio Aero) behind the EJ200 can assist India to increase its level of technology knowledge in the most effective way possible. Eurojet believes that a straight forward contracting route could be established to ease the contractual process and to allow the initiative to progress quickly and smoothly. With a committed focus on collaboration in development, production and exchange of technology in a result-oriented environment, the Indian Government can fast track a speedier implementation of the Nation's defence needs.

Courtesy : Eurojet



The F125 displayed in front of a Jaguar at Aero India. (photo : Angad Singh)

Chasing the propulsion 'Sweet Spot'

Honeywell and its legacy companies have been developing engines for military, business and regional aircraft for over 60 years and are today leaders in the sub-10,000lb thrust class, powering civil platforms ranging from the Cessna Caravan to the Gulfstream G280 business jet. It is in the defence space however, where we support the widest range of platforms, where our propulsion systems feature on aircraft from light turboprops to heavy lift helicopters, advanced fighters to battle tanks and UAVs. It is an exciting time to be at the forefront of propulsion innovation, with demand driving technology forward thanks to militaries including the Indian Air Force seeking upgrade opportunities. But what is defence leadership looking for from today's propulsion systems? And what does it take

from engine manufacturers like Honeywell to meet those requirements?

Typically that 'sweet spot' lies in the balance of performance and efficiency. Whether it is a single-prop light aircraft or a heavy lift helicopter, the objective of the operator is the same – to do more with less or, in other words, extend operational capabilities through the lowest possible operational cost and longest effective lifecycle.

For engine manufacturers, first is to focus attention on fuel consumption, the objective being to get the Specific Fuel Consumption (SFC) as low as possible without sacrificing required levels of thrust. However there is a limit to how far SFC can be engineered down before it begins to impact power. Consequently, manufacturers have turned their attention to

reliability and maintenance in the hunt for greater efficiency gains. Today the reliability of an engine is one of the top purchasing influencers as the costs associated with unplanned grounding due to component failure can be significant.

One of the most long-standing and reliable engines from our stable is the TPE331 turboprop. Originally developed in 1959 and certified in 1965, it was Honeywell's first turboprop and today includes 18 variants and over 100 configurations. It also has a long standing in India - over 25 years ago we signed an agreement with HAL to co-produce the TPE331 in India. Working with Honeywell, HAL has built more than 225 TPE331 engines for the Dornier 228 in service with the Coast Guard, Navy and Air



TPE331 on the Dornier 228

Force. With over 122 million flight hours around the world the flexible TPE331 today powers everything from the Antonov An-2 bi-plane to the General Atomics MQ-1 Predator UAV.

The more predictable maintenance costs of an engine are, the more attractive it becomes to an operator. Traditionally engine manufacturers have targeted this by scheduling servicing at a set number of flight hours and then working to make these intervals as far apart as possible. However, customers are increasingly opting for an 'on-condition' rather than scheduled maintenance model, that is, the replacement and servicing of engines as required.

This is being made possible through designs that are easier and faster to service, as well as advances in onboard health monitoring systems such as those on our F124/F125 turbofan engines in use today on aircraft such as the Alenia Aermacchi M-346 Master Advanced Jet Trainer (AJT) and the Aero Vodochody L-159 multi-role combat aircraft. This is the same engine model currently being assessed for India's Jaguar re-engine programme. The F125IN variant is a high performance, after-burning version of the F124 engine, offers best-in-class thrust-to-weight ratio, a modular engine design, an integrated engine health monitoring system and proven reliability with over 700,000 flight hours across the F124/F125 engine family. As well as offering between 17 percent and 40 percent greater thrust and an up to 36 percent range

increase for the Jaguar fleet, its design makes maintenance faster and therefore unplanned grounding time shorter.

An aircraft on ground is 100 percent cost with no operational return and consequently reduced maintenance time is extremely important for military propulsion. In order to get an aircraft back in the air as quickly as possible, the modular design means certain parts can be replaced without complete disassembly of the engine. In fact, Line-Replicable Units (LRUs) in most Honeywell turbofan engines can be replaced in around 20 to 30 minutes using tools from a typical toolbox.

Fuel efficient, highly reliable engines are one thing, but the other side of that 'sweet spot' is performance, which must be engineered to the highest possible levels. Our TFE731 engine, for example, powers both civil and military applications with thrust ranging from 3,500 to 5,000 lbs. The architecture's scalability makes it a highly versatile engine capable of delivering the necessary power to a wide range of platforms, which enables Honeywell to balance performance against efficiency depending on each new platform's requirements.

Derived from that engine, the F124 boosts performance to over 6,000lbs thrust while delivering exceptional inlet distortion tolerance and stall resistance. The engine also benefits from a Full Authority Digital Electronic Control (FADEC), which means the engine includes all controls and sensors required for fully automatic operation and

unrestricted throttle movement throughout the flight envelope. This makes it the ideal powerplant for AJT aircraft such as the M-346, which has now been selected as the AJT of choice by six Air Forces around the world.

Despite the advanced capabilities of modern aircraft powerplant, we continue to innovate behind the scenes, with many exciting upgrades and new technologies expecting in the coming years. But for now, with engines such as the TPE331, TFE731 and F124/F125 reaching that 'sweet spot' of performance and efficiency in their respective classes, there is already technology on the market today that can power India's defence fleets and ensure they continue to achieve mission success in the high performance 21st century battlefield.

Arijit Ghosh,
President, Honeywell Aerospace India



VAYU Interview with

Jim Roche, VP Government Aviation & Deputy CEO, Pilatus

VAYU : In an interview with Vayu before Defexpo 2014, you stated that discussions regarding manufacture of PC-12 airframes to meet Pilatus' offset obligations were ongoing. Has this progressed any further since then and is there any information on when and where production will commence?

JR : Pilatus has always considered the establishment of a production facility in India as a key element in our strategy for the Indian subcontinent and the greater Far East region. The decision was taken regardless of the off-set obligation and also as a sign of our commitment to India as a future major aerospace hub and market.

A major milestone in this context was the recent signing of a long-term contract between Pilatus and Tata Advanced Systems Limited (TASL) for the assembly of PC-12 aero structures at TASL's facility in Hyderabad. The project includes tooling, jigs and training of TASL's personnel at Pilatus' facilities in Switzerland. The training will enable TASL to supply PC-12 NG aero structures for the Pilatus global supply chain.

TATA is without doubt a partner of choice for Pilatus in the continued expansion of its portfolio of international subcontractors. The partnership is also important in connection with Pilatus' offset obligation resulting from the sale of the PC-7 Mk.II Training Aircraft System to the Indian Air Force.

VAYU : On a related note, your offset partnership with Bharat Electronics Limited (BEL) has been underway for some time, with BEL set to manufacture electrical harnesses for Pilatus' global supply chain. Has supply of these harnesses from BEL commenced as yet?

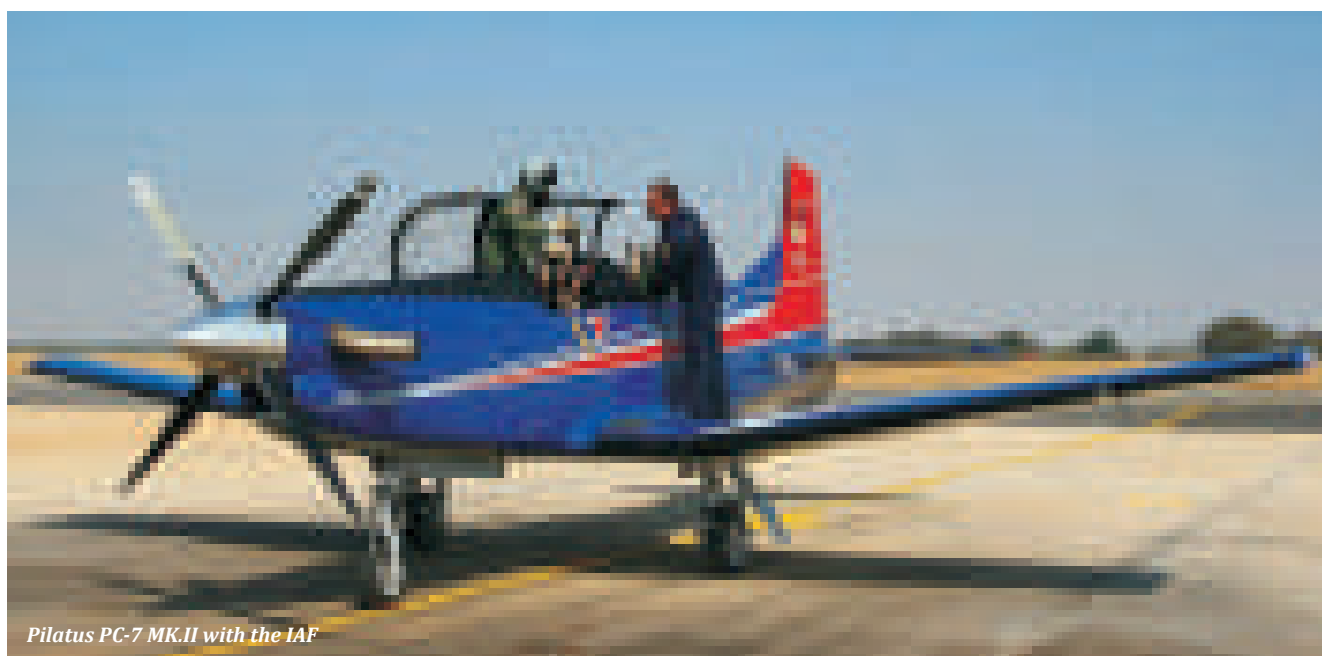
JR : The production of harnesses commenced earlier this year after completion of an extensive training programme in 2013. Meanwhile, the first ship sets of harnesses have already been produced and delivered to Pilatus in Switzerland and have been successfully installed in PC-12 aircraft. The production rate will enjoy a further increase in 2016. Pilatus is pleased with the performance of BEL and looks forward to continuing this successful offset venture.



VAYU : Basic training on the PC-7 Mk II is in full swing at AFA Dundigal and the first ground based simulator was also made operational earlier this year. There have been indications for over a year now that the IAF is keen to exercise the option included in the contract for an additional 37 aircraft, and even to purchase more aircraft. Has there been any further movement on this?

JR : We are focused, with the highest priority, in ensuring that the balance of the fleet (serial numbers 148 to 175) is delivered on time to the agreed schedule with the IAF.

The Indian Air Force issued an RFI to Indian industry earlier in 2014 to elicit



Pilatus PC-7 MK.II with the IAF

responses for a 'Buy & Make' Indian programme for the PC-7 Mk.II. Pilatus has been engaged with many of those companies and has responded to their requests for information as appropriate in each instance. The matter is now back with the IAF to progress their proposal for a 'Buy & Make' programme for the balance of the BTA requirement to enable the expansion of cadet pilot training to meet their growing pilot needs. We await further developments depending on the decision of the GOI and will be happy to support this initiative to the same extent as we have done up till now.

understand that the delivery of the 17 new Hawk Advanced Jet Trainers (AJTs) is ongoing and should the Indian Navy decide to re-establish their own basic flying training capability in the future, we believe that the PC-7 Mk.II would provide the Indian Navy with an optimal training platform.

VAYU : *In an earlier interview with us, you had noted that Pilatus was "proud that the well respected Medanta is relying on the outstanding safety, dispatch reliability and mission flexibility" of the PC-12 aircraft. Has*

is now buoyant. The new mood swing is bringing in many new buyers who are showing huge interest in pre-owned as well as new Pilatus PC-12 aircraft. We believe that those days are not too far when we will see a significant number of sales being closed in India.

VAYU : *Now that Pilatus has established a track record of working with the Indian military, are you exploring the para-military market as well? If so, please elaborate on aircraft and systems that may be offered.*



Pilatus PC-12 in Indian colours

VAYU : *The Indian Navy recently commissioned a training squadron equipped with HAL built BAE Hawk aircraft, and is building up a significant aviation capability around new aircraft such as the MiG-29K and Boeing P-8I. Has there been any interaction with the Navy toward establishing its own ab-initio training capability?*

JR : We are aware that the Indian Navy previously conducted elements of in-house pilot training with the HPT-32. We

Medanta's order had an effect on the broader air ambulance market in India? Have you received interest or orders from new operators?

JR : Yes, there is a growing sense of optimism within the industry in India following the recent watershed election result, which brought the new Government to power. The equity markets have also cheered up. Indian CEOs have been showing tremendous positivity in the Indian market since the establishment of the new Government and the market

JR : Pilatus is constantly monitoring the development of the aviation market in India. In the government sector, we see a significant future growth potential not only in the trainer segment but also in other areas such as transport, air ambulance, special missions and intelligence, surveillance and reconnaissance (ISR).

Thanks to our diverse product range, we are in a position to offer the right product for all of these requirements. To this end, we have already commenced dialogue with a variety of governmental entities/authorities.

Globemaster III

Unmatched Capability and Reach

Very shortly after the Indian Air Force inducted the Boeing C-17 Globemaster III at Air Force Station Hindan, the aircraft were deployed to transport equipment for the Indian Army in the island territory of Andaman and Nicobar. This was in support of rotational movement of infantry battalions at the strategically located islands, some 2400 nautical miles away. The C-17 Globemaster III strategic airlifter, made by Boeing in Long Beach, California, has now become an integral part of the IAF's operations to different parts of the country.

Last year, the Indian Air Force (IAF) deployed their new C-17 aircraft for Cyclone 'Phailin' relief efforts to transport troops and ferry rescue and medical materials including heavy vehicles and ambulances. In the Bihar flood relief effort, the C-17 aircraft transported doctors, technical experts, medical teams, paramilitary personnel and supplies to remote areas to tackle the flood situation in the state. Currently, the C-17 is being extensively used by the IAF in the flood relief operations in Jammu & Kashmir ferrying emergency supplies and airlifting flood victims to safer areas.

Dennis Swanson, vice president, Boeing Defense, Space & Security in India explains that the C-17's strategic and tactical capabilities are particularly suited to meet these diverse and challenging conditions. "The Indian Air Force selected the C-17 Globemaster III to provide versatility to augment their airlift capability and perform a wide range of operations, from peacekeeping and disaster relief to troop movements from semi-prepared airfields".

The C-17 has significantly enhanced the IAF's strategic reach, transporting oversized payloads in unpredictable conditions across vast ranges and land on short, austere runways. The aircraft has demonstrated its ability to carry large equipment, supplies and troops directly to small airfields in harsh terrains day or night. For an aircraft of such immense proportions (wing-span of 51.8m, length 53m, height 16.8m), the C-17 can take off from a 7,000-foot airfield, fly 2,400 nautical miles un-refuelled, and land on



small, austere airfields of 3,000 feet or less and just 90 feet wide.

The aircraft is capable of performing tactical airlift, medical evacuation and airdrop missions. With a maximum payload of 77.5 tonnes the C-17 can, for example, carry an Arjun main battle tank, a Chinook or three Dhruv ALHs with tail rotor blades removed. It has the ability to rapidly deploy a combat unit to a potential battle area and sustain it with regular supplies.

The aircraft can transport 102 paratroopers or 188 seated passengers while in an aeromedical configuration, the aircraft has nine litters, with provision for an additional 27 litters, if required.

Swanson explains that the IAF's C-17 fleet is supported through the Globemaster III Integrated Sustainment Program (GISP) Performance-Based Logistics contract. "The GISP 'virtual fleet' arrangement ensures mission readiness by providing all C-17 customers access to an extensive support network for worldwide parts availability

and economies of scale. The C-17 GISP is a system-level partnership designed around PBL concepts, where the customer pays for readiness, rather than specific parts or services".

Training of initial Indian Air Force C-17 personnel was conducted by the U.S. Air Force at Joint Base Charleston in South Carolina in 2012 where 100 airmen received instruction from the 373rd Training Squadron Detachment 5. The first group graduated in November 2012.

Boeing has so far delivered seven C-17 Globemaster III aircraft to the Indian Air Force with the balance three aircraft planned for delivery later in 2014. Overall, the company has delivered 260 C-17s to the US Air Force as well as to Australia, Canada, Qatar, the United Arab Emirates, the United Kingdom and the 12-member Strategic Airlift Capability initiative of NATO and Partnership for Peace nations.

Courtesy : Boeing (photos: IAF)



Defence Minister Arun Jaitley during his visit to Air Force Station Hindan, after briefing on IAF C-17 Globemaster IIIs

VAYU Interview with

Mr Kishore Jayaraman, President, Rolls-Royce India and South Asia



VAYU : *Rolls-Royce has been a key strategic partner for India's Armed Forces with its presence of over 80 years in the country. What of the future ?*

KJ : India is one of the most important strategic markets for Rolls-Royce and we continue to build on our legacy and long-standing partnership. Rolls-Royce started its association with India in 1932 with Gypsy engines on the first Tata Aviation aircraft. With a powerful portfolio of products, we believe that we can offer India the right combination of experience and new technologies and contribute towards building capabilities in critical growth sectors of India such as defence, marine, civil aviation and energy.

In India we employ around 500 people directly and indirectly across our business sectors. Gradually, Rolls-Royce in India has moved beyond sales and licensed production to engineering services and component manufacturing and plays a strategically important role in the Group's global operations.

We have established a sizeable engineering support operation with TCS and QuEST with almost 1000 outsourced engineers working in Rolls-Royce managed engineering centres in Bangalore. We also have a marine facility in Mumbai, which services our customers with a dedicated spares warehouse, ship repair unit and supports electrical and automation manufacturing operations.

In the Defence area, Rolls-Royce is well established with our engines powering a range of Indian Air Force and Indian Navy aircraft, and through a strong partnership with Hindustan Aeronautics Limited. We also offer 'MissionCare', which utilises a collaborative approach with customers, to jointly develop solutions based around customer values. By sharing experience and perspective, the team is able to construct a solution which is optimised for their requirements.

In 2013, International Aerospace Manufacturing Pvt Ltd (IAMPL), a joint venture between Rolls-Royce and HAL, became operational. We have now successfully started production of compressor shrouds and cones for the technologically advanced Trent family of civil aero engine. We are also actively involved in pursuing innovation through the Open Innovation Programme, launched last year in July 2013.

VAYU : *Rolls Royce has a joint venture with HAL focused on the civil sector. What is the status ?*

KJ : In 2013, the International Aerospace Manufacturing Pvt Ltd (IAMPL), a joint venture between Rolls-Royce and HAL, became operational to produce the components for the technologically advanced Trent family of civil aero engine. Built with an investment of \$25 million, this facility is spread across 7, 200 sq. m. in Bangalore. IAMPL manufactures compressor shrouds and cones for Rolls-Royce gas turbines both for new production and the aftermarket.

IAMPL currently delivers more than 130 different engine compressor parts to Rolls-Royce aero engines facilities. This facility represents another commitment to the long-standing partnership with HAL and the future of Indian aerospace industry. We have now successfully started production and will reach full capacity by end of 2014.

VAYU : *Are there plans to use India as an export hub by the JV?*

KJ : We already have a strong manufacturing presence across our businesses in India and for now, are concentrating on ensuring that our projects run smoothly as planned.

In 2013, International Aerospace Manufacturing Pvt Ltd, a joint venture between Rolls-Royce and HAL, became operational to produce the components for the technologically advanced Trent family of civil aero engine. The IAMPL facility in

Bangalore is testimony to our long standing association with HAL.

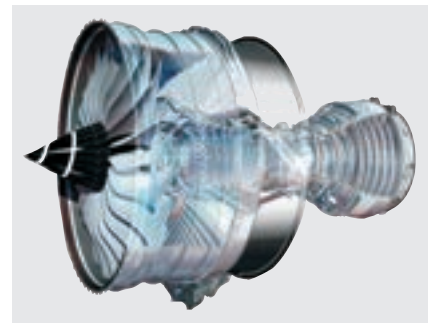
Going forward, as the market opens up, we see a huge potential in this space in the country and we will definitely leverage our strategic partnerships. This means that the journey has begun and the destination is dependent on future growth and market potential. Rolls-Royce's relationship with HAL is one of the longest in the industry and we hope that it will continue to grow from strength to strength.

VAYU : *Please enumerate on recent orders won by Rolls-Royce in India and what's in the pipeline.*

KJ : India is a key market for Rolls-Royce. We have a strong footprint here. As India gets ready to move on its growth path and focus on upgrading its aerospace and marine capabilities, we look forward to strengthen and expand our commitment to this region and work closely with our customers to enable them to benefit from our innovative products and technologies.

VAYU : *With FDI allowed by foreign airlines in India last year, Air Asia and Tata-SIA rapidly entered the market ? What does the country need to encourage a flourishing airline industry ?*

KJ : The Indian civil aviation industry is amongst the top 10 in the world with a size of around USD 16 billion. It has the



The RR Trent XWB

potential to become the third largest aviation market by 2020 and the largest by 2030 as per FICCI-KPMG 'Indian Aviation 2014' report. With a promising civil aviation market, I believe that the way forward for India is wide-body aircraft since it could be a key method to increase efficiency in passenger load and air traffic.

Also, with increased number of Indian carriers flying overseas and with the 49 % FDI in aviation coming into play, we expect a huge interest in the Trent XWB and Trent 1000, which powers the A350 and B-787 respectively. These wide-bodied aircraft has the potential to be a key solution to increase efficiency in passenger load and air traffic in India, and our engines presents a sustainable solution.

Our Trent XWB is the world's most efficient aero engine, that will power the first Airbus A350 XWB into commercial service with Qatar Airways later this year. The Trent XWB is specifically designed for the aircraft and improves the aircraft efficiency by almost 25 per cent making it 16 per cent more efficient than the first-generation Trent engines. The fifth generation of the Trent engine family, the Trent 1000 engine was selected as launch engine when the Boeing 787-8 aircraft entered service in 2011 and has been selected as launch engine when the 787-9 aircraft enters service in 2014. The Trent 1000 powered Boeing 787 Dreamliner is 20% more efficient than the Boeing 767 aircraft it replaces.

With such a leading portfolio of products, we believe that Rolls-Royce can offer India the right combination of experience and new technologies, to contribute towards building capabilities in the wide-bodied aircraft market for India.

There is renewed focus on creating better infrastructure across India. We are sure plans will include road networks, railways, and also aviation. We think we will also see a growing business friendly environment and combined with the focus on better infrastructure, it will ultimately support a more robust civil aviation industry. This in turn will drive India's domestic as well as international travel. This means that passenger traffic in and out of India will grow at an even faster rate, which is forecasted to triple in the near future.

VAYU : Rolls Royce has always claimed India to be a strategic market. What are you plans for the country over the next five to ten years?

KJ : Rolls-Royce is well poised to cater to the growth opportunities available in the India and South Asia region. We also believe that this region can play a greater role in our strategy for profitable growth.

The Indian market represents a host of significant opportunities across all sectors as can be seen below :

- ★ the defence equipment market over the next five years is in excess of USD 50 billion
- ★ the civil aerospace market is growing at a double digit pace
- ★ there is a huge energy deficit with large eventual opportunities for the gas distribution, distributed power generation and nuclear sectors despite short term challenges
- ★ The marine sector has been designated a strategic industry, though also facing immediate challenges.

India also offers the Group very significant supply side advantages due to cost-competitive, world class IT and BPO industries and growing engineering and manufacturing capabilities. Furthermore, in contrast to other large emerging markets, India is predicted to remain a relatively low-cost, competitive source of labour for the foreseeable future, owing to favourable demographics.

With over 1000 engineers, our engineering activities in India have reached a significant scale, amounting to substantial savings for the Group. Although we have made a start, there are more opportunities to expand our level of supply chain sourcing from India. Recently, we have begun to manufacture components here and we look forward to significantly increasing value to the Group from these activities, providing job opportunities, as well as transferring skills and knowledge in the process.

Despite the recent slowing of the economy and immediate regulatory challenges, India and the region are likely to account for a greater proportion of World GDP in ten years and we are taking a fresh look at the actions we need to take now to increase future market share at a time when traditional markets might stagnate.

VAYU : The Government just approved raising the FDI limit in defence to 49 per cent. Do you believe that is enough for international defence companies to start investing in India ?



UT design vessel India Greatship Dhriti

KJ : Rolls-Royce welcomes the government's decision to allow 49% FDI in defence. We believe this is a step in the right direction towards realising the country's efforts to obtain strategic self-reliance. It will help catalyse rapid indigenisation and substantially increase the attractiveness of the sector as a place to transfer technology and set-up a manufacturing hub. The increase will also help the country to become one of the major defence producers of the world.

VAYU : How does India create a vibrant indigenous defence industry?

KJ : The government has set a very clear vision for building an indigenous defence industry which will help boost manufacturing and attract funds to build the country's infrastructure. The new defence procurement policy is a progressive move as it aims at creating a level playing field for the Indian Industry. We are hopeful that the new policy will be helpful in balancing the competing requirements of expediting capital procurement, developing a robust indigenous defence sector and conforming to the highest standards of transparency.

This will be in line with the National Manufacturing Policy that calls for setting up of national manufacturing zones, creating 100 million manufacturing jobs and raising the manufacturing industry's contribution to GDP from 16% today to 25% by 2022. The new FDI limit has been set in the hope that it will give an impetus for foreign defence equipment manufacturers to set up base in India. It can be one of the biggest drivers of manufacturing and can help reduce dependency on imports. The FDI hike in defence will also help create jobs and also encourage collaboration between foreign defence equipment manufacturers to get into co-development and co-production arrangements with Indian companies.



photo : Angad Singh

C-130 Hercules Diamond Anniversary

The Lockheed Martin C-130 Hercules tactical transport aircraft achieved another milestone on 23 August 2014, which marked the 60th anniversary of its first flight at Burbank, California in 1954.

The C-130 Hercules was conceived out of a need to provide the US Air Force a tough, versatile heavy lifter with plenty of 'trunk' space to haul troops, supplies and equipment; and have tremendous lift capacity, long range and austere landing field capabilities. It had to be a versatile transport aircraft which was "at home in the dirt, comfortable in the cold and in its element in dusty, hot environments". In effect, the Hercules was to offer something that had not previously existed:

a tactical airlifter with inbuilt potential and flexibility.

The focus on flexibility and multi-role, multi-mission capabilities can be traced to the original C-130A, which featured a large, unobstructed, fully-pressurised cargo hold, and could be reconfigured for the carriage of troops, cargo, special stores, for casualty evacuation. The C-130's combination of a cargo floor at truckbed height and rear loading ramp provided ease of loading and unloading with true roll-on/roll-off (or RORO) capability.

Since its debut, the C-130 Hercules has exhibited a combination of tenacity, flexibility and innovation that makes it the world's most prolific airlifter. In fact, the C-130 has had the longest, continuous

military aircraft production run in aviation history. To date, more than 2,500 C-130s have been ordered or delivered, the type operating out of 70 countries and produced in more than 70 variants. All of the C-130's production models have been built at the Lockheed Martin Aeronautics' Marietta facility.

It is hardly an exaggeration that the Hercules has been everywhere and is known for its ability to tackle "any mission, anywhere, at any time". Aircrews have flown it to both poles, landed or airdropped military supplies to combat zones and performed countless relief operations around the globe. From the highest airstrips in the Himalayas to landing on an aircraft carrier in the middle of the ocean, the

The Hercules is powered by four Rolls-Royce AE2100 turboprop engines



C-130 regularly defies expectations. A ski-equipped version of the Hercules resupplies Distant Early Warning radar sites in the Arctic, and in many of the special mission C-130s that followed, the special equipment was removable, thus permitting the aircraft to revert to transport, combat delivery, or medical evacuation tasks. Legacy C-130s and C-130Js also operate for VIP transport; fire-fighting (Modular Airborne Fire Fighting Systems or MAFFS); medevac or as a flying hospital; oil/herbicide dispersion, intelligence, surveillance and reconnaissance (ISR) and armed ISR signals intelligence (SIGNIT), search and rescue and as an aerial refueller.

The newest Hercules model, the C-130J Super Hercules, which is also operated by the Indian Air Force, incorporates the advantages of new technology built on the inherent strength of the aircraft and its design. The Hercules has been reinvented again and again, and its continuous improvements have created virtually unlimited flexibility.

In January 2014, the C-130J expanded its offerings to include the LM-100J, the updated version of the civil-certified L-100 that was built from the 1960s through the

1990s and operated by freight companies around the world. Through select design changes, the LM-100J will perform as a civil multi-purpose air freighter capable of rapid and efficient cargo transport. The LM-100J is expected to be an efficient and ideal airlift solution when delivering bulk and oversize cargo particularly to austere locations worldwide.

"In its first six decades, the C-130 shaped aviation history, redefined industry standards and exhibited flexibility that other aircraft have yet to match," said

George Shultz, Lockheed Martin vice president and general manager, C-130 programmes. "The C-130 remains the world's most proven airlifter because of its ability to adapt, remain relevant and deliver results no matter the mission. As we celebrate the Hercules, we want to thank the people who designed, and now build, deliver, fly, maintain and sustain it. It's their contributions that have kept the global C-130 fleet flying and will continue to do so for decades to come."

Courtesy: Lockheed Martin



Flying into the future !



SR-SAM : “vital for the IAF and India’s defence industry”

The progress, or perhaps lack thereof, in advancing the SR-SAM (*Maitri*) short range air defence project has been much in the news since its inception back in 2007. In January 2013, following talks between French President Francois Hollande and then Indian Prime Minister Manmohan Singh in Delhi, it

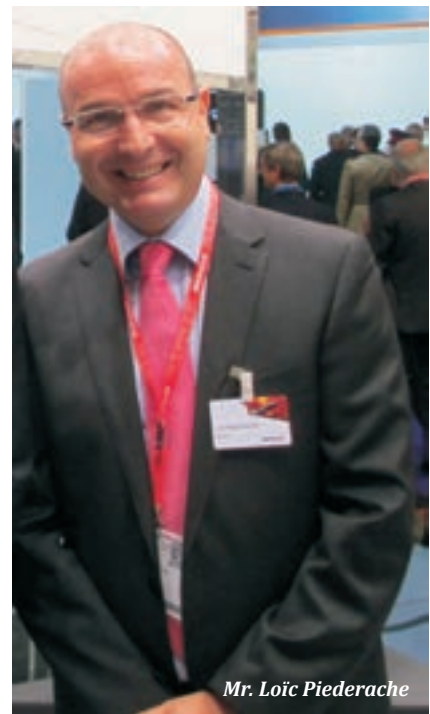
was announced that negotiations had been “finally concluded”. Seemingly, everything was in place and ready to go, technology had been discussed, exchanged and evaluated, only awaited was the green light to proceed.

However, such a green light has not been forthcoming as yet even though the IAF is in “desperate need” of an advanced

short range air defence system capable of providing necessary levels of protection against future air threats. Such urgency exists equally in the Indian Navy as well and is why MBDA has been working closely with the DRDO for many years to propose a solution “that will provide an optimised solution to the needs of these two services”.

Prime Minister Narendra Modi has made clear his commitment not only to strengthen India’s military prowess to meet the security challenges posed in the region, but also to ensure that the necessary upgrades are carried out as far as possible by using domestic industrial facilities. Such latter commitment has been formalised in the government’s ‘Buy and Make in India’ strategy which has already been reflected in some of the actions carried out by Defence Minister Arun Jaitley.

SR-SAM meets this requirement as well as MBDA’s long term business objective in India, a strategy revolving around technology transfer at the very highest level and in-depth partnership with the Indian defence industry sector, both at DPSU and private sector level. There is no doubt that India needs a vibrant private sector working in tandem with the large public sector to give the Indian armed forces the equipment they will need in the 21st century. Similarly, most observers are convinced that the private sector needs access to levels of world class technology that are not currently



Mr. Loïc Piederache

fully available in India. With SR-SAM, the Indian industry will obtain modern weapon system technologies such as vertical launch, solid fuel motors, automated defence equipment production lines as well as radar and IR seeker technologies including their associated algorithms. These such technologies are vital in taking India towards the necessary levels of strategic missile autonomy being sought.

However there are critics who feel that the money apportioned towards SR-SAM would be better off spent domestically. This argument is fatuous as 75% of the contract value will go directly to Indian industry in a product managed by the DRDO that will be 100% domestically manufactured. Above all, capabilities of the SR-SAM are required by many other armed forces around the world. With the assistance of MBDA's global commercial team, the export potential for SR-SAM is considerable with resultant revenue more than compensating for any upfront costs. Not only will export success contribute to India's economic welfare it will also boost the Indian defence industry's reputation on a global scale.

Economics and strategy issues aside, it must be accepted that, at an operational level, SR-SAM is the optimal solution to the IAF's expressed requirements. With the Indian Navy also looking for a significant number of air defence systems to protect its range of recently commissioned and impending frigates and corvettes, the time is now to advance the SR-SAM project.

Following recent successes with the Akash SAM, the need for SR-SAM had been questioned. However, one cannot compare the conventionally-launched, semi-active radar equipped Akash system based on 1990s technology with the vertically launched SR-SAM. The latter represents the latest thinking in air defence technology and features a fully autonomous, interoperable active radar/passive imagery seeker. With a typical Akash firing unit capable of dealing with only four targets simultaneously, this is not comparable with the 32-target, anti-saturating attack capability of SR-SAM. Air defence experts around the world have explained the need for a layered approach. Akash, with its 35km range, could certainly handle the medium range element of a layered approach, but to handle saturating attacks being carried out simultaneously by threats ranging from fast combat aircraft

to cruise missiles and UCAVs, a vertically launched, short range system is an absolute necessity.

MBDA has established a long-standing relationship with the IAF over the years with weapons such as the Magic and Super 530D short and medium range air-to-air missiles. Recent orders for MICA (Mirage upgrade programme) and ASRAAM for the Jaguar have further reinforced this partnership. In arming the future MMRCA, MBDA will be linked even more closely with future capability of the IAF.

General Michel Pétré, Market Development Director for MBDA, states that: "The importance of SR-SAM, both to India and to MBDA, cannot be stressed strongly enough. It far outweighs what we have so far achieved together. SR-

SAM will not only provide the IAF and Indian Navy with a much needed latest generation, short range air defence system, I am totally convinced that it will also help India make a quantum leap in its defence industry capability as it strives to meet the challenging times ahead. Both India and France have invested a significant amount of time and effort at the very highest levels in getting SR-SAM to where it is now. In fact, I would go so far as to say that given the exceptional, even unprecedented, level of French transfer of technology that has already been approved, combined with Indian support to date, a 'no-go' for SR-SAM would be a humiliation for many in France".

Loïc Piedevache

MBDA Group Country Head, India

Loïc Piedevache receives French National Order of Merit

Loïc Piedevache, India Country Head for the MBDA Group, received insignia of the *Chevalier de l'Ordre du Mérite* (Knight of the Order of Merit) on 21 September 2014. The decoration was handed over by François Richier, the French Ambassador to India by order of the President of the French Republic following the nomination made by Laurent Fabius, French Minister of Foreign Affairs and International Development.

The Order of Merit is awarded for "exceptional civil or military achievements to distinguished persons, both French and foreign."



Loïc Piedevache accepting the award (seen pinned to his jacket) alongside Ambassador François Richier



File photo of Mirage 2000 of the Indian Air Force (photo: Dassault Aviation)

Thales : partnering India's Armed Forces

As India strives to improve and modernise its defence infrastructure, defence production companies have made significant progress in adopting world-class technologies while collaborating with multi-national corporations.

With an enviable history of innovation and excellence, Thales is a global technology leader in the areas of defence, security, aerospace, space and transportation. Since 1953, Thales has had presence in India and is recognised today as a reliable partner by both the Indian Armed Forces as well as the civil sector. With an objective to significantly develop its industrial footprint in the country, the company has been actively partnering with Indian industry and seeks to realign its solutions and industrial footprint according to local needs. Thales has identified India as a key country for its growth and employs over 300 employees across the country.

India's defence industry has substantially grown in recent years and is now experiencing significant and progressive change. Thales has been historically catering to the needs of the Ministry of Defence, providing air surveillance capabilities and air defence systems for the country. For many years Thales has provided avionics, IFF and INGPS for military aircraft.

Since 2011, Thales and Dassault Aviation have worked together towards upgrading the IAF's Mirage 2000 fleet, the first of which made its maiden flight at Istres, in October 2013. The upgrade will significantly enhance the IAF's air potential by extending operational performance of the existing Mirage fleet and taking full advantage of its capabilities, as a result of which, the IAF will have a coherent platform-system combination for the next 20 years. The IAF's air potential will be further enhanced by the integration of new capabilities which include longer-

range detection across the entire spectrum, improved tactical situation awareness, longer-range weapon firing against multiple targets simultaneously, weapon stealth and extended operating envelope with the capability to engage ground targets while countering airborne threats.

Thales has been actively partnering with the Indian industry and proactively sharing knowledge, technical know-how and expertise. Taking this mandate forward, the company has created a partnership with HAL and has joint ventures with Samtel, BEL and L&T Technology Services. In addition, Thales has also been developing its local supply chain with 15 small businesses in India.

Thales is looking at increasing its industrial footprint in India to develop talent and initiate innovations. The company aims to expand locally in India through its own wholly owned subsidiary Thales India Private Limited, its JVs and all the partnerships with the local industry that can be envisaged.

Thales is arguably the only company in the world with leadership positions for both onboard equipment (cockpit and cabin solutions) and ground equipment (radar, air traffic management systems). In India, its products include In-Flight Entertainment (IFE) on Air India's and Indian Airlines Airbus and Boeing fleets; critical avionics for low cost carriers like IndiGo and navigational aids for the Airport Authority of India, among others.

In the Indian ground transportation sector as well, Thales has been playing a pivotal role with systems operating in both metro rails and main line railways. In urban transportation, Thales' contributions include 'ticketing systems' for the New Delhi and Gurgaon metro rail systems and 'Communication and Supervision systems' for New Delhi, Mumbai, Bangalore, Jaipur



PR4G F@STNET - Thales Combat Net Radio.

metros. In December 2012, Thales India was appointed to provide 'Communications Based Train Control' (CBTC) - the country's first CBTC deployment - and also 'Integrated Communications and Supervision' (ICS) systems for the Hyderabad Metro Rail Project. In main line transport, Thales was first to introduce electronic axle counters on the Indian railways network in 1999. It recently won a contract from the Southern Railway to supply an ETCS Level 1 solution (known in India as Train Protection and Warning System - TPWS) on the Basin Bridge-Arakkonam section. This is the first ETCS contract awarded to Thales in India, and also the first step of a large modernisation programme of TPWS systems of the Indian Railways network.

"Thales will continue to support India's defence modernisation needs and will stand as a pillar of strength for India. The company has a clear strategy to enhance the presence in India, focusing on three key pillars: Growth, Competitiveness and People. To foster growth, Thales proactively explores business opportunities across the domains it operates in, and creates products that are specially adapted to the specific needs of our customers. This means enlarging current operations in transportation, civilian security and space while continuing with efforts in the defence sector. We have been committed towards creating state-of-the-art, technologically advanced products and are open to working with companies in order to offer better products and services to our customers in India."

Courtesy: Thales

25 years of UAV innovations from Sagem



The Patroller drone

At the recently concluded UAV Show Europe 2014 held at the Bordeaux Mérignac airport, Sagem (Safran) showcased its latest developments in unmanned aerial vehicles (UAV), for both civil and military applications, in France and abroad. Sagem was selected to lead a 'civil drone' road map initiative in June 2014, under the auspices of the French Ministry of the Economy, within the scope of a programme involving 34 'New France Industry' projects.

The project aims to structure and develop a national industry for civilian drones by calling on several agencies of public policy: economy ministry, transport ministry (civil aviation agency DGAC), competitiveness clusters (Pégase, Aerospace Valley), and the public investment bank. This policy will support a broad network of innovative small and medium sized enterprises in this booming sector, with support from the French civilian drones trade association, FDPC.

Sagem will bring to the table its experience as a manufacturer of drone systems, along with its leading position in the civil aviation sector, including the production of safety-critical guidance and flight control systems, plus special-mission

equipment. It has also worked for many years on the integration of drones in civil airspace, and certification and regulatory issues. The overall aim is to allow higher-performance, more autonomous drones to meet emerging requirements in agriculture, network monitoring, environmental protection, etc. while also satisfying safety needs.

Sagem is a prime contractor for military UAV systems. At UAV Show Europe, it displayed the Patroller long-endurance tactical drone system, along with drone solutions for infantry soldiers and special forces. The Patroller can be used for homeland security and all types of military missions. Featuring a modular design, it incorporates

a high-performance, multi-sensor payload, mounted in the fuselage or on wing pods (including optronics, radar and electronic warfare equipment). It can fly for over 20 hours at altitudes up to 20,000 ft.

Sagem's expertise in this field is based on strong R&D and production capabilities in France: greater Paris area (R&D), Fougères (electronics cards), Dijon (optronic sensors), Poitiers (infrared cameras), Montluçon (integration, ground stations, avionics and navigation equipment).

Over the last 25 years Sagem has produced over 150 Sperwer tactical drones, and provides front-line support for the systems deployed by the French army.

Courtesy : Sagem



Sperwer Mk. II UAV

Elettronica's expertise in naval **RECM** capability

Elettronica has an enviable tradition in the development and manufacture of Electronic Warfare systems for a wide range of applications and has received worldwide recognition for its Radar Electronic Counter Measures (RECM) capability ensuring the self-protection of Navy units.

Since 1960, Elettronica has supplied RF jamming systems to various Navies and its systems are on board many Italian Navy units, including the recent *Horizon* and *FREMM* frigates and *Cavour* carrier. Foreign naval units equipped with such systems include the Navies of France, Spain, India, Australia, South Africa and Thailand. Over a period, Elettronica has pursued system innovation, seeking the most advanced technologies available, acquiring TWT know-how in the early years up to today's state-of-the-art technology based on solid state active phased array units.

The company's long standing experience, which produced major technological developments and an invaluable field-proven know-how, has strengthened Elettronica's capability to continuously provide the most appropriate solutions based on advanced architectures for ship borne jamming systems. In particular, the RF jamming system, referred to as RECM, represents the core 'soft-kill' countermeasure system, whose role is to defeat radar guided threats for both ship and enlarged area self-defence for the protection of a High Value Target (HVT), such as an aircraft carrier.

The Elettronica RF jammer provides the ship with offensive ECM capability against radar threats (air, surface, search, targeting, etc.) in support of anti-air and anti-surface warfare assets in both blue-water and littoral operations, employing several active jamming techniques for preventing detection, foiling the acquisition & tracking phases (noise jamming technique); confusing, denying or delaying radar acquisition ('multiple false target' technique); seducing/deceiving range tracking terminal threats, artillery and/or missile, based on tracking radar (range gate pull off) even if high resolution SAR/ISAR modes are encountered.

Elettronica has developed – and has in service on board the Italian and French *Horizon* and *FREMM* Frigates – the Nettuno 4100 RECM system based on solid-state Active Phased Array (APA) and Active Electronically Scanned Aperture (AESA) transmitters, which represents the most modern and advanced solution for generating high power signals in EW systems, having already been well-proven at sea.

The constantly evolving naval scenario has prompted Elettronica to pursue the self-funded development of a new family of ESM/ECM integrated systems, named *Virgilius*. These are characterised by an innovative architecture that leverages the natural evolution of EW passive sensors (ESM/ELINT) and actuators (ECM) to achieve a fully integrated, compact, optimised but still scalable solution, where



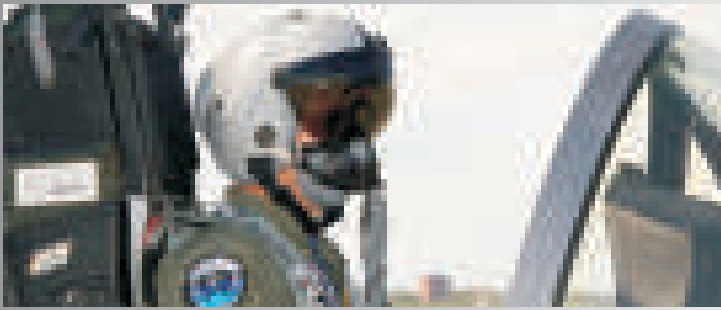
each resource is shared between different functions and designed to meet the requirements for protection of all classes of ships.

Virgilius encompasses all these requirements with features such as fully digital processing, full integration of the three main EW functions (threat awareness, surveillance and jamming), and incorporating all the outstanding features of the Nettuno 4100 RF jammer family. It basically consists of a SW-designed Multifunction Unit (MFU) performing both ESM and ECM tasks, and the related ESM and ECM sensors.

Concerning its specific jamming capability, the antenna phased array actuators are based on the latest active phased array design using GaN T/R modules, combining high performances with reduced dimensions when compared with the current GaAs modules.

The countermeasure techniques generation function provides threat countermeasures as well as threat detection, discrimination, classification and prioritisation in order to maximise ECM effectiveness in multi-threat scenario, further enhanced by an autonomous selection of the best ECM techniques stored in the equipment library depending on the ship's mission. Virgilius arguably represents the most innovative approach in EW system design since it combines the ESM/ECM functions in a single unit and uses the most advanced technologies in the ESM and ECM antenna sensors.

Courtesy : Elettronica



VAYU Interview with Ram Prasad, Managing Director, Rockwell Collins India

VAYU : At Defexpo 2014, Rockwell Collins displayed a number of products, such as the HeliSure Helicopter Synthetic Vision System (H-SVS), RT-8400 Software Defined Radio (SDR) and Persistent Surveillance System. What is the potential interest for these in the Indian market ?

RP : These products are representative of the wide range of products that we are offering to India today, from avionics, to communications and surveillance products. While we have not sold these three specific products as yet to Indian customers, we have sold several million dollars in communication systems since Defexpo, including the fixed-site, net-centric 721S radio transceiver.

VAYU : What is Rockwell Collins' presence in the civil aviation sector in India? What sort of support and maintenance presence is maintained for Indian operators ?

RP : Rockwell Collins is committed to India, growing our investment and providing technology transfer in country. We have been extremely successful in the commercial market in India as demonstrated by the selection of our avionics, communications and electronics systems by multiple airlines such as IndiGo, SpiceJet, and Jet Airways. We also recently won a Dispatch asset management performance- based service agreement on Air India's Boeing 787.

Because our experience has shown us that the key to developing long-standing relationships is providing exceptional service to all of our customers, we have recently formed partnerships with AirWorks and Indamer to serve our business aviation customers. As authorised resellers of maintenance, repair and overhaul services, who better to be able to quickly respond to

a customer's needs than a provider based in India ?

In addition, with our acquisition of ARINC last year, we are also providing our suite of passenger processing technology to Terminals 1D and 3 at Delhi International Airport. India's Bureau of Immigration also uses Rockwell Collins' ARINC eBorders Advanced Passenger Information System (APIS) which allows them to review passenger information even before the aircraft lands at their destination airport, optimising efficiency and passenger flow and enhancing overall border security and control. Several local carriers use Rockwell Collins' datalink services, supported by Remote Ground stations installed across India.

VAYU : Your company now has two facilities in India, at Delhi and Hyderabad. Please comment on the activities undertaken at each location and how they impact Rockwell Collins' Indian as well as global operations ?

RP : We opened our India Design Centre in Hyderabad in 2008 and have since grown that facility to 600 employees. This capability provides vital contributions to local Indian programmes and exports software and systems expertise to our international operations. We also opened a business office close to New Delhi to assist in the development of relationships with our customers and to co-locate our systems engineering and programme management teams. Expanding this triad of capabilities is a model that has proven to be successful for Rockwell Collins across the globe.



With our acquisition of ARINC last year, we also added a presence at Delhi International Airport, where a team handles maintenance and servicing of our passenger processing technology at the airport.

VAYU : Rockwell Collins has had a long relationship with HAL, could you elaborate on the products supplied for the Dornier 228 and the scope of support provided?

RP : We provide radios and navigation equipment on the HAL-Dornier 228.

VAYU : Does the Rockwell Collins partnership with Tata Power SED extend beyond the software defined radio (SDR) competition for the Indian Air Force ?

RP : We are very interested in working with Tata on future software defined radio pursuits in India as well as other pursuits for Indian defence forces. Tata is a highly respected company in India and an invaluable partner to Rockwell Collins.

VAYU : This summer Rockwell Collins ESA Vision Systems delivered the F-35 Gen III Helmet Mounted Display to Lockheed Martin for software integration with the JSF. Please share some details on this HMDS.

RP : The F-35 Gen III Helmet Mounted Display System (HMDS) is the world's most advanced biocular helmet-mounted display system providing unprecedented capability to the world's most advanced tactical aircraft. Its integrated head-up display is the first to provide pilots with all the critical information they need on the helmet's visor ensuring that every mission, day or night, is supported with unsurpassed situational awareness, tactical capability and safety. Key benefits include enhanced situational awareness; integrated, virtual head-up display on the helmet visor for critical flight and mission information with a smooth transition to HMD symbology; night vision capability built into the helmet; lightweight helmet with optimal centre of gravity for maximum comfort and reduced pilot fatigue and providing weapons targeting by looking at and designating targets, and target verification when receiving steering cues from onboard sensors or via datalink.



On 14 September 1939, Igor Sikorsky lifted off in his tethered VS-300 helicopter, beginning a flight test programme that proved the efficiency and controllability of the single rotor design



Igor Sikorsky in a variant of the VS-300 helicopter. The VS-300 is on display at The Henry Ford Museum in Dearborn, Michigan.

Transforming Aviation: 75 Years since Sikorsky's VS-300 Helicopter

On 14 September 1939, 50-year-old chief designer and chief test pilot Igor Sikorsky lifted off the ground to tabletop height in an experimental helicopter designated the 'VS-300'. That first flight event led to a four-year test programme that proved the efficiency of Sikorsky's single rotor design, gave birth to a global helicopter industry, and forever changed the course of aviation history.

"Tens of thousands of helicopters today fly the world's skies, and the configuration almost all of them use is a single main rotor coupled to an anti-torque tail rotor. That configuration was designed and perfected by Igor Sikorsky 75 years ago," said Sikorsky President Mick Maurer. "Our most acclaimed helicopters, among them the Black Hawk, S-61, CH-53, S-76 and S-92 aircraft, and many more by other manufacturers, trace their heritage to the first flight of the VS-300 aircraft. We remain immensely proud of our founder, and we recall with deep respect the fulfillment of his life-long dream to build an efficient vertical lift machine for the benefit of humankind."

In the spring of 1909, Igor had tried to build a helicopter at his family home in Kiev, Ukraine. His apparatus consisted of a wood and wire-braced frame built around a 25-horsepower engine connected to a transmission of wooden pulleys and belts that drove coaxial shafts topped with two twin-bladed rotors. He tried again in the spring of 1910 with a second design consisting of two new three-bladed rotors, but the craft

could barely lift itself off the ground without a pilot. Realising that technology would have to catch up with the idea of vertical lift flight, the young engineer abandoned his dream for a career in fixed wing aviation.

"The helicopter was always my father's first love," said Igor's son and company ambassador Sergei Sikorsky, who worked as an apprentice mechanic on the VS-300 aircraft. "By the late 1930s, my father wanted to prove that after two aviation careers -- in Russia before and during World War I, and in the United States building transoceanic flying boats before the Second World War -- that he could design and build a helicopter without knowing how it should be done, and then to try to fly one never having flown one before. That was a challenge many said couldn't be done."

In 1938, Igor made a compelling argument to United Aircraft, now United Technologies Corp. The board of directors gave Igor and his team \$30,000 to test his single rotor helicopter theory.

"Igor settled on a single rotor configuration for its design simplicity, and to enable the optimum placement of major components that would allow precise control of hovering take-offs and landings, and quick conversion to horizontal flight," said Mark Miller, Sikorsky Vice President of Research & Engineering. "Igor was not the first to conceive a vertical lift rotorcraft, nor did he develop any complex new technologies to ensure success. It was the genius of his design, integrating mature

technologies in an innovative way, which enabled efficient vertical lift flight. Three generations later, we at Sikorsky are following a similar design approach with our next-generation X2 co-axial helicopter programme."

The 1,601 kg max. gross weight VS-300 helicopter consisted of a welded steel tube frame with an undercarriage of three wheels. A 75-horsepower engine, transmission belts and gears drove the three-blade main rotor and single-blade counterbalanced wooden tail rotor. In flight, the main rotor turned at approximately 255 RPM.

On 14 September 1939, outside the Stratford, Connecticut factory, Igor sat in the open VS-300 cockpit wearing his trademark overcoat and fedora as he pulled the collective control lever at his left. The VS-300 cleared the ground for a few seconds to the height of its short tether ropes. Many such 'hops' over the course of ensuing days and weeks proved that the aircraft could be controlled. Sikorsky and other pilots then flew different variations of the VS-300 aircraft for a total of 102 hours and 35 minutes into 1943.

The US Army placed America's first helicopter production contract with Sikorsky in 1942 for 131 R-4 helicopters (Sikorsky designation S-47) of different variants. A YR-4A aircraft flew the first ever helicopter rescue mission under combat conditions in Burma in April, 1944.

Reflecting on his achievement years later, Igor Sikorsky said, "If a man is in need of rescue, an airplane can come and throw flowers on him. But a direct lift aircraft could come in and save his life."

Rheinmetall marks its 125th anniversary

A full quarter century before start of the first World War, the German company Rheinmetall began the manufacture of munitions and cannon. Now a globe-spanning technology enterprise, throughout its 125-year corporate history, Rheinmetall has remained attached to its defence engineering roots, while continuously branching out into other futuristic industries, successfully striving for excellence and positioning itself as a leader in markets around the world, focusing on security and mobility.

The image of Rheinmetall has long been associated with state-of-the-art defence and automotive technology. KSPG AG, the Group's automotive arm, is a globally renowned auto parts maker, supplying major international car manufacturers with a wide range of engine-related modules and systems. In the defence sector, Rheinmetall provides the armed forces of Germany, its NATO partners, and many other nations with land forces defence technology along with naval and air force applications.

In 2014 the company celebrates its 125th anniversary. Beginning in 1889 as an *Aktiengesellschaft*, or joint stock company, it has been an AG ever since and generally listed on the stock exchange. This is a unique success story, as very few companies in Germany – especially joint stock companies – are able to achieve such a long history, all the more remarkable given the manner the company had to begin and also endure two World Wars in 1914-18 and 1939-45.

In fact, by end of the First World War, Rheinmetall had emerged as the Reich's second largest producer (after Krupp) of heavy guns and ammunition for the German Army and Navy. After 1918 the company was

The famed MG3 machine gun

forced to shift to civilian manufacturing, including locomotives, steam ploughs and office machines; starting in 1921, however, production of armaments recommenced.

The company quickly outgrew its role as a mere maker of rifle ammunition. It was Heinrich Ehrhardt – that inventive and enterprising Thuringian engineer who for many years stood at the company's helm and guided it to early greatness – who laid the groundwork for Rheinmetall's rise by helping to develop the recoiling cannon. This proved to be a turning point in the history of artillery technology, enabling the introduction of rapid-fire field guns.

Founded by the former Hörder Bergwerks und Hüttenverein (a mining and steel concern), Rheinmetall's sole initial purpose was to complete a major ammunition order awarded to the Hörder Verein by the German Reich. The partnership contract for the new company, known as 'Rheinische Metallwaren- und Maschinenfabrik Actiengesellschaft', was signed on 13 April 1889; its name was entered in the Commercial Register less than a month later on 7 May. The newly founded company began operations on 3 September 1889 in rented premises in Talstrasse in the Bilk district of Düsseldorf, producing ammunition for the 'Gewehr 88', a widely used bolt-action rifle made by a number of German arms makers, including the Royal Prussian Rifle Factory in Spandau.

Today, the product range of the group's defence arm encompasses a wide array of military trucks, tracked and wheeled



Demonstrating Rheinmetall's proprietary Ahead Technology Digital Turret and Digital Vehicle CAISTAR systems

armoured vehicles, medium- and large-calibre weapon systems and ammunition as well as turret, air defence and force protection systems. Rheinmetall Defence is also a leader in simulation technology, advanced soldier systems, sensor solutions and fire control technology.

Rheinmetall AG's defence and automotive units make it a significant employer, with a global workforce of around 25,000 at 34 locations worldwide, accounting for roughly 10,500 jobs in Germany alone. The group has production facilities and sales units in numerous countries even outside Europe, stretching from Canada and the United States to Brazil, and from China and Australia to South Africa.

Following a less than stellar foray into civilian production in Düsseldorf after the war, and reprivatization through the sale of state-owned Rheinmetall shares to the Röchling Group as well as separation from Borsig in Berlin, in 1956 Rheinmetall was free to return to its traditional core competency: defence technology. And this is precisely what the German government had in mind. Along with control of Rheinmetall, the Röchling Group was given the express mission of establishing an efficient producer of defence technology equipment in Germany.

The company's contribution to arming the new Bundeswehr began with the production of infantry weapons: the MG 42/MG 3 machinegun and G3 assault rifle well as a 20mm automatic cannon for the Bundeswehr's first infantry fighting vehicle. In 1964 Rheinmetall resumed cannon production, building on its long decades of experience.

A major milestone in Rheinmetall history was the company's participation in the Bundeswehr's tank programmes. In particular, its 120mm smoothbore tank gun set a new global standard for technical and tactical excellence and still does in the Leopard 2A7 MBT.

Starting in the 1960s Rheinmetall began diversifying into civil industry, acquiring companies in the mechanical engineering and civil electronic sectors, among others.

The takeover of Pierburg (in 1986) and Kolbenschmidt (1997) proved to be particularly significant: the two companies, united in KSPG AG, now form the group's automotive unit. After shedding its peripheral operations, since the beginning of the 21st century Rheinmetall has focused entirely on its two mainstays, defence and automotive.

Rheinmetall produces highly protected vehicles such as the Fuchs/Fox wheeled armoured transport vehicle and the Boxer multirole armoured fighting vehicle. Gladius, the world's most advanced soldier system, is currently being introduced in Bundeswehr combat units. In a class of its own, Germany's ultramodern Puma infantry fighting vehicle will gradually replace the Marder, first fielded some forty years ago.

With a current annual budget of over €70 million, research and development is another area in which Rheinmetall makes a valuable contribution to ensuring the effectiveness of tomorrow's armed forces, ranging from force protection technology to the hardware necessary for achieving successful outcomes, underpinning a responsible approach to national and international security.

Courtesy: Rheinmetall



Rheinmetall provides the smoothbore tank gun for the Leopard MBT

Fourth J-20 prototype makes maiden flight



The fourth known prototype of the Chengdu J-20 fifth-generation fighter made its first flight from the company's Huangtianba airfield on 26 July 2014. The aircraft, bearing tail number '2012,' in line with the changed numbering scheme that started with the third prototype, was first seen in June and began undergoing taxi tests in early July. According to observers, the prototype flew for nearly two hours, and displayed the various design refinements seen in the third prototype, tail number '2011.' Principal among these are an undernose fairing for an electro-optical targeting system (EOTS), diverterless air intakes and clipped tips on the vertical stabilizers.

Images of the first flight do not give any signs that Chinese-made Xian WS-15 turbofans have been integrated with the airframe, despite much speculation on that engine's maturity, which has been undergoing tests on an Il-76 operated by the China Flight Test Establishment (CFTE). With airframe and systems development apparently progressing more rapidly than the indigenous engine, the J-20 may well enter service with a variant of the Russian Saturn AL-31 engine.

Korea's KF-X future fighter programme



The South Korean industry is reportedly speeding up development of the indigenous KF-X fighter programme and invites for the project definition could be shortly called for. The KF-X is to be a twin-engine fighter to replace the ROK Air Force's McDonnell F-4E Phantoms and Northrop F-5E Tiger IIs, with deliveries beginning in 2025. Korea Aerospace Industries is expected to lead the \$8.24 billion programme.

Third Y-20 Flies



File photo of Y-20 in flight

The third prototype of China's Xian Y-20 'Kunpeng' four-engined military transport aircraft made its maiden flight on 31 July at the Yanliang flight test centre in China. According to reports, the People's Liberation Army Air Force (PLAAF) will need at least 400 Y-20s, it being suggested that a major airlift capability is needed to transport troops to China's frontiers. The aircraft will be organised into ten PLAAF divisions, each with two regiments of 20 Y-20s.

F-16s for Indonesia

The Indonesian Air Force took delivery of three refurbished Lockheed Martin F-16C/D Block 25s on 25 July after delivery flight from Hill AFB, Utah. Tanker support was provided by a US Air Force McDonnell Douglas KC-10A Extender.



Two F-16s of the Indonesian Air Force in Ngurah Rai Airport, Bali (photo: Bapak Alex)

The three F-16s are former USAF aircraft refurbished by the Ogden Air Logistics Complex at Hill AFB under the *Peace Berna-Jima II* programme. The remaining 21 in the contract will be delivered by the end of 2015. The refurbished fighters will be divided between two units, *Skadron Udara 3* at Iswahjudi and *Skadron Udara 16* at Rusmin Nuryadin Pekanbaru.

Tusas delivers F-16s to PAF



Photo: Alan Warnes

Tusas Turkish Aerospace Industries (TAI) have completed the F-16 upgrade programme with delivery of the last four aircraft to the Pakistan Air Force (PAF) at a ceremony in Ankara. The programme, effected through a contract between Pakistan and TAI in 2009, involved avionics and structural modernisation for 41 of the PAF's early F-16s. PAF personnel were given on-the-job training by TAI.

TAI has earlier upgraded a number of Turkish F-16s, and has been engaged in designing an indigenous Turkish fighter aircraft (T-FX).

Australia orders Boeing P-8A



US Navy P-8A Poseidon at Farnborough 2014

A contract for up to 12 Boeing P-8A Poseidon maritime patrol aircraft to be purchased by Australia has been agreed with the US Navy, with deliveries expected from 2017. The Australian government approved the \$3.7 billion acquisition of eight of the 737-derived aircraft, plus options for four more, in February 2014.

The P-8As are being purchased from the US government under the Foreign Military Sales programme, and will replace the fleet of AP-3C Orions. The initial eight aircraft are to be delivered by 2018, and will be fully operational by 2021. Australia is seemingly following the USN's example in its maritime patrol acquisitions, as it has planned to acquire a mixture of the manned P-8A alongside Northrop Grumman MQ-4C Triton unmanned air vehicles.

Negotiations between Boeing and the US government to integrate the AGM-84 Harpoon Block 1G anti-ship missile with Australia's P-8As began in July. A Pentagon notification has it that work on the Harpoon mainly relates to integrating the weapon with the aircraft's combat system software.

HAL Cheetals for Afghanistan



Hindustan Aeronautics is to deliver three Cheetal light helicopters to Afghanistan's Air Force in October, transported via commercial cargo plane to Kabul airport from Bangalore. The Cheetal is powered by a Turbomeca TM 333 2M2 turboshaft, which generates 1,100shp.

The Indian Air Force received its last Cheetal from an order of 10 placed in 2006. The Indian Army placed an order for 20 of the type in February 2013, with deliveries expected to be complete by 2017. HAL has manufactured more than 347 Chetak and 275 Cheetah helicopters since licence production first began 45 years ago.

Thai Gripens in Australian exercise

The Royal Thai Air Force deployed its Saab Gripen C/Ds to Darwin in northern Australia for exercise *Pitch Black* 2014, the service's first such overseas deployment of the type. Four single-seat fighters and two twin-seat aircraft were flown to Darwin without



tanker support, flying from Surat Thani air base with an overnight stay in Singapore and a refuelling stop in Bali.

The Gripen primarily conducted air-to-air tasks during the 1-22 August exercise, carrying simulated Raytheon AIM 120 AM-RAAM and AIM-9X missiles. Led by Wg Cdr Chareon Watanasrimongkol, commanding 701 Squadron, the Gripens reportedly had very high serviceability. Fifteen Thai pilots participated, only five of whom had previously attended a *'Pitch Black'* exercise.

The Royal Australian Air Force participated with 26 Boeing F/A-18A/B Hornets, eight F/A-18F Super Hornets, two Airbus Defence and Space KC-30/A330 tanker/transport, a Boeing E-7 airborne early warning and control (AEW&C) system aircraft, Lockheed C-130J Hercules and Beechcraft King Air 350 transports.

Other participants were from Singapore, which sent six Boeing F-15SGs, eight F-16C/Ds, a Boeing KC-135R tanker and a Gulfstream G550 AEW&C platform; and the United Arab Emirates, with six Dassault Mirage 2000-5s and one A330 tanker.

Australia to expand aircraft capability



(photo: Duan Zhu)

According to reports from Canberra, Australia is considering acquiring additional KC-30/A330 multirole tanker transports and Boeing C-17 strategic transports as detailed in a Defence White Paper.

The Royal Australian Air Force has five KC-30s in service with No. 33 Squadron, based at Amberley air base in Queensland. The RAAF's No. 36 Squadron operates six C-17s from Amberley, and the service could look to acquire two of up to 12 unsold 'white tail' C-17s which Boeing will complete by early next year.

Oman retires its Jaguars



IAF and RAFO Jaguars during exercise over the Arabian Sea (photo: IAF)

On 6 August 2014, without much fanfare, the Royal Air Force of Oman retired their Jaguar strike fighters, the first of which was delivered in 1977 as part of a 12-aircraft order, followed by a second order in 1980. At the time of retirement, the RAFO operated two Jaguar squadrons (Nos. 8 and 20) from Thumrait air base in southern Oman.

Omani Jaguars have conducted large-scale exercise with Indian Air Force Jaguars on two occasions: *'Eastern Bridge-I'* at Thumrait in 2009 and a second edition, *'Eastern Bridge-II'* at Jamnagar in Gujarat in 2011. Additionally, two Omani Jaguars ordered as attrition replacements, had once served with the IAF's No. 14 Squadron before being transferred back to the UK, and then later overhauled and delivered to Oman.

With this phasing out of the type, the Indian Air Force becomes the last operator of the Jaguar, with retirement from IAF service scheduled for the late 2020s.

Turkey considers French missiles

Turkish President Tayyip Erdogan has stated that Turkey was in talks with France on the purchase of a long range missile defence system, after 'disagreements' with China for the same, "on the issues of joint production and technology transfer during negotiations over missile defence system." The \$3.4 billion order, awarded to China Precision Machinery Import and Export Corp (CPMIEC), has been a source of concern in the Western world as the Chinese corporation is currently under US sanctions for selling arms and missile technology to Syria and Iran.

US launches campaign against ISIL



An F/A-18F from VFA-213 loaded with ordnance seen launching from USS George HW Bush to conduct airstrikes against ISIL targets in Iraq

US President Obama has announced an offensive to aggressively take out the ISIL, which has captured vast amounts of territory in West Asia. “We will conduct a systematic campaign of airstrikes against these terrorists,” said Obama. “I will not hesitate to take action against ISIL in Syria, as well as Iraq,” he added. In light of his 2011 decision to pull US troops out of the region, this step is being seen as a necessary turnabout in order to combat the growing force of the ‘Islamic State.’

Air strikes have been underway in Iraq since 8 August in support of Kurdish forces, with US aircraft bombing ISIL territory. Strategic dams have been a key target for jihadists, and an attack on the Haditha Dam by the ISIL was held in check by US airstrikes.

AgustaWestland and Italian Air Force cooperation



Finmeccanica – AgustaWestland has signed an agreement with the Italian Air Force for training services aimed at further strengthening their cooperation through the future set up of joint training services. The partners intend to co-develop rotary wing training services by integrating the capabilities and synergies between

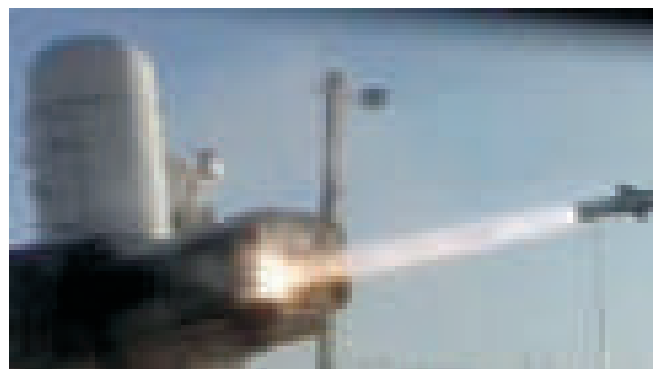
the AgustaWestland Training Organisation facility and the Italian Air Force’s 72nd Wing, both located at Frosinone. Through this collaboration, AgustaWestland will further expand the range of services it can offer in the training sector, while the Italian Air Force will enhance the level of training for its personnel.

Airbus A400M demonstrates tanker capability



The Airbus A400M new generation airlifter has performed successful air-to-air refuelling tests with an F/A-18 Hornet fighter. The tanker test campaign was developed in five flights in which the A400M performed 33 dry contacts and dispensed 18.6 tonnes of fuel to an F/A-18 Hornet in 35 wet contacts. The A400M has a basic fuel capacity of 50.8 tonnes which can be increased by the use of extra cargo hold tanks. The standard A400M aircraft has full provisions for Air-to-Air Refuelling (AAR) operations already installed as standard and only requires the rapid installation of the optional air-to-air refuelling kit to become a tanker.

Raytheon Block 2 missiles for USN



Raytheon has delivered the first Block 2 variant of its Rolling Airframe Missile system to the US Navy as part of the company’s 2012 Low Rate Initial Production contract. RAM Block 2 is a significant performance upgrade, featuring enhanced kinematics, an evolved radio frequency receiver, and an improved control system. RAM is a cooperative programme between the US and German governments with industry support from Raytheon and RAMSYS of Germany.

Hellfire missiles with MH-60R Seahawk



The Royal Australian Navy's newest maritime combat helicopter, the MH-60R Seahawk 'Romeo', has successfully fired its first Hellfire missile in the United States. The AGM-114 Hellfire air-to-surface missile was fired by Australian Navy's 725 Squadron, from aircraft currently deployed to the United States Navy's Atlantic Undersea Test and Evaluation Centre off the Florida coast.

The Australian Navy took delivery of the first two of 24 Seahawk Romeos in December 2013 at Lockheed Martin's Mission Systems Facility in Owego, New York, and two more aircraft were accepted in February 2014.

Airbus DS air surveillance capabilities for Indonesia



Airbus Defence and Space has provided the Indonesian Air Force with the latest aircraft identification and air surveillance equipment, thus improving the air traffic control and air defence capabilities over the country's islands. The company has been awarded a contract by SBL Star Technology Pte Ltd. Singapore to deliver two of its Monopulse Secondary Surveillance Radars MSSR 2000 I to equip the mobile air surveillance and tracking systems which will be operated by the Indonesian Air Force, the final delivery at the beginning of next year. In air surveillance and air traffic control, secondary radars such as MSSR 2000 I complement primary radars in identifying individual aircraft and establishing a comprehensive recognized air picture. MSSR 2000 I is used for automatic friend-or-foe identification (IFF) in the military field, thus avoiding friendly fire, i.e. erroneous engagement of friendly forces.

First RAF 400M makes maiden flight



The first Airbus A400M new generation airlifter ordered by the Royal Air Force has made its maiden flight, marking a key milestone towards its delivery. The aircraft (MSN15) took off from Seville, Spain, on 30 August and landed back on site 5 hours and 5 minutes later. Edward Strongman, Chief Test Pilot Military, captained the flight and stated after landing, "It was very satisfying to conduct this first flight of the first A400M for the Royal Air Force. I have no doubt that its combination of true tactical capability with strategic range will be an enormous contributor to future air mobility in the RAF."

Brazil orders Airbus C295 SAR aircraft

Brazil has contracted with Airbus Defence and Space for the acquisition of three Airbus C295 search and rescue (SAR) aircraft. The three aircraft will progressively be delivered to the Brazilian Air Force (FAB) from the end of this year under the terms of an agreement which also includes a five-year Full In Service Support (FISS) contract.

In Brazilian service the SAR aircraft will join 12 transport-configured C295 aircraft, taking the total FAB C295 fleet to 15. In addition to the aircraft fleet, the FAB is also using a Full Flight Simulator for the C295 at the Air Base of Manaus-Brasil (BAMN facility), that allows it complete autonomy in the training of its crew.

Italian Eurofighter Storm Shadow trials



Alenia Aermacchi has confirmed that the first phase of tests for integration of the Storm Shadow long-range missile onto the Eurofighter Typhoon has been completed. Storm Shadow is a long range, all-weather, high precision stand-off weapon already in service on Royal Air Force Tornados, proven to great effect in operations in Iraq and Libya, neutralising hardened command bunkers and other high value targets. In the deep attack role, Eurofighter Typhoon will carry two Storm Shadow missiles whilst maintaining the ability to carry eight air-to-air missiles.

Beechcraft King Air 350ER for Mexican Navy



Beechcraft Corporation, a subsidiary of Textron has delivered the first of four Beechcraft King Air 350ER aircraft ordered by the Mexican Navy *Secretaría de Marina* (SEMAR). In addition to the aircraft, Beechcraft will support SEMAR with on-the-ground

service, support and training through its Global Mission Support organisation. The specially modified Beechcraft King Air 350ER is fitted with a unique and flexible mission package that supports search and rescue, fishery inspection, pollution monitoring and seaway/shipping lane surveillance missions.

ASL to procure LM-100Js

ASL Aviation Group have signed a Letter of Intent with Lockheed Martin to order up to 10 LM-100J commercial freighters, civil-certified version of the C-130J Super Hercules and an updated version of the L-100 (or L-382) cargo aircraft. Safair, an ASL associated company based in South Africa, currently operates one of the world's largest L-100 fleets.

Through select design innovations, the LM-100J will perform as a civil multi-purpose air freighter capable of rapid and efficient transport of cargo. The LM-100J is an efficient and ideal airlift solution for delivering bulk and oversize cargo, particularly to austere locations worldwide.

JAL and Mitsubishi sign for 32 MRJs



Japan Airlines (JAL) and Mitsubishi Aircraft Corporation have signed a Letter of Intent (LOI) to order 32 Mitsubishi Regional Jet (MRJ) aircraft as the next-generation regional jet for the JAL Group, which plans to deploy the MRJ on domestic routes from 2021, operated by J-AIR, the group's 100% owned regional airline subsidiary.

Mitsubishi Aircraft has made steady progress on development of the MRJ, Japan's first passenger jet, with a scheduled first delivery in 2017. Equipped with newly developed Geared Turbofan engines, the MRJ will achieve significantly lower operating costs than current regional jets. The MRJ will allow JAL to maintain its commitment towards improving products and service quality from the passengers' point of view and developing more convenient networks.

Airbus A350 XWB Route Proving Tour



The Airbus A350-900 successfully completed a series of Route Proving trials, visiting 14 cities over three weeks. At a technical Route Proving, the aircraft must demonstrate its readiness for airline operations on a global scale. This series of trials is required for Type Certification, which is expected in Q3 this year. The A350 XWB completed its Route Proving from Helsinki, Finland after landing in Toulouse, France on 13 August. During its World Tour, the aircraft flew approximately 151,300 km in some 180 flight hours, with all flights performing on schedule.

LATAM Airlines orders Airbus A350s

The LATAM Airlines Group has ordered 22 Airbus A350 aircraft in a deal worth \$7 billion, the agreement including five additional Airbus jetliners of the same model that had been on order since 2005. LATAM is the product of a merger of Chile's LAN and Brazil's TAM carriers in 2012, flying to 135 destinations in 22 countries. Despite the merger, the two airlines continue to operate as separate brands. The aircraft will be delivered between the end of 2015 and 2019, with TAM in line to be the first carrier in the Americas to operate the A350.

IAG orders 8 Airbus A350-900



International Airlines Group (IAG) has converted eight A350-900 Options into firm orders for Iberia. The aircraft will be equipped with efficient Rolls Royce Trent XWB engines and will deliver "huge operational benefits through Airbus' unique family values." IAG secured commercial terms for the A350 aircraft as part of the long-haul order announced in April 2013.

Two AW139s for Heliconia Aero Solutions



Heliconia Aero Solutions has taken delivery of two AW139 intermediate class twin-engine helicopters to perform offshore transport missions in Morocco. The contract also includes options for two additional AW139s. Over 210 customers from more than 60 countries have ordered nearly 790 AW139 helicopters so far. Nearly 700 AW139s are already in service around the world and the fleet recently surpassed the 1 million flight hour milestone.

CFM on track for "another record year"

2014 is on track to be another record year for CFM International (CFM) with the company logging orders for a total of 2,071 engines through June, including 1,017 CFM56 engines (commercial, military and spares) and 1,054 LEAP engines.

As the company logs record commitments, CFM is also achieving historic production rates for the CFM56 product line, the company delivering 1,502 CFM56 engines in 2013 and on track to deliver 1,550 by year end 2014. This represents the highest production rate in the industry, but plans are already in place to reach more than 1,800 engines per year by 2020 as the company transitions from CFM56 to LEAP engine production.

Ryanair order 200 CFM LEAP-1B engines

Ryanair has announced its commitment to purchase 200 LEAP-1B engines to power 100 Boeing 737 MAX 200. Ryanair also has options to purchase an additional 100 LEAP-1B-powered 737 MAX 200 airliners. Ryanair first became a CFM customer in 1998

with an order for 28 CFM56-7-powered 737s and today operates a fleet of more than 300 Next-Generation 737-800s, representing the largest fleet of CFM-powered Boeing airplanes and the largest CFM56-7B-powered Boeing Next-Generation 737 fleet in Europe.

BOC Aviation order LEAP-1B and CFM56-7B engines



LEAP-1B first engine test in June 2014

BOC Aviation have ordered 100 LEAP-1B engines to power 50 new Boeing 737 MAX 8 aircraft, as well as 60 CFM56-7BE engines to power 30 additional Boeing Next-Generation 737s. BOC Aviation has also placed orders for the LEAP-1A engine to power Airbus A320neo aircraft and the LEAP-1C engine to power the COMAC C919. All of BOC Aviation's new Next-Generation 737s will be powered by the CFM56-7BE engine, the production configuration introduced in mid-2011.

Zephyr 7 HAPS non-stop flight

The Zephyr 7 High Altitude Pseudo-Satellite (HAPS) has just completed its most demanding mission to date and thus set a new benchmark in persistent, year-round operations for this class of Unmanned Aerial Systems (UAS). The test consisted of over 11 days of non-stop flight, in winter weather conditions with a

new primary payload, including flight controlled through satellite communications – three more benchmarks reached by Zephyr 7. HAPS runs exclusively on solar power, which is used during the day to charge a battery that is used to power the flight through the night, so this flight in shorter days and longer nights was significantly more demanding than any previous one. This most recent flight allowed over 250 hours of flight testing of the Zephyr 7 prototype, which will now be used to refine the final design of Zephyr 8, the next-generation HAPS vehicle currently being developed by Airbus Defence and Space.

Sikorsky, Boeing selected to build Technology Demonstrator



Sikorsky Aircraft and Boeing have been selected to build a helicopter for the US Army's Joint Multi-Role Technology Demonstrator Phase 1 programme (JMR TD), paving the way for next generation vertical lift aircraft. The US Army Aviation Technology Directorate (AATD) selected the Sikorsky-Boeing team to continue development of the SB1 Defiant, a medium-lift helicopter configured to Sikorsky's X2 coaxial design. First flight is expected in 2017. The Defiant will feature counter-rotating rigid main rotor blades for vertical and forward flight, a pusher propeller for high-speed acceleration and deceleration, and an advanced fly-by-wire flight control system.

UTC wheels and carbon brakes for A320neos, B-737s

UTC Aerospace Systems has been selected by Airbus to supply new wheels and carbon brakes for A320neo family aircraft. The equipment is scheduled to enter into service on the current A320 family of aircraft in 2015. The new wheels and brakes are designed as a product improvement, parallel to the existing design and will be introduced with compatibility across the current A318/A319/A320 and A319/A320neo platforms. The new equipment includes next generation oxidation protection system and a larger carbon

sink mass. The brake and wheel structures of the new equipment are optimised for weight and performance.

Meanwhile, UTC marked a major milestone when it delivered its 5,000th set of landing gear for a Next-Generation 737 to Boeing. The Landing Systems business also provides landing gear for other Boeing airplanes, including the Boeing 747-8, 767 and 777.

Rolls-Royce in C-130 engine enhancement package

The US Air Force has completed final engineering review and approved Certification Basis for the Rolls-Royce C-130 Engine Enhancement Package. This action approves the T56 Series 3.5 package for use on USAF C-130 aircraft as the service prepares to introduce the fuel-saving technology into its transport fleet. The C-130 Engine Enhancement Package includes specifications for 7.9 per cent reduction in fuel use. However, fuel savings have been as high as 13 per cent in ground and flight testing on C-130 and P-3 aircraft with the Series 3.5 package. The enhancement package also allows T56 engines to operate at significantly lower turbine temperatures, extending parts life and improving reliability by 22 per cent. The USAF has estimated that incorporating the engine enhancement into its C-130 fleet would save \$2 billion, while extending the life of the fleet “for decades.”

Exelis EW technology for F/A-18

Exelis has delivered the first full rate production next-generation Electronic self-protection systems for F/A-18 fighter aircraft to the US Navy. The ALQ-214(V)4/5 is the latest variant of the onboard jammer subsystem in the Integrated Defensive Electronic Countermeasures (IDECM) suite. Through a series of enhancements, including miniaturisation and improved electronics packaging, the ALQ-214(V)4/5 can be installed on both F/A-18E/F Super Hornets and F/A-18C/D Hornets.



Fury lightweight PGM

Textron Systems' Weapon & Sensor Systems and Thales UK have introduced its new small, lightweight 'Fury' precision guided glide weapon. Fury applies elements of mature weapon systems from

both companies to shorten the development cycle and time. Fury is 27 inches long, three inches in diameter, weighs 12.7 lbs. and uses a common interface for rapid integration on multiple manned and unmanned aircraft systems. The lightweight weapon and rack design creates very little drag on an aircraft, causing minimal impact on its performance and endurance. The system has been integrated onto an aircraft platform, with test events proving accuracy within 0.2m of the target.

Javelin JV missile vehicle-launch



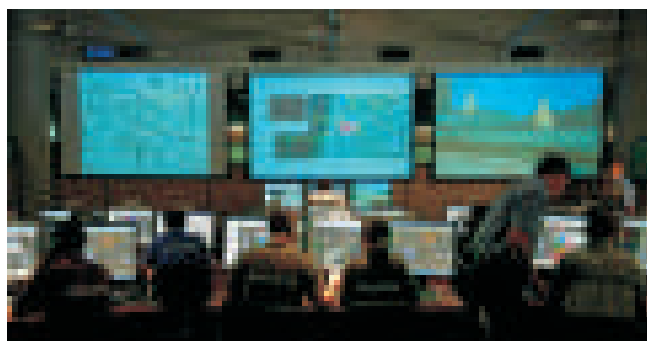
Raytheon and Lockheed Martin Javelin Joint Venture recently fired a Javelin missile from a remote weapon station integrated onto a wheeled vehicle at Redstone Arsenal in Huntsville, Alabama. The test demonstrated Javelin's vehicle-launch capability to an international customer that has expressed interest in purchasing vehicles integrated with Javelin. The Javelin missile launched successfully hit a T-62 tank target from a range of 1,000m. Immediately after missile launch, the remote weapon station engaged an alternate target with its ballistic weapon, demonstrating a seamless Javelin integration that supports the warfighter's requirement to quickly transition between multiple weapon systems.

RQ-4 Global Hawk in expanded mission capabilities

After several test flights, the US Air Force RQ-4 Global Hawk Wide Area Surveillance Unmanned Aircraft System (UAS) has proved “its ability to collect mission data and operate with an expanded variety of intelligence exploitation ground stations.” The RQ-4 Global Hawk UAS is built by Northrop Grumman and equipped with a Multi Platform Radar Technology Insertion Programme (MP-RTIP) sensor capable of detecting fixed and moving targets. Test flights out of Edwards Air Force Base provided the first demonstration of interoperability with the latest Air Force Distributed Common Ground System (DCGS) upgrades. Another test saw positive results from new MP-RTIP maritime modes,

demonstrating the collection capabilities that make the Global Hawk relevant to the Arctic and Mediterranean missions of the NATO Alliance Ground Surveillance (NATO AGS) system.

Elbit Systems Advanced Electronic Systems



Elbit Systems has been awarded an \$80 million contract to supply a Latin American country with Command, Control, Computer & Communications (C4I) systems. The project, to be performed over a three-year period, is part of that Army's extensive modernisation programme and is designated for all echelons, from the manoeuvring forces up to the command headquarters. The new, unified communications network will play an important role during emergencies, natural hazards and disasters and will facilitate a real-time common operational picture, providing the Land Forces with enhanced operational performance and situational awareness.

IAI's B-767 Tanker



IAI's Bedek Aviation Group B767 during a FBW boom system test-flight

Israel Aerospace Industries (IAI) recently performed successful test-flights on a B767-300ER aircraft, equipped with an advanced Fly-by-Wire (FBW) boom system. The new FBW boom capability joins and enhances the company's extensive experience in various aircraft (B767, B707, C-130, and Il-78) to tankers or multi mission tanker/transport (MMTT) platforms for more than 12 customers

worldwide, including the Israeli Air Force. Israel is "continuously looking at improving and upgrading" its Tanker/Transport aircraft and can offer a 'Smart Tanker' version that performs additional tasks while in the air, such as ELINT, SIGINT, and ESM, or serve as a communications hub or as a Command and Control post.

US SOCOM contract for Carl-Gustaf

Saab has signed a new framework contract with the US SOCOM for the company's Carl-Gustaf man-portable weapon system (known in the US as MAAWS: Multi-role, Anti-armour, Anti-personnel Weapon System). The contract is a follow on agreement to a previous five year contract for the 84mm recoilless rifle system. The framework contract enables the US SOCOM to place orders for weapons and ammunition over a five year contract period up to a total value of SEK 1.3 billion (approx. \$187 million).

The Carl-Gustaf system has had a successful history and has been modernised and adapted to meet new requirements. Anticipating future operational needs, a new, lighter weight version of the Carl-Gustaf is currently under development. The next generation system will also include additional functionality that will greatly increase the capability of the weapon system. Other recent advancements in the Carl-Gustaf system include the release of the new 655 CS (Confined Space) High Explosive Anti-Tank (HEAT) round designed to reduce backblast and allow soldiers to safely employ the weapon in confined spaces, minimising the hazardous effects of traditional shoulder fired munitions.

Finmeccanica/Selex ES new surveillance radar



Finmeccanica/Selex ES has introduced the Gabbiano TS-80 PLUS, a brand-new surveillance radar system weighing just 44 kilos and latest member of the Gabbiano family of radars which provide a set of surveillance capabilities including high resolution SAR (Synthetic Aperture Radar) and ISAR (Inverse Synthetic

Aperture Radar) for protection, patrol and surveillance missions. Modular and flexible, the radars can be installed in a wide range of platforms. The key improvement of the TS-80 PLUS is its use of solid state technology, giving it the same performance of the Gabbiano T200 system, while saving 25 kilos of weight and increasing its mean time between failure rate to 2500 hours. A 360° antenna group with wide-elevation scan (+20°/-55°), a one metre wide flat antenna plate and 80 watts of power provide for effective long-range surveillance.

4000th IRIS-T series production missile delivered



The 4,000th IRIS-T series production missile has been handed over to Sweden. The IRIS-T (Infra Red Imaging System Tail/Thrust Vector Controlled) is a state-of-the-art short-range air-to-air missile with combat and intercept performance. The IR-seeker-assisted radar proximity fuze and the large warhead give the missile a remarkable anti-missile capability against incoming air-to-air and surface-to-air missiles. Predictive flight path tracking and lock-on-after-launch features enable the missile to engage targets in the rear hemisphere of the launch aircraft.

Planned as the successor for obsolescent Sidewinder missiles, the IRIS-T was developed by Greece, Italy, Norway, Spain, Sweden and Germany and series production started in 2005. IRIS-T will enhance the self-defence capability and survivability of Eurofighter (Typhoon), Tornado, Gripen, EF-18 (Spanish Air Force), and F-16 considerably. In addition to the six participating IRIS-T programme nations, Austria and Saudi Arabia have procured the IRIS-T missile, as well as South Africa and Thailand.

Comac C919 progresses

Comac's C919 jet airliner programme has made progress with the mid fuselage of the first aircraft coming off AVIC Xian Aircraft Industry's production line, as the airframe moves towards final assembly of the narrowbody by the end of 2014.

Following a delivery ceremony, this section was sent to Comac's Shanghai facility in September, having taken delivery of the C919's first forward fuselage section on 24 August. Manufactured by Jiangxi Hongdu Aviation Industry, this is the first major C919 structure to be delivered to Comac.

AVIC CAC Commercial Aircraft is working towards an end 2015 first flight target for the C919.

LM DMLGB in training exercises



Lockheed Martin's Dual Mode Laser Guided Bomb (DMLGB) was successfully employed during recent US Marine Corps weapons and tactics instructor training.

During the training exercises at Marine Corps Air Station Yuma in Arizona, AV-8B Harrier aircrew released 19 GBU-12F/B DMLGB weapons, in tactically representative engagements, and used various targeting modes against fixed targets. "All weapons performed successfully and met Marine Corps mission objectives."

As the sole-source developer and provider of the DMLGB kits, Lockheed Martin have upgraded more than 7,000 Paveway II LGB guidance kits with dual mode, all-weather capability. Additionally, the company has delivered more than 70,000 LGB kits and over 135,000 Enhanced Laser Guided Training Rounds to the US Navy, Marine Corps, Air Force and 20 international customers.

Thales I-Master radar in new maritime mode

Thales I-Master radar is now available with a Maritime Moving Target Indication (MMTI) mode, which new maritime capability, enabled through a software package, can be used simultaneously with the existing Ground Moving Target Indication (GMTI) and Synthetic Aperture Radar (SAR) modes. The choice of modes in a single sensor, together with its small form factor and high-performance capability, makes I-Master ideally suited for a wide range of manned and unmanned platforms.

MMTI allows users to detect and track targets on water- from small, fast-moving craft such as jet-skis; to larger, slower vessels such as ships and tankers, in all weather conditions, day and night. Algorithms designed specifically by Thales allow users to perform a range of tasks that include detecting unusual vessel movements, perform "pattern of life" analysis, and conduct persistent tracking of targeted vessels.

Ethiopian Airlines to receive 35 Boeing 737 Max 8s

Ethiopian Airlines has placed a US \$2.1 billion order for up to 35 Boeing 737 Max 8s, the order split between 20 firm aircraft and 15 options and purchase rights. The aircraft will use CFM International Leap 1-B engines.

“Today’s order underlines our commitment to our 15-year strategic plan, ‘Vision 2025’, in which Ethiopian will strive to become the leading airline group in Africa carrying 18 million passengers per annum,” stated Tewolde Gebremariam, chief executive of Ethiopian. “The 737 Max will form a key component of that strategic vision, enhancing our single-aisle fleet and keeping us at the forefront of African aviation.”



New submarines at Sevmash

Sevmash director general Mikhail Budnichenko has stated that three new nuclear-powered submarines (*Borei*-class ballistic missile submarine *Knyaz Oleg*, *Yasen*-class multipurpose submarine *Krasnoyarsk* and the Project-09851 vessel *Khabarovsk*) have been laid down at Severodvinsk on 27 July 2014, which also happened to be Russian Navy Day. President Putin visited the home base of Russia’s Northern Fleet in the city of Severomorsk in the Murmansk region.

The president stated that Russia was committed to development of the Navy, and revealed that in the past year, Russian ships had performed 43 missions, including anti-piracy operations. Putin also hailed Russian shipbuilding activities, noting that 26 warships had been launched and seven delivered to the Navy in the past year, with sixty ships of various classes presently under various stages of construction. Recently delivered vessels included the *Borei*-class strategic nuclear submarines *Yuri Dolgoruky* and *Alexander Nevsky* and the first *Yasen*-class multipurpose nuclear submarine *Severodvinsk*, all three constructed at Sevmash.

With these three new vessels laid down, the *Borei*-class now has two submarines (*Yuri Dolgoruky* and *Alexander Nevsky*) in service, one undergoing trials (*Vladimir Monomakh*) and two under construction (*Knyaz Vladimir* and *Knyaz Oleg*). The *Yasen*-



Borei-class boat 'Vladimir Monomakh' (photo : Sevmash)

class has one vessel (*Severodvinsk*) in service with three (*Kazan*, *Novosibirsk* and *Krasnoyarsk*) under construction. Project 09851 is a classified “special purpose” nuclear vessel, and its genesis, role and specifications are unclear.

Vietnam building its naval deterrent

Vietnam is steadily building up its naval capability as a deterrent against China in the South China Sea. The Vietnamese had signed a \$2.6 billion contract with Russia in 2009 for six *Kilo*-class submarines, of which two have been delivered, one is to be received in November, and the remaining three are due to be delivered over the course of two years.

With Beijing’s placement of an oil rig in waters claimed by Hanoi, area denial operations off the coast of Vietnam seem likely, with large scale naval expansions underway.

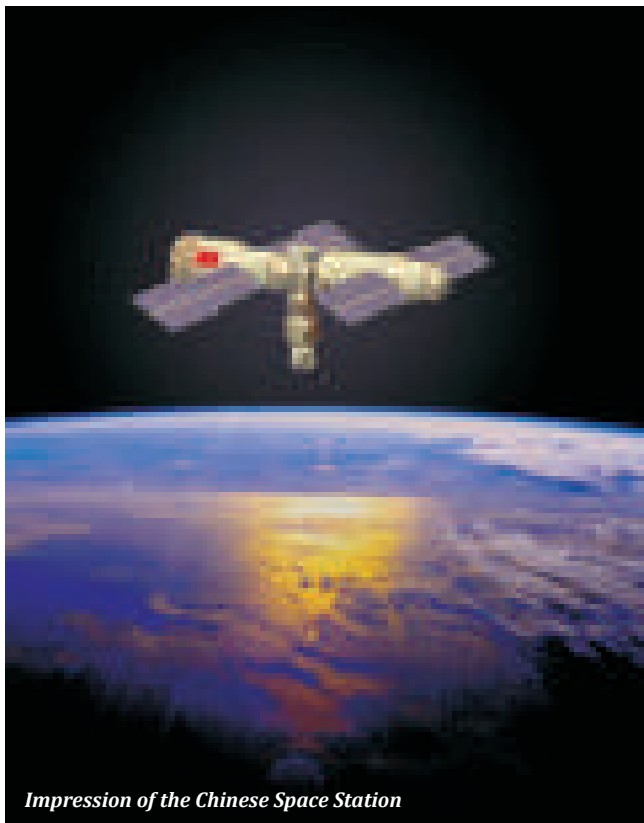


File photo of Kilo class submarine

China to build first space station by 2022

China's Manned Space Agency official and China's first astronaut, Yang Liwei has announced the timetable building up to the country's establishment of its first space station around 2022. At an annual meeting of the Association of Space Explorers, Liwei announced that after the launch of the Tiangong-2 space lab around 2016, the Shenzhou-11 spacecraft and the Tianzhou-1 cargo spacecraft will be launched to dock with it. By 2018, the core of the space station is to be launched, with completion set for four years later.

Tiangong, translated as 'heavenly palace,' is a space station programme of China. The first laboratory, the Tiangong 1, was launched on 29 September 2011 where three astronauts spent 15 days in orbit and docked with the Tiangong 1.



Impression of the Chinese Space Station

Changes in Saab management

Certain Saab business units have been restructured, effective September 2014, reportedly 'to improve long term operations, particularly in business-to-business interactions.' A new business area, Industrial Products and Services, is being established and is to contain business unit Aerostructures (formerly part of Business Area Aeronautics), business unit Avionics (formerly part of Business Area Electronic Defense Systems), independent technical consultancy

company Combitech, and the Saab Ventures portfolio (currently part of Saab Corporate).

The business units in Industrial Products and Services focus on business-to-business customers, or they operate independently from Saab's main end-user sales, while other Saab business areas typically work with government or national authority end-users. This altered customer focus creates distinct management needs and priorities when it comes to strengthening business in the long-term, alongside developing individual growth strategies for each the organisation's component units.



Saab's former Deputy CEO and Head of Business Area Aeronautics Lennart Sindahl (in photo) has become full-time Deputy CEO. Ulf Nilsson, Head of Gripen within Business Area Aeronautics, has become the new Head of Business Area Aeronautics and a member of the Group Management. Jonas Hjelm, Head of Market Area Americas, has become new Head of Business Area Support & Services and has also become a member of the Group Management.

Head of Group Communication Åsa Thegström has become a member of the Group Management. The current Chief Strategy Officer, Dan Jangblad, is now Head of new Business Area Industrial Products and Services and shall remain a member of the Group Management.



Renaissance for the Gnat

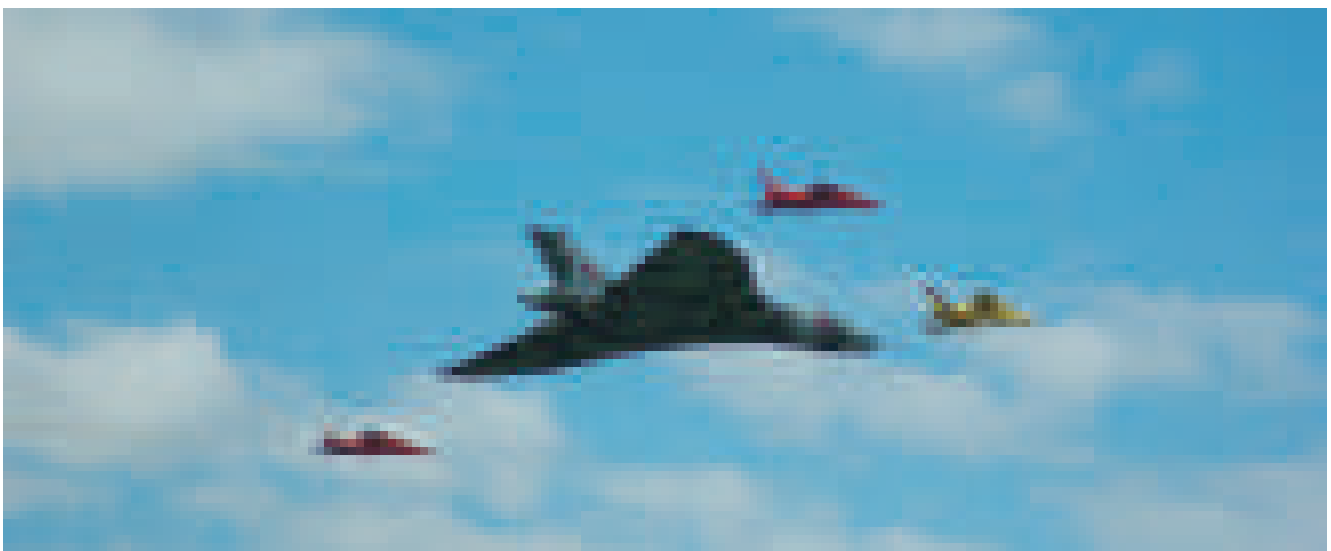
Vayu's UK editor Richard Gardner reports from Hampshire, England

Although the Royal Air Force started to phase out its diminutive Hawker Siddeley Gnat T1 advanced trainers in 1979 in favour of the Hawk T1, these tiny jets have long retained their popularity with former fast jet pilots and enthusiasts

within the aviation community. Partly this is because a whole generation of RAF and overseas exchange pilots flew the Gnat T1 in their early flying careers, and also as a result of the aircraft flying all over the world as the mounts for the famous *Red*

Arrows RAF Training Command aerobatic team.

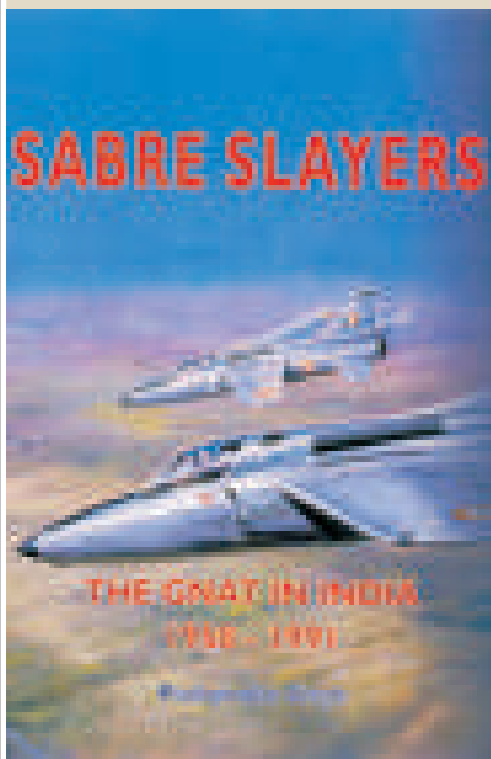
India's enthusiastic adoption of the fighter version, the F1, also established a global reputation that remains to this day. The *Red Arrows*, with their bright



The Gnat light fighter with the Indian Air Force

Marking the 33 years of its service with the Indian Air Force, this book was published in 2008, authored by Pushpinder Singh and published by *The Society for Aerospace Studies*, New Delhi.

In brief, the Gnat light fighter was adopted by India in 1956, even while it was at the incubation stage in England, the Government of the time having both faith and vision in the concept, not the least because of the need to expand the IAF and the existing economic situation.



The Gnat light fighter story goes back some years earlier, to the winter of 1954 when an IAF team were visiting Europe to evaluate contemporary fighter-types and just chanced upon the Midge at Chilbolton in southern England. The rest, as they say, is history and the reader will be transported back to that time and continue for the next 35 years as the Gnat was conceived (in England), adopted (by India), nurtured by the surrogate country, applied war paint by the IAF before this Service baptised it during the 1965 war. Much else was to occur as Indian test pilots, designers and producers struggled to tame this sprightly fighter which again fired its cannon in earnest in 1971, earning honours and the highest award for gallantry.

Bestowed the sobriquet 'Sabre Slayer' for posterity, the Gnat became perhaps the most vivid symbol of the country's prowess in the air and the light weight fighter assumed virtually larger than life status, although its Achilles heel remained the longitudinal flight control systems and unreliable gun feed system which let it down repeatedly, otherwise there would have been even fewer Sabres left to slay !

After over 200 Gnat Mk.Is were produced by HAL, the Mk.II was evolved, given an Indian name, the Ajeet (Victorious) intended primarily for the ground attack role but a combination of technical constraints and evolving operational scenarios conspired to foreclose this programme and only 80 Ajeets were built instead of the 300 planned. Then some 33 years after induction, the light fighter was formally retired from IAF service but the residual and fond feelings for the Gnat have only grown with time.

The 'Gnat Brotherhood', which was formalised at Pune in 2006 has since grown in numbers and enthusiasm, with the 50th year of the Gnat light fighter in India celebrated by HAL at Bangalore in November 2008.

red-painted Hawks, are still providing the RAF with global prestige resulting from high profile displays of outstanding flying skills. Nine aircraft remain the team display strength, though two extra aircraft provide a back-up if there is a technical fault or bird-strike damage to repair. This year the team is celebrating its 50th Anniversary, since forming on Gnats in 1964, but in addition to these familiar red Hawks, the graceful shape of the Gnat is once again to be seen in UK and European skies, flying in formation and through an exciting aerobatic sequence as part of the privately operated *Gnat Display Team*.

When the Gnat T1 fleet was retired from advanced flying training service it was retained for many years for ground training at RAF Halton, where aircraft engineering instruction was undertaken, and other Gnats were used for aircraft ground handling training and some were used in conjunction with research programmes at Boscombe Down and Farnborough, but some surplus airworthy aircraft were sold to private operators and individuals in the UK and USA. The Heritage Aircraft Trust is a UK-based charity which operates its three currently airworthy Gnat T1s under the title of *The Gnat Display Team*. It has its own CAA certified maintenance organisation, with approved engineers as well as experienced volunteer pilots who all hold the appropriate CAA Airshow Display Authorisations. Now in its third busy display season, the team recently took part in a unique combined formation display sequence flying alongside the last airworthy Avro Vulcan. The contrast between the tiny swept-wing Gnats and the massive delta-wing Vulcan bomber recalled a similar formation in the early 1950s, when the prototype Vulcan appeared at the Farnborough Air Show in formation with two Avro 707s and a BP111, which were one-third-size Vulcan test aircraft used for various delta wing in-flight handling trials.

The Folland (later Hawker Siddeley) Gnat was designed and built at Hamble, Hampshire, in England and first flown in 1955. Developed from the Folland Midge, the Gnat F1 was intended as a lightweight fighter that could operate from relatively short runways and undertake high speed air defence and ground attack missions. It was capable of a top speed of up to Mach 1.3 in a shallow dive and was extremely agile. Its unusually small size helped keep

its cost low, and yet it offered an impressive performance, while being a small target in air combat. The single seat Gnat F1 was bought by India and Finland, with the type being produced in large numbers in India by HAL. In the Indo-Pakistan conflict of 1965 Indian Gnats shot down seven Sabres, leading to the appellation 'The Sabre Slayer'. This endorsed the original concept that although of minimal dimensions, the Gnat was a formidable combat aircraft, well able to hold its own against larger and more powerful fighters.

which performed at air shows during the summer season, but which were part of the training fleet. Late that the year, the success of the team led to the creation of a full time aerobatic unit which would replace the previous RAF aerobatic teams, the *Black Arrows* and *Blue Diamonds*, which were equipped with Hawker Hunters. The much larger and heavier Mach 2 Lightnings of No.74 Squadron had provided the last Fighter Command aerobatic team, often flying with the *Blue Diamonds*, but this

flown in red and white 4FTS colours, and the third Gnat is painted as XR911 in the yellow scheme of *The Yellowjacks*. The team has a fourth aircraft which is currently being restored to flying condition. It is a single-seat former Indian Air Force Gnat F1, No E296, which is now registered as G-SLAR. The aircraft was one of around a dozen F1s sold by the IAF, and this one has been brought to the UK from its previous owner in the USA. The team is still seeking additional spares and components to ensure



Its modest cross section made it very difficult to see head-on, which was also an advantage if flying on a ground-attack mission, armed with bombs or rockets.

In the UK a two-seat version with extra fuel capacity, the T2, was ordered to replace Vampire T11s in the advanced flying training role. From 1962 they equipped No.4 Flying Training School at RAF Valley and served for nearly two decades, during which time they trained 1,421 fast jet pilots and accumulated over 157,000 flying hours. The RAF formed an aerobatic team, *The Yellowjacks*, in 1964,

supersonic fighter's priority role was within the front line Quick Reaction Alert air defence force and although very agile, it was not an ideal aerobatic platform for routine display flying. The Gnat T2 was better suited for this duty, and the new team's aircraft were painted a highly distinctive overall red and named, appropriately, *The Red Arrows*.

The Gnat Display Team currently flies three Gnat T2s from its base at the former Battle of Britain station at North Weald in Essex, England. One aircraft is painted as XS111 in Red Arrows red, XR538 is

that it can have a lengthy flying career. In the meantime, restoration work in the team's North Weald hangar is continuing so that it can return to flying as soon as possible, and it will then enable a four-ship aerobatic team to be displayed.

So while the official RAF *Red Arrows* celebrates its half century and continues the tradition of a national aerobatic display team, there is now also another UK based fast jet aerobatic team re-creating the sights and sounds of the so-called "golden era" of UK aviation in the 1960s. And once again Gnats grace the skies over their native home.

Celebrating 80th Anniversary of the French Air Force...



...and 100 Years of Aerial Bombardment!

The French Air Force was born by the signature from a decree on 1 April 1933. Its organisation was defined by the law of 2 July 1934 but its history begins with those of all the military flights created since 1912. It was formed in 1909 as the Service Aéronautique, a service arm of the French Army, then was made an independent military arm in 1933.



During the weekend of 5-6 July 2014, the Nancy air base (*Base Aérienne 133 Nancy-Ochey*) played host to an air show celebrating the 80th anniversary of the French Air Force (*Armée de l'Air*) as well as the 100th anniversary of the world's first recorded aerial bombardment. The 80th anniversary of the French Air Force was celebrated in conjunction with a number of different milestones at various airbases, each with their own theme : BA 120 Cazaux celebrated 100 years of aerial reconnaissance, BA 113 St Dizier celebrated

100 years of aerial battle, BA 125 Istres celebrated 50 years of the French Strategic Air Forces Command.

Theme of the 100th anniversary of aerial bombardment was marked at a hangar which had with World War I memorabilia and a replica of a Bleriot aircraft of that era. On 14 August 1914, two French pilots (Lieutenant Cesari and Corporal Prudhommeau) took off from Verdun in a pair of Farman MF.7s to target airship hangars in the Metz area. They dropped their ordnance

blindly and could not see the results, but were acknowledged as the first aerial bombers. After damage assessment they were credited for the destruction of two German airships.

The Air Show

At Nancy airbase, the first day of the show was hampered by bad weather. Heavy rainshowers cancelled all flying except for a limited air display in the late afternoon. On the second day, a brief shower around noon was the only dissonant aspect of the

330 aerobatic aircraft, an A400M transport aircraft and a Mirage F1 conducting its very last air show demonstration.

International participation included a Dutch F-16 demo, Belgian F-16 demo, Belgian Siai-Marchetti SF.260 demo (*Red Devils* team), an Italian Eurofighter and an Austrian Saab 105 (special 'Tiger' paint scheme).

There were also various other displays flown by civilian-owned aircraft such as a restored Flamand, Spitfire, Mustang, Bronco and many more. The static display was also packed, primarily by military aircraft including local Mirage 2000Ds, Mirage 2000C, Mirage F1, Rafale, a Dutch F-16, Italian G.222, German Eurofighter (in 'Tiger' scheme) and Austrian Saab 105, among others (see photographs in the following pages).

Joris van Boven / Sentry Aviation News

day, as sunny weather arrived after the rain. Owing to the precipitation, however, the airshow was rescheduled and most aircraft flew in the afternoon instead of the morning.

Naturally, the French Air Force was dominant at the show with aircraft that included two Mirage 2000Ds, Dassault-Dornier Alpha Jets of the *Patrouille de France*, Socata TB 30 Epsilons of the *Cartouche Doré* team, EC725 Caracal conducting a CSAR demo, Dassault Rafale in a special 'Tiger' paint scheme, Extra EA-







Exercise 'Green Shield 2014'



Special Green Shield 2014 exercise patch



Mirage 2000-5F from BA 116 Luxeuil taking off

In April 2014, the French Air Force (*Armée De L'Air*) organised the 4th 'Green Shield' exercise with the Royal Saudi Air Force (*al-quwwāt al-ġawwiyyah al-malakiyyah as-suūdiyyah*) at its Nancy air base (*Base aérienne 133 Nancy-Ochey*). The two-week exercise lasted from 3 until 18 April, a VIP/media day organised by the French Air Force on 16 April 2014.

Genesis

Over the past few years, several *Green Shield* exercises have been held between France and Saudi Arabia, on a more or less biannual schedule: 2007 at the King Khalid air base at Khamis Mushait in Saudi Arabia (the exercise was named 'Tiger Gust'), 2009 at the Dijon air base in France, 2012 at the King Faisal air base in Saudi Arabia, and 2014 at the Nancy air base in France.

In the 2014 edition, a large number of fighters and helicopters flew their missions from Nancy including :

- 6 Royal Saudi Air Force Boeing F-15S (4 single-seat and 2 twin-

seat) from 2nd Squadron, 7th Wing based at King Faisal air base

- French Air Force Dassault Rafales from the nearby St-Dizier air base
- French Air Force Dassault Mirage 2000s (-5F and -C) from Luxeuil and Orange air bases
- French Air Force EC725 Caracal CSAR helicopters from Cazaux air base
- French Air Force Mirage 2000Ds from the hosting Nancy air base

During the second week of the exercise, a French E-3F flew airspace control missions from its home base at Avord, while during the first week control was performed via ground station CDC Drachenbronn. Both in the air in the E-3F and on the ground, Saudi air-controllers sat next to the French air-controllers and trained alongside them.

Transport aircraft of the Royal Saudi Air Force consisted of two Lockheed C-130s and two Airbus A330 MRTTs to fly in stores and some 200 personnel to France.

The Exercise itself

The objectives for this exercise were to :

- Reinforce relations between the two participating air forces
- Exchange experiences
- Improve knowledge of aerial combat
- Improve the coordination of the crews through a set of air defence missions

The focus lay on electronic warfare, Link 16 datalink, threat-countering of surface-to-air missiles (using SA-8 systems and 'Smokey SAMs' from ground positions) and CSAR (Combat Search And Rescue).

Both Air Forces were led by their Chiefs: Commander of the *Armée de l'Air* General Denis Mercier and Commander of the Royal Saudi Air Force General Fayyadh Bin Hamed Al Ruwaili. The briefing was conducted by Colonel Louis Pena, Commander of the Nancy air base and French exercise director of *Green Shield 2014*.



Saudi F-15S landing with extended speedbrake

Colonel Pena outlined the history and the current situation at BA133, noting that Nancy is one of the largest airbases in France, housing three squadrons of Dassault Mirage 2000Ds totalling some 60 aircraft, or one quarter of the fighter strength of the French Air Force and including the Operational Conversion Unit for the Mirage 2000D. A number of Mirage 2000Ds are on permanent standby to conduct military action worldwide,

such as those in recent conflicts on countries like Mali, Chad, Afghanistan and Libya.

Col Pena stated that during three weeks of the exercise, there was overall satisfaction after some initial problems at the beginning. The three weeks of working and flying together resulted in “highly mature training” with better understanding of the participating planners, pilots, ground crews and other personnel.

Thereafter, Lt Col Pascal Leroux, French mission coordinator for *Green Shield* 2014, stated that aim of the exercise was to “increase knowledge, exchange experience and foster friendship”.

He went on to detail the aircraft involved in the exercise : in the first flying week, the participants were six F-15S, four Mirage 2000-5F from Luxeuil, two Mirage 2000C from Orange, plus a number of local Mirage 2000Ds. During the second week, three Rafales from St. Dizier replaced the Mirage 2000Cs and two EC725 Caracals arrived from Cazaux for the CSAR missions.

With electronic warfare as one of the focus areas, a former Soviet SA-8 SAM unit was located in the target area to simulate an actual surface-to-air missile threat, in addition to a number of mobile stations that simulated radar emission of other SAM units. As a ‘real’ threat, some ‘Smokey SAMs’ were fired too.

The missions were put together as building blocks, starting with “easy” air-defence scenarios to get acquainted, different and increasingly difficult scenarios were added to the missions, such as air-defence against more numerous enemies, even larger air packages for ‘Blue’ and ‘Red’ air (COMAO) and CSAR.



A St Dizier-based Rafale B touches down after a sortie



Saudi F-15S in afterburner takeoff

The preparations, briefings and debriefings took place together in one room for all participants, allowing pilots to obtain the necessary information. The target area was a 150 km by 80 km area west of Nancy, reducing transit and maximising training time. This also allowed the organisers to conduct and debrief the missions on the same day. There was a special 'regeneration area' on the southern side of the target area where all aircraft 'killed in battle' could be 'born again' and re-enter the scenario. All GPS-movements of the participating aircraft were logged and with the SIRPAM system,

the missions could be replayed during debriefing.

In the two weeks of flying, some 140 French and 60 Saudi missions were flown, totalling around 200 flying hours. The exceptionally good weather in northern France allowed for a very high number of missions flown during the exercise and aircrew were "very satisfied" with the lessons learned from this exercise.

After the briefings, Colonel Pena specially lauded the two planners of the exercise, Group Captain Khalid bin Sultan Al-Subaie of the Saudi Air Force and Lt Col Leroux of the French Air Force.

Some Saudi impressions

1st Lt 'Barqi' (no name given, only call sign) from RSAF 2nd Squadron at King Faisal air base has 500+ flying hours and 300+ missions in the F-15S and this was his first *Green Shield* exercise in France. Training of an F-15 pilot takes some three years, including time spent in the Saudi Air Force Academy. 'Barqi' is a 2-aircraft element leader and flew six missions in France, against Rafales and Mirage 2000s. The learning points for him were the electronic warfare 'attacks' and jamming during the air-defence missions, followed by the complex CSAR missions involving the protection of slow-moving



A Luxeuil-based Mirage 2000-5F taxis back to the apron after a mission



Saudi F-15S taxiing out for a mission

helicopters. 1st Lt 'Bargi' enjoyed his stay in France and the opportunity to train against dissimilar aircraft types like the Rafale and the Mirage 2000.

CSAR Demo

During the static show at Nancy, the EC725 Caracal conducted a CSAR demo. Soldiers were lowered to the ground using the fast-rope technique and were then extracted by attaching them to a large rope, removing them swiftly from the ground without landing the helicopter.

Air Support Training Centre

During the media day, a short visit was organised to the Air Support Training Centre (*Centre de formation à l'appui aérien*, CFAA). This French-German forward air control school trains observers to become Forward Air Controllers, using the available FAC equipment of the countries plus a real FAC simulator. Increasingly data is exchanged between aircraft, ground soldiers and mission commanders, reducing radio-traffic but increasing data-traffic. With the data exchange, all participants get a real-time situational awareness about friends and foes on the battlefield.

Joris van Boven



EC725 Caracal helicopter executing a turn over parked Saudi and French fighters



Final Flight of the Mirage F1

14 July 2014 was a nostalgic day at Base Aérienne (BA) 279 Châteaudun in France as this was the last time French Air Force (*Armée de l'Air*) Dassault Mirage F1 aircraft would participate in the annual 'Bastille Day' aerial parade over Paris. Each year the military parade on the *Avenue des Champs-Élysées* is climaxed by a flypast overhead. The parade commemorates storming of the Bastille prison in on 14 July 1789, which sparked the French Revolution. During the flypast over Paris, the Mirage F1s flew in a block dedicated to the 100th anniversary of the 1st reconnaissance mission (*100e Anniversaire De La Première Mission De Reconnaissance*), together with three Dassault Rafales, the aircraft destined to succeed them in the role.

The last formation of five Mirage F1s consisted of a Mirage F1CR in a special paint scheme, Mirage F1CR in desert camouflage, Mirage F1CR in jungle camouflage, Mirage F1CR in a special paint scheme and a Mirage F1B in a special paint scheme.

The formation was led by Lt Col Souberbielle (squadron commander of

Escadron de Reconnaissance 02.033 'Savoie') with callsign 'Soubi,' while the remaining aircraft were flown by pilots with the callsigns 'Pablo', 'Little', 'Doume' and 'Cochon.'

In addition, there were two Mirage F1s on standby at Châteaudun: a Mirage F1CR and a Mirage F1B. After the parade in Paris, the Mirage F1 formation made a pass over the base, then a formation break. Each aircraft conducted an overshoot, followed by their final landings. Mirage F1CR 660/118-CY was the last of the five Mirages to touch down.

After landing, all five aircraft did one last 'throttle-up' after which their engines went silent for the very last time. In true French tradition, the personnel at BA 279 opened some bottles of champagne to celebrate the last Mirage F1 flights and with that, the last ER 02.033 'Savoie' flights came to a halt and the squadron will now be disbanded and its pilots will move to other aircraft of the French Air Force.

*Joris van Boven/Sentry
Aviation News*







Photo courtesy Luftwaffe

JG74 are the 'Bavarian Tigers'

A Eurofighter Typhoon belonging to the 74th Tactical Fighter Wing, formerly known as JG 74 is now the 'Bavarian Tiger', part of the Luftwaffe's fleet which has been awarded the top prize for 'Best Painted Aircraft' at this year's NATO 'Tigermeet' in Germany. The stunning

'Tiger Typhoon' clinched the international award at the event in Schleswig, North Germany. Over 60 aircraft from 12 different nations attended the 'Tigermeet' which is a regular event aimed at encouraging nations to freely explore interoperability and joint operations in an informal and flexible environment.

The 'Bavarian Tigers' first formed in March 2013 following restructuring of the Luftwaffe that year, the Fighter Wing being based at Neuburg and Lechfeld Air Base in Bavaria. The tiger tradition was handed over from former Fighter-Bomber Wing 32 in Lechfeld to Fighter Wing 74.

Kommodore Frank Graefe, who heads the Fighter Wing, said: "Everywhere we go the 'Tiger Typhoon' has been getting a fantastic reaction. There is no doubt that it is an incredible looking aircraft."

"Although the award may have its light-hearted side, the NATO Tigermeets serve a serious purpose in ensuring pilots from across the organisation can hone their skills to perfection as they practice a number of scenarios in testing and demanding operational exercises. We were delighted

with the way the event went and we were proud to represent a continuing and strong tradition."

The Eurofighter Typhoon multi-role/swing-role combat aircraft is currently in operational service with a number of Air Forces (Germany, the United Kingdom, Italy, Spain, Austria, Saudi Arabia, while Oman has selected the type).

Since delivery of the first Eurofighter Typhoon to the Royal Air Force in the United Kingdom at the end of 2003, 412 aircraft have been delivered to six nations. The 100th Eurofighter was delivered to the Royal Air Force in September 2006, the 200th aircraft was handed over in November 2009 to the German Air Force, the 300th aircraft delivered to the Spanish Air Force in November 2011 while the German Air Force received the 400th Eurofighter in December 2013.

In the past 10 years with the German Air Force and its other operators, the Eurofighter Typhoon has demonstrated high operational effectiveness in actual missions and training exercises and has accumulated more than 246,000 flying hours.



Eurofighter Typhoons at Air Power 2013, Austria (photo: Luca Genkinger)

India's Sentinel

Select writings of Air Commodore
Jasjit Singh AVSM, VrC, VM



Edited by
Manpreet Sethi ✦ Shalini Chawla

Foreword by
Air Marshal Vinod Patney SYSM, PVSM, AVSM, VrC (Retd)

18 July 2014 would have marked the 80th birthday of Air Commodore Jasjit Singh, who unfortunately passed away last year. At the 'First Air Commodore Jasjit Singh Memorial Lecture' held at his favourite location, 'Gulmohar', India Habitat Centre, this book, compiled by Dr Manpreet Sethi and Dr Shalini Chawla of the Centre for Air Power Studies (CAPS), was released. It pays great tribute to one of India's foremost strategic analysts and as it summarises, "the only constant for him in over three decades of research, analyses and writing was the centrality of national interest. Indeed, the man never let the nation down, whether as an air warrior or a strategist – ever ready

to voice his views irrespective of how the wind was blowing – and always remaining practical in approach".

Ever an optimist, he believed that India would inevitably rise to power by the sheer size of its economy and human resource potential. A greater concern for him, however, was the need to sensitize his compatriots to the national security challenges that would arise as the country rose, and to equip them with the capability to optimally address these. He did so through his writings and talks.

This book is a modest compilation of his select writings on two specific issues – nuclear strategy and Pakistan – since he considered these as critical amongst India's

many security challenges. Of course, the range of Jasjit Singh's writings and the expanse of his knowledge is immense and beyond capture in one book. But, this is a small effort in the direction of spreading his message/ideas to the current and future generation of scholars and policy makers. Hopefully, it will encourage students of national security to look for more of his writings beyond the few that we have been able to carry in this volume.

Air Commodore Jasjit Singh remained on the editorial panel of *Vayu Aerospace Review* and in fact his last article for this Journal "The Challenge of Indigenisation" appeared in Issue V/2013, a tribute to this great air warrior and brilliant strategist.

The Great Indian Escape

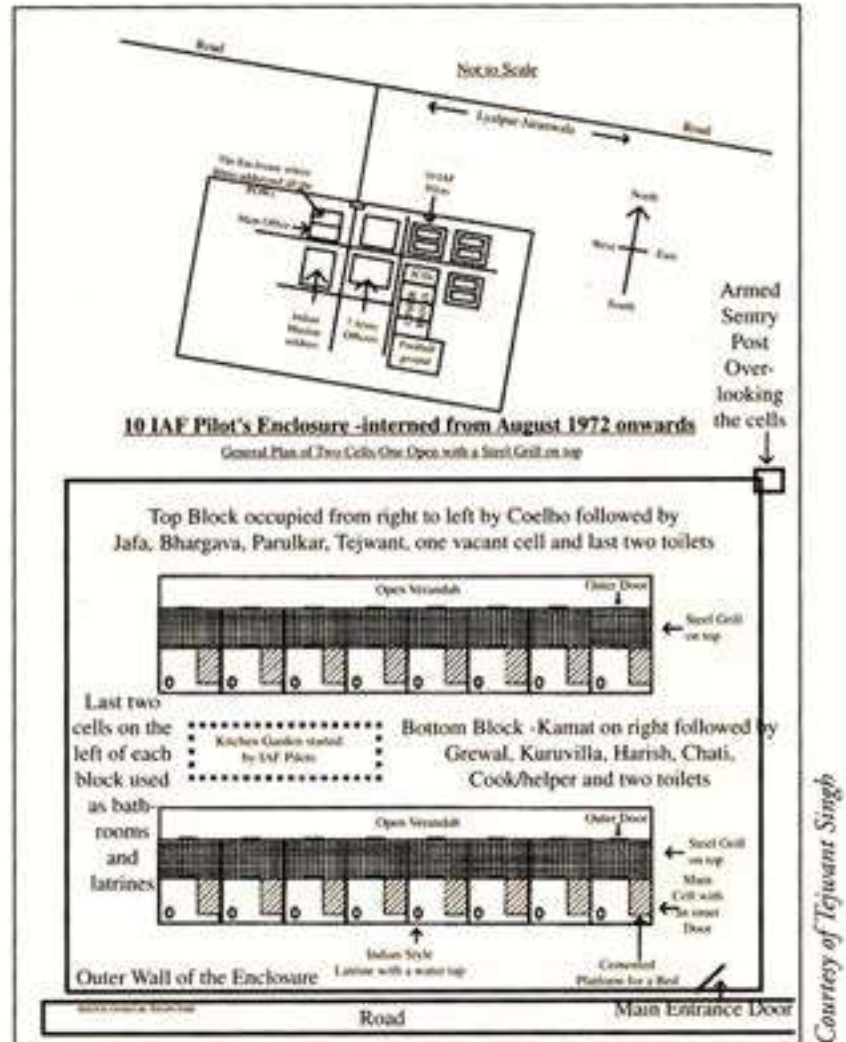
The image of handsome, strapping young men in immaculate flying suits, helmets in hand, returning to the crew room after their sorties with a phalanx of fighter aircraft in the background is sharply etched in one's mind. Their return is a metaphor for the 'back to base' report signifying their ability to dominate the elements, reach enemy targets and attack them with dramatic effect. That is their daily routine at the home base: peace time flying, a regime that prepares them for actual air warfare when called upon to do so.

The pilot puts into practice all the lessons learnt during training at various stages in his flying career, constantly honed to near perfection and wishing for an opportunity to display his prowess whilst facing the enemy.

The book under review has as its theme the survival challenge faced by twelve IAF combat pilots who were not lucky enough to make triumphal return to their bases after carrying out missions during the 1971 Indo-Pak war. The aircraft of ten of them were shot down by enemy fire; they ejected, were captured and made Prisoners of War, while the two who were captured on the ground during FAC operations on the Rajasthan - Sind border. The 'dozen' were Wing Commander BA Coelho, Squadron Leader DS Jafa, Squadron Leader AV Kamat, Flight Lieutenant JL Bhargava, Flight Lieutenant Tejwant Singh, Flight Lieutenant DK Parulkar, Flight Lieutenant MS Grewal, Flight Lieutenant Harish Sinhi, Flight Lieutenant AV Pethia, Flying Officer VS Chati, Flying Officer KC Kuruvilla and Flying Officer HND Mulla-Feroze.

As POWs in Pakistan, all but two of them spent nearly a year in confinement at Rawalpindi and Lyallpur before being repatriated on 1 December 1972. Two of them, Mulla-Feroze and Pethia, were released earlier on medical grounds and allowed to return home.

Appropriately titled 'Four Miles to Freedom', the book is a fascinating dramatisation of the attempt by three of them - Parulkar, Grewal and Sinhi, - to escape from No. 3 Provost & Security Flight



General layout of the Lyallpur Central Jail used as POW camp for Indian Army personnel and Air Force pilots

of the PAF serving as detention Camp at Rawalpindi.

One of the three organic constituents of the narrative revolves around this Rawalpindi Provost Camp with descriptions of how the POWs were given meagre facilities, poor and restricted movement, each prisoner being escorted to the bathroom and back and so on. The POWs spent time playing cards, 'seven tiles' and French cricket. What makes this book particularly interesting is how Parulkar, Grewal and Sinhi planned

their escape and nearly found their way to Afghanistan - and freedom. While others helped in every possible way, the threesome were central to this venture: boring a hole through the prison wall, collection of intelligence, procuring an atlas and improvising a compass. Finding a 'time-window' over the long weekend before 14 August 1972, Pakistan's Independence Day, they got out, found their way to Peshawar travelling on top of a local bus and from there trekked to Landi Kotal enroute to the Khyber Pass. Their next and



IAF POWs of the 1971 War on arrival at Palam on 1 December 1972

final destination, which would hopefully usher them to freedom, was Landi Khana, just four miles away. But, despite their nearly perfect impersonation, the intrepid trio were apprehended by a suspicious clerk of the local Tehsildar, and so reported to the PAF authorities.



Former POWs of the 1971 War arriving by an HS-748 at Palam on 1 December 1972



IAF POWs on arrival at Lyallpur (now Faisalabad) Jail, late August 1972, watching Janamashthami celebrations by Indian jawans (also POWs)

After being subjected to a Court of Enquiry and found guilty, the trio were sent to a bigger and more spacious jail at Lyallpur along with the remaining seven still lodged at Rawalpindi. Lyallpur provided a distinctly different, more congenial environment. But even here, Parulkar expressed determination to attempt an escape, for that was his 'duty' under the Geneva Convention. However, on 24 November 1972, President Zulfikar Ali Bhutto of Pakistan visited Lyallpur jail and announced unilateral release of the Indian prisoners.

A week later, 30 November 1972, was a great day for these IAF pilots, travelling by an evening train from Lyallpur to Lahore where they were lodged at an Army Mess and provided with batmen, hot water and other facilities as befit officers.

It was a cold but sunny afternoon at the Wagah border on 1 December 1972 when these ten IAF fighter pilots walked past the gates into the open, eager arms of their loved ones, fellow officers and officials.

"Sir, we did it!" shouted Parulkar, Grewal and Sinhji as they feverishly gulped the crisp air of freedom. This shout of joy was, perhaps, particularly addressed to this reviewer who was there and took it as confirmation of the efficacy of survival training (with emphasis on escape, evasion and interrogation of prisoners of war) that they had received earlier at the IAF's Jungle & Snow Survival School, with which the reviewer had been associated. It was, indeed, a unique reward for the gruelling training regimen the returning IAF pilots had gone through.

Kudos to Faith Johnston for her adroit and captivating handling of the story as it unfurls. There are cliff-hanger moments and the reader misses a heartbeat wondering 'will they, or will they not'. She delves into the psyche of these restless but resolute IAF pilots, struggling to escape, with the spectre of tortuous uncertainties of captivity in enemy prison.

Parulkar emerges as the chief protagonist with Grewal and Sinhji as complementing dauntless spirits. 'We have returned to reinforce strength of the IAF' was the message, loud and clear, given by them to their fellow Air Warriors.

The narrative is racy and gripping and as one reads the text, page after page, pausing seems to be anathema.

Gp Capt(retd) JC Malik

Four Miles to Freedom

Escape from a Pakistani POW Camp

By Faith Johnson

Published By

Random House Publishers India Private Ltd.

Noida 201301

Air Vice Marshal (retd) Cecil Parker continues his series on **Ancient Aviator Anecdotes**



The Power of Two

From my batch of 30 newly commissioned Pilot Officers in 1952, 17 were sent to Agra for twin-engine conversion on Dakota transport aircraft, while 13 of us were sent to Hakimpet for single-engine conversion on Spitfire and Tempest fighters. On successful completion, we were posted to various transport and fighter squadrons. In those early days there was, however, very

little cross connection between the two main streams of 'singles' and 'twins'.

In 1958, as a flight lieutenant having served in two fighter squadrons, with Vampire, Toofani and Hunter aircraft, and having completed an instructional tenure as a QFI (Qualified Flying Instructor), I was rather surprised to receive a signal posting me to Air HQ Communication Squadron in Palam to fly twin-engined Dakota

and Il-14 and four-engined Viscount aircraft! On reporting I discovered that the squadron had a separate flight equipped with Vampire, Harvard and Devon aircraft and my duties were to organise and supervise flying practice on these aircraft types for staff officers of Air HQ and HQ Operational Command (now HQ WAC).

My apprehension of being a 'singles' misfit in this twin / multi-engine VIP squadron was totally misplaced as I was welcomed, guided and trained by many highly qualified transport pilots. My own primary duties were light and I had plenty of time to qualify as a captain on the twin-engined Devon aircraft, a second pilot on Dakota aircraft and finally as a captain on the same aircraft but only for non-VIP flights. This not only helped with perennial aircrew shortages but also enabled me to see a great deal more of the country and gave me 'twin' experience that was to serve me well in the future. I also learned to enjoy the confidence of having two engines and the privilege of having a navigator to give me my ground position!

In 1965, as a squadron leader attending a course at the IPIS (Instrument Pilot Instructor School) of the USAF in Texas



The ubiquitous C-47 Dakota

USA, I was required to fly the twin-engined jet T-39 Sabreliner. My earlier experience came in handy and I was soon very comfortable in the cockpit. The USAF Standardisation Board, like our AEB (Aircrew Examining Board) arrived on a short notice visit and 'Major Parker – India' was one of the names drawn from a hat to be tested by them. I was most impressed with the professional manner in which both pupil and instructor were tested simultaneously on flying skills, instructional techniques, relevant knowledge and responses to problems/emergencies in the air and on the ground. The ground subjects test was entirely verbal, practical and based on problem solving.

On return to India and my squadron, I was warned to be ready for a posting to AEB and mentally resolved to implement much of what I had observed and learned. But soon after there came a signal posting me on promotion to raise and command the IAF's first Hunter Operational Training Unit in Jamnagar where, thanks to the happy co-location of an HF-24 squadron, I was able to add the twin jet Marut to my log book. Finally, shortly before leaving the air force in 1986, I

managed a sortie in the twin-engined Jaguar, captained by an ex-pupil of mine – but that is another story.

Examiner Ethics

In the early 1960s our air force upgraded the appointments of Squadron and Flight Commander, in single-engined combat squadrons, to the rank of Wing Commander

and Squadron Leader respectively. I was posted to a Hunter squadron as the senior Flight Commander and a Wing Commander arrived from the Aircrew Examining Board (AEB) to take over command. He was the younger of two brothers, both in the Flying Branch of the IAF; by a co-incidence I had earlier served under the elder brother's command as a Flying Officer in one of the



IAF Toofani



HAL HF-24 Marut

first Toofani (Ouragan) squadrons. His formidable professional reputation preceded him. Traditionally the Commanding Officer in a squadron is known as the 'Boss' and our new Boss soon established his mark on the unit.

We also found out that his bark was much worse than his bite; I personally learnt a great deal from him and we worked as a team. One of the first tasks he set me was to ensure that all our fully operational pilots were instrument rated. Instrument Rating (IR) determines the weather conditions in which a pilot can fly and had three categories ranging from 'White' (Initial), 'Green' (Experienced) to 'Master Green' (Highest) and required to be renewed annually by a flying test to ensure skills and a ground subjects one to establish relevant knowledge. This test had to be conducted by a Type Examiner. Since my own MG IR was coming up for renewal, I programmed our Boss to carry out the test next day.

When he saw the Flying Programme the Boss called me to his office and said that he preferred not to do my test. I must have looked puzzled so he explained that, since I worked directly under him, he felt morally obligated to refrain from being my examiner. Accordingly, a young Flight

Lieutenant examiner from AEB arrived and stated that though he was qualified on Hunter aircraft, he was not current and needed to be checked out himself before he could captain a Hunter aircraft. Being the only trainer captain QFI available that day, I carried out his check flight. After refuelling and briefing, he meticulously conducted my test both in the air and on the ground after which he renewed my card.

Sometime later our Boss moved on promotion as a Station Commander and I had meanwhile qualified as an IRI/Type Examiner. I knew that the expiry date of our ex Boss' IR was close to Republic Day and very soon he called me up to say that since I was no longer under his command, could I possibly fly our trainer across and carry out his test? At that point of time I was under a great work load as I was acting as the CO and also leading a Hunter box in the Republic Day flypast. He must have spoken to the SASO as I was told by HQ WAC to make a quick trip, do his test, and get back as soon as possible. On arrival I had to turn down his request for a practice sortie due to paucity of time; as expected, he flew an immaculate test sortie. Over a cup of tea at the dispersal while the aircraft was being refuelled, I threw him a couple of questions

to assuage my conscience on the 'ground subjects' part of the test! Having signed his IR card, he asked me to stay and have lunch. I simply did not have the time but could not resist a (mischievous) response: 'Sir, your whole station knows you used to be my Boss and if you give me lunch just after I have done your test, it wouldn't look right ... but give me a rain check!' He burst out laughing, gave me a playful punch and said 'Given'.

Many years later, after retiring in air rank and migrating to the UK, my ex Boss settled in Oxford and continued flying as an instructor with the Kidlington Flying Club. As I was in the UK attending a course, he and his wife drove down to London and took my wife and I out to dinner. When I thanked him for a truly splendid and enjoyable evening all he said with a smile was that I had only cashed my rain 'cheque'! Incidentally I might add that the 'young Flight Lieutenant from AEB' retired as an Air Marshal and even now in his eighth decade, continues to keep in touch with this ancient aviator.

Now and Then

Last month, after a gap of three years, I attended the bi-annual Combined

Marshal of the Air Force Arjan Singh presenting the Sword of Honour at AFA, Dundigal



Graduation Parade (CGP) at the Air Force Academy (AFA) in Hyderabad. Having been a Commandant of the AFA 31 years ago, I was of course quite familiar with the entire preparation and procedure for and final presentation of the CGP. However, over the years numbers have increased and now a total of 193 cadets (including 41 women) plus six naval aviators, all from eight different courses covering Pilot, Navigator and five Ground Duties specializations, were commissioned as Flying Officers into the Indian Air Force (IAF) by the Reviewing Officer (RO) who was Chief of Air Staff (CAS). As a visual spectacle the CGP, comprising a para-drop, flypasts, rotary wing formation flying and solo aerobatics by a high performance aircraft, together with a smart parade against a back-drop of aircraft, is a treat hard to beat even for vintage air veterans.

I happened to be seated next to a very senior, respected and much loved ex-CAS who, even now in his tenth decade, is as spry, fit and alert as ever. Though I was 10 years his junior, we reminisced about the changes in the IAF we had experienced and seen. He himself was commissioned 72 years ago in Ambala from No 11 Pilots Course (PC) as an acting Pilot Officer and sent into operations a week later as WWII was in progress! I recalled my relatively simple Passing Out Parade 62 years ago in Begumpet where 30 of us from No 58 PC were commissioned as Pilot Officers by Subroto Mukherjee in front of a small gathering of our instructors, their families, friends and a few visitors which included my parents, a four year old brother and a very young mulkhi school teacher who is now my wife of over 58 years! In those days it had been a tradition for newly commissioned pilots to present their new 'wings' to their flying instructor and receive, wear and retain his old one. I was one of two graduating pupils of the same instructor who had kept a second used wing in his pocket thus ensuring that we were both treated alike! It was a small, symbolic gesture but a high-value reminder of a never changing *guru-shishya* relationship.

On the evening of the CGP, a delightfully informal dinner was hosted by the CAS who incidentally is just a few years older than my son! He did comment on

the somewhat time consuming and tiring procedure of individual commissioning by the RO which involved removal of near 400 shoulder flashes to reveal Flying Officer rank badges, 200 handshakes / salutes, pinning-on of close to 100 wings / brevets and mentioned that the IAF was trying to find an acceptable alternative. There is nothing so permanent as change, so here is a thought to reduce time spent on the commissioning element of CGP:

'At an appropriate order from the Parade Commander, there is a roll of drums during which each graduating Flight Cadet, in a synchronized movement, will raise both hands to remove the white shoulder flashes, place them in his / her trouser pocket(s) from where a wing / brevet (if applicable) is brought out from the right pant pocket and affixed to the loop / hook on top of the left shirt pocket. All then continue to stand to attention attired correctly while the RO commissions them verbally and collectively into the IAF.'

Every now and then progress requires some change. The suggested change from individual to collective commissioning will save up to 20% in time and a great deal of wear and tear on the RO!

Lofty Thoughts

Among the 51 of us Flight Cadets who reported to the Air Force Academy in Ambala in early 1951, was a tall, fair, light-eyed gangly youth. His height immediately determined his sobriquet of 'Lofty' and compelled our short – statured Drill Instructor (DI) to nominate him as our 'Marker' (Lead-Man) on the parade ground. Lofty's good nature, agreeable temperament and cheerful disposition endeared him to everyone. He proudly confessed to being incredibly lazy and demonstrated it every morning by lying in bed in his uniform while the camp barber shaved him and his orderly fed him tea: yet he was never late!

Of Kashmiri ethnicity, Lofty was born and brought up in Rawalpindi and post-Partition, his family crossed over to settle in Agra where their proximity to the airfield motivated him to join the air force. His somewhat paternal attitude towards those of us a shade younger than him, and tendency to address us as 'Lads', earned him another nickname of 'Dad'. The strict ceiling on flying hours to be sent on one's first solo flight had reduced our

numbers and nearly 40% had been sent home. Both 'Dad' and I were still waiting to be sent solo so I asked him if he was concerned. 'No my lad' he replied 'if I am doing my best then being sent solo is my instructor's problem not mine!' (Many years later, as a flying instructor myself, I was to remember the intrinsic wisdom of this thoughtful response from a man of few words).

At the final rehearsal of our Passing Out Parade (POP), our harried DI stood looking up at Lofty and said 'Flight Cadet, day after tomorrow you will become an officer and I will make you smart if it is the last thing I do'. Drawled Lofty in reply, 'Sarge for 18 months you couldn't make me smart, how you will do so in two days?' All of us, including our DI, burst out laughing. Our POP went off well and, of the 30 of us who graduated, Lofty and I were part of the group of 13 who went on to fly single-engined combat jets in various squadrons. We met again as students at the Flying Instructors School where his sole complaint was the extra effort required to climb into the rear (instructor) cockpit. He went on to become a very successful flying instructor and held responsible appointments in training.

Once, travelling by train with our families from New Delhi, I went across to their coupe to find Lofty spread out comfortably on the lower berth while his very patient wife was perched precariously on the upper! Admonished for his ungallant behaviour he explained patiently, 'My lad I am too old to climb – you see, she is younger than me!' Post retirement, Lofty and I settled in our respective houses no more than 100 yards apart in the same housing colony and our granddaughters were playmates. He took up secretaryship of our local RSI for many years before relocating to Goa where the laid back, easy going life style suited him admirably. Some years later he became a widower but, escorted by a very loving and supportive daughter, he flew to Delhi to attend the Diamond Jubilee Reunion of our Pilots Course now reduced in number to 15 octogenarians!

Recently, Lofty visited us again and I was delighted to catch up with a course mate, friend and one of the few individuals I know who is blessed with the gift of contentment.

74 Years ... and counting

'Q' Flight, Indian Air Force, Drigh Road January 1940

On the outbreak of the Second World War, a detachment of 'A' Flight under the command of Flt Lt AB Awan moved from Ambala to Karachi, re-designated as 'Q' Flight, to carry out coastal defence duties and defend the Aircraft Depot at Drigh Road. They were equipped with the Hawker Hart.

This rare photograph was given to *The Society for Aerospace Studies* by Wg Cdr Kartar Singh who was also the first in the IAF to receive 'mention in despatches' for his part in the Waziristan operations, 1937, specifically for accurate bombardment of the Fakir of Ipi's headquarters.



(Standing – top) ACI Bashir Ahmed, LCA PK Balakrishnan, LAC Bhaskaran, ACI Kartar Singh, Cpl Kartar Singh, ACI Jaleel-ul-Rahman, Cpl Atma Singh, AC2 Kumaran Nair, LAC Mohammed Shah.
(Standing – middle) Cpl JR Weller, Cpl UK Nair, ACI A Ghattak, AC 2 Ghulam Rabbani, AC 2 Yusuf Ali, LAC Sewa Singh, ACI Darshan Singh, ACI GV Jaykant, AC2 Bhagwan Das, AC2 H Latimour, Cpl Pritam Singh, Cpl. GW Hall,
(Seated) F/Sgt G Cooper, F/O Mehar Singh, F/Lt Awan, AB, F/Lt, AB Mukerjee S, F/O H Khan, F/O Burhanuddin, P/O SN Goyal, Sgt Harjinder Singh.

25 Years Back

CAS Interview

Air Chief Marshal SK Mehra, the CAS, has stated that the Agni and Prithvi missile systems under development in India would be deployed by the IAF as soon as they are available.

About progression on the Light Combat Aircraft (LCA), the CAS was less enthusiastic. He cautioned that instead of entering into IAF squadron service by middle of the next decade, it was more likely that only the second half of the nineties may witness such a happening, "if everything goes well". And, if it does not, stated Air Chief Marshal Mehra, then "we may have to make some hard options" to meet the immediate requirements. The Air Chief also listed a "totally refurbished MiG-21" as among the important projects in the perspective plans of the IAF.

The Advanced Light Helicopter (ALH) will achieve IOC by 1991-92, but the Advanced Jet Trainer (AJT) is still some distance away, despite there being a pressing need to fulfil this requirement.

Contract for more MiG-29s

India has finalised a contract for the purchase of one more squadron of MiG-29 fighter aircraft from the Soviet Union in fly-away condition. With this, the strength of MiG-29s in the Indian Air Force will rise to three squadrons. The first two squadrons of MiG-29 were received in batches in the middle of 1987 and inducted into service in December that year.

The latest MiG-29s will incorporate "some improvements" over the previous batch. The Soviet Union is said to have indicated that it was producing another advanced version of the MiG-29 with higher fuel capacity to give the aircraft better endurance, range and with enhanced air-to-ground capabilities.

Prithvi's successful launch

The second test flight of the Prithvi surface-to-surface missile was successfully carried out on 15 September. Director of the IGDMP Dr. APJ Abdul Kalam, the Scientific Advisor to the Defence Ministry Dr. VS Arunachalam and Major General Sundram, among others, were present at Sriharikota during launching of the second Prithvi.

Decision on ALH's gun

The Government is to shortly make its choice on which 20 mm gun system will arm the attack version of the Advanced Light Helicopter (ALH). The ALH, being developed by HAL in cooperation with MBB of West Germany, will have a military as well as a civil version, for domestic use and export.

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Among the companies offering gun systems are General Electric (GE) of the United States and Giat of France. The former is offering its universal turret system (UTS), employing the M-197 20mm three-barrel Gatling gun, which also arms the AH-1 attack helicopters. Giat, on the other hand, is offering a single barrel 20mm weapon mounted in a newly developed turret.

LCA engine's FADEC tests

A ten-week breadboard FADEC test was recently completed at Bangalore's Gas Turbine & Research Establishment (GTRE), using the GTX-37-14U demonstrator engine. The system controlled engine light up, regulated stable acceleration, governed up to 80 per cent Nh, and controlled engine shut down. Phase two will include reheat and fuel-nozzle control.

The system will eventually be used on the production standard GTX-35VS engine, which is slated to power the LCA. The aircraft, scheduled to be qualified in 1992, may however be delayed, as a result of several sectors of the programme running behind schedule.

First indigenous submarine for Indian Navy

On 30 September the first SSK Type 1500 submarine was undocked and put to sea at Bombay. Named INS *Shalki*, the submarine was built for the Indian Navy by Mazagon Dock Limited (MDL) in technical collaboration with Howaldtswerke Deutsche Werft (HDW) of West Germany.

The submarine launched is the first of the first two SSK Type 1500s to be built by the MDL and carries a rescue sphere capable of ejecting all crew in any contingency. It had taken longer than "normal" to complete this submarine, work on which began in 1984, for it was the first boat of this type to have been taken up from indigenous construction. Constraints of depth at the dockyard led to its being built in a dry dock on a pontoon specifically designed for it.

NAL expands activities

The National Aeronautical Laboratory, which plays an important role in indigenous aerospace efforts has, in a significant achievement last fiscal year (1988-89) commissioned its second transonic tunnel designated H3. It is the largest high-speed facility designed and built entirely within the country.

NAL was given the responsibility to design, develop, construct and commission the new transonic wind tunnel. The cost of about Rs.2 crore was shared among Council for Scientific and Industrial Research and other major user agencies which included Indian Space Research Organisation (ISRO), Defence Research and Development Organisation (DRDO) and Hindustan Aeronautics Limited (HAL).

Martin-Baker Mk.10L seats for PAF F-7Ps

Martin-Baker has signed a contract with CATIC for 80 ejection seats with full support equipment for the Chinese Chengdu F-7P fighters being purchased by the Pakistan Air Force. This initial batch will be followed by at least 30 more, including some for the two-seat FT-7.

Pakistan was launch customer for the Mk.10 seat, fitted in their Shenyang F-6 fighters in 1973 and intends to retrofit M-B seats in other aircraft.

India's first combat aircraft



Move over, IAF historians ! So which was India's first combat aircraft ? Wapiti IIA ? Bristol Bulldog ? Sopwith Camel ? How far back can one go ?

Far enough : it was the Maurice Farman M.F.7 biplane, a handful of which accompanied the Indian Expeditionary Force to Egypt in late 1914, to defend the Suez Canal from the Turks who were allied with the Germans and Austrians during World War I . These aircraft were flown by British Officers of the Indian Army, the M.F.7s having been paid for by the Maharaja of Gwalior, whose interest in aeroplanes is legendary. The Maharaja also built an airfield at the outskirts of Gwalior, Maharajpur, which is today one of the IAF's foremost fighter bases, housing Mirage 2000s.

Mind It !



In July 2014, after the IAF announced launch of its mobile video game, 'Guardians of the Skies,' the application was finally available across all major platforms (Android, iOS and Windows Phone). Curiously, given that this is an "official" product, it features scenarios that had players in fits of hysteria,

as it depicted anti-piracy operations on the high seas conducted by Su-30s equipped only with unguided rockets and machine guns, along with oil rig ASW conducted by a Mi-17 transport helicopter.

Play on !

So help me God !

The US Air Force has recently told a sergeant he will have to leave the military unless he agrees to take an oath with the phrase "so help me God". In the latest



religious controversy to roil the USAF, the atheist airman has recently been denied his request to re-enlist because of his refusal to swear to God -- and he is now poised to take the military to court.

In the past, an airman could opt for an alternative phrase and omit the words "so help me God," but the US Air Force changed its policy in October 2013. The other branches of the American military do not require the reference to God and make the phrase optional. In the meantime, "a written legal opinion is being requested" from the Pentagon's top lawyer.

Old, Bold Pilots



"There are old pilots, and there are bold pilots, but there are **no old, bold pilots.**" So goes the saying with which most aviators were taught to fly. It was with this thought in mind that a handful of pilots of yore decided to meet to commemorate having beaten the odds themselves. What better name for such a group than "Old-Bold Pilots"?

In the fall of 1996, Pete Madison, a World War II Lightning pilot who had

flown with the USAAF's 475th Fighter Group, invited a small group for breakfast. From this humble beginning of about 10 pilots, sprang one of Coachella Valley's most successful social groups.

From the ground up, the 'Old Bold Pilots' was formed under one rule: "There are no rules!", only a desire to enjoy the company of fellow aviation enthusiasts, including lady pilots.

(The lead photo was sent by Dorothee Miller whose husband flew B-24 Liberators in World War II).

Rats !



It is probably the most clinching evidence yet that the beleaguered national carrier, Air India, is not quite a sinking ship - mixed metaphor notwithstanding - as some have been predicting.

Despite repeated snags in its Dreamliner aircraft and sporadic tales about the excesses of its crew members, a category of passengers considered as bellwether of any carrier's continued serviceability since time immemorial, have not deserted it: rats! On the contrary, vast amounts of these self-serving rodents - portrayed as willing to abandon spaces that are in danger of going under - apparently continue to repose their faith in Air India.

Sadly, they are not commercially significant passengers, otherwise Air India may have been happier about their endorsement. That the rats' penchant for Air India is probably directly related to the food served onboard could have also been spun as a plus point, had the rats been known for their fastidious palates, but they are as partial to copper wires and synthetic carpets as to asparagus and bread rolls.

(From Economic Times)

Afterburner

Recaro

Shinmaywa