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Cover: Saab's next generation Gripen E fighter, which was rolled out on 18 May 2016 (photo: Saab)

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IAF in downward spiral

Two recent presentations made by defence minister Manohar Parrikar to Prime Minister Narendra Modi have had one focus: the crisis within the Indian Air Force. This escalation of the IAF's troubles to the highest political authority's attention highlight the fact that worry has now turned into consternation. The IAF is eleven squadrons short of its sanctioned strength : it has just 31 fighter aircraft squadrons against the sanctioned force of 42 squadrons. Within the next few years, all its vintage MiG-21 and MiG-27 fighters will be retired. Sluggish domestic production means that their intended replacement, the indigenous Tejas LCA will take over a decade to fly in. Serviceability of the IAF's mainstay of over 200 Su-30s is a cause for concern as are delays in a programme to jointly develop futuristic fifth-generation fighter aircraft (FGFA) with Russia.

"Our numbers are not adequate to fully execute an air campaign in a two-front scenario," Vice Chief of Air Staff Air Marshal BS Dhanoa said at a press conference in New Delhi. (The defence ministry's operational directives of 2009 require the armed forces to prepare for simultaneous war with China and Pakistan). "Probability of a two-front scenario is an appreciation you need to do. But are the numbers adequate? No. The squadrons are winding down," he stated.

The IAF's troubles come at a time when Pakistan and China are transforming their air forces quantitatively and qualitatively, narrowing the gap between the IAF and the PAF and the PLAAF. Pakistan recently ordered a fresh batch of F-16s from the US and will complete upgrading its existing fleet of over 80 F-16s, supplemented by the Sino-Pak JF-17. China in turn will field close to 800 fourth and fifth generation fighters by 2020.

For a service which began an ambitious transformation a decade back, the IAF has made some strategic blunders. One of the biggest mistakes was in its long-delayed quest for multi-role combat aircraft. This began as a straightforward requirement for 126 Mirage 2000 fighters in 1999 which turned into a decade-long multi-cornered fight for an M-MRCA, the contest lasting over a decade, with costs ballooning to a monstrous $25 billion before the Modi government pulled the plug on it.

Then came an announcement by the Prime Minister during his state visit to Paris last April that India would directly buy 36 Rafales, just a quarter of the original number with no production in India. A year later, the contract is yet to be signed but indications are, after months of negotiation, the price has reportedly come within sight of the $ 9 billion that the Indian government is willing to pay France. Even if the Rafales do come, the IAF will have a long way to go to build up its required strength.

If the IAF's free-falling fighter fleet numbers evoke *deja vu*, it is because the force has wrestled with the crisis in numbers ever since it began retiring its first MiG-21s around a decade ago, and its replacement, the LCA, stayed years away from induction. A few years from now, this crisis will peak when all obsolescent fighters are phased out of service faster than they can be replaced, leaving the IAF with an existential dilemma. A parliamentary standing committee report on defence presented before the Lok Sabha in February this year mentions the IAF's strength will sag to just 25 fighter squadrons by 2017-18.

The IAF is trapped between costly imports on the one hand and the dysfunctional public sector monopoly of HAL on the other. The IAF placed orders for two squadrons of 40 LCAs on the Aeronautical Development Agency in 2007. Till date, just one aircraft has been delivered. Air Vice Marshal (retd) Kapil Kak, formal additional director of Centre for Air Power Studies, traces the root cause of the IAF's woes to the decades-old practice of research/production agencies overestimating indigenous capability and delivery timelines. "It is this 'overpromise-underdeliver' syndrome, never questioned by political leadership, that has brought the IAF to this sorry pass," he rues.

The contract to buy the modest number of Rafales, however, has no transfer of technology clause. This means India cannot repair and upgrade the aircraft. Hence, the government is now again on the lookout for another new fighter to fill in the gap. Late last year, defence minister Parrikar made an intriguing statement, that India was looking at 'one or two' light fighters to build in the country under 'Make in India'.

Parrikar has effectively restarted the Medium Multi-role Combat Aircraft (MMRCA) campaign but under the benign auspices of his government's 'Make in India' campaign. Three of the fighter types in competition with the Rafale in the MMRCA contest are back with offers to build their aircraft locally with attractive offers for transfer of technology. In the past few months, executives from Boeing, which makes the F/A-18 Super Hornet, Lockheed Martin, manufacturer of the F-16, and Sweden's Saab which makes the Gripen, have made interesting presentations and lucrative offers. The foreign aerospace firms would partner with private sector firms to make the aircraft in India, thereby reducing the IAF's dependence on HAL. A new waiting game for the IAF may just have begun.

Extract from an article by Sandeep Unnithan, in India Today

India and US need some space now

On the eve of his latest visit to India, US secretary of defence Ashton Carter spelt out the American perspective on ties with India at a meeting at the CSIS in Washington DC. Cutting through the hype, he said that while the US was looking for "closer and stronger" relationship with India, it was not looking for "anything exclusive", beyond what emerges from the convergence of interests in the US pivot to Asia and India's 'Act East' policy.

Actually, at this juncture, both New Delhi and Washington need some space from each other. Moves by the US to boost its ties with Pakistan through new arms packages, aimed at prodding Islamabad to get the Taliban to the negotiating table, don't quite gel with Indian-American strategic ties.

Clearly, Indian and American views are at variance here, because New Delhi is sceptical of Islamabad's peace-making credentials and does not believe in the concept of the 'good' Taliban and the 'bad' Taliban. The recent hyphenating of India and Pakistan on the nuclear issue, too, have not been taken kindly by New Delhi.

But Carter's mission is to line up India for shoring up a coalition to confront China in the South China Sea. Last year, during President Obama's visit to India the two sides adopted a *Joint Strategic Vision* for the Asia Pacific and the Indian Ocean. On security issues, they affirmed "the importance of safeguarding maritime security and ensuring freedom of navigation and overflight throughout the region, especially the South China Sea." Clearly the American push for joint patrolling comes from our own commitment to them.

Since last December, the two sides have been discussing the joint patrolling issue to underscore their common support for the freedom of navigation of the seas. Earlier in March, defence minister Manohar Parrikar appeared to downplay the issue. At a press conference, Parrikar said, in something of a *non sequitur*, that India was into joint exercises

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with the US and had not yet taken part in joint patrols; "So the issue of joint patrols at this time does not arise."

While New Delhi may patrol wherever it wishes with the US Navy, it would have to carefully think through the consequences of patrolling in the South China Sea, because through the Nine Dash line, Beijing claims almost the entire South China Sea. At present it is incrementally, but clearly, enhancing its military capacity there. An Indian military presence there could well result in a Sino-Pakistani riposte in the seas adjacent to India.

My view is not that New Delhi should back away at the prospect of Sino-Pak retaliation, but that it should carefully work out its responses to the escalatory steps it may confront thereafter.

It is in this context that the other elements of the Carter agenda come through – the need to press India to sign a number of foundational agreements to enable the US and Indian military to operate together effectively, especially in an operational scenario. In themselves, the agreements are not particularly onerous. Especially if you take the view that they will not tie you down, if you do not wish to be tied down. That is the big lesson India must learn from the US relationship with Pakistan.

As for the other key element, especially dear to Ash Carter, the Defence Trade and Technology Initiative (DTTI), we need to cut through the verbiage and understand that no one, but no one, gives away technology. For this reason, the DTTI will never quite live up to its hype. To generate defence technology, India needs to go up the long hard climb to first become part of the American/Western production and supply chains, and simultaneously provide strategic R&D funding to Indian firms, technology institutions and universities and, perhaps, see the results 20 years down the line.

One of the big gaps in the Indian-US security engagement is the lack of any significant cooperation in the Persian Gulf and the Arabian Sea. The US needs to be reminded that the 'Joint Vision' also covers the Indian Ocean. Little or no discussion goes on here because the US military engagement with India is confined to its Pacific Command which stops mid-ocean at Diego Garcia.

Prime Minister Modi has recently taken bold steps in reaching out to the UAE and Saudi Arabia, now he must leverage the US partnership to make deeper Indian economic and security inroads into the region, which is by far more important to us than the South China Sea.

In its ties with the US, New Delhi needs to think and act strategically. The US desire to come closer to India presents great strategic opportunity for India and we would be criminally negligent if we did not take it. But whether it is in the area of geopolitics, or technology, India needs to have a clear-cut set of goals with five-, ten- and 15-year markers to guide us along.

Dr. Manoj Joshi in Mail Today

The launch of Navic

The Indian Space Research Organisation (ISRO) has launched the seventh and last satellite required to set up India's own satellite-based navigational system, which should be fully operational within a few months. The Indian Regional Navigation Satellite System, which has been named Navic (Navigation with Indian Constellation), will offer accurate positional coverage within the Indian territory and roughly 1,500 km beyond India's borders. With this, India also joins a select club of nations since Navic will eventually offer services similar to the American GPS, Russia's Glonass, Europe's Galileo and China's BeiDou. All the other systems are designed to offer global coverage by deploying over 25 satellites, while the seven-satellite Navic will focus on coverage on and around the Indian subcontinent.

Like GPS, Galileo and Glonass, Navic will offer different categories of services. Some of these would be free and others would be available at a price. The claimed minimum positional accuracy of 20 metres for the generic service is much less impressive than GPS and Glonass standards, which have an accuracy average of between five and 10 metres. However, Navic in reality, should have an accuracy of five to 10 metres, within India's land borders and territorial waters. The restricted services, meant for the national security forces, would offer positional accuracy of an order that is currently not available. Navic is, in fact, considered a security imperative. The GPS or Glonass don't make their most highly accurate offerings available, except to their own security forces. Indeed, there are no guarantees that even the public services of those systems could not be shut down at will, sending users into crisis.

From *Business Standard*

National Insecurity

"Something is seriously wrong with our counter-terror security establishment," Parliament's Standing Committee on Home Affairs has lamented in its latest report. Faced with the questions many Indians have been asking about January's attack on the Indian Air Force base in Pathankot—how the border was so easily penetrated, and why the base's perimeter was so poorly guarded—the standing committee has, however, only platitudes to offer. Its calls for more effective police action against cross-border trafficking, to "effectively seal the border" and for "better intelligence and operational coordination" have been made dozens of times before—to little avail. The truth is that the resources to do what the committee knows needs doing just do not exist. Had it dug further, it would have discovered that Punjab Police patrol vehicles were operating for just a few hours a day because of chronic budget shortfalls that have meant funds are not available even for fuel and maintenance needs. It would have found that the BSF is desperately short of officer-rank personnel. And it would have found that the IB and R&AW are over a third short of staff allocations that were, in any case, drawn up for peaceful times when India did not confront significant terrorist threats. Throughout the security sector, the committee would have discovered, training standards are being diluted, and specialist skills are in short supply.

The real scandal is that it has taken so long for Parliament to wake up to the problem—and that it still isn't demanding accountability. For decades now, flag-waving has been allowed to gloss over gross failures in security management. The disgraceful early conduct of the Kargil War by top military commanders, documented in scholarly work and legal proceedings in the almost two decades since, was never punished. There was no serious audit of the manifold failings of the Mumbai Police and NSG during 26/11, nor a lessons-learned exercise. In the case of Pathankot, the home ministry has been spending a great deal of energy on explaining to a bewildered nation how elite forces spent over 24 hours firing on a building from which not the smallest trace of weapons or explosives has since been recovered.

The problem has been a simple one: Accountability can't be demanded unless security forces are given functional autonomy, and credible resources to go with it.

From *The Indian Express*

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Are We on the Road to Perdition?

Admiral Arun Prakash on India's Civil-Military Dissonance

India's Republic Day, on 26th January 2016, was celebrated with traditional pageantry and the citizen got a panoramic view of the country's military capability. Intelligence inputs had warned that it would be yet another test for the security apparatus and the whole nation remained on tenterhooks. The occasion was also an opportune occasion for introspection and review of how India has dealt with its complex security challenges, so far. Regrettably in India's National Security 'Hall of Shame' we can now add, 'Pathankot 2016' after 'Kandahar 1999', 'Parakram 2002' and 'Mumbai 2008.'

Given that India is a nuclear weapon state, which fields one of the world's largest armed forces and spends upwards of $40 billion annually on defence, one cringes at accounts of our seemingly inept handling of yet another terrorist attack. Equally disheartening is the fact that, eight years after 26/11, we lack the ability to deter the architects of this attack, and the will to punish its perpetrators.

It is a matter of sheer good fortune that the cross-border terrorists who managed to enter the Pathankot air base failed to target aircraft, helicopters and missiles as well as the huge bomb-dump and fuel-storage facilities. We overlook the fact that some of our air bases, adjuncts to the nuclear deterrent, may also house nuclear warhead components. So, while cautioning the world about the dangers of Pakistani warheads falling into jihadist hands, we need to ensure that a similar fate does not befall our own.

The calibre of a nation's leadership is tested by a crisis. Whether it is floods, an aircraft hijacking or a terror strike, India's response to any crisis has followed a depressingly familiar sequence. Regardless of intelligence inputs, the onset of a crisis finds multiple agencies pulling in different directions, lacking unitary leadership, coordination and, above all, a cohesive strategy. Ad-hoc and sequential damage-control measures eventually bring the situation under control, with loss of life and national self-esteem. After a free-wheeling blame-game, the state apparatus relapses into its comatose state - till the next disaster.

From the media discourse, it appears that this template was faithfully followed in the Pathankot episode. While the military has due processes for learning from its mistakes and dealing with incompetence, one is not sure about the rest of our security system.

Whether or not India-Pakistan peace talks are resumed, the Pakistani 'deep state' perhaps has many more 'Pathankots' in store for India. For Pakistan's Inter-Services Intelligence (ISI), cross-border terrorism is an inexpensive method of keeping India off-balance. The strategy of plausible deniability and threat of nuclear 'first-use' assures them of impunity from retribution. Such situations call for all components of India's national security, military, intelligence, bureaucracy, central and state police forces to work in the closest synergy and coordination. Regrettably, civil-military relations have, of late, been deeply vitiated and the resultant dissonance could

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have adverse consequences for the nation's security.

What is worse, civil-military recriminations, so far confined within the walls of South Block, seem to be proliferating. Post-Pathankot, the constabulary has jumped into the fray and, if an intemperately-worded newspaper article by a serving Indian Police Service (IPS) officer is an indicator, civil-military relations may be entering a downward spiral. This outburst should compel the political leadership to undertake a re-appraisal of the prevailing civil-military equation which contains many anomalies; one of them being the role of the police forces, whose numbers, have been steadily boosted to almost match those of the army.

Democracies, worldwide, seek to ensure that an unmistakable distinction is maintained between the appearance and functions of the military and civilian police, the latter being charged with the maintenance of law and order, crime prevention/investigation and traffic regulation et al. India's unique security compulsions have seen the Indian Police Service (IPS) not only retaining the colonial legacy of sporting army rank badges and star plates but also garnering unusual influence in national security matters over the years.

Many of our Central Armed Police Forces (CAPFs) have attempted to blur the distinction between police and military; terming themselves 'para-militaries', with constables wearing military style combat fatigues and being addressed as 'jawans' (a Hindi word, traditionally, used for 'soldier'). There are only three, duly constituted, para-military forces in India: the Coast Guard, Assam Rifles and the Special Frontier Force, headed, either by military or their own officers. The five CAPFs, namely BSF, CRPF, ITBP, CISF and SSB - cumulatively over a million strong - are headed exclusively by IPS officers.

The knee-jerk deployment of the army, in response to the February 2016 Jat stir in Haryana, brought to fore a number of thorny issues: (a) use of the army as a 'first responder' to quell civil disorder – clearly a police function - was legally and ethically inappropriate; (b) allowing police indiscipline and cowardice (as seen on video clips on the Internet) in the face of riotous mobs to go unpunished was a reprehensible act on the part of Haryana government, and (c) the fact that army columns had to

display placards with ARMY written on them, showed the serious damage done by the Home Ministry permitting CAPFs to copy military uniforms and badges.

The deployment of CAPFs in border-guarding as well as counter-insurgency roles calls for military (read infantry) skills; for which neither the police constables nor officers receive adequate training. This lack of training and motivation as well as a leadership deficit has manifested itself inthese forces repeatedly suffering heavy casualties (confined only to rank and file constables) in Maoist ambushes; and in recurring instances of infiltration taking place across borders guarded by CAPFs.

One has often heard senior police officers bemoaning non-implementation of the 'Prakash Singh Committee Report' and blaming 'political interference' for all ills of our police forces. Perhaps it is time, for them, to start introspecting about the quality of leadership – at all levels of IPS officers – that is being provided, to lead the constabulary of our police as well as our million-strong CAPFs.

In the case of the anti-terrorist National Security Guard (NSG), its combat capability is drawn, on deputation, from the army; yet, by government mandate, it is headed by a police officer. The fact that this elite force has seen 28 director generals in 31 years makes one wonder if round holes are being filled by square pegs.

A second anomaly in the civil-military matrix pertains to the fact that the Government of India 'Rules of Business' have designated the civilian secretary heading the defence ministry as the functionary responsible "for the defence of India and for the armed forces". Since no military officer, including the three chiefs, finds mention in the Business Rules, the Service HQs are subaltern to a 100 percent civilian ministry. Every major decision - whether it pertains to finance, acquisition, manpower or organisation - requires a ministry nod which can take decades. There has never been a uniformed representative of the armed forces, either on any pay commission, or on the committees, invariably constituted, post-pay commission to address the anomalies pointed out by the military.

A false and dangerous belief prevails on Raisina Hill that civil-military relations constitute a zero-sum game in which 'civilian control' is best retained by boosting the bureaucracy and police at the expense of the military. Post-independence, the civil-military balance has been steadily skewed by pushing the military officer well below his civilian counterparts with the same years of service. The recommendations of the 7th Pay Commission Report have been seen as discriminating blatantly against the armed forces in, yet another, attempt to downgrade them vis-a-vis the IAS and IPS cadres.

This has served to aggravate the deep resentment existing in the military, at the raw deal being consistently being given to them post-independence. The resultant hierarchical distortion could lead to a civil-military logjam, the last thing the nation needs at this juncture.

It is high time the Indian politician sheds his traditional indifference to national security issues and faced reality. He needs to initiate tangible measures to ensure a stable and equitable civil-military paradigm - one which ensures a say for the military in matters that impinge on the nation's security and call for their expertise. Until that happens, Republic Day parades will remain a vain and glorious display of hardware and pageantry, while the nation's security remains in parlous straits.

OPINION

Sacred contract

Air Marshal Brijesh Jayal on the importance of viewing debates from a wider perspective

Judging by the high-decibel debates and over-the-top coverage of some recent controversies, it has appeared for some months now that the Indian nation is at war with itself. When high-profile television anchors choose to start a prime-time debate with the words, "I am very angry today", or suave anchors choose to remind viewers that the entire international media are looking at India with considerable concern, clearly the stage is being set for a one-sided debate. The latest in this series is the recent happening in the Jawaharlal Nehru University campus that morphed into a debate on what constitutes nationalism.

As one with little pretence of knowledge of university campus life or indeed of the intellectual world beyond, one was not really qualified to enter this debate. It is, however, the adverse reactions to the observations of the Delhi High Court when granting conditional bail to the president of the JNU students' union - where Justice Pratibha Rani has invoked the sacrifice of the armed forces - that have prompted this piece.

To begin with, so consumed did we get with the issue of intolerance that many a distinguished intellectual chose to return their national awards and a delegation representing writers, artists, scientists and academics called on the president, submitted a memorandum and thereafter issued the statement saying that President Pranab Mukherjee has said that the return of awards by writers and intellectuals was "evidently spontaneous" and a way of protest that has triggered a nation-wide debate on the issue of intolerance. Strangely, not many objected to the slight to national honour with national awards being summarily returned in a pique of spontaneity.

Whether or not this storm in a tea cup resulted in any change in the national tolerance index is difficult to say, but soon the issue appears to have receded into the background, presumably because another one had presented itself in the form of the suicide of Rohith Vemula, a Dalit PhD scholar who had been expelled by the University of Hyderabad, where trouble had been brewing amongst political student factions for the past year. His suicide sparked outrage as an example of caste-based discrimination in elite educational institutions. Politicians, not wanting to miss the photo opportunity, descended in hordes, shedding crocodile tears. What they pretended not to know was the information given out by members of the Ambedkar Students' Association of the university that the phenomenon was not new and as many as 12 students belonging to the scheduled castes had taken a similar tragic step since the university came into existence in the early 1970s. But statistics like this, or the one by the blog, *Aasra: Helping People in Despair,* that quotes health ministry statistics of 16,000 student suicides across the country in the three years before 2013, are of little interest to those who grieve not for the tragedy of Vemula losing his life or of Dalit discrimination, but delight at the political opportunities it affords. The issue finally reached Parliament and was the subject of a debate following which one can predict that nothing is expected to materially change, and statistically, every 90 minutes a teenager will continue to attempt suicide in the country.

Even before Vemula could fade from national conscience came another golden opportunity in the form of some students in the prestigious JNU choosing to commemorate the hanging of Afzal Guru - during which patently anti-India slogans were raised. One is consciously avoiding the term, 'anti-national', although, as a military veteran of 40-years' standing one sees no difference between the two! As it happened, around the same time, a story of another kind was also unfolding and vying for media space. Lance Naik Hanumanthappa Koppad, who, along with nine other colleagues, had been buried under an avalanche at a Siachen post and presumed dead, was found alive after six days and rushed to the Army Research and Referral Hospital in Delhi - a stone's throw from the prestigious JNU campus - where he battled for life. The sharp contrast between these two stories playing out in the capital, one of selfless courage, sacrifice and human endurance at the alter of national security and the other of an anti-India rant of " *Bharat ki barbadi tak jang rahegi*" and "*Bharat tere tukde honge: Inshah Allah, Inshah Allah*" under the umbrella of constitutional freedom of free speech, was hard to miss.

Whether the law-enforcement agencies over-reacted in booking the JNUSU president and others for sedition or whether the anti-India slogans were seditious or not is for the judiciary to decide. The concurrent news of these two happenings, one involving a prestigious and highly treasured institute of higher learning where free thought and speech flow and another of the institution of the armed forces where, under impossible human conditions, individuals are ready to lay down their lives mostly unsung, made comparisons inevitable. Sensibilities of those who

genuinely care for the safety, honour and welfare of the country (a military man's uncluttered understanding of what is national interest) could not but have been hurt on learning of the anti-India slogans. But to those starved of a cause after the intolerance and anti-Dalit student issues had been milked dry, the very meaning of nationalism became the next rallying point.

It is perhaps with this sensitivity at the back of her mind that Justice Rani, whilst delivering the Delhi High Court judgment granting interim bail to the JNUSU president, went at some length to delve into the larger national security issues at stake. She mentioned that "it has to be kept in mind by all concerned that they are enjoying this freedom only because our borders are guarded by our armed and paramilitary forces". She also noted that such persons enjoy the freedom to raise such slogans in the comfort of university campus without realising that they are in this safe environment because our forces are there at the battlefield situated at the highest altitude of the world where even oxygen is so scarce that those who are shouting anti-national slogans holding posters of Afzal Guru and Maqbool Bhat close to their chest, honouring their martyrdom, may not even be able to withstand those conditions for an hour. Finally, she cautioned that the "kind of slogans raised may have a demoralising effect on the family of those martyrs who returned home in a coffin draped in the Tricolour," and concluded that "thoughts reflected in the slogans raised by some of the students of JNU, who organised and participated in that programme, cannot be claimed to be protected as fundamental right to freedom of speech and expression".

Yet, in keeping with the trend of idolising the JNUSU president and others under the constitutional umbrella of freedom of speech, these remarks have been roundly criticised by many a distinguished commentator, with some eminent lawyers nitpicking on legal niceties and even terming such comments as bad judgment.

One stakeholder conspicuous by its absence in this entire debate is the institution of the armed forces, not because its members are not seeing, hearing and thinking, but because their conditions of service put limitations on their freedom to speak in public. On their behalf, one can say with some confidence that this one observation by the learned justice has given them solace that at least one vital pillar of our democracy understands their value and cares for their sacrifice.

It is also a safe bet that most of those exercising their freedom to chant about the breaking-up of India are not aware that a majority of military officers are graduates from the National Defence Academy or other military institutes that are constituent institutes of JNU and hold degrees recognised by their own revered university. Although in hindsight, one can venture to say that mercifully this is not through the luxury of living in their campus, but in a more rigorous, frugal and real-world environment.

Since national security rests on the morale and professionalism of our men and women in uniform, and since the above and other associated observations of Justice Rani have drawn widespread criticism, a perspective of this unfortunate episode from their viewpoint merits mention.

Armed forces draw heavily on the trust and support of the civil society that maintains them. They repay this trust through their voluntary commitment to a sacred contract of unlimited liability, the foundations of which are based neither on the laws of the land nor on rules of service, but on mutual trust and moral and ethical conduct on the part of both parties. Lance Naik Koppad and his dead colleagues were merely honouring their part of this sacred contract. Those indulging in anti-India slogans in the campus and their many cheerleaders outside were clearly breaching the moral and ethical part of theirs.

The day the armed forces begin to believe that the society is tolerant of those who idolise convicted terrorists and call for the nation to be broken up, there is every danger of the mutual trust between the society and the armed forces coming under stress or even breaking down to the detriment of this sacred contract. Where does that leave the nation and its security? Justice Rani seems to have cast her vision beyond legal technicalities and seen this issue within the larger canvas of national security at a time of ever worsening international security dynamics where non-State actors are becoming a predominant threat to nations and their people from within. Many others have chosen to miss the point.

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J & K : The External Machinations

Among the many grave challenges that India continues to confront since independence is not only the absence of the desired degree of emotional integration of some in the state of Jammu & Kashmir (J&K) with its mother nation but also the serious security ramifications emerging for India from this restless state. That India's multi faceted problems since J&K's legal, albeit tumultuous accession to India in 1947, are primarily attributable to external machinations is a well accepted universal fact. That India has successfully thwarted Pakistan mounted aggression in 1947-48, 1965, 1971, 1999 respectively and contained Pakistan's enduring well crafted terror and insurgency in India's northern and vitally strategic state of J&K, should keep India constantly vigilant about Pakistan's perennial mischief in J&K– will be the least India can do. That India appears to be reactive and not pursuing a long term, consistent and a coherent policy for J&K, notwithstanding changes in governments at Delhi and Srinagar is also the stark and bitter truth.

A simplistic yet inalienable fact of J&K's time honoured philosophy is that its ethos of 'Sufism' and 'Kashmiriyat' is far closer to India's multi plurality than to the fundamentalist and exclusive orientation of the Pakistani state. Thus India needs to introspect, that despite the natural Kashmiri affinity for the Indian way of life, why even 68 years after Indian independence and J&K's accession to India, there exists, off and on, turbulence and unrest in J&K and antagonism against its parent nation. Additionally, it will also be prudent to ponder whether these values still resonate with 65 per cent of the Kashmiri populace, now under 35 years of age, and grown up in an environment where Islamic radicalism is ascendant, both in the neighbourhood and across the Islamic world. Is extremist Salafist Islam more appealing to the Kashmiri youth of today than the Sufism of their ancestors ?

It will be reiterating the obvious that the problem in Kashmir (the internal dimension) is inextricably linked to the problem of Kashmir (the external dimension). By effectively addressing the former, employing the vast resources and genius of the state, will go a long way in thwarting external machinations. However, blaming only external factors for the current mess in J&K would be an utter folly which decision makers, both at the centre and the state, often tend to take shelter behind !

Current situation in J&K

Since its violent birth in 1947, Pakistan has been overly obsessed with J&K and made Kashmir the main agenda point governing its turbulent relationship with India, reducing India-Pak relations to a zero-sum game. Pakistan's infamous spy agency, the Inter Services Intelligence (ISI) has been stoking the fires of unrest and insurgency in J&K, since decades by employing both Pakistani terrorist non-state actors like the Lashkar-e-Toiba (LET), Hizb-ul-Mujahideen (HUM), Jaish-e-Mohd, Al Badr and local anti-India separatists like its old war horse Syed Ali Shah Geelani, Yasin Malik, Shabir Shah, Masrat Alam, Asiya Andrabi and those of the moderate Hurriyat like Mirwaiz Umar Farooq, Abdul Ghani Lone, Abdul Ghani Bhat among others, to pursue its nefarious agendas in J&K, especially in the Valley. That despite the terror incidents and fatalities figures having registered, overall, a downward trend since the last many years, newer contours of terror and violent incidents in J&K have distinctly emerged in 2015.

Notwithstanding the high turnout in the state elections to the J&K Assembly in late 2014 (around 65 per cent) and the formation of a state government spanning different ideologies, namely of the local PDP and the right wing BJP, this has not brought the desired results in governance in J&K. Has this coalition of unlike-minded parties been merely a marriage of convenience and power sharing or can it prove to be a historical and unique exercise to bring peace and stability to the turbulent Valley? The current situation and the results on the ground, however, do not display much optimism.

Although terror incidents inside J&K have been on the decline since some years, regrettably, the number of ceasefire violations along the line of control (LOC) and the international border, both well demarcated otherwise and fenced, registered a sharp increase in the last few months. Pakistan resorted to frequent machine gun, mortars and artillery firing along the LOC and IB targeting innocent civilians. Indian retaliation would also have inflicted unnecessary suffering on Pak civilians located in villages along the borders and Pakistan needs to factor in the futility of such meaningless duels along the borders. The reason for Pak enthusiasm to indulge in ceasefire violations has been primarily to keep the Kashmir issue alive internationally, besides provision of covering fire to support infiltration and thirdly to keep the pot boiling even for poor civilians who reside on both sides of the LOC and IB.

Another ominous development has been the resurgence, especially after Friday prayers at a few Sunni mosques in the Valley, of Pakistani flags and now alarmingly ISIS flags. Pelting of stones at the local police and sporadic Pak flag waving has been the tactic of local separatists, on instructions from their masters from across, but the intensity of these incidents appears to becoming alarmingly high which Indian security agencies need to analyse and firmly curb. However, it must be noted that the marked influence of the separatists is restricted to only five districts out of the twenty-two in the state.

The China-Pak Nexus and J&K

The Chinese and Pakistani military nexus goes back over 50 years having been cemented by Pakistan unilaterally and illegally ceding 5180 sq kms of territory in the Shaksgam Valley from their occupied part of J&K to China in 1963. Since the visit of Chinese President Xi Jinping in April 2015 to Pakistan and the announcement of Chinese investments of over US $ 46 billion as part of the China Pakistan Economic Corridor, linking Xinjiang with Gwadar Port, Pakistan has been in raptures economically and strategically speaking ! This so called 'Silk Road and Economic Belt' will be running through restive Gilgit Baltistan—Pakistan Occupied Kashmir and thence through the insurgency hit Balochistan.

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A consequence of the Chinese President's visit has been a distinctly emboldened Pakistan adopting a far more strident anti-India stance, including raking up the Kashmir issue in the UN, in spite of the fact that the UN had taken off J&K in 2010 from its Disputed Territories List.

According to authentic reports, including from the US media, China has stationed nearly 50,000 troops in Gilgit-Baltistan and POK, masquerading as a labour and engineer force, ostensibly to build infrastructure along the Karakoram Highway whilst having taken a 50 years lease of this region from Pakistan. In addition, China will reportedly be deploying its troops in this area to curb any anti-China activity by the Uighur militants of the East Turkmenistan Force. The presence of large Chinese forces, immediately in our northwest and in the disputed territories of the erstwhile J&K state, obviously has serious security concerns for India.

Armed Forces Special Powers Act (AFSPA)

The, retention or otherwise, of the AFSPA in J&K has been extensively debated since some years with some improvement in the overall security situation in J&K, some advocating lifting the AFSPA from the interior districts of the state while retaining it in the border districts of the state.

The AFSPA was enacted by the Indian Parliament in September 1958 and confers special powers to security forces operating in "disturbed areas"– which the Governor of a state can certify/declare. It must be understood that this Act is central to the operations of the security forces who require some legal immunity while operating in areas afflicted by terror and insurgency. However, some state governments, NGOs and leading human right activists have unfairly dubbed this Act as 'draconian' which confers on the Armed Forces a 'licence to kill.' It is perhaps not known to many that it is only the Indian Army, in the entire history of global operations against insurgency and terror, that has not used heavy weaponry or air power (except once in 1955 against Naga rebels) in anti-insurgency operations. From personal experience of J&K and Nagaland, this writer can state with pride and conviction that the Indian Armed Forces use the maximum restraint while dealing with indigenous insurgents as they are our own misguided people. However, as and when the situation further improves, there will be no harm in our hierarchy, both political and of the Armed Forces, re-visiting the need of the AFSPA in the entire state of J&K. In fact, the Indian Army will be more than glad to let the state police and the para military forces totally take over the counter-insurgency grid.

Article 370

Article 370 is a law in the Constitution of India which grants special status to J&K within the Union of India. This law ordains that except for foreign affairs, defence, finance and communications, the state government's approval will be required by the Indian Parliament or the Central government for introduction or application of any other laws on aspects/issues other than mentioned ibid. Article 370 falls under the Constitution of India's Part XXI called 'Temporary and Transitional Provisions.' On 27 November 1963, Pandit Nehru himself had confirmed in Indian Parliament that "Article 370 would be eroded progressively". But as the years have passed, Article 370 appears to have become effectively permanent and for the local political leaders of the Kashmir Valley, an emotive issue. They insist that any repeal of Article 370 will have severe repercussions regarding the status of accession of J&K to the Union of India.

The BJP government, during their last general elections campaign, had advocated the repeal of this Article but, after coming to power, not much importance is being accorded to it by either the BJP or the Opposition parties. Anyway, it is hardly the time for even Article 370 to be discussed and its nuances could be left for latter years for the nation to re-visit.

Handling local separatist leaders

This has been an area where the local state government and equally the Centre have continually faulted since decades. As India is a vibrant democracy and dissent is permitted, everyone in the state and the nation has the privilege to express their opinions and vent their anger. But dissent cannot take the shape of sedition and thus all anti-national activities must be curbed with firmness and legal propriety. India must not allow any meetings and confabulations between local separatist leaders and visiting Pakistani leaders or with their High Commission staff in New Delhi. Reciprocity is the principle in Diplomacy and Pakistan does not allow our High Commissioner in Islamabad to meet Baluchi or Sindhi nationalists or any MQM anti Pakistan leaders. In addition, the financial transactions of Indian separatist leaders should be constantly monitored, and if they are found to be indulging in anti-national activities, should be dealt firmly under the law of the land. "House arrests" in Srinagar do not serve any purpose.

Rehabilitation of Kashmiri Pandits

Militancy which hit the state in the '90s had led to over 3 lakh Kashmiri Pandits (KPs) leaving their ancestral homes in Kashmir and fleeing to places outside the state or taking shelter in refugee camps in the Jammu region. Some of the KPs yearn to return to their roots but are anxious about their security. Most old locals want them to come back to their old homes in the rural areas or in the walled city of Srinagar whereas the state govt has offered to build small composite townships for them on grounds of security. Thus the situation appears rather uncertain for the KPs, who though wish to return but fear for their security and the impasse continues. Most young KPs are unclear as to the employment opportunities for them in the state. Thus, regrettably, the ethnic cleansing, which the militancy generated in the '90s appears to have been made permanent with KPs becoming refugees in their own land ! Anyway, KPs must also not succumb to the temporary safety of 'ghettos' which the state government appears to be encouraging.

Unrest in PoK and Gilgit-Baltistan

The area referred to now as Pakistan Occupied Kashmir (POK) and Gilgit-Baltistan (GB), earlier known as Northern Areas, were also part of the erstwhile princely state of J&K when the ruler of J&K, Maharaja Hari Singh had signed the Instrument of Accession with India in October 1947. As the Indian Army had not completely cleared the entire state of Pakistani invaders in 1948 with the ceasefire being enforced, the status of GB and POK as part of the erstwhile princely

The Kashmiri Sikhs

The Sikhs of Kashmir have been intrinsic part of the State for centuries. It is a historic fact that Maharaja Ranjit Singh's forces wrested the Valley from the Afghans and thereafter Ladakh from the Tibetans during the 19th century and Jammu & Kashmir was part of his Empire till the British annexed it after the Anglo-Sikh War of 1849. A century later, the Sikhs of Kashmir faced the Pakistani-led tribal invasion and were uprooted from what is presently Pakistan Occupied Kashmir.

Inspite of the trials and tribulations over half a century, the Sikhs remain at their hearths and homes in the Kashmir Valley, in fact right along the line of control (LOC), and in fact it is their visible presence that gives credence to the statement that 'Kashmir is the Guarantee of India's Secularism and claim to the State'.

state does not change. Over the last many decades, surprisingly, India has not been sufficiently vociferous in reclaiming these areas. In keeping with the Indian Parliament's 22 February 1994 resolution, India must strongly put forward this legitimate and legally enforceable demand. Whenever Pakistan clamours for a dialogue on J&K, India must firmly also take up the case of in GB and POK, the illegal and provocative settlement of the Chinese in these areas and the settlement of non Kashmiris in these regions from the Pak plains which have altered the demographic character of this region and thus rendered any plebiscite demands of the Pakistanis for J&K null and void. That Pakistan did not withdraw its troops from the disputed areas as asked for in the 13 August 1948 UN Resolution, further puts the final nail on the so-called plebiscite coffin.

Implications of US drawdown from Afghanistan

Though the US has temporarily halted the complete drawdown of around 10,000 of its troops still left in neighbouring volatile Afghanistan for the time being, when it does eventually happen the reverberations will certainly be felt in J&K. Pakistan's notorious ISI, in cohorts with the Afghan Taliban and the Haqqani network, would be working overtime to finalise their devious plans to relocate some of their terrorists to J&K to intensify their nefarious activities in the state. Indian security agencies will need to factor in such ominous developments.

Suggested Indian Road Map for J&K

Festering problems, spanning many decades, do not lend themselves to quick-fix solutions especially when it involves neighbouring nations, wars having been fought and the problem compounded by lack of a coherent strategy, lack of consistency and national resolve. It is time for India to come out of its reactive mode on its J&K policy and make it amply clear to the world, and Pakistan in particular, about a simple clear cut Indian strategy as encapsulated below:

- India should make it clear to all stake-holders that there will be no discussion on the political status of J&K which has been amply made clear in the resolution adopted by Indian Parliament of 22 February 1994.
- However, if Pakistan, as a neighbouring country, wishes to discuss any issues to improve the overall environment engulfing J&K, say cross border trade, facilitation of movement between the people on both sides of the LC / IB in J&K, assistance during natural calamities, ceasefire violations etc it could do so. India, as earlier, would gladly welcome more people to people contacts between Kashmiris of all hues.
- Pakistan must follow, in letter and spirit, the clauses on J&K, enshrined in the Shimla Agreement 1972 and the Lahore Declaration 1999 as both India and Pakistan are signatories to these landmark agreements.
- Pakistan must not allow its territory to be used for terrorist activities against India from its soil as duly guaranteed by its former President, Gen Parvez Musharraf.
- Pakistan must be reminded that as two nuclear armed nations, both India and Pakistan have to live in peace, and thus it will be self-defeating for Pakistan to continue its antiquated anti-India agenda.
- India must adopt a multi pronged strategy to comprehensively reach out to heal any and all wounds inflicted or seen to be inflicted on the Kashmiri populace. A generous economic package for J&K must be accorded with education and employment for the J&K youth prioritised.
- India must take dissent by the Kashmiri populace in its stride but with no seditious activities permitted.
- Security forces operating in the state must be firmly instructed to be more humane and civil in dealing even with agitators. However, anti-national leaders must be dealt with firmly.
- Kashmiri youth, employing various measures, must be weaned away from any radical influences, whether of the IS or from terror master across the border.
- Pak atrocities in POK and GB should be highlighted across the entire world.
- Finally, it must be firmly conveyed to Pakistan that India too, is more than aware of Pakistan's many fault lines and prudence lies in Pakistan thus changing tack in its anti-India policies.
- All political parties must rise above their petty vote bank politics and by a process of mutual discussions, arrive and thence support, the national consensus on a coherent and consistent India's Kashmir policy.
- Track 2 dialogues have their own utility but the red lines must be made clear to both our negotiators and those on the Pakistani side.

It has been often stated–emphatically–by Indian leaders in the past that J&K is a symbol of India's secularism. Unequivocally, Kashmir is more than a symbol : "It is the guarantee of India's secularism." To sanctify this assurance, India thus needs not only an unambiguous national strategy, a firm national resolve but importantly, the sinews of adequate economic and military strength to sustain its national objectives with pride and conviction.

Lt General (R) Kamal Davar

IAF at Red Flag 2016

DARIN II Jaguars refueling from an Il-78MKI over Dubai (photo: IAF)

The Indian Air Force took part in the multinational *Red Flag-Alaska* air exercise, which ran from 28 April to 13 May 2016 at Eielson AFB, Alaska. The Exercise was originally conceived in 1975 by the US Air Force to provide operational exposure and mutual exchange of knowledge and capability among friendly Air Forces.

The IAF contingent, led by Group Captain H Assudani and comprising four Su-30MKIs, four DARIN II Jaguar strike fighters, two Il-78MKI tankers and two

An IAF Su-30MKI landing at Eielson AFB on 16 April (photo: USAF/SSgt Joshua Turner)

Il-78MKI on the apron at Eielson AFB during the work up phase of the exercise (photo: USAF/SSgt Joshua Turner)

sq km, and in special use airspace across the state of Alaska. *Red Flag-Alaska* provided "opportunities for exchange of ideas relating to concept of operations in a dynamic warfare environment, and allowed IAF pilots to hone their skills and gain new knowledge."

Red Flag-Alaska is particularly important given the improving military relations between India and the USA, and builds on increasing IAF participation in multinational air exercises in recent times.

(Detailed report in next issue)

IAF Su-30MKIs in formation over Eielson AFB during Red Flag-Alaska (photo: via DPR MoD)

C-17 airlifters, departed from Jamnagar on 3 April 2016 for Alaska, stopping enroute in the Middle East, Europe, and Canada. They landed at Eielson on 16 April, and commenced work up for the exercise. During *Red Flag-Alaska*, the IAF operated alongside a range USAF and US Navy aircraft, including F-16 and F-15 fighters, EA-18G Growler electronic attack aircraft, and HH-60G Pave Hawk Combat Search and Rescue (CSAR) helicopters, in various formations and orders of battle, under a range of realistic combat scenarios. A small contingent of Indonesian airmen also participated in the exercise, which was conducted in the Joint Pacific Alaska Range Complex (JPARC), the largest instrumented air, ground and electronic combat training range in the world, covering over 165,000

Jaguar strike fighters being marshalled on the flight line at Eielson AFB during the exercise (photo: via DPR MoD)

VAYU on-the-spot report

New stripes for the

INAS 300 re-equip with the MiG-29K/KUB

On 11 May 2016, INAS 300 'White Tigers,' the Indian Navy's premier fighter squadron, traded its iconic Sea Harrier V/STOL jets for brand new MiG-29K/KUBs to become the Navy's OTU. Admiral RK Dhowan, Chief of Naval Staff, who once served as Direction Officer at INAS 300, was chief guest at the ceremony held to mark the changeover at INS Hansa in Goa. Also present were numerous 'White Tiger' luminaries, including former Navy Chief Admiral Arun Prakash, the Navy's pioneer Sea Harrier pilot who commanded INAS 300 when it first received its V/STOL fighters in 1983. Other retired officers present included Vice Admiral Shekhar Sinha (also a pioneer Sea Harrier pilot), Vice Admiral Subhash Chopra, Admiral Sureesh Mehta, Vice Admiral Vinod Pasricha and Vice Admiral Sunil Damle, the latter four having flown CATOBAR Sea Hawks during their time at INAS 300.

INAS 300 CO Cdr Shikku Raj conducting the last ever (official) vertical landing of an IN Sea Harrier

'White Tigers'

After the CNS was presented an honour guard, INAS 300 performed its final Sea Harrier sorties, led by outgoing Commanding Officer Cdr Shikku Raj Pillai and the Squadron's Senior Pilot, Lt Cdr Gokul Suresh. Additional Sea Harriers were on static display at the ceremony, and all bore special '1983-2016' markings beneath the trademark leaping 'White Tiger' insignias on their tails.

The airborne Harriers were accompanied by a pair of the aircraft type that are to replace them — supersonic MiG-29KUBs, still bearing the snarling 'Black Panther' insignias of INAS 303. The Fulcrums were led by the CO-designate of INAS 300, Captain KHV Singh, accompanied by Lt Cdr Vikram Chauhan.

Earlier, the Navy had planned to establish a dedicated training squadron, INAS 553 'Fighting Lions' on 11 May. However, it was decided not to 'numberplate' the iconic INAS 300, so the MiG-29K/KUBs and the training role passed to the 'White Tigers' instead. INAS 553 will eventually be established once INAS 300 moves on as an operational squadron to the new INS *Vikrant*.

Text and photos: Angad Singh

Sea Harrier and MiG-29KUBs break formation to symbolise the transition of INAS 300

Chinks in the DPP 2016

Awaiting Strategic Partners!

India's defence manufacturing sector has come of age, even as the government has taken the decision to award major combat systems and upgradation programme of existing weapon platforms and systems to the private Indian industry under the 'Make' category. The new policy decision on defence procurement has brought out a more dynamic approach to address the issue of self-reliance and indigenisation in the defence sector. New inductions in the procurement policy such as increase in the offset contract threshold from Rs 300 crore to 2,000 crore, and the new category, *Indigenously Designed, Developed and Manufactured* (IDDM), clearly marks a bias towards indigenisation. The new policy guidelines have also envisaged greater participation of the private sector in the design and development of weapon systems. Therefore, one can expect that the new Defence Production Procedure (DPP-2016) and related offset policy, eagerly anticipated will be significantly different from the previous versions and will attempt to facilitate a smoother transaction of procurement, one that had become cumbersome over the years, which directly affects operational readiness of the Indian Armed Forces.

Defence manufacturing capability is imperative so as to address the issue of self-reliance and indigenisation. The new policy would address crucial challenges in defence procurement policy and create a level playing ground for the private

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sector. However, experts opine that much more is required so as to improve the manufacturing capacity and capability in the country. The manufacturing sector has been riddled with multiple challenges which deprived India from achieving eminence here, particularly in the defence sector. Historically, India had missed out on the 'industrial revolution' under the British Raj and was reduced to being only the supplier of raw material. After independence, India's non-aligned policy antagonised the west and high-tech weapon systems were denied to India.Further, technological denial regime (Nuclear Suppliers Group, Wassenaar Arrangement, Australia Group and Missile Technology Control Regime) clamped a ban on 'dual-use' technology exports to India.

The Reconnaissance & Surveillance Helicopter (RSH) requirement of the Indian Army has remained unfulfilled for several decades

Unfortunately, defence technology and scientific research received lesser attention in the early decades, which factors have been primarily responsible for India's lack of self-sufficiency in defence production and its continued dependency on foreign Original Equipment Manufacturers (OEMs)for cutting edge technology.

To improve Indian defence production prowess, the Ordnance Factory Board (OFB) and Defence Public Sector Undertakings (DPSU) were created soon after India's independence. However, increasing gaps in technology forced India to rely upon licenced production to meet needs of the Armed Forces. Thus, temporarily, even as such licence production boosted India's ability to attain self-sufficiency in developing aircraft and weapon systems, in the longer run, this did not lead to any significant changes in the country's defence production capability. Unfortunately, the Defence Public Sector has not utilised the extensive infrastructure to its fullest potential, and therefore, benefited little after licensed production.

In fact, DPSUs and OFs have never had any formal 'technology absorption centres'in receiving cutting edge technologies from OEMs, while transfer of technology (ToT) did not enable DPSUs and OFs to innovate and come out with upgraded versions or even reduce the import content.

Lack of credible competition and keeping their monopoly of the home defence market has, in a way, led to complacency, which left little scope for product innovation, technology upgradation, quality control, export promotion, finance and human resource management. This then not only delayed the procurement cycle, but has also stalled the defence-manufacturing sector from anymajor transformation. Moreover, with only meagre investments in scientific research, Defence R&D has not progressed in addressing the issue of indigenisation of defence equipment.

India's expenditure on Defence R&D is minimal when compared with global standards. Speaking at a recent conference in New Delhi, Dr S Christopher, DG DRDO, pointed out the need for enhanced budget and augmentation of scientific manpower. "A mere 5-6 per cent of defence budget for R&D is inadequate to meet the aspirations of India's defence needs".

In fact, the DRDO's expenditure is around 31.6 percent of the total R&D budget in this field. Apart from DRDO, Hindustan Aeronautics Limited (HAL) and Bharat Electronics Limited (BEL) are the two major entities spending some 6-8 percent of their turnover on R&D. Other DPSUs and OFs have no dedicated R&D establishment and rely on the DRDO or foreign OEMs for technological assistance.

Still, one cannot underrate role of the public sector and DRDO in achieving some self sufficiency in defence equipment. They have experience in high-end technology and built requisite infrastructure over a period of time, but the rapidly evolving security environment demands robust defence manufacturing capacity and proactive R&D labs to counter emerging security threats in the region. The country's current defence manufacturing capacity is clearly inadequate to meet the requirements of rapidly modernising armed forces and therefore the government's proposal for a new defence procurement policy (DPP) to create additional capacity in the private sector and encourage defence innovation and research.

Role of the Private Sector

In the post-liberalisation period, India's private sector has shown great ability, particularly in skill-intensive sectors such as automobiles, engineering products, IT and pharmaceutical sectors, etc. To bring in the private sector for defence, the procurement procedures and structures were first mooted by the Ministry of Defence in 2001, in pursuance of recommendations of the Group of Ministers to reform the National Security System. The actual procedures for defence procurement laid down in 1992 were comprehensively reviewed and a revised Defence Procurement Procedure (DPP) was introduced in December 2002.

Initially, defence manufacturing was really never of much interest to the private sector owing to multiple entry barriers. A few major and some small-scale industries had limited exposure, working in tandem with the DRDO, DPSUs and the OFs. In order to increase private sector participation in the defence sector, DPP's 'Make' category was introduced to involve Indian manufacturers from the initial stage of development itself. Integrated Material Management Online System (IMMOLS), Integrated Air Defence Command and Control System (IACCS) Tactical Communication System (TCS), Battlefield Management System (BMS) and Futuristic Infantry Combat Vehicles (FICV), are a few major 'Make' project areas

The Saab BAMSE air defence missile, launched from an Ashok Leyland vehicle

where private players got involved from the initial stages.

The small and medium scale industry plays a crucial role in defence manufacturing, with OFs procuring a significant amount of input and material from MSMEs (about 50%). Similarly, large Public Sector Undertakings in the Defence Sector have been outsourcing upto 20-40% of their requirements, part of which are from MSMEs. According to statistics recently shared by the Minister of State for Defence, Rao Inderjit Singh, recent policies were aimed to increase defence exports to Rs 441crore (in 2015). Of this, the private sector accounted for 63 percent of total defence export against 13 percent in the previous year. The private sector's export of military material clearly indicates its capability of taking on an important role in India's defence production.

Defence procurement for India's forces over the next decade is going to increase to some US$ 100 billion, with resulting offsets being nearly US$ 20 billion, which provide an immense opportunity for India's private industry. At the same time, the government has embarked on major policy reforms to enhance private sector participation in the defence sector. Defence Minister Manohar Parrikar has been keen to expand the defence infrastructure in the country and has urged dynamic changes in the new DPP, based on the Dhirendra Singh Committee's recommendations on a Strategic Partnership (SP) model, under the 'Make in India' initiative in six areas, which include submarines, aircraft and missiles.

The SP model

The SP model will be created in addition to the existing capacity and infrastructure in the public sector and would elevate private sector capacity to reach par with the public sector. Meshing public and private sector resources and capability will certainly reduce production costs and speed up delivery of weapon systems. Most of the large private industries have no specific capability for defence manufacturing and it can take up to a decade to actually see significant progress in this domain. Therefore, new policy guidelines emphasising 'Indigenously Designed, Developed and Manufactured Platforms' cannot be achieved until the private sector has been provided adequate under standing and support by the DPSUs, the DRDO and various other scientific labs.

The PPP model

Despite technological denials to India, various DRDO labs, DPSUs and the private sector have succeeded in achieving self-reliance in key defence areas and lessons learnt from these successes should be implemented across the aspiring defence entrants in India. In the defence sector, R&D has remained largely within the public domain with government institutions, essentially Hindustan Aeronautics Limited (HAL), National Aerospace Laboratories (NAL), DRDO, Indian Space Research Organisation (ISRO) and Council of Scientific and Industrial Research (CSIR). Ideally, Government-run R&D labs should work in tandem with the private sector while developing major combat systems, as the latter can certainly identify major components and subsystems needed for the complete combat equipment. This will also serve private industry's purpose to widen their technology base and under take their research in a specialised fields help in aggregation of defence technology capability of the country, thereby largely obviating future imports.

The Public Private Partnership (PPP) is another viable model to build links between the public and private sectors. Globally, PPP have been successful models, widely replicated both in the general and defence sectors. The approach in having an agreement in place between government entities and private companies to utilise the natural resources needs to be encouraged for real growth in the aerospace and defence sectors, which would also greatly help to improve financial viability of indigenous projects. Success of the BrahMos supersonic missile is a classical example, which can be replicated in other major 'Make' category, providing opportunities in domestic industries. As a national strategy, it is imperative for DRDO and DPSUs to support India's private sector from the design & development stage to production and support, the PPP model being an ideal manner in enhancing the private sector's capacity.

Recalling the nation's experience in the defence and aerospace sector spanning many decades, we must now boost existing capability by enhancing role of the private sector. The present procurement policy suggests a greater role for the private sector but the defence and aerospace sectors are technological and capital intensive sectors which require a much more pragmatic approach to enhance the national capacity.

Ideally, the public sector should act as a catalyst in developing capabilities of the private sector which should be seen (and treated) as a partner rather than a competitor. This would go a long way to achieve the national goal of indigenisation and self-reliance in the manufacturing of weapon systems.

Prakash Panneerselvam
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Rafales for the IAF: continuing ambiguity

Following a flurry of media reports in mid-April that the government of India had finalised the contract for 36 Rafales, after the two sides had negotiated the price down to 7.89 billion Euros and BJP tweeted that "the deal had been finalised for US $8.8 billion (Rs 59,000 crore)", Defence Minister Manohar Parrikar added that this programme was at "an advanced stage… with the intention to close it quite soon."

Reports then had it that the deal was expected to be finalised by end-May "but not before the formal Cabinet approval was received." Meanwhile, Minister of State for Defence Rao Inderjit Singh stated that "most of the hitches that were there have been addressed and shall be reviewed at the next DAC." Defending acquisition of this aircraft he said, "development can happen in a country only when the borders are safe and when the sky over the country is safe. And if that security is not there, even *rotis* made of grass cannot be eaten!"

Air Chief Marshal Arup Raha, CAS IAF also stated that the Rafale deal "is at a very advanced stage" but as to "when", he responded, "we have seen so many years go past…how can I give an assurance?"

India considers Predator UAVs

According to official sources, the Government of India is in discussion with US authorities for procurement of up to 40 unarmed General Atomics Predator XP surveillance drones. "The country has increased focus on unmanned technologies both to bolster intelligence-gathering capabilities as well as to augment combat capability along the long and varied land borders with Pakistan and China." The Indian Navy also deploys drones for maritime surveillance along the extensive coastline.

The Indian armed forces presently operate some numbers of (mostly Israeli) surveillance drones even as the country is developing UAVs indigenously as well as considering procurement of armed drones from Israel (*see Vayu V/2015*). The US Government has reportedly cleared San Diego-based General Atomics to offer the unarmed Predator XP to India in late 2015, but Vivek Lall, the Company's chief executive for US and International Strategic Development said that "this would be a government-to-government decision."

Longbow LLC radar for Indian Air Force Apaches

The US has awarded Longbow Limited Liability Company (LLC) a $57.1 million foreign military sale contract to provide the Indian Air Force with Longbow Fire Control Radar (FCR) systems for their new Apache AH-64E helicopters. Longbow LLC is a joint venture of Lockheed Martin and Northrop Grumman Corporation. The contract covers the production of 12 Longbow FCR systems and spares for India. Production will extend through to early 2019 at Lockheed Martin's Orlando and Ocala, Florida facilities and at Northrop Grumman's Baltimore facility.

The Longbow FCR enables Apache aircrew to automatically detect, locate, classify and prioritise targets, with rapid, multi-target

engagement in all weather, over multiple terrains and through battlefield obscurants. "With Longbow FCR, the Indian Air Force will receive rapid all-weather targeting capability," said Jim Messina, Longbow LLC president and director of Longbow programmes at Lockheed Martin Missiles and Fire Control. "The FCR's air over-watch mode provides aircrews with 360-degree situational awareness, improving survivability and mission success."

Raytheon Stinger missiles for IAF

The Indian Ministry of Defence has signed an agreement with the US Department of Defence to acquire 245 Raytheon Stinger air-to-air missiles along with launchers and engineering support. "The Stinger has notched more than 270 fixed- and rotary-wing intercepts and is deployed with 19 nations." India's Stinger acquisition is part of a $3.1 billion deal with the US that includes combat helicopters, weapons, radars and electronic warfare suites.

IAF Chinooks with Rockwell Collins' CAAS

The Boeing Company has selected Rockwell Collins to provide its *Common Avionics Architecture System* (CAAS) for 15 CH-47F Chinook helicopters ordered for the Indian Air Force. Initially developed for the US Army's Special Operations Aviation MH-47G Chinook and MH-60L/M Black Hawk aircraft, CAAS is a fully integrated cockpit flight and mission management capability "that provides exceptional mission effectiveness for modernised cargo and utility helicopters." Adopted by the US Army as standard CH-47F cockpit avionics, CAAS is currently fitted on over 400 Chinooks worldwide and will be on another 200 aircraft over the next 10 years. Integration work is scheduled to begin this year and run through 2018. The Rockwell Collins India Design Centre will provide implementation and test of specific software changes requested by the Indian Army to meet key mission needs and safety requirements. "This contract and the work we're performing reaffirms our commitment to 'Make in India' initiatives," stated Sunil Raina, managing director of Rockwell Collins India.

OIS-AT and Sagem in JV for AASM Hammer

OIS Advanced Technology (OIS-AT) and Sagem (Safran) of France are entering into Joint Venture collaboration for manufacturing Sagem's AASM Hammer Bomb Guidance and Glide Kits in India. Considered as the most advanced, precision bomb guidance and range extension kit, the AASM Hammer was originally designed and manufactured by Sagem for French Air Force and Navy Rafales. "The AASM Hammer has been extensively proven in combat, and the version that will be manufactured in India will be customised to specifically exceed Indian Air Force requirements."

Defence Minister Parrikar visits China

Indian Defence Minister Manohar Parrikar made his first visit to China in mid-April, beginning with formal talks with his Chinese counterpart Gen Chang Wanquan. "India attaches highest priority to its relations with China and is committed to further developing friendly and cooperative relations," Parrikar told Chang in his opening remarks before the two delegations started formal talks.

Parrikar was earlier accorded a ceremonial welcome at headquarters of the Chinese defence ministry in Beijing by a contingent of the PLA. India's defence minister also called on Chinese Premier Li Keqiang and visited China's recently-integrated Western Command military headquarters in Chengdu which has jurisdiction over the entire frontier with India. However, reflecting the Chinese attitude towards its southern neighbour, a state-run daily sarcastically commented on the ongoing Indian dialogue with the United States in that "India would like to continue to be the most beautiful woman wooed by all men, notably the two strongest in the house, US and China… but evidently enough, it needs to feel its way forward and try not to agitate China by crossing the bottom line and consequently it declined to discuss the prospect of joint patrols in the South China Sea, despite the obvious interest and much enthusiasm from its American counterpart."

US Defence Secretary Carter visits India

Carter and Parrikar on board INS Vikramaditya

US Secretary of Defence Ashton Carter made a 3-day visit to India in April, during which he engaged extensively with his Indian counterpart, Defence Minister Manohar Parrikar, as also visited the aircraft carrier INS *Vikramaditya* at the Karwar naval base in Karnataka. Carter stated that it is "critically important for the USA and India to expand their military relationship" and highlighted on-going cooperation on "warship construction and jet engine development."

A reported highlight of Carter's visit was the "commitment" from India to sign the *Logistics Exchange Memorandum of Agreement* (LEMOA), a modified India-specific version of the Logistics Support Agreement (LSA), allowing signatories access to each other's bases, as well as providing a streamlined means of accessing fuel, consumables and repair facilities. This agreement was first mooted in 2004, when the UPA was in power, but has faced concerns that other countries might perceive this as India abandoning its longstanding policy of 'non-alignment'.

Carter and Parrikar also addressed the issue of China's recent activity in the South China Sea, with their joint statement committing to ensuring freedom of navigation in the disputed region. However, Defence Minister Parrikar was careful to avoid any talk of 'joint patrols' with the US Navy in the region. On the subject of India electing to build either the Boeing F/A-18E/F Super Hornet or the Lockheed Martin F-16 Viper in-country, Parrikar pointed out that the US Government–and not privately held companies–control rights to technology, and that the US would have to guarantee transfer of technology for local production of fighter aircraft if this was to be feasible.

Technodinamika after-sales support in India

So as to support Russian-origin helicopters and aircraft in India, Technodinamika, a Rostec State Corporation have made after-sales service deliveries worth Rs 166 crores to the Indian Air Force in 2016-2017. "India is one of the largest after-sales service markets for us. By 2018 we plan to cover 15 % of the demand in India for repairs of assemblies and components for the aircraft produced in Russia," stated Maxim Kuzyuk, head of Technodinamika. Some 900 aircraft produced in Russia (and the former Soviet Union) are in operation with the IAF

The new service centre to be set up in Delhi will be for repairs of Russian equipment used by the IAF, the centre responsible for procuring hardware and ground equipment as well as to supply components for Russian-origin aircraft and helicopters.

IAF Commanders' Conference

The bi-annual Air Force Commanders' Conference took place at Air Headquarters (Vayu Bhawan) in New Delhi on 11 April 2016 with Rao Inderjit Singh, Raksha Rajya Mantri in attendance. Aim of the bi-annual conference is to "enhance the operational capability of the IAF" and the CAS reportedly updated the RRM on operational status of the IAF, security measures in vogue, progress on infrastructure development and efforts made to increase aircraft serviceability. Senior leadership of the IAF deliberated on issues pertaining to air operations, maintenance, human resources and

Raksha Rajya Mantri Rao Inderjit Singh with Air Force Commanders at the Air Force Commanders' Conference. Also seen are the Defence Secretary G Mohan Kumar and Secretary (Defence Production) AK Gupta

administration. Aspects of support provided by Defence PSUs through indigenised production of prime equipment were also discussed in a daylong session on 13 April 2016 with representatives from HAL, BEL and BDL also attending.

Continuing depletion of IAF fighter squadrons

Over the past year, another three IAF fighter squadrons have been number-plated, following expiry of their service lives, exemplifying the crises faced by India's air arm. While the current six MiG-21 Bison squadrons will continue for some more years, as will the two upgraded MiG-27UPG squadrons, the remaining force of MiG-21Ms and MiG-27MLs are being phased out. The latest to be number-plated is No.18 Squadron ('Flying Bullets'), which in fact had just received its colours from the President of India on 28 November 2015 and is the only IAF unit to have a PVC (Flg Offr Nirmaljit Singh Sekhon) to its honour.

Air Chief Marshal Arup Raha flies LCA

On 17 May 2016, Air Chief Marshal Arup Raha, CAS IAF flew the Tejas LCA at Bangalore, and his remarks after the 30-minutes sortie were "it is a good aircraft … (ready) for induction into the IAF." The Chief flew in the LCA trainer PV-6 (KHT-2010) with Gp Capt M Rangachari (CO designate No.45 Squadron) in the front seat. Various manoeuvers were carried out over the entire flying envelope, including simulated air-to-ground attacks and air to-air interceptions, employing the radar (Elta 2032) and helmet mounted display sight (HMDS).

After landing, Air Chief Marshal Arup Raha, seen with HAL Chairman T Suvarna Raju, DK Venkatesh (HAL Director Engineering and R&D), S Subrahmanyan (HAL Director Operations) and Air Marshal RKS Bhadauria DCAS, IAF

"It is a morale boosting gesture from the IAF Chief and reposes great confidence of our valuable customer in our abilities", stated T Suvarna Raju, Chairman HAL. Series production of the LCA is under way at HAL's Bangalore Complex, SP-2 having been delivered in March 2016, with SP-3 and SP-4 to follow in the months ahead. This will enable the first IAF squadron on the Tejas LCA to be formed 'before Diwali' this year even as aircraft are steadily delivered. No.45 Squadron will remain based at HAL airport Bangalore for the first year or so, which is logical with immediate support available from HAL, ADA, NFTC and the ASTE.

IAF helicopters firefighting in Uttarakhand

The Indian Air Force deployed five Mi-17 helicopters to assist in firefighting efforts in the Uttarakhand forests in early May even as the National Disaster Response Force (NDRF) deployed three teams to control forest fires in Uttarakhand that destroyed nearly 1,900 hectares of forest land in 13 districts. The NDRF teams were posted at Almora, Pauri and Gauchar in Chamoli districts, equipped with water tankers, floating pumps and medical setup to assist the rescue operation. The IAF helicopters carried underslung 'Bambi buckets' with 3,000 litres of water to douse the forest fire, scooping up water from nearby Bhimtal Lake.

HAL records high turnover in 2015-16

"HAL's turnover has surged to Rs 16,524 crores for the Financial Year 2015-16. It is an all time high with PBT standing at Rs 3210 crores for the year", stated T Suvarna Raju, CMD, HAL. "All 12 Su-30MKI aircraft produced during the year were from raw material phase while production of 17 Hawk aircraft is the highest ever achieved in a year", he added.

Aircraft production for the year 2015-16 includes 60 new aircraft and helicopters, overhauling of 229 aircraft and helicopters, 94 new engines produced, 446 engines overhauled and supply of 143 aerospace structures. HAL has contributed Rs 4284 crores to the Government as buyback of 25% of the share capital apart from paying a dividend of Rs 510 crores for FY 2015-16.

HAL "gives back" capital

In what is regarded as a "reversal" of the past policy, HAL has made a contribution of Rs 4284 crores to the Government as buyback of 25% of the share capital and free reserves from HAL. "This is apart from a dividend of Rs 510 crores paid during 2015-16. We are proud to contribute to the nation such a significant amount of Rs.5879 crores (including tax) in the Platinum Jubilee Year", stated

T Suvarna Raju, CMD, HAL (fourth from left) presenting the cheque for the buyback to Manohar Parrikar, Defence Minister at DefExpo 2016 at Goa in the presence of Ashok Kumar Gupta, Secretary, Defence Production (second from right), Surina Rajan, Additional Secretary (Defence Production, extreme right) and others

T Suvarna Raju, CMD, HAL who presented the cheque to the Defence Minister, Manohar Parrikar during the DefExpo at Goa.

Total contribution of the company from 1973-74 till date works out to of Rs 12333 crores (including buyback, dividend and relevant taxes) to the Government against an investment of Rs 482 crores (inclusive of bonus shares), or some "26 times of the amount invested."

BEL's record turnover

Navratna Defence PSU Bharat Electronics Limited (BEL) completed FY 2015-16 registering a sales turnover (provisional) of Rs.7,510 crore, a growth of 12% over the previous year's turnover of Rs.6,695 crore. BEL made exports worth $ 85 million in 2015-16, registering a growth of 47% over the previous year's export turnover of $ 58 million.

Major projects executed during the year include the Akash missile system, low level light weight radar, naval communication and fire control systems, night vision devices, 3D tactical control radar, Schilka weapon upgrade, shipborne electronic warfare system, hull mounted sonar Humsa 3G, heliborne surveillance & targeting system and L-70 gun upgrade.

BEL Chairman & Managing Director SK Sharma stated that "During the year the company has given enhanced thrust on self-reliance and capacity building, higher investments in R&D and modernisation, forging new collaborations with technology partners and increased outsourcing to SME sector. These efforts will enable BEL to effectively address future opportunities in defence business and achieve the desired growth."

Mountain Strike Corps to get BAE M777 ultra-light howitzers

The long-stated requirement programme to equip the Indian Army's XVII Mountain Strike Corps with lightweight artillery is reportedly under finalisation, with the Indian and US


File photo of M777 ultra-light howitzers

governments coming to an agreement on its 'Make in India' content. The MoD is looking to procure 145 BAE Systems M777 ultra-light howitzers, which programme was also discussed during US Defence Secretary Ashton Carter's visit to India in April. The initial price notified by the USA in 2012 was $694 million, but price escalations owing to repeated delays have resulted in a fresh estimate of about $750 million. The howitzers will come equipped with Laser Inertial Artillery Pointing Systems (LINAPS), maintenance, personnel training and training equipment, technical assistance, engineering and logistics support services. BAE Systems had earlier selected Mahindra as its Indian partner for a proposed in-country Assembly, Integration and Test (AIT) facility for the M777 (*see Vayu II/2016*).

Chief of the Army Staff assesses Kashmir situation

The Chief of Army Staff, General Dalbir Singh made an official visit to Headquarters Northern Command at Udhampur on 17 April 2016 and was briefed on the overall security situation in the Command theatre by Lt Gen DS Hooda, Army Commander. "The Army Chief made a firsthand assessment of the prevailing internal security situation specifically in view of the recent incidents at Handwara and Nutnusa."

Earlier, on 13 April 2016, a wreath laying ceremony was held at the Siachen War Memorial at Base Camp to pay tribute to the martyrs on this "frozen frontier."

Exercise Shatrujeet

The Indian Army's mammoth two-month long Exercise *Shatrujeet* concluded on 23 April in Bikaner, Rajasthan. The exercise, conducted as part of regular training to hone warfighting skills of the Army's XXI Strike Corps involved some 30,000 troops, according to MoD sources. "*Shatrujeet* successfully validated synergy between the Indian Army and the Air Force in executing air-land battles and the ability to orchestrate battles in network centric environment." The conclusion of the exercise was witnessed by Army Chief General Dalbir Singh on 22 April.

About the same time, the Pakistan Army's XXX Corps carried out an exercise near Jhelum, witnessed by their Army Chief General Raheel Sharif. According to the military's media wing, "The exercise is being conducted in an overall framework of effectively repulsing an enemy offensive through integrated application of artillery, air combat aviation firepower."

6/1 Gorkha Rifles formed

The youngest battalion of the Gorkha Rifles has been raised at Sabathu in the Simla Hills, which also houses the 14 Gorkha Training Centre. The 6th Battalion, 1st Gorkha Rifles (6/1 GR) affectionately called 'Kanchi Paltan', is unique in that all its troops are of Indian domicile instead of hailing from Nepal as with the other regiments (the 1st, 3rd, 4th, 5th, FF, 8th, 9th and 11th GR).

This is the first Gorkha battalion to be raised in half a century, the unit's regimental flag being unfurled by Colonel of the First Gorkha Rifles, Lt Gen Ravi Thogde, at a ceremonial parade at Sabathu. The Army's plans are for each Gorkha regiment to raise an additional battalion in due course as part of approved force accretions and ongoing organisational restructuring.

The Army has also recently raised the Sikkim Scouts comprising locally recruited youth from the state for deployment in the border regions, this unit affiliated with the 11th Gorkha Rifles.

Reliance Defence in agreement with Ukrainian firms

On 29 April, Reliance Defence signed strategic partnership agreements with Ukrainian state companies Ukroboronprom, Spetstechno Export and Antonov. Reliance Defence is a wholly owned subsidiary of Reliance Infrastructure, led by Anil Ambani. Under the agreement with Antonov, Reliance and Antonov will jointly propose a Medium Military Transport Aircraft programme to HAL, and also collaborate on assembly, manufacture and maintenance, repair and overhaul (MRO) of Antonov aircraft in India "as also mutually agreed global markets."

Cooperation between Reliance Defence and Spetstechno Export will focus primarily on upgrade programmes for BMP-2 armoured fighting vehicles and marine gas turbines for the Indian Navy. The IAF operates over 100 An-32 tactical transport aircraft, the Army has some 2,000 BMP-2s in service, while a large proportion of the Navy's surface fleet, including destroyers and frigates, rely on Ukrainian gas turbines for power.

Boeing contracts with Bharat Forge

Boeing has awarded a contract to Bharat Forge involving titanium forgings for the Boeing 777X. "We are pleased to expand our partnership with Bharat Forge who started supplying titanium forged flap tracks for the Boeing Next-Generation 737 aircraft earlier this year. They've demonstrated not only a high level of technical expertise, but also an understanding of the need to meet market requirements for affordability," stated Pratyush Kumar, president, Boeing India.

The titanium forgings will be developed and manufactured by Bharat Forge using a closed die forging process, the first two forgings scheduled for shipping to Boeing in late 2016, and followed by two more forgings in early 2017. The company will also supply forgings for the 737 MAX, scheduled to enter service in 2017.

Bharat Forge and AM General team in LSV programme


Representative image

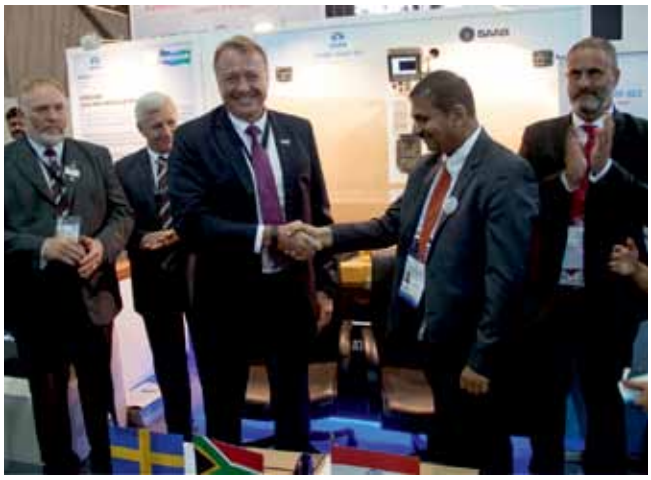
Kalyani Group's flagship company, Bharat Forge Limited and US based AM General LLC, have announced their bid for India's Light Specialist Vehicle (LSV) programme using AM General's battle-tested HMMWV as the LSV's base platform with final build and production to take place in India. The Indian Army has stipulated that the LSV needs to perform reconnaissance and patrol roles for all arms, provide space and cross mobility in all terrain (including high altitude and deserts) to small parties/teams (approximately six) and operate independently in the battle field. Additionally, with the Indian Armed Forces looking to rapidly modernise their protected wheeled vehicle fleet, there could be numerous additional opportunities for this team effort beyond the LSV programme.

Saab and Ashok Leyland in JV

Saab and Ashok Leyland are collaborating to manufacture truck simulators in-country under the 'Make in India' concept. The two companies signed a teaming agreement in the end of 2015 with the simulator based on the Ashok Leyland Stallion 4x4 vehicle, the most widely used by the armed forces and paramilitary forces. "The simulator will bring in a drastic change in drivers' skills development, enabling the driver to drive and operate the Ashok Stallion vehicle in different terrain, different weather conditions and under all types of potential challenges." The simulator combines the Ashok Stallion cabin realism with a powerful motion base, 4K computer graphic visualisation for total trainee immersion.

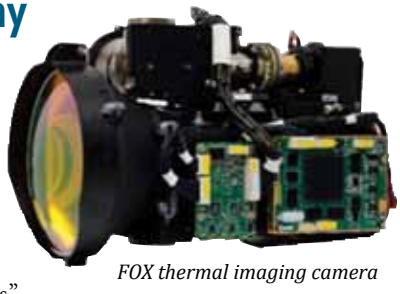
Saab and Tata Power SED in JV

Saab and Tata Power Strategic Engineering Division will jointly be manufacturing self-protection systems for land-based platforms, to fulfil Indian market requirements as well as export needs. The



partnership will also involve joint development of a next generation self-protection system. The Transfer of Technology process for production of initial orders for Saab's global customers has already commenced at the Tata Power SED facility in Bangalore. Tata Power SED will eventually manufacture a large part of the system in India and also do final assembly, and also be responsible for marketing the system in India.

Controp optronic sensor systems for Indian Army



FOX thermal imaging camera

Controp Precision Technologies, specialists in advanced electro-optics (EO) and infrared (IR) defence and homeland security solutions, have announced the supply of "hundreds" of FTA Optronic Sensor Systems for the Indian Army's L-70 Air Defence upgrade programme. Following extensive product assessment, the FTA was chosen by the Indian Army to be part of the modernisation of the L-70 air defence gun, providing day/night anti-aircraft protection by means of the advanced automatic air tracking system. The FTA cameras will be supplied through 2016-2017. The unique FTA is a ruggedised day/night optronic sensor system, which includes the FOX-250, a high performance thermal imaging camera and a high performance colour CCD day camera, each with a continuous optical zoom lens.

Johnny Carni, Controp's VP Marketing, added that "the Indian Army chose our FTA System following very successful field trials and is enthusiastic due to the outstanding performance of these optronic systems in harsh environmental conditions." In addition, Controp has supplied dozens of FOX thermal imaging cameras to a large Defence Public Sector Undertaking (PSU) systems integrator in India, as part of the new Naval Fire Control System programme. These FOX thermal imaging cameras, which include Controp's proprietary continuous zoom lens, have been interfaced with a weapon station and with fire control radar.

FTA Optronic Sensor System

Controp (Israel) and DEFSYS (India) partner

Controp have announced an agreement with the Indian company Defsys Solutions Pvt. Ltd. According to the agreement, Defsys will market and locally produce Controp's advanced electro-optical system for the Indian market. According to Dror Sharon, Controp's President and CEO, "We are delighted to partner with the Indian company, Defsys, a supplier of electro-optic solutions to the Indian Ministry of Defence. The company has very advanced manufacturing facilities that will allow us to produce our products in India, and thus meet the 'Make in India' policy promoted by the Indian government. Controp has been active in India for more than 10 years. There is a significant need in India for our extremely popular intruder detection systems and camera payloads, which their unique technology characteristics make them good value for money solutions. We see the Indian market as strategic and with huge potential and are very much ready to transfer knowledge and production to local industry."

HAL Light Combat Helicopter weapons trials

After successful completion of basic performance flight testing and trials for cold weather, hot weather as well as hot and high altitude testing in 2015, HAL's Light Combat Helicopter (LCH) achieved yet another milestone when the third prototype (TD-3, ZF4603) carried out successful rocket firing in early March 2016. LCH TD-3 is integrated with an Elbit-BEL electro–optical (EO)

turret, Solid State Digital Video Recording System (SSDVR) and 70mm rocket pods in conjunction with an updated glass cockpit.

"Initial rocket firing trials have been carried out at Jaisalmer, establishing satisfactory integration of hardware and software, structural integrity and safe separation of rocket ammunition. Integration work for weapons such as rockets, turret gun (20 mm) and air-to-air missiles on LCH will further continue," stated T SuvarnaRaju, CMD, HAL. "These trials give us confidence for carrying out certification firing trials planned during April-May 2016," he added. The LCH also participated in the IAF's '*Iron Fist*' firepower demonstration on 18 March 2016 *(see article in this issue)*.

The first LCH prototype made its maiden flight on 23 March 2010, the second on 28 June 2011, and the third on 12 November 2014. The fourth prototype (TD-4) first flew on 1 December 2015. The programme has completed performance trials, paving the way for certification of the type's 'basic configuration,' with a letter to this effect handed over to HAL by CEMILAC in the presence of Defence Minister Manohar Parrikar on 16 October 2015.

BEL hands over EOIR payload to IAF

Bharat Electronics Limited (BEL) has handed over the first batch of Electro Optic Infra Red (EOIR) payloads for helicopters to the Indian Air Force at Chennai on 21 March. AVM AS Butola, ACAS, Operations (Transport & Helicopters), received the EOIR payloads on behalf of the IAF from Amol Newaskar, Director, BEL at BEL's Chennai Unit.

The EOIR payload manufactured by BEL-Chennai is a Stabilised Turret Assembly consisting of day and night camera with eye-safe laser range finder which provides capabilities for day / night target detection, recognition and identification and range measurement in various weather conditions. BEL has established facilities in collaboration with Elbit of Israel for manufacture of EOIR payload at its Chennai, Pune and Machilipatnam plants. BEL commenced production of EOIR payload for the Advanced Light Helicopter (ALH) programme in November 2014.

MKU and JSC Shvabe sign MOU

MKU and Russian firm JSC Shvabe have signed an MoU to manufacture electro-optical devices in India, with production facility facilities to be situated at MKU's headquarters in Kanpur. This JV agreement is not only on manufacturing of electro optical devices but also to service EO equipment with the Indian Army and MoD. As per the MOU, Shvabe will assist in setting up of EO manufacturing and servicing unit in India with MKU. Training initially will be given to technical personnel from MKU to carry out maintenance and repair of in-service EO units, which will give an initial start to the JV and later become a full fledged manufacturing unit by mid 2017.

OIS-AT and SAMP in JV

OIS Advanced Technology (OIS-AT) and SAMP of France have entered into a Joint Venture agreement to manufacture advanced penetrator bombs in India, and conduct research and development "for India's customised requirements." This will utilise advanced technology from SAMP, which is a proven supplier in this field. "We are pleased that SAMP has agreed to support establishing a joint venture with OIS-AT to manufacturing, and research and develop a portfolio of advanced penetrator bombs in India. We believe that these also directly support and advance the Government of India's 'Make In India' programme", stated Sanjay Bhandari, Chairman and Managing Director of OIS Advanced Technology.

Rockwell Collins receives contract from ECIL

Rockwell Collins has received orders from Electronics Corporation of India Ltd (ECIL) to supply communications and navigation components for radios being indigenously manufactured by ECIL for Indian defence forces. These components supplied by Rockwell Collins are used for integration into digital V/UHF radio, an IP-enabled state-of-the-art transreceiver for ship-to-ship, ship-to-shore and ground-to-air communications. "The recent award is part of a long-term agreement signed with ECIL in 2010. To date, Rockwell Collins has delivered more than 1,000 units to ECIL", stated Sunil Raina, Managing Director, India.

Reliance Defence and Rafael in JV

As possibly the biggest joint venture between an Indian prirate company with an OEM, Reliance Defence Ltd, a 100% subsidiary of Reliance Infrastructure Ltd and Rafael Advanced Defence Systems Ltd will set up a joint venture company in India in the areas of air-to-air missiles, air defence systems and large aerostats. "The joint venture will provide major thrust in the field of indigenous production and development of high precision and state of the art weapon systems in India."

The Reliance and Rafael joint venture will have 51% holding from Reliance Defence and 49% by Rafael as per the current guidelines of the Government of India. Rafael has already provided large aerostat systems to the Indian Air Force for its surveillance, reconnaissance, communication and intelligence needs.

Thales and BEL-Thales Systems Ltd to develop Pharos

Thales and BEL-Thales Systems Limited (BTSL), the joint venture between Bharat Electronics Limited (BEL) and Thales, have signed a partnership agreement for joint development of the the Pharos fire control radar for both gun and missile systems. Pharos provides defence against small, fast moving and highly manoeuvrable air and surface targets that may also be encountered in littoral missions. The multiple target tracker is capable of simultaneously controlling — in all weather conditions — the engagement of these targets with guided ammunition. This joint development will strengthen the co-operation of Thales and BTSL in the field of innovative technologies. The responsibility of overall system design will be borne by Thales.

Pierre-Eric Pommellet, Executive Vice President, Defence Missions Systems at Thales, exchanging the partnership agreement with SK Sharma, CMD BEL

Controp LOROS for critical site protection in India

Controp Precision Technologies Ltd has announced the sale of Long Range Observation Systems (LOROS) as part of a security solution for critical sites in India. The MEOS Modular Long-Range EO/IR Day/Night Observation System was procured by a large Public Sector Undertaking (PSU) for Indian Homeland Security (HLS) applications. The MEOS System is an advanced, wide area, passive, real time 24/7 EO/IR observation system with panoramic scanning and automatic target detection capabilities. The system includes a medium range or long range Thermal Imaging Camera with Continuous Zoom Lens and a medium range or a long range Day Camera as well as an optional Laser Range Finder (LRF). The MEOS is easily deployable and can be installed on a tripod, a mast or on a fixed structure.

Controp's VP Marketing Johnny Carni told *Vayu* that "the MEOS modular EO/IR system is proven for border and coastal security as well as perimeter protection of critical sites including military bases, offshore oil/gas rigs and more. We are confident that this purchase will encourage the additional procurement of such systems for use in important defense and HLS applications in India".

BEL, Rosoboronexport sign MoU

Bharat Electronics Ltd (BEL) and Rosoboroneexport (part of Rostec State Corporation) signed a Memorandum of Understanding (MoU) on 29 March during Defexpo 2016. Under the framework of this MoU, BEL and Rosoboroneexport will co-operate for the joint development of various sub-systems

P C Jain, Director (Marketing), BEL, exchanging the MoU between BEL and Rosoboronexport with Vadim V Belyaev

of major defence projects under the offset clause of the Defence Procurement Procedure (DPP) . The industrial tie-up will cater to the requirements of all the three arms of the Indian Defence forces, as well as the civilian sector.

HAL and PHL to establish helicopter MRO at Delhi

HAL and Pawan Hans Ltd (PHL) have signed an MoU to establish a Joint Venture at Rohini (Delhi) for maintenance work related to all types of helicopters "and address the needs of defence and civil markets in India and other countries." Ashok Gajapati Raju, the Union Minister for Civil Aviation, Rajiv Nayan Choubey, Secretary, Ministry of Civil Aviation, T Suvarna Raju, CMD, HAL, Dr BP Sharma, CMD (PHL) and other senior officials were present on the occasion.

Indian Navy ships in Persian Gulf

The Indian Navy dispatched a flotilla of warships to the Persian Gulf on an on-going diplomatic outreach to countries of the region. The guided-missile destroyer INS *Delhi*, *Talwar*-class stealth frigates INS *Tarkash* and INS *Trikand*, missile frigate INS *Ganga*, and tanker INS *Deepak* of the Western Fleet sailed from Mumbai for Dubai (UAE) on 3 May 2016.

File photo of INS Delhi

After the UAE, the ships continued on to Kuwait, Manama (Bahrain) and Muscat (Oman) before returning to India at end of the month. Also in late May 2016, another Indian Navy detachment made a port call at Bandar Abbas on the southern coast of Iran. Indian officials stated that the visits were "at enhancing defence relationships" with countries in the Gulf region, home to over eight million Indian expatriates, as also being major trading partners, "particularly with regard to energy."

INS *Kalvari* on sea trials

The first of six *Scorpene*-class submarines constructed at Mazagon Dock Limited (MDL), INS *Kalvari* ('Tiger Shark'), headed out for sea trials on 1 May 2016. The vessel had been launched in October 2015 and spent the intervening period conducting basin trials and harbour acceptance trials. Once sea trials are complete, the boat will formally be commissioned into the Indian Navy during the latter half of 2016

Commissioning of ICGS *Shoor*

Indian Coast Guard ship *Shoor* the second in a series of six Off Shore Patrol Vessels (OPV) was commissioned at Goa by Nitin Jairam Gadkari, Minister of Shipping, Road Transport and Highways on 11 April 2016 in the presence of Director General Rajendra Singh, Director General Indian Coast Guard, and the CMD Goa Shipyard Limited. *Shoor* means 'Valiant' and is a projection of the Indian Coast Guard's will and commitment "to serve and protect the maritime interest of the nation."

This 105-metre OPV has been designed and built by GSL and fitted with advanced navigation and communication equipment, sensors and machinery, including 30mm CRN 91 gun, Integrated Bridge System (IBS), Integrated Machinery Control System (IMCS), Power Management System (PMS) and High Power External Fire Fighting System. The ship is designed to carry a twin-engine light helicopter and five high speed boats including two QRIBs for fast boarding operations, search and rescue, law enforcement and maritime patrol. On joining the Coast Guard Fleet, *Shoor* will be based at New Mangalore and deployed for EEZ surveillance and other duties along the western seaboard in general and the States of Maharashtra, Karnataka and Goa in particular.

Full mission naval simulator for IN

ARI Simulation has delivered a new full mission naval bridge simulator to the Indian Navy's Andaman & Nicobar Command at Port Blair. This next-generation simulator incorporates ARI's latest D-Series technology platform and has been delivered with a range of extended features including the ability to simulate beaching operations with two custom-developed LCU and LST vessel models as well as a sophisticated new OPV vessel. This fifth ARI full mission bridge simulator joins those already installed in Kochi, Karwar, Mumbai and Vishakhapatnam.

Interceptor Boat 'ICGS C-158' commissioned

Indian Coast Guard Interceptor Boat C-158 was commissioned on 12 April 2016 at Goa, with more Coast Guard surface platforms and aircraft planned to be inducted over the next few years, to be based at Goa depending upon the infrastructure and availability of operational logistic support facilities.

Built by Bharati Shipyard Ltd, Goa, Interceptor Boat C-158 is meant for multifarious tasks such as surveillance, interdiction, search & rescue and assistance to boats and craft in distress at sea.

New civil aviation policy imminent

The Ministry of Civil Aviation is to formally announce its new policy shortly, including that on the '5/20 rule' that restricts airlines from flying abroad unless they have flown in India for five years and have a fleet size of 20 aircraft. "The 5/20 rule in its present form will not exist for sure," according to a senior ministry official, adding "to ensure that the older airlines do not complain, some form of restrictions will be there." Any relaxation in the 5/20 rule will benefit Vistara and AirAsia India. "The policy is in its final stage and the draft Union Cabinet note has already been prepared," stated civil aviation secretary Rajiv Nayan Choubey.

Honeywell systems for GoAir's A320s

Honeywell will install and maintain the Auxiliary Power Units for GoAir's fleet of 72 A320neo airliners. Honeywell will also provide GoAir with its fifth-generation flight recorders ('black boxes'), which feature resilient memory capabilities for data logging and tracking. Besides augmenting operational performance, Honeywell's 131-9A APU will also lower operational costs and emissions for GoAir, "as it consumes 3.3 percent less fuel."

Airbus H125 for Himalayan Heli Services

Himalayan Heli Services has ordered an additional H125 light helicopter from Airbus Helicopters to add to their existing fleet of four H125s, with delivery scheduled in September 2016. "The H125 is ideal for operations at high altitudes as well as in hot conditions, especially in the Aerial Work segment; this additional H125 will help us to achieve our expansion plans in a sustainable

manner," stated Wangchuk Shamshu, Director at Himalayan Heli Services. "Himalayan Heli Services and Airbus Helicopters have formed a long-standing partnership. We stay committed to ensure full support and services to Himalayan, which in turn provides affordable heli-services in the Himalayan region of India," stated Xavier Hay, President, Airbus Helicopters Division at Airbus Group India.

Honeywell and Jet Airways in Boeing 777 Maintenance Contract

Honeywell Aerospace will provide maintenance services for Auxiliary Power Units on Jet Airways fleet of 10 Boeing 777 aircraft. This latest Auxiliary Power Unit (APU) maintenance service agreement for the GTCP331-500 model is designed to keep servicing costs under control while maintaining equipment at the latest modification standard, helping the airline reduce variable costs and improve flight performance. The agreement is an extension of Jet Airways' comprehensive APU maintenance programmes already in place for its B737NG and A330 aircraft.

Dassault Falcons for Indian operators

Dassault Aviation displayed its range of Falcon large cabin, long range business jets at the 'India Aviation 2016' show held in March 2016. Dassault remains Indian market leader for large cabin, long range aircraft, with 22 aircraft currently in service

and several more on order and predicts strong demand among Indian customers for the all-new Falcon 5X very large body twin, currently in development and due to enter service in 2020. "The 5,200 nm/9,630 km 5X will offer the largest cabin cross-section of any business jet and the lowest ownership and operating costs in the 5,000 nm segment."

Meanwhile, Dassault continues to reinforce its regional support presence and have opened a new Bangalore office and authorised Ligare Engineering, a division of Ligare Voyages, to provide AOG Service Level Maintenance for the Falcon 7X at its Delhi service facility. The deal with Ligare followed previous Authorised Service Centre agreements with Taj Air/Metrojet, for the Falcon 2000 series and Air Works India, for the Falcon 900EX/LX. Both of these operations are located in Mumbai and are supported by satellite facilities around the country.

First A320neo for IndiGo

IndiGo has taken delivery of its first A320neo, making this airline the first A320neo operator not only in India but Asia. IndiGo is one of Airbus' biggest A320 Family operators having ordered 530 aircraft in total, including 430 A320neo from orders placed in 2015 (250 A320neo) and 2011 (180 A320neo). IndiGo also placed an order in 2005 for 100 A320s all of which have been delivered.

The A320neo (new engine option) incorporates many innovations, including latest generation engines and large Sharklet wing-tip devices, which together deliver 15 percent in fuel savings immediately and 20 per cent by 2020, equivalent to a reduction of 5,000 tonnes of CO_2 per aircraft per year. Indigo's first A320 neo is powered by Pratt &Whitney's Pure Power Geared Turbofan for which orders were placed in 2012 to power 150 Airbus A320neo family aircraft plus a long-term maintenance agreement. Meanwhile, the PurePower engine family has completed more than 50,000 cycles and 32,000 hours of testing.

Airbus establishing pilot and maintenance training centre in NCR

Airbus is establishing "a world-class" pilot and maintenance training centre in the National Capital Region of Delhi, to support the requirement for large numbers of Airbus pilots. According to Airbus' latest global market forecast, India requires

over 1,600 passenger and freighter aircraft in the next 20 years (to 2034) with an accompanying demand for new pilots and maintenance engineers. This investment is a key strategic Airbus initiative in line with the country's 'Skill India' programme launched in 2015 to develop a wide range of advanced competencies. The centre will be owned by Airbus Group India with training delivered by Airbus' specialised training instructors. The centre will be built in a modular concept in order to accommodate four A320 full-flight simulators, with a potential for expansion.

Airbus has been providing maintenance training from its existing centre in Bangalore since 2007 and has so far trained over 2,750 maintenance engineers. The new centre will accelerate the pace of training to help match the A320neo deliveries to India. Staffed by Airbus instructors, the new pilot training centre will have the capacity to train over 8,000 pilots and 2,000 maintenance engineers over 10 years from 2018 onwards. "On an average, one Airbus aircraft is expected to be delivered to Indian carriers per week over the next 10 years. The need for top quality training will be perpetual," stated Dr. Srinivasan Dwarakanath, President of Airbus in India.

Club One Air to connect 200 airports by 2020

Club One Air, India's first luxury jet charter operator has become the country's largest charter owner, with connectivity to over 100 airports/airstrips across the country and increasing to nearly 200 airports/airstrips across India over next 3-4 years. "Over the years we have achieved very high growth of connectivity in states like Rajasthan, Uttar Pradesh, Maharashtra, Madhya Pradesh and Gujarat and expect similar growth in other states as well. The potential of regional connectivity is immense and keeping in mind we have synced our growth plan accordingly and will induct 10 more jets by 2020 to meet the demand of regional connectivity with time. This will also help us to achieve our 200 crore turnover target by 2020," stated Bhupesh Joshi, CEO Club One Air.

With introduction of their third Falcon-2000 into its fleet, Club One Air has doubled its total fleet size to 10. Growing at 20% the company has also opened F&B services and ground handling services under the brand name of *Club One Class* and *Club One Concierge*. The organisation aims to achieve Rs.100 crore by next financial year and a combined turnover of over Rs.200 crore by 2020.

ISRO launches 7th satellite for India's own GPS

On 28 April 2016, the Indian Space Research Organisation (ISRO) introduced the country's own navigation system with the successful launch of IRNSS-1G, last in the series of seven navigation satellites. Polar Satellite Launch Vehicle (PSLV) C33 carrying IRNSS-1G (Indian Regional Navigation Satellite System) lifted off from the Satish Dhawan Space Centre in Sriharikota and 20 minutes after liftoff, PSLV-C33 successfully placed IRNSS-1G in orbit. The satellite has a 12-year mission life.

With this constellation of satellites in orbit, India has joined the league of countries that have an indigenous navigation system, reducing the country's dependency on the US owned Global Positioning System. Apart from India, the European Union, China and Russia have their own navigation systems in place. The IRNSS system is designed to provide accurate position information to users within the country and in the region extending up to 1500km from the national boundaries.

Earlier, on 10 March, the Indian Space Research Organisation had made the penultimate step in developing the country's own navigation system with the launch of IRNSS-1F navigation satellite. Polar Satellite Launch Vehicle (PSLV) C32 was carrying the 1,425kg IRNSS-1F (Indian Regional Navigation Satellite System).

Thales' Catherine thermal imaging cameras for India

Thales has announced the award of a contract by Beltech to provide Catherine thermal imaging cameras for India's T90 battle tanks. As part of this contract, Thales is doing a transfer of production to integrate 260 compact LWIR thermal imaging (TI) Catherine into Beltech's TI Sights that will be installed on the T90 battle tanks of the Indian Army.

The Catherine family is the 'most complete range of cameras available on the world market' for target acquisition and weapon engagements by land vehicles. Thermal imagers allow gunners, commanders and land recce observers to see by night and by day in adverse conditions. More than 7000 of these cameras are in service on-board 30 types of fighting vehicles globally. The Catherine thermal imager is already in service with the Indian Army and this new order further consolidates Thales' position in optronic technologies in India.

CSL delivers the 17th FPV to ICG

On 12 May, Cochin Shipyard Limited (CSL) delivered ICGS *Arush*, the seventeenth in a series of twenty Fast Patrol Vessels under construction for the Indian Coast Guard, ahead of the contractual schedule. The Protocol of Delivery and Acceptance was signed between Suresh Babu NV, Director (Operations), CSL and Commanding Officer (Designate) of the vessel Cmdt Pramod Pokhriyal. DIG TP Sadanandan, Principal Director (Materiel), Madhu S Nair, CMD, CSL, DIG G Devanand, CGRPS (KOC) and other senior officials of ICG and CSL were present on the occasion. The vessel will be operated from the Coast Guard Station at Porbander, Gujarat.

Suresh Babu NV, Director (Operations), CSL and Commanding Officer (Designate) of the vessel Cmdt Pramod Pokhriyal.

These Fast Patrol Vessels are primarily intended for patrolling within the exclusive economic zone and coastal patrol, carrying out anti-smuggling, anti-piracy and search and rescue operations, and for fisheries protection and monitoring. They also have a secondary role of providing a communication link, and escort coastal convoys, in times of hostilities and war. The sixteenth ship of the series ICGS *Arnvesh* was delivered on 12 January 2016 almost 3 months ahead of the contractual deadline. Of the remaining 3 vessels to be delivered, the builder's sea trials of two vessels have been completed and the last vessel in the series BY 520 was launched on 29 January 2016 and is presently undergoing outfitting works.

Minister of State for Home Affairs Kiren Rijiju with a Sukhoi Su-30 MKI aircraft of No.220 Squadron before his sortie at Air Force Station Halwara in Punjab on 18 May 2016

APPOINTMENTS

Admiral Sunil Lanba appointed new CNS

Admiral Sunil Lanba, earlier Flag Officer Commanding-in-Chief (FOC-in-C) of Western Naval Command, has been appointed as the new Chief of Naval Staff, assuming charge on 31 May 2016. He was commissioned into the executive branch of the Navy on 1 January 1978 and has held several command as well as staff appointments during his 38-year career with the Navy.

He is a specialist in Navigation and Direction and will have a full three-year tenure as the Navy Chief, succeeding Admiral RK Dhowan. Admiral Lanba has served on the corvette INS *Sindhudurg* and frigate INS *Dunagiri*, has commanded four frontline warships including INS *Kakinada* (minesweeper), INS *Himgiri* (frigate) and INS *Ranvijay* and INS *Mumbai* (destroyers).

He has also held key staff assignments including Fleet Operations Officer of the Western Fleet and Chief of Staff, Southern and Eastern Naval Commands, Commander-in-Chief of the Southern Naval Command at Kochi, prior to being FoC-in-C Western Naval Command.

Air Marshal PP Khandekar is AOM

Air Marshal PP Khandekar has assumed the responsibilities of Air Officer-in-Charge Maintenance at Air HQ, New Delhi. The Air Marshal is a graduate of VNIT, Nagpur and was commissioned in the IAF's Aeronautical Engineering (Electronics) stream on 25 July 1977. He is a Post Graduate in Industrial Engineering from NITIE, Mumbai, an alumnus of Defence Services Staff College, Wellington and Master in Science in Defence & Strategic Studies from Madras University. He has commanded Air Force Station High Grounds and Air Force Station Kanpur, has held various appointments at HQ MC, HQ IDS & Air HQ and has the unique distinction of being the first Commandant and Director of MILIT, a tri-service technology training institute. He was Senior Maintenance Staff Officer of an Operational Command and ACAS (Maintenance Plans) at Air HQ. Prior to taking over as AOM, he was Senior Maintenance Staff Officer at HQ Maintenance Command.

Lt Gen NPS Hira is Deputy Chief of Army Staff

Lt Gen NPS Hira, earlier Chief of Staff of Northern Command at Udhampur (J&K) has taken over as Deputy Chief of the Army Staff. Commissioned in the Sikh Light Infantry, he has consolidated experience in counter insurgency operations in J&K and in the North East region, as well as conventional operations in Western Command. He commanded his battalion in Assam (Op *Rhino*) during which time, the unit won 32 gallantry awards and COAS citation. He later commanded 12 Infantry Brigade in the strategic Uri sector deployed on the Line of Control. The General commanded XI Corps at Jullundhur, before moving to Army Headquarters.

Rajan Bargotra is new Coast Guard (East) Commander

Rajan Bargotra assumed charge as Coast Guard Commander and Inspector General of Eastern Region on 1 May 2016. Bargotra a sixth batch officer of the Indian Coast Guard took over from Satya Prakash Sharma who retired after serving the maritime force for 36 years. New Delhi-born Bargotra has had several appointment in the Coast Guard including Chief of Staff, Coast Guard Western region, and Commander, Coast Guard District, Gujarat. Prior to taking up the new role, Bargotra was the Principal Director (Logistics) at Coast Guard Headquarters in New Delhi.

Panasonic

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VAYU on-the-spot report

Demonstrating the "Weapons... On Target... On Time!"

Vayu with the Indian Air Force at 'Iron Fist 2016'

On 18 March 2016, the Indian Air Force carried out the second edition of its *Iron Fist* firepower demonstration (formerly known as *Vayu Shakti*) at the Pokhran range in Rajasthan. *Vayu* was on-the-spot to report on this mammoth day-night event, featuring over 180 aircraft, ranging from transports and UAVs to fighters and attack helicopters. This edition of the firepower demonstration, three years after the first (*see Vayu II/2013*), also featured a number of notable 'firsts,' including the public debut of the indigenous Akash SAM and Astra BVRAAM, as well as the first time the HAL Light Combat Helicopter (LCH) fired its 70mm rockets at an IAF exercise. The Tejas Light Combat Aircraft (LCA), although yet to achieve FOC, demonstrated its 'swing role' capability by launching a laser guided bomb and then engaging an aerial flare with an R-73 infrared guided missile. Special Forces operations with fixed and rotary-winged assets were also demonstrated.

Media personnel were flown from Delhi to Jaisalmer in an Il-76MD from No. 44 Squadron 'Mighty Jets,' before continuing on to Pokhran by road

As in previous years, the proceedings commenced with a trio of Mi-17V5 helicopters trooping colours, before a No.28 Squadron MiG-29 shattered the stultifying desert air with a low-level supersonic pass in front of the grandstand. This was followed by a MiG-27ML that flew in low and slow front of the audience towing an 'Iron Fist-16' banner, as a two-seat DARIN-II Jaguar flying in the distance transmitted live video of the proceedings with a Reccelite pod.

capability to punish

Above: the all Russian-origin fighter aircraft composite formation was centerpiece of the 'transformation' display over Pokhran

Supersonic pass by a No. 28 Squadron 'First Supersonics' MiG-29 in full afterburner

MiG-27ML towing the 'Iron Fist' banner (note wire trailing from base of ventral fin)

The rarely seen A-50/Phalcon AWACS, with its distinctive fixed radome

The first 'package' of the day was intended to showcase the IAF's transformation over the years, and began with a flying display by the IAF Vintage Flight's de Havilland Tiger Moth (HU-512). The Vintage Flight's recently-acquired North American Harvard trainer was also due to fly in formation with a pair of Pilatus PC-7 Mk.IIs, but was grounded in Delhi owing to a hydraulic problem. Instead, the Tiger Moth display was followed by a straight-and-level flypast by three PC-7 Mk.IIs. The centrepiece of the 'transformation' displays was a composite formation of all Russian-origin aircraft in service with the IAF, with a MiG-21 Bison leading a pair of MiG-27UPGs, two MiG-29s and two Su-30MKIs *(see lead image)*. The first package then concluded with a four-ship display by the recently revived Surya Kiran team in their new BAE Hawk Mk.132s.

The second package was intended to highlight network-enabled operations of the IAF before commencing the firepower demonstration proper. To this end, the indigenously developed DRDO-CABS AEW&C system, integrated with an Embraer 145 aircraft, and the Israeli Phalcon-based A-50 AWACS made their *Iron Fist* debuts, before a pair of Mirage 2000 dropped the first bombs of the day,

The IAF's first EMB-145 AEW&C conducting a silent flyby in front of the grandstand

Mirage 2000H dropping 250kg bombs

targeting a mock radar site with five 250kg bombs each. The Mirages were followed by a Su-30MKI, which came in from the southwest to drop four 450kg high-speed, low-drag (HSLD) bombs on a simulated runway. The gravity bombs briefly gave way to propelled munitions as two MiG-27UPGs dove in firing 80mm rockets on a soft target, before a Sukhoi Su-30MKI and Jaguar strike fighters took over with bombs once again. A lone Sukhoi conducted a Griffin LGB strike on a mock bridge, but the bomb impacted some distance from the target. Of course, in an actual combat scenario, such a mission would be conducted with multiple bombs available to the strike aircraft, with, in all likelihood, more than one aircraft assigned to the target. The Sukhoi was followed by a pair of DARIN I Jaguars which came in at low level to drop three 1000 lb Retarder Tail Unit (RTU) unguided bombs each on a simulated ammo dump, utterly obliterating the target. The package then ended with another single LGB release by a Jaguar, which scored a direct hit on a mock bunker.

As the sun descended closer to the horizon, the day's third package, highlighting the IAF's air defence capabilities, commenced with a flypast by a pair of Su-30MKIs simulating in-flight refueling from an Il-78MKI tanker. This was followed by a 'swing role' demonstration by Tejas LCA LSP-4 (KH2014), which first

Pair of DARIN I Jaguars approaching for low-level RTU bomb strike (Inset: a Jaguar-launched LGB makes a direct hit on target #11, the bunker)

Pair of Su-30MKIs simulating refueling from an Il-76MKI

Osa AK-M firing at an airborne target

HAL Tejas LSP-4 after LGB strike, with live R-73E missiles on both outboard pylons

dropped a laser-guided bomb, then quickly manoeuvred around to engage a target flare with an R-73E infrared-guided short-range missile. While the missile firing appeared to have gone off without a hitch, the LCA's LGB strike missed by a considerable margin, prompting senior IAF officers to announce after the firepower demonstration that the LGB misses by the Sukhoi and Tejas 'would be investigated'. A HAL official who was part of the Tejas detachment for *Iron Fist* 2016 also pointed out that the LCA had successfully engaged both targets during the dress rehearsal for the demonstration, held on 15 March.

Mi-35 conducting CAP during the CSAR demo

The air defence package continued with a MANPADS demonstration, featuring two Igla (SA-16) shoulder-fired missiles launched at an airborne target, before giving way to a Combat Search and Rescue (CSAR) demonstration in which a Mi-17V5 inserted troops to rescue a hypothetical downed pilot in enemy territory, while heavily armed Mi-35 gunships circled overhead as Combat Air Patrol (CAP). The three CSAR rotorcraft were 'bounced' by a Mi-25U, simulating an enemy helicopter, which was then chased off by the two escorting Mi-35s. The final event of the air defence package was another Surface-to-Air Missile (SAM) firing, this time by a pair of Osa AK-M (SA-8) Transporter-Erector-Launcher and Radar (TELAR) units engaging a target dropped from the rear ramp of an Antonov An-32 orbiting far above the Pokhran Range.

BAE Hawk Mk.132 firing 68mm rockets

Air defence operations gave way to a Combat Support Operations and Counter Surface Force Operations (CSFO) package,

LCH TD-3 after completing its rocket attacks

Mi-35 firing 80mm S-8 rockets

Sukhoi Su-30MKI straddling the target with twenty six FAB-250 bombs

C-17 dropping paratroopers over the range

which commenced with the third HAL Light Combat Helicopter (TD-3, ZF4603) making its live firing debut at *Iron Fist* with a 70mm rocket attack on a logistics dump. The LCH at *Iron Fist* was commanded by Wg Cdr (retd) SP John, a veteran HAL rotary wing test pilot. A pair of Mi-35s came in next, attacking a mock tank formation with salvos of 80mm S-8 rockets, and were followed by two MiG-21Ms firing massive S-24 240mm rockets at a Forward Area Arming and Refueling Point (FAARP).

The diminutive BAE Hawk Mk.132 advanced jet trainers of the IAF displayed their combat prowess next, with one aircraft striking a vehicle convoy with 250 kg HSLD bombs, and another taking out a building with 68mm rockets. A Su-30MKI followed, conducting a Medium Altitude Level Release (MALR) of an incredible twenty-six FAB-250 bombs to obliterate an area target. A lone C-17 Globemaster III then came in from the east, carrying out the type's first public para drop demonstration with scores

An Mi-17V5 coming in to insert a Fast Attack Vehicle (FAV)

IAF C-130J Super Hercules landing on dirt strip in front of the grandstand

IAF Garud Special Forces slither down into action

of airborne troops leaping through the aircraft's side doors and gently descending to the designated drop zone in front of the grandstand.

Three Mi-17V5s took over after the para drops to insert a strike team tasked with destroying an enemy radar installation. The first helicopter landed on the ground to launch a fast attack vehicle (essentially an armed Maruti Gypsy carrying soldiers), while the other two hovered on either side to allow soldiers to fast-rope out and down to the ground. The strike team placed explosives on the target and blew the charges as they were extracted by the same helicopters that had carried them in.

The helicopter strike demonstration was followed by a heavy drop conducted from

Su-30MKI launching Astra BVRAAM

the ramp of an Il-76MD escorted by a pair of upgraded MiG-29UPG fighters. As the Il-76 passed the grandstand after dispensing its cargo, the MiG-29s raced in from the east to protect their high value asset, and one of them fired an R-73E missile at a target flare.

The highlight of the fourth package was a C-130J assault landing on the short dirt strip in front of the grandstand. A No. 77 Squadron 'Veiled Vipers' Super Hercules made an impressive short-field landing, kicking up great clouds of dust as it slowed to a halt, and discharging soldiers from its rear ramp even before the aircraft had come to a halt! In nearly no time, the soldiers were in position and had 'secured' the airstrip, as the C-130J turned around and took to the air once again. The package concluded with a display of fire fighting operations by a pair of Mi-17V5s, which worked to extinguish a fire using their specialised 'Bambi Buckets.'

With sunset imminent, the Sarang helicopter aerobatic team conducted their now-familiar display before giving way to a Su-30MKI that carried out a low-level display made all the more spectacular for the way the fading daylight highlighted the Sukhoi's distinctive blue-white afterburners. As the display concluded with the Sukhoi's signature 'Vertical Charlie' manoeuvre whilst dispensing flares, a pair of Mi-17V5 entered for the Special Forces demonstration. The helicopters inserted two IAF Garud teams, one directly atop a target building, and the other some distance away. The two teams then demonstrated various operational skills, from clearing the building to engaging dug-in hostile forces.

As the staccato of small arm fire died away, a second Su-30MKI raced in from the west, slowed and positioned itself directly in front of the grandstand, then fired a single indigenously developed Astra BVR missile, marking the first time this missile had been fired in public. The aircraft was commanded by Wg Cdr KU Rao, a seasoned test pilot at the Aircraft Systems and Testing Establishment (ASTE).

The night-time portion of the exercise featured a combat free fall paratrooper insertion from an An-32, rocket firing from both fighters and helicopters, search light and troop-insertion operations by Mi-17V5s, and a number of bomb drops. While the unguided bombs dropped by Sukhois and Jaguars faced few issues, an LGB strike by a Mirage 2000 had to be aborted owing to cloud cover over the target. The night operations also featured the first firing of the indigenous Akash SAM system at *Iron Fist*, before concluding with a dramatic deployment of anti-missile flares by an An-32 and a C-130J.

As Chief of Air Staff, Air Chief Marshal Arup Raha stated at the event, primary objective of the firepower demonstration was to reassure the nation about the IAF's "commitment and capabilities in safeguarding our national interests." The Air Chief noted that the IAF maintains "a high combat potential for meeting challenges," despite constraints (presumably financial).

Earlier, at a curtain raiser press conference for the event in New Delhi, Vice Chief of Air Staff, Air Marshal BS Dhanoa quoted Theodore Roosevelt's famous aphorism, "Speak softly and carry a big stick," stating that *Iron Fist* would be a demonstration of "the business end of the IAF – the 'Big Stick' – our capability to deter." However, Air Marshal Dhanoa also sounded a note of caution on the state of the IAF's fighter fleet, candidly admitting that the IAF's numbers are not adequate for a "two front scenario," and that the Air Force is currently down to some 33 fighter squadrons, as against a sanctioned requirement for at least 42.

Text and photos: Angad Singh

Dramatic night firing by an Mi-8 helicopter

Enter the Gripen E

Revolutionary fighter breaks cover in Sweden

Saab's significantly upgraded JAS 39 fighter looks much like its older siblings, but the similarities are only skin-deep. The Gripen E is a revolution in virtually every way, including its price, with Saab claiming to have "broken the cost curve" with their new fighter.

On 18 May 2016, Saab rolled out the first pre-production, next generation Gripen E aircraft (numbered 39-8) at its facility in Linköping, Sweden. The ceremony was attended by Swedish Minister for Defence, Peter Hultqvist, the Swedish Air Force Chief of Staff, Maj Gen Mats Helgesson, Commander of the Brazilian Air Force, *Tenente-Brigadeiro-do-Ar* (General-Brigadier) Nivaldo Luiz Rossato, and other dignitaries from Sweden and around the world. Saab was represented by Chairman of the Board Marcus Wallenberg, CEO Håkan Buskhe, and Head of Business Area Aeronautics, Ulf Nilsson.

"Nations need modern air defences to uphold national sovereignty. Meanwhile, the cost in relation to other investments in society needs to be reasonable. Therefore, Saab has developed design and production methods for the Gripen E to both increase capability and to reduce costs," said Håkan Buskhe during the rollout, highlighting one of the key focus areas for the entire Gripen E programme.

While externally similar to the earlier Gripens, the 'E' is a revolutionary development of the JAS 39 platform, and is different from the Gripen C in numerous ways. Its power plant is the new General Electric F414G-39E which develops around 98 kN of thrust in afterburner, over 20 per cent higher than the F404-based Volvo RM12 in the Gripen C. This has necessitated larger air intakes. The Gripen E also has a higher maximum take-off weight (16.5 tonnes versus 14 tonnes), translating to substantially higher payload. The undercarriage has been redesigned and the mainwheels are now relocated to bulges under the wing roots, freeing up room inside the fuselage for much more fuel as well as creating space under the airframe for additional hard points. The Gripen E also incorporates a new self-protection and EW suite, using the latest gallium nitride (GaN) antenna technology. A new AESA radar from Selex is one of the primary distinguishing features of the new Gripen, and features an antenna mounted on a canted steerable swashplate that widens

the field of view of the planar array. The infrared-search and track (IRST) sensor, also from Selex, is one of the most visible changes to the Gripen, which allows the aircraft to passively detect and track targets at beyond-visual ranges.

Brazilian Air Force Commander *Tenente-Brigadeiro-do-Ar* Nivaldo Luiz Rossato hailed the Gripen E's advanced capabilities, saying that the new fighter "will represent a major advance to face any threat to airspace sovereignty. These fighters will be the backbone of the Brazilian Air Force."

In fact, Aircraft 39-8 is the first of three planned test aircraft, which will support the Gripen E programme. It is expected to make its maiden flight before the end of this year, according to Saab, and will be used initially to verify the type's general systems, airframe and aerodynamics. The next two test aircraft are already under assembly.

The Gripen E/F programme began with a low-cost technology demonstrator based on the Gripen D, modified to incorporate many of the proposed Gripen E/F changes, from the new engine to redesigned landing gear, and of course, an all-new cockpit layout (implemented for the rear seat only). This risk-reduction platform, aircraft 39-7, first flew in May 2008 and has logged some 300 flights (totalling around 260 hours) since it first flew in 2008, validating vital systems and airframe attributes of the new project. This aircraft was also demonstrated in India during the M-MRCA trials and

After the roll out : Swedish and Brazilian Air Force officers with Håkan Buskhe, CEO of Saab

set a record of sorts, being flown from Sweden to India and back even while it had logged few hours after its roll out (*see Vayu III/2008*).

Although appearing broadly similar in design and layout, the definitive Gripen E does not retain much of the older airframe, only reusing parts of the fuel and air systems, the ejection seat, windshield, canopy and outer elevons. Extensive capability improvements for the Gripen have not come with equally high cost increases. Saab's focus on minimising production and testing costs and timeframes are expected to translate to a unit cost for the new aircraft that is comparable to the older Gripen C/D. Pre-production design work has resulted in a reduced parts count for the new airframe, and shorter component manufacturing times, making each aircraft less complicated and quicker to put together, resulting in large savings on the factory floor. Saab estimates a 50 per cent increase in productivity as compared to the later stages (that is full rate production) of the Gripen C.

"This is the only fighter programme on time and on budget," says Ulf Nilsson, Saab's Head of Business Area Aeronautics.

The test programme is also incredibly frugal, owing to Saab's extensive use of software modelling for the Gripen E/F. Where the Gripen C/D programme required some 4,000 test sorties to conclude development, the Gripen E/F is expected to require no more than a total of 1,200 sorties spread across three test aircraft, a tremendous feat in both engineering and cost-cutting.

Initial customers for the Gripen E/F are Brazil and Sweden, with orders for 36 and 60 respectively, while Saab estimates worldwide demand between 300 and 400 units over the next two decades. The first Gripen E deliveries are planned in 2019, to Sweden and Brazil, with the Swedish Air Force expecting to achieve Initial Operational Capability in 2021, and full capability two years later.

During Vayu's earlier visit to Saab's Aerostructures hangar in Linköping, Gripen E was seen under assembly

The Gripen Demo, prototype for the new generation (NG) Gripen or the definitive Gripen E, was flown all the way to India for rigorous flight trials during the M-MRCA competition where it proved its attributes

'Make in India' for Gripen

Chief among Saab's export targets for the new fighter is India, particularly given the IAF's significant shortfalls in combat aircraft numbers, which is projected to get worse over the coming decade (*see Vayu II/2016*). The Gripen E is already being offered under the 'Make in India' initiative, along with comprehensive transfer of technology to build and further develop the type in India.

"The Gripen E is a specific configuration of the Gripen NG [New Generation] chosen by the Swedish customer. The exact configuration for another customer, such as India, will depend on discussions with that customer," said Jan Widerström, Country Head and Chairman, Saab India Technologies, highlighting both the industrial and technological aspects of a possible deal with India.

"I think we have a very good opportunity in India," said Ulf Nilsson about Saab's continued interest in the Indian fighter market. "We can make an attractive offer that would suit the Indians with their 'Make in India' concept."

Saab, which has an active presence in the Indian defence and aerospace market, has long maintained that India would need a large number of 'affordable' fighters to meet long-term requirements for its combat aircraft fleet. Mikael Damberg, Sweden's Minister for Enterprise and Innovation, has said that instead of looking only at exports from Sweden, Saab is now looking at how to develop capability and production processes in India to fit into the 'Make in India' initiative.

"It has been one of the greatest successes of Saab International that many countries see that the business model is very attractive. Swedish firms and companies are doing a lot of investments in India. One of India's successful strategies has been attracting international capital. Modern economies are not only about export. They are also about finding the right partners. There are very exiting partners in Sweden and the market in India is exciting," said Damberg.

The Government of Sweden has formally offered the Gripen NG to India when the high-powered Swedish trade delegation visited Mumbai during the 'Make in India Week' in February this year, and reports indicate that a structured Government-to-Government (G2G) deal has been forwarded by the Swedish administration for consideration by their Indian counterparts.

Gripen pilots with a newly updated MS20-standard JAS 39C, sporting SDBs and Meteor BVRAAMs

The Incredible 'C'

The rollout ceremony also saw a Gripen C performing an aerobatic display over Linköping, and a static display of a Swedish Air Force's Gripen equipped with the new MS20 operating software standard. The new software enables the Gripen C/D to deploy additional weapons, including MBDA's Meteor BVRAAM and Boeing's GBU-39 Small Diameter Bomb (SDB). Additional enhancements include enhanced Link 16 capability for situational awareness, a new data link for improved close air support mission effectiveness, expanded functionality for the helmet-mounted sight, an infrared reconnaissance pod and an automatic ground collision avoidance system (Auto-GCAS).

The MS20 upgrade makes the Gripen the first combat platform in the world to operationalise the 'game-changing' Meteor missile, while the GBU-39 significantly increases the fighter's ability to carry out precision strike missions with low collateral damage.

Mikael Olsson, Experimental Test Pilot for Saab at Linköping

The structured offer likely comprises a combination of technology transfer and local production, coupled with long-term investment commitments. Saab executives highlight the extensive technology and production sharing plans in place for the Brazil deal as evidence that the company is not only prepared but also well equipped to execute a similar arrangement with India. "The solution we did there ... could very well be suitable for India," said Ulf Nilsson, adding that Saab is already talking to potential Indian partners.

Sweden's Government has also signalled an increasing willingness to foster an expanded partnership with India. Prime Minister Narendra Modi and his Swedish counterpart Stefan Lofven have already signed a joint commitment to continue dialogues in areas of aviation, air defence, combat training and maritime security systems.

In Conversation with Jan Widerström CMD Saab India

"Gripen would serve India well"

India's Prime Minister Narendra Modi had first mooted the idea of 'Make in India' on Independence Day 2014, which truly brought focus on what India was trying to do: increase manufacturing in India both for domestic consumption, and for export as well. 'Make in India' is a very powerful idea, and the country has a competitive advantage in terms of human resources and a captive advantage in high-end technology.

"The 'Make in India' initiative could do a lot of good for both India and Indians in terms of increased job opportunities. India can also leverage her large, skilled population for a bigger piece of the global manufacturing space. We believe that there should be a knowledge transfer mechanism built into the core of all joint production. In an interconnected world, the goal should be to see how both Indian and foreign companies can share knowledge, also learn from each other. In that way, 'Make in India' will transform itself into a mission which will be spoken about in the years to come, by providing a tremendous boost to joint development and manufacturing," stated Jan Widerström, Chairman and Managing Director, Saab India Technologies Pvt Ltd (SITL).

Saab has been present in India since 1976, and today has a very broad footprint in the country, including a Research & Development Centre, a partnership for developing Combat Management Systems, sourcing arrangements for aerostructure components, a joint venture for aerostructure assemblies and an office in New Delhi.

"Saab and Sweden have a long history of sharing knowledge with their partners, and it is with this spirit of sharing that they enter any process in the globalised world. The real progress is where both parties in a partnership can say that they have learnt something beneficial from the partnership," says Widerström.

To the 'Make in India Week' recently held in Mumbai were invited some of the world's leading companies to increase cooperation with India. Saab was one of several Swedish companies that were part of a business delegation led by Swedish Prime Minister Stefan Löfven, one of the few heads of government present at the event – an important fact for Saab and the other Swedish companies. Under the slogan *'Sweden Makes in India'*, Swedish companies showcased some of their cutting-edge products, as well as their ideas for greater cooperation for the future of the Indian market.

"We have had plenty of opportunities to discuss future business potential and technology transfer with the Indian decision makers as well as with Indian partners and future partners. It is a very promising future in India for Sweden and Saab," stated Group CEO Håkan Buskhe.

One of the important future businesses discussed was the Gripen multirole combat aircraft. "Saab is willing to offer Gripen to India, an offer consisting of a unique combination of operational performance, availability, cost effectiveness, technology transfer and industrial partnership. The offer includes setting up of a full manufacturing facility; transfer of state-of-the-art technology; setting up of an aerospace eco-system in India; creation of a local supplier base of ancillary systems; and employment of a well-trained Indian workforce. We would train Indian engineers in Sweden, as we're doing with Brazilian engineers right now for the Brazilian Gripen programme. We see ourselves as a catalyst. We will provide India with cutting-edge technology which will energise India's aerospace ecosystem," stated Jan Widerström.

Saab believes that Gripen is "the perfect fighter aircraft for India's requirements. Gripen would serve India well, with a lasting impact on the existing support infrastructure. In a force mix with India's existing fleet, Gripen would be the ideal frontline fighter for the country. We believe Gripen is more than just a smart fighter – it will provide affordable air power and industrial growth for the Republic of India. It will be the national asset of India," asserted Widerström.

In wake of Defexpo 2016

As *Vayu's* editor exclaimed on meeting Manohar Parrikar, Indian Defence Minister, just after the inauguration of Defexpo 2016, "You've pulled it off!" There was much significance in this statement, or salutation, depending on the context taken, but the very fact that the Defence Exhibitions Organisation, supported by herculean efforts of professional organisations such as the redoubtable RE Rogers, had transformed a dusty field around the 'boondocks' of South Goa into a massive international showground in just about a month, was creditable enough.

But why Naqueri Quitol in Quepem Taluka of South Goa? If this small state along India's western coast had to be chosen to play host to such a prestigious defence exhibition, especially under the umbrella of 'Make in India,' surely there were many other options for a venue in

The DRDO-Tata Kestrel WhAP kicking up clouds of dust during its dramatic demonstration

Naval Tejas NP-1 over Defexpo 2016

Goa, not least because of pre-existing infrastructure, cell phone connectivity, ease of access, and appropriate facilities available. The heat and humidity only accentuated what was on everyone's minds, expressed openly or not !

The Defence Minister must have been acutely aware of all these factors when he apologised to the audience, who were "cooking in the heat and humidity" (his words) as they awaited the commencement of ceremonies, since many VIPs had been held up in traffic snarls along the narrow roads leading to the showgrounds. However, Mr Parrikar said "that in future," the Chief Minister of Goa would ensure that roads are widened and infrastructure improved, clearly hinting at intentions to host future editions of Defexpo here again, in Quitol.

But as the invitees, delegates and exhibitors soon found out, not all the ten Halls listed had comprehensive displays (and effective air conditioning) and several lay forlon, either semi–occupied or not at all. Still, the statistics were impressive – 1,055 companies in total, including 224 delegates from 45 countries, attending a show spread over a mammoth 40,725 sq m – a near 50 per cent increase over the previous edition of Defexpo held in Pragati Maidan, New Delhi.

Arjun Mk.I battle tank in action after the inaugural ceremony

At his inaugural address, the Defence Minister announced that the much anticipated DPP 2016 had been formally released online that morning "at 9 am," with printed copies to be made available within a fortnight, albeit without the much-anticipated chapter on 'Strategic Partnerships'. After the inaugural speeches – and there were several – the stage was trundled away and some air and land demonstrations begun. These included red dust-churning movements by the indigenously designed and built Arjun Mk.I and Mk.II MBTs, the DRDO-Tata Wheeled Amphibious Platform (WhAP, also called 'Kestrel'), a number of Tata trucks, and an AM General M1151 HMMWV ('Humvee'), which is being considered for production in India by the Kalyani Group.

Above this amphitheatre, the IAF's Sarang helicopter team did their best to enthrall a fast-diminishing audience, and were followed by the Naval LCA prototype (NP-1) in its first public display, flown brilliantly by Cmde Jaideep Maolankar, CTP at the NFTC. The Tejas LCA is no stranger to Goa, development aircraft being based at the Naval Air Station, INS *Hansa*

Navy Chief Admiral RK Dhowan at the inaugural ceremony

(Dabolim) for various trials, including missile firing of the Rafael Derby BVR missile (see *Vayu* I/2016).

Back to the pavilions at Naqueri Quitol. The exhibitors were initially uncertain as to 'footfalls' expected in this remote *taluka* in southern Goa, as, unlike Pragati Maidan in the heart of New Delhi, which is a hop, step and jump away from the Ministry of Defence, various Service headquarters and those of the Paramilitary Forces, specially cleared officers would this time on, first have to fly to Dabolim in Goa and then wend their way southwards to the exhibition site, spend rest of the day and then return home in the same manner. However, to everyone's agreeable surprise, there still were large numbers of visitors from the armed forces, striking in their white, green and blue, including Chiefs of the Army and Navy and Vice Chief of the Air Force (the CAS being away abroad at the time). Not surprisingly, 'whites' were predominant as Goa is 'Navy territory', with the FOGA (Flag Officer Goa Area) and FONA (Flag Officer Naval Aviation) ensuring that officers and sailors did not miss out on this unique opportunity at their virtual doorstep.

The Defence Minister (formerly Chief Minister of Goa) Manohar Parrikar was, not surprisingly, all over the Show. In a marked departure from previous editions of Defexpo, this Defence Minister was observed walking from hall to hall all day, spending quality time engaging various exhibitors - both Indian and international - in keen discussions.

The Minister was obviously pleased with the elaborate DRDO and DPSU displays in Hall 2, which included those from HAL, OFB, BEL, BDL and various public sector shipyards. However,

Indian Defence Minister Manohar Parrikar

Mr Parrikar evinced equal interest in foreign displays, particularly at the Norwegian pavilion in Hall 2 with its array of missiles and other munitions. In Halls 1 and 3, the Minister had much to take in, as they hosted

With the Air Chief visiting Israel during Defexpo, VCAS Air Marshal BS Dhanoa was the seniormost IAF officer in Goa

gargantuan stands for Israeli, Russian, European and American industries. Even as Mr Parrikar 'did the rounds' virtually on his own, with a mere handful of aides, the Armed Forces were well identified by their uniforms with delegations led by senior officers.

The Israelis had a huge range of equipment and systems, as did the Americans and Russians. Another big stand was that of Saab who also had a 'live' Gripen multirole fighter simulator which was crowded by both Air Force and Naval Aviation pilots. BAE Systems displayed models of their proposed 'Combat Hawk', while other big aircraft models included the F/A-18 Super Hornet and F-16 Viper in the American section. Conspicuous by its absence was the Rafale, no model or even an image being evident at this Defexpo.

Hall 10 had smaller displays including those by specialist international firms such

The Army Chief, General Dalbir Singh, was in attendance at Defexpo 2016

'Make in India' was the central theme of the show!

as Austria's Hirtenberger Defence Systems, with their lightweight man-portable mortars, which attracted the Defence Minister's attention. Just down the aisle in Hall 10, were also the cluster of trade media booths, including the *Vayu*, these being "dynamic" in character as many were involved in producing and then distributing the Show Dailies. For the record - and future reference - this must be the only international trade show where the professional media is actually *charged* to cover the event and that too, facing incredible logistic nightmares, such as to print, deliver and distribute Show Dailies at a remote location. Some (not the *Vayu)* had to be printed far away, in other places of Western India, including Mumbai or Ratnagiri, and then transported by air or road at enormous cost and effort. To labour the matter, news and editorial had to be put together, pages laid out and proofed before committing to print, and then at dawn, rush them to Quepem Taluka of Southern Goa, not far from the border with Karnataka. A mighty job thereafter to distribute the Show Dailies in the various Halls well before the first exhibitors arrived. Whew !

DRDO's press conference was held at the dedicated Hall 6 and had the Director General Dr S Christopher candidly fielding varied questions from the assembled media. Queries ranged from replacement of the INSAS rifle, weight of the Arjun Mk.II MBT, to status of the Tejas LCA and the next-gen AMCA.

Saab's Gripen simulator drew significant interest

On the Rustom-II MALE UAV, the DG DRDO revealed that fast taxi trials are underway, with first flight expected by the end of April 2016. Regarding the indigenous AEW&C programme, Dr Christopher stated that the first aircraft would be delivered to the IAF "within this year", followed by the second a year later. The follow-on AWACS programme has yet to be progressed, for which eight aircraft are to be procured (reportedly the A330).

One could well feel the sense of achievement during *Vayu*'s meeting with HAL Chairman Mr Suvarna Raju, at the company's sprawling display in Hall 2. The financial year 2015-16 was nearly at an end and the Chairman/MD was pleased to share an overview of the results : a record turnover of over Rs 16,500 crore, manufacture and supply of 60 new aircraft, including 12 Sukhoi Su-30s, 17 Hawk Mk.132s, 21 Dhruv ALHs plus some Dornier 228s, Cheetals, two IJTs–but only one LCA (*detailed report in this Issue*).

Vayu in conversation with HAL CMD T Suvarna Raju

Outdoor exhibits included the indigenous Akash SAM system

Meetings & briefings at Defexpo 2016

Interview with
Pierre de Bausset, President & MD, Airbus Group India

"We are already making in India"

VAYU :You here crossed $500 million in annual procurement from India last year and this was independent of any defence offset obligations. How did you manage this feat?

PdB : That's because we have embedded Indian suppliers, both publicly and privately owned companies, into our global supply chain. We have over 45 suppliers today in India contributing to all our commercial aircraft programmes, some helicopter programmes (civil and defence) and to a range of our military aircraft platforms. For example on the civil side: Hindustan Aeronautics Limited makes half of the A320 Family forward passenger doors produced worldwide. Dynamatic Technologies makes flap-track beams for the A320 Family on a global single-source basis and has been contracted to manufacture them for the A330 Family. UTC Aerospace Systems makes evacuation slides, interior and exterior lighting, power drive units, auxiliary motors and passenger supply cabin modules for all our commercial aircraft. Mahindra Aerospace is on contract to supply a million aero-components per year. Aequs recently added to a pre-existing sheet metal, assembly and forging facility. Tata Advanced Materials (TAML) provides composite parts for the wing for the A350 XWB and the A320 while TAL Manufacturing Solutions is supplying over 500 sheet metal and machined parts and sub-assemblies for the A320. Infosys, Geometric and Tech Mahindra provide Engineering & IT services.

VAYU : Any examples of your defence sourcing from India?

PdB : Sure. Wipro has received technology transfer from an Airbus Defence and Space JV company in Spain to manufacture more than 8,000 aerospace actuators per year, which go on platforms such as the A400M, CN235 and C295W. SEFEE India designs, develops, manufactures and tests complete electrical harness systems for A400M and several Airbus Helicopter models.

VAYU : What is your roadmap for 'Make in India'?

PdB : We have a two-pronged 'Make in India' roadmap. On one hand we are already making in India through suppliers. Last year we exceeded US$500 million in annual procurement from over 45 suppliers in India, supporting more than 6,000 local jobs. On the other hand, we are competing in several 'Make in India' defence and space programmes. We have bid to produce the C295W together with Tata and have partnered Mahindra for helicopter manufacturing. Our value proposition for these programmes is that together with partners, we will help India create an indigenous defence industrial eco-system. We will help set-up final assembly lines in India for these products, make industrial investments, support local supply chain development and skill people. I believe this is what India wants. In fact, this is what it needs and we are ready to do it.

VAYU : Skill development is another area which is very dear to this government and it is all the more important in a high-technology field like aerospace and defence. What role are you playing here?

PdB : As a company which is keen on creating an industrial eco-system in India focused on aerospace and defence, we realise our responsibility to help in the skill development of the local work force. And that's why we work with our suppliers here who, as I said earlier, employ over 6,000 people on our projects. We provide them intensive training and mentoring. We invite their teams over to our own or our supplier facilities in Europe and expose them to best practices which they bring home with them. Whenever required we station our experts at supplier premises to consult them on technical issues. Ask any Airbus supplier in India and one thing they will say they like about us is how we help them grow. I am also impressed by how partners, like TASL in particular, have set up programmes to skill their blue collars, and I believe there are lessons in this. If we get the defence programmes we are competing for, we will further ramp-up our training and skilling programmes, working alongside partners.

VAYU : What is the status of your C295W bid?

PdB : The evaluation process is on as per the defence procurement procedure. This is an excellent *Make in India* project. Out of the requirement for 56 aircraft, Tata and we would build the majority of the aircraft in India. The local final assembly line will spawn a robust base of domestic suppliers that will feed the production line. This is a tangible opportunity to translate *Make in India* into reality. Moreover when the programme will start, we strongly believe that the production will not stop at 56 but will increase to cover additional Indian and global orders.

Boeing's Apache and Chinook for the IAF

In of September 2015, the Government of India finalised an order with Boeing for 22 AH-64E Apache attack helicopters and 15 CH-47F Chinook heavy-lift helicopters for the Indian Air Force. Just days before Defexpo 2016, Bradley Rounding of the Vertical Lift Global Sales & Marketing team at Boeing Defence, Space & Security gave *Vayu* details about Boeing's vertical lift business and how the Apache and Chinook would be best suited for the Indian Air Force's requirements.

"With the selection of the AH-64E, the dominant force projection capabilities of the Indian Air Force will be enhanced considerably," Rounding said. "The Chinook has unsurpassed ability to deliver heavy payloads to high altitudes, and is eminently suitable for operations in the high Himalayas. The aircraft has been battle-tested in diverse extreme conditions throughout the world, and has proven capability to operate in the wide range of conditions that typify the Indian subcontinent."

The AH-64E Apache, the most modern variant also flown by the US Army, features enhanced performance, joint digital operability, improved survivability and cognitive decision aiding. The CH-47F Chinook is an advanced multi-mission helicopter operated by the US Army and 18 other defence forces. The Chinook has proven its ability to operate in the range of conditions that typify the Indian subcontinent, including delivering heavy payloads to high altitudes.

AH-64E Apache attack helicopter

CH-47F Chinook heavy-lift helicopter

Dennis Swanson, Vice President, Defence, Space & Security in India, also explained that the Apache and Chinook represent the best of high-performing technologies that will modernise India's defence capabilities, "We look forward to delivering the newest Apache and Chinook to our customers and remain focused on delivering on its commitments to the Indian Air Force and India's Ministry of Defence," Swanson said.

India is the 14th nation to select the Apache and the 19th nation to select the Chinook. "Both the Apache and Chinook will strengthen the country's homeland defence significantly and deter regional threats." The Chinook's ramp and pylon is made in India by Dynamatic Technologies while Apache fuselages will soon be produced in India as part of a joint venture that Boeing signed with Tata Advanced Systems recently.

Accelerating momentum for 'Make in India'

Soon after PM Modi announced the launch of 'Make in India' in September 2014, Boeing introduced a new manufacturing line at Dynamatic Technologies (DTL) in Bangalore. DTL has been working on the P-8I since 2010 and has since expanded to include the manufacture of critical ramp and pylon parts for the CH-47 Chinook since 2013.

In November 2015, Boeing and Tata Advanced Systems (TASL) signed an agreement to establish joint venture (JV) that will manufacture aerostructures for aircraft and collaborate on integrated systems development opportunities in India. The JV will create a manufacturing centre of excellence "to produce fuselages for the AH-64 Apache helicopter and to compete for additional manufacturing work packages across Boeing platforms. Boeing and TASL intend to grow the JV partnership in the future with a focus on opportunities to collaborate."

"Over the last 12 months, we have doubled our sourcing from India and are committed to continue that journey," continued Pratyush Kumar, President, Boeing India. "Our commitment was demonstrated by Boeing Chairman Jim McNerney's presence at the recently concluded aerospace Innovation Summit in New Delhi and this JV is a clear example of Boeing's long-term commitment to 'Make in India'."

Elettronica's Nettuno naval ECM solution

Italian FREMM frigate Carlo Margottini with Nettuno installation on the mast (photo: Piergiuliano Chesi)

"Elettronica's electronic warfare portfolio is based on the firm's strengths in key areas such as phased array antennas, Digital Radio Frequency Memory (DRFM), solid state Rx/Tx modules, and digital receivers. The Nettuno-4100 naval ECM system is intended to provide naval platforms with an active electronic defence using selected ECM tactics, exploited through DRFM generated signals. The system can be equally effective against both missile attacks in the terminal phase and hostile long range designation radar systems, surface search and tracking radars."

The Nettuno-4100 has a scalable architecture, which can be configured for different needs by assessing the needed Effective Radiated Power (ERP) in relation to the host ship's Radar Cross Section (RCS) and role, and by dimensioning the antenna array and the transmitted power to the ERP required for the defence purposes. In addition, Nettuno 4100 systems can operate in conjunction with other onboard EW sensors and emitters.

The system has full azimuth coverage and can steer through 50° in elevation, and features electronic beam steering, including electronic stabilisation to counter ship movements. Of particular importance is a single Nettuno installation's ability to jam multiple threats through time-sharing resource management. It covers the H to J band frequencies and its solid-state design ensures both high ERP and graceful degradation in case of minor failures. The design also removes the need for system warm-up times, and is inherently more reliable and maintainable than legacy systems, with Built-In Test Equipment (BITE) down to the module/card level. The solid state architecture also makes for relatively simple shipboard integration and installation, as no microwave guides are required.

The Nettuno-4100 system is designed for ease of maintenance and support, and a host of products and services are readily available to minimise downtime. These include field test equipment, ground support equipment, automatic test equipment, library programming, and library loading/unloading. Nettuno family systems are installed in a range of operational warships, including the Italian STOVL carrier Cavour and the multinational Horizon and FREMM frigates.

"ASK AMERICA FIRST": USA at Defexpo

The United States was amongst Defexpo's largest international exhibitors, with more than 40 exhibitors, the size of the American contingent being a strong indicator of how important the region is to the US defence and security business, and that India and its allies are likewise interested in working with US companies to further their defence, security and economic goals.

There were 29 exhibitors in the Pavilion, ranging from publicly-traded stalwarts to privately-held small-and-medium-sized enterprises (SMEs). Pavilion exhibitors represented a cross-section of leading American suppliers working to strengthen or initiate international partnerships. "When US companies commit to exhibit at DefExpo, they believe in the power of this event to attract real business prospects and customers. The global interest in this show speaks for itself," stated Kallman Worldwide President and CEO, Tom Kallman. "Our team is proud to help our exhibitors capitalise on this influential international business opportunity to grow their share of the marketplace and our nation's trade and investment partnerships in the region."

In addition to organising the national Pavilion, Kallman Worldwide promoted US exhibitors with its **Ask America First** advocacy campaign. "The United States is the world's biggest aerospace and defence supplier, but that's no guarantee that buyers will look to work with US companies over others," said Kallman. "As the organiser of the US presence at DefExpo 2016, we have a responsibility to advocate not only for our exhibitors, but for our nation in this highly competitive marketplace. We want every visitor to 'Ask America first' at DefExpo, and to be assured that America is listening."

"25 years of co-operation between IAI and India's defence forces"

Israel Aerospace Industries (IAI) presented a wide range of strategic systems, including special mission aircraft such as AEW&C (ELM-2090) and exclusive economic zone (EEZ) maritime defence solutions including the Heron MALE unmanned aerial system (UAS) at Defexpo 2016. The company featured its air and missile defence and loitering weapon systems such as the MRSAM/ LRSAM Barak 8 air and missile defence system and the Green Dragon- a tactical, low-cost loitering weapon designed to provide small ground and special operations units with significant situational awareness and firepower in a compact envelope. Radar and communications systems include the Drone Guard (ELI-4030) for drone detection, identification and flight disruption; the Green Rock (ELM 2138) : a mobile autonomous tactical counter rocket, artillery and mortar system; and CIMS (Counter IED and Mine Suite)which is an integrated suite of sensors, for protection of tactical maneuvering vehicles.

Joseph Weiss, IAI President and CEO

"IAI has a 25+ year history of demonstrated strategic cooperation with India's defence forces and industry. The company collaborates with many Indian companies (both public and private) and works closely with all branches of the Indian Armed Forces to support the government's *Make in India* policy."

"India's main goal has always been to acquire cutting-edge technologies, and has become a prominent market for Israeli defence companies", stated Joseph Weiss, IAI's CEO and President. "India has unique operational needs and IAI is committed to devoting our best minds and technologies to achieve the challenges set by the customer and continue our long-term strategic cooperation with India for a brighter and safer future."

IAI has indeed been involved in many development programmes for India's Navy and Air Force, in cooperation with DRDO and Indian defence industries, such as the joint development of long-range surface-to-air missiles with Bharat Electronics Limited India (BEL). These projects include joint production of subsystems, such as a recent teaming agreement with Alpha Design to produce IAI's mini-UAVs in India. This teaming agreement will better position IAI's mini-UAVs to potential customers in India, including security agencies, coastguards, defence organisations and border security forces. Ongoing projects with India include the Barak 8, co-developed with India as part of the LRSAM naval air defence; MRSAM land-based air defence systems; various types of radars and large numbers of Heron UAS.

High-tech in India: Si2 at Defexpo

Sanjay and Dinanath Soni of Si2

Si2 Microsystems was established in 1996 as an electronics manufacturing firm in Bangalore. Since then, the company has expanded and evolved into a global player, with particular expertise in military electronics in India. In 2007, Si2 acquired Silitronics, a San Jose-based American semiconductor firm to strengthen their R&D and manufacturing base across product lines.

In the defence sphere, Si2 carries out obsolescence management and indigenisation of military electronics for a range of systems in service with all three branches of the Indian armed forces, as well as design and development work in support of indigenous development programmes. Notable successes for Si2 include indigenous products delivered to a number of Indian customers including ISRO, ADE, HAL, BEL, the Indian Navy, and RCI for projects ranging from missiles to EW to the Tejas LCA. In addition, the firm works with a number of foreign companies, such as Israeli defence company Elta Systems and European missile makers MBDA, both as part of their supply chain and as an offset partner.

Beyond obsolescence management and indigenisation of existing equipment, Si2 specialises in miniaturising equipment to reduce volume and weight, which is particularly relevant to satellites, avionics, munitions and so on. In more recent times the firm is moving on to design of larger subsystems and systems, such as missile test benches for MBDA, as part of the offset obligations for the IAF Mirage upgrade contract.

Sanjay Soni, President of Si2, in an interaction with *Vayu* at Defexpo said that "reverse engineering/replicating parts for indigenisation or obsolescence management" is not the company's priority, as it "does not add value or solve key issues. Si2 tries to re-engineer as far as possible." This, noted Soni, was only possible because the company has an active R&D capability, and is not simply manufacturing third party designs and products.

Si2 is interested in partnering more extensively with the armed forces as well as being a more active participant in development programmes for indigenous military hardware. At Defexpo, Soni revealed that Si2 is planning to set up electronics spares for all Army wheeled and tracked vehicles, and has signed a MoU with Russian company Uralvagonzavod for this purpose. Another area where the company believes it can make a strong impact is in aerospace, where they already have considerable expertise thanks to their past work with avionics, satellites and munitions.

BAE Systems 'Make-in-India'
as M777 takes centre stage at Defexpo 2016

BAE Systems' battle proven M777 Ultra Lightweight Howitzer (ULH), for which India and the United States have been in discussions for a Foreign Military Sale to the Indian Army, took centre stage at the company's stand at Defexpo 2016. BAE Systems recently reaffirmed its commitment to 'Make in India' by down-selecting Mahindra and Mahindra as its business partner for the proposed in-country Assembly, Integration and Test (AIT) facility for the M777.

In addition to the M777 ULH, the company's showcase included the Archer 155 mm FH 77 BW L52 self-propelled gun along with a full range of munitions including the Hyper Velocity Projectile, 81 mm mortar, 105 mm and 155 mm artillery ammunition, 120 mm tank ammunition and 3P programmable ammunition.

Underlining BAE Systems' capabilities for the naval forces was the Mk 45 Mod 4 Naval Gun System, a proven, reliable and effective automatic 5-inch (127 mm) gun, and the 40Mk4 Naval Gun, an extremely flexible weapon system with a high rate of fire and capability to switch between optimised ammunition types.

Broadsword Spine, a new wearable technology which incorporates a power and data distribution network suitable for the military, law enforcement and emergency services who need to charge electronic equipment 'on the move,' was also featured at the BAE Systems stand.

Recognising the ever-increasing importance of cyber in the defence mix, BAE Systems also showcased its cyber defence and intelligence capabilities at Defexpo, giving company experts an opportunity to engage with local sector participants and demonstrate a unique set of solutions, systems, experience and processes. These, combined with BAE Systems' Cyber special forces, enable a robust defence against cyber attacks, fraud and financial crime, enable intelligence-led policing and solve complex data problems.

The Hawk advanced jet trainer, with 123 aircraft ordered to date by the Indian Air Force (106) and the Indian Navy (17), also had prominence at the stand. In May 2015, BAE Systems and HAL signed a memorandum of understanding regarding future plans for the Hawk programme in India. This covered a number of areas for potential future development including an advanced derivative of the Hawk.

Leading the BAE Systems participation at the show were John Brosnan, Managing Director, India and South East Asia, Dr Joe Senftle, Vice President and General Manager, Weapon Systems, BAE Systems Inc, and Alistair Castle, General Manager and Vice President, India. As John Brosnan, Managing Director, South East Asia and India, said, "Defexpo is a strategic platform for the Company to demonstrate our commitment to partner India to 'Make in India.' Our showcase curates a range of capabilities and equipment, every one of which has a Make in India vision. In particular, the Show is an excellent platform for us to strengthen existing partnerships and activate new ones."

Alistair Castle, Vice President and General Manager, India, added, "The India defence industry continues to build significant capability. As founding partners of defence manufacturing in India, we underline our longstanding commitment to sharing technology and capability with Indian industry."

"Diversification Efforts"

In conversation with BEL Chairman and MD SK Sharma

BEL CMD, SK Sharma

"BEL is working on many strategic areas such as AESA-based modern radars, new generation Electronic Warfare (EW) suites, air defence systems, tactical communication systems, battlefield management systems, passive night vision devices and multi-sensor stabilisation systems, in order to anticipate and pre-empt many impending modernisation requirements from the Indian Armed Forces."

As the CMD confirmed, BEL has already entered into strategic alliances with defence laboratories, the Ordnance Factory Board (OFB), other DPSUs and several global and Indian companies, in order to address the emerging requirements of the Indian defence forces. Various products and systems under consideration include Surface-to-Air Missile (SAM) systems, air defence radars, sonar systems, next generation night vision devices, gun upgrades and new gun programmes, Inertial Navigation Systems (INS), Medium-Altitude Long-Endurance (MALE) Unmanned Aerial Vehicles (UAVs), electronic ammunition fuses, electronics systems for the Army's Future Infantry Combat Vehicle (FICV) programme, SATCOM terminals and missile containers.

BEL's exports, expansion and diversification plans

BEL achieved its highest ever export sales of USD 57.85 million in 2014-15, registering a growth of 37.7% over the previous year's export turnover of USD 42 million. The export sale for the year 2015-16 is expected to surpass the targeted USD 65 million and cross USD 80 million. The long-term export plan of BEL is to sustain revenue from export sales at 10% of total turnover, compared to the current level of 5.3%.

BEL is focusing on opportunities in the areas of offset obligations of foreign OEMs responding to various MoD RFPs. The focus is on 'Build to Print,' 'Build to Spec,' and 'Buyer Nominated Equipment.' BEL has signed MoUs with many foreign companies and is working with major aerospace and defence firms to establish long-term supply chain relationships. BEL is also pursuing possibilities for export of products and systems to 'friendly' countries with MoD approval. Currently, BEL's coastal surveillance system, naval air surveillance radars, sonars, night vision devices and electronic voting machines are being promoted to South East Asian, Middle Eastern and African countries.

Major export programmes already being executed include Naval Surveillance Radars to Myanmar, TI fire control systems to Israel, electro-mechanical parts to GE and Siemens, and more.

The present business environment in defence equipment manufacturing is changing as the MoD encourages greater participation of private companies. The increase in the FDI limit to 49% will also help foreign players to set up joint ventures with Indian industry. As a diversification strategy, BEL has been exploring opportunities in related defence and non-defence areas for enhanced business growth, leveraging the strengths and capabilities acquired over decades in the defence electronics domain.

In the past decade, BEL has entered into several new business areas as part of diversification efforts, resulting in substantial revenue increases. Efforts are underway to enter and consolidate in business areas such as indigenous SAM systems, airborne radars, image intensifier tubes and thermal imaging detectors for night vision devices, inertial navigation systems, electronic ammunition fuses, pressurised missile containers, critical infrastructure protection, air traffic management radars, intelligent traffic management systems, solar power plants and smart city elements for future business growth.

BEL produces high-technology products, such as this eye-safe laser rangefinder, for the Indian Army

Thales: "Supporting Indian military's modernisation goals"

"With the third-largest armed forces in the world, India is moving towards an era of self-reliance in defence. Thales, since 1953, has been playing an essential role in India's growth story by sharing its technology and expertise. Today, it is wellknown for delivering technologically advanced and innovative products and solutions to the Indian armed forces.In addition to the defence domain, Thales is also actively present in the Indian aerospace and ground transportation (railways and metros) sectors. It has a wholly-owned subsidiary Thales India Pvt Ltd that currently employs about 300 people across its offices in New Delhi, Bengaluru, Hyderabad and other cities."

Mr. Caput stated that "the company is proud to have been supporting the armed forces of the country all these years. It offers full scope of its solutions and defence expertise to them. For the Indian Air Force, Thales in association with Dassault Aviation is working on the Mirage 2000 fleet upgrade. Its other solutions include low-level transportable radars, avionics, Inertial Navigation and Global Positioning System (INGPS), Identification Friend or Foe (IFF) and reconnaissance pods for various military aircraft. For the Indian Navy, Thales' contracts include Electronic Warfare (EW) systems, anti-submarine warfare sonar systems, mine-hunting solutions, and long-range surveillance radar while for the Indian Army, these include thermal imagers and fire control radars, among others."

Article authored by Antoine Caput, VP & Country Director, India, Thales

At Thales, the approach has been to share technology and seek growth through collaborations. This is evident in the company's strategy for India wherein it has formed several cooperative partnerships with the Indian defence PSUs and private sector firms to develop its industrial footprint in the country. Over the last five decades, Thales has been working closely with Hindustan Aeronautics Limited in all technological areas that can be used for military aircraft. Joint Ventures with Bharat Electronics Limited and Samtel along with L&T Technology Services in the fields of civilian and select ground-based military radars, military avionics and airborne sensor systems, and avionics software respectively further reinforce the company's commitment towards India.

Innovation is at the heart of Thales' strategy. Nearly 20% of the annual sales is dedicated to R&D. Innovation enables Thales to better focus its efforts on high value-added products, making them more attractive, differentiating Thales from its competitors and increasing the company's overall performance.The company has also been working towards strengthening the knowledge and innovation ecosystem in India. In January 2016, Thales and IIT Bombay signed an MoU to create a jointly supervised IIT Bombay-CNRS PhD fellowship scheme starting July 2016. It also collaborated with Indian Institute of Science Bangalore in October 2015 for a PhD fellowship scheme.

"The company remains committed to India, contributing significantly to the growth of the Indian defence sector by sharing technology and expertise with its local counterparts. The way forward is to invest in India by partnering with customers, universities, commercial and technology partners and to hire and train local people to be as local as possible. Backed by decades of experience and trust built in the country, Thales looks forward to be an active participant in the major initiatives of the government."

Rockwell Collins and its 'Make in India' alignment

Rockwell Collins demonstrated its commercially-based, technologically-advanced products and systems for Indian and other customers at Defexpo 2016. "We are fully aligned with the government's 'Make in India' campaign by developing capability locally while simultaneously aligning with local strategic partners," said Sunil Raina, Managing Director, India for Rockwell Collins. "We are proud to showcase our wide array of Rockwell Collins technologies here."

The Rockwell Collins exhibit featured a number of advanced defence solutions, which included *Pro Line Fusion*, an integrated flight deck that leveraged advanced commercial technology for military platforms, *Tru Net*, an exportable, programmable, networked communications system for enhanced situational awareness, *Wideband HF communications* that transmit high-bandwidth data across any terrain and long distances, a *Multi Mode Transceiver*, which is a multi-channel software-defined radio with frequency coverage from 70 MHz to 6 GHz, *CNPC-1000*, a reliable and secure unmanned aircraft system command and control data link for UAS operations in civil airspace, the *Patrol Persistent Surveillance System*, a scalable integrated sensor solution to protect from perimeter breach, and *Micro Guide* and *Remote Secure Receiver*, ruggedised and secure hand-held GPS systems.

OIS-AT was "an active participant"

OIS-AT has arguably been one of the most active participants at previous editions of DefExpo and this time around too showcased a wide range of products and services. The company focusses on research, development and manufacturing of advanced technologies across defence and homeland security, being also a system integrator of advanced technology based solutions.

OIS-AT has emerged as India's largest private sector company involved radar house. Extensive research has resulted in the development of a 3D Bird Radar Detection, Monitoring and Deterrent Radar system, aimed for both military and civilian airports.

OIS-AT has designed, developed and manufactured another industry first, the 4D multi-function, multi-mode UAV detection and tracking and air surveillance radar system. Another product development is OIS-AT's foliage penetration, minefield IED and dismount detection radar system. OIS-AT has also designed an advanced portable ground surveillance radar system for both military and homeland security applications.

"OIS-AT offers solutions for border security, coastal security, offshore security, critical infrastructure, airports and airfields, mining security, port/ harbour security, safe cities, counter insurgency and electronic surveillance. The company provides products ranging from radars, cameras, UAVs, unmanned ground vehicles, aerostats, all-terrain vehicle" stated a company spokesman.

Addressing the critical requirement of airport security offered are multilayered integrated security solutions with architecture based on systems to detect, track, determine, delay and defend against simultaneous multiple threats. "OIS Advanced Technology (OIS-AT) addresses the latest threat perceptions of airports and provides highly secure airport/airfield security systems that provide a 24x7 all weather comprehensive situation awareness picture in real-time to the operators to take immediate corrective action. Intelligent person, baggage and cargo screening systems and access controls would also play a key role in achieving desired degree of security."

UAV DTRS

Use of Micro-UAVs by terrorists has emerged as a new challenge, which raises both security and flight safety issues. ATC radars have not been designed to detect micro-UAV threats which leaves gaps in air surveillance coverage with respect to these mini UAVs. OIS-AT's 4D UAV Detection Radar has been designed to take care of this threat at airports. OIS-AT's approach is to address the latest threat perceptions of airports and provide foolproof security systems that are ergonomically designed for the operator.

Mobile Surveillance Vehicle (MSV) by OIS-AT is specifically designed to meet needs of a portable and quickly deployable surveillance solution to be used by police teams for monitoring and situational awareness in and around the city. The vehicle can be an overt or covert, non-descript vehicle which will give a situational awareness but not easily identifiable.

OIS-AT's strategy is in complete alignment with the 'Make in India' campaign, developing IP and globally marketing its Indian manufactured products.

"India's Defence Production Policy recognises the importance of the SMEs in augmenting the indigenisationof defence production in India and lays a special emphasis on the SME sector. Having over 40 SME supply chain partners OIS-AT offers a comprehensive portfolio of products and services to offer to the OEM's to support their offset obligations from defining technology products and work packages for OEM to offset proposal price and competitiveness of main bid. This makes OIS-AT an 'Industrial Partner of Choice' for foreign OEMs," summed up the company spokesperson.

Elbit's Helicopter Enhanced Flight Vision System

Elbit Systems' have performed several flight tests with the Helicopter Enhanced Flight Vision System (EFVS), HeliEVS in its operational configuration, combining the EVS sensor, HUD and fused image display processor. The operational configuration flight tests were performed onboard a Bo105 testbed helicopter, testing the system during different hours of the day, in various locations including rooftop landings and oil rig approaches above the sea, in order to evaluate real operational flight conditions during SAR, EMS and rig transportation missions.

HeliEVS is based on the ClearVision EVS for fixed wing applications. The system is packaged in a single Line Replaceable Unit (LRU), which autonomously performs the complete Enhanced Vision System capability. HeliEVS uses multi-spectral sensors to capture and display of terrain in darkness and reduced visibility. The sensors are combined and fused on the head-up display, with global terrain database (Synthetic Vision System – SVS), functioning as a Combined Vision System (CVS). The CVS provides high fidelity view of the outside world even when actual visibility is zero, thus enabling the pilot with effective situational awareness even in total darkness, fog or dense haze.

GE's Marine Gas Turbines in India

GE are arguably one of the world's leading manufacturers of marine propulsion products, solutions and services including aeroderivative marine gas turbines ranging from 6,000 to 70,250 shaft horsepower/4.5 to 52 megawatts (MW). GE's marine gas turbines come in various sizes and power ranges and can be arranged in flexible propulsion system configurations including mechanical, electrical and hybrid drive applications. "The company's gas turbines meet current and future marine emissions regulations and provide 'superior availability and reliability' for diverse military applications such as patrol boats, corvettes, frigates, destroyers, cruisers, supply and amphibious ships and aircraft carriers," said the spokesman.

GE has supplied six LM2500 gas turbines to the Indian Navy for its P17 *Shivalik*-class frigate programme. The three P17 frigates each use two LM2500 gas turbines in a Combined Diesel or Gas turbine (CODOG) arrangement with two diesel engines. The *Shivalik, Satpura and Sahyadri* were launched in April 2003, June 2004 and May 2005, respectively.

In addition, four GE LM2500 gas turbines will power the Indian Navy's P-71 aircraft carrier which, according to a recent Indian Navy press release, is expected to be delivered by the end of 2018. *Vikrant* will be the Indian Navy's first indigenously built aircraft carrier and was launched in August 2013.

A total of 11 LM2500s have been delivered to Hindustan Aeronautics Limited Industrial and Marine Gas Turbine Division in Bangalore, for assembly and test prior to installation in the aforementioned vessels. HAL is licensed by GE to assemble, inspect, test and service LM2500 marine gas turbines for Indian Navy propulsion applications.

Namer APC with Rafael's Trophy Active Protection System

The Trophy is a situational awareness and active protection 'hard-kill' system that operates in three major stages: Threat detection and threat tracking followed by hard kill countermeasure (Multiple Explosive Formed Penetrators – MEFP) activation and threat neutralisation. The neutralisation process takes place only if the threat is about to hit the platform.

The Trophy HV (Heavy Vehicle) was declared operational by the Israeli Army in August 2009 and is currently in full production. Trophy is the only operational, combat-proven armour APS in the world and Merkava-4 tanks integrated with Trophy active protection systems are presently deployed in combat areas along Israel's borders. In the summer of 2014, Trophy intercepted more than 10 anti-tank missiles fired at Israeli tanks in the Gaza Strip.

The Namer is considered the most protected armoured vehicle in the world, proving its combat abilities during *Operation Protective Edge*, protecting the lives of soldiers against a multitude of threats. Following its success protecting the Merkava tanks and in accordance with the Ministry of Defence decision, every new Namer will be equipped with the Trophy system, which is adaptable on any combat platform. Numerous elements are taken into consideration for each vehicle variant or type. For vehicles with relatively basic or light armour, e.g. the Stryker, the Trophy provides full protection against all types of RPG (as well as other threats) due to the fact that the Trophy destroys these types of threats without detonation.

"The Trophy systems have a very high kill probability and testing has shown them to be successful against all known CE threats (RPG, ATGM, tank-fired CE, etc). The systems' average collateral damage is estimated at a less than 1% chance of a dismounted soldier being injured by Trophy or an incoming threat," stated the company.

Trophy on the Merkava-4 tank

VAYU Interview with

Igor V Vilnit, CEO Rubin Design Bureau

On 1 September 1965, the then Soviet Union and the Republic of India signed the very first agreement for the delivery of naval equipment, including four Project I641 diesel-electric submarines (*Kalvari*-class). The agreement also envisaged Soviet technical assistance in submarine base construction in Vishakhapatnam.

First four submarines of Project I641 were delivered by the USSR to India between 1967 to 1969. India was the first foreign customer to get ships built to specific design, before which only 'standard' ships and motorboats were delivered to foreign countries. Later in 1972-1974, another four submarines of improved Project I641K (*Vela*-class) were built for India.

From 1986 to 2000, India received ten Project 877EKM diesel-electric submarines built in Russia, thereby becoming the largest foreign operator of Russian submarines. The last submarine of the series, INS *Sindhushastra*, was built to a modified project and the first one to be equipped with the Club-S missile complex (at that time the complex was not available even to the Russian Navy). After 2000, the Club-S complex was retrofitted on all Indian 877EKM submarines during their mid-life refits.

Igor V Vilnit, CEO Rubin Design Bureau, spoke to *Vayu Aerospace & Defence Review* about prospects of future cooperation with the Indian Navy.

VAYU : In October 2015, the Indian MoD signed the contract for mid-life refit of Project 877EKM submarine (INS Sindhukesari) in Russia. How will Rubin participate in this contract?

IVV : Rubin, as the ship designer, was involved in this contract from its inception. The second refit will add up to ten years to the specified service life of 25 years of INS *Sindhukesari*. Operating and combat characteristics of the ship will be improved as well. The ship will be equipped with a number of indigenous systems as requested by the Indian Ministry of Defence. We are sure that second refits will prove a high modernisation margin of *Kilo*-class submarines. It may be recalled that one of the Indian submarines of Project I641K was in service with the Indian Navy for thirty six years before she was finally decommissioned in 2011. We are waiting for the decision of Indian MoD and Indian Navy on the second mid-life refits of three more 877EKM submarines and are ready to conduct modernisation of these ships in India as envisaged by the 'Make in India' programme.

VAYU : The Indian Navy is interested in equipping submarines with AIP. What does Rubin envisage in this regard?

IVV : Our version of the AIP uses diesel fuel available onboard the submarine. Moreover, it is a very important consideration as nothing is required in addition to the standard fuel load. The required hydrogen is produced onboard by reforming. The advantage of this AIP is in safety of operations at sea and the pier side. Rubin's AIP plant has cleared all land-based trials and proved all specified parameters and the next step is to conduct mandatory sea trials. We have already committed to the Russian Navy, which plans to install this AIP on Russian submarines. I assume that in a year or two the plant will be ready for shipboard installation. Since this plant has modular design, it can be plugged into the ship's hull at the construction stage. DRDO and IN specialists are well aware of our progress and we have already offered latest information about our activities to our Indian colleagues.

VAYU : The 'Make in India' programme envisages acquisition of state-of-the-art weapons. Submarines Lada, which were the basis for development of export Project Amur-1650 offered for Project 75(I) submarine, are under construction for the Russian Navy. However, the process is rather slow...

IVV : The second and third submarines of *Lada*-class are under construction at the Admiralty Shipyards in St Petersburg. They have improved design. Taking into account these improvements, the keel-laying ceremony was repeated for these two ships in 2013 and 2015. Therefore, improved *Lada*-class submarines, equipped with powerful weapon complex, will fulfill all tasks assigned to non-nuclear submarines by modern navies. At present, Russia is also renewing its fleet, including the fleet of non-nuclear submarines. Russian Navy's orders and export orders are for some 12 submarines to be built by Admiralty Shipyards in the 2010-2016 time frame, and four more submarines for Project 636 and *Lada*-class are planned to be built by the end of 2018. The construction time of one Project 636 submarine, including trials, is three years. It should be noted that the Russian Navy requested its Project 636 submarines to be built to a substantially modernised design. The construction time of *Lada*-class submarines, so far, is three to four years, though as the number of ships in the series increases, the time required for construction of a submarine decreases with experience.

Since 2008, Rubin has been closely cooperating with Indian Naval Headquarters on Project 75I, and we are aware of requirements of 'Make in India' programme and are looking forward to further cooperation with the Indian Ministry of Defence as well as governmental and private Indian companies and shipyards.

VAYU : In an earlier interview with Vayu (Issue VI/2015), Admiral RK Dhowan, Chief of the Naval Staff, noted that all six P75(I) submarines will be constructed at a suitable Indian yard in collaboration with an identified foreign collaborator under 'Transfer of Technology'. Is Rubin prepared to meet this requirement?

IVV : A key point that makes the Russian proposal so attractive for India is our willingness to transfer the most advanced and sensitive technologies. As the implementation of the new non-nuclear submarine programme requires a systematic approach, our Indian colleagues will certainly set up design offices, upgrade shipyards and create infrastructure that will serve the Indian Navy for at least fifty years. Rubin and other Russian shipbuilding companies are ready to render assistance in this process.

I would like to note that the year 2015 was momentous for Rubin not only because of a half-century anniversary of cooperation with the Indian Navy, but also because our Bureau celebrated its 115th birthday. For 115 years of Rubin's work, some 943 non-nuclear and nuclear submarines were built to Rubin's designs. The total displacement of these ships is about 2 million tons, enough to strengthen several navies! Our Design Bureau possesses design technologies for the creation of various ships, and we are keen to offer this diversified experience to the Indian Navy.

USC: Keeping the partnership alive

Rubin CEO Igor Vilnit, USC Director for Military-Industrial Cooperation Alexey Dikiy, and Nevskoye Design Bureau CEO Sergei Vlasov at Defexpo (photo: Angad Singh)

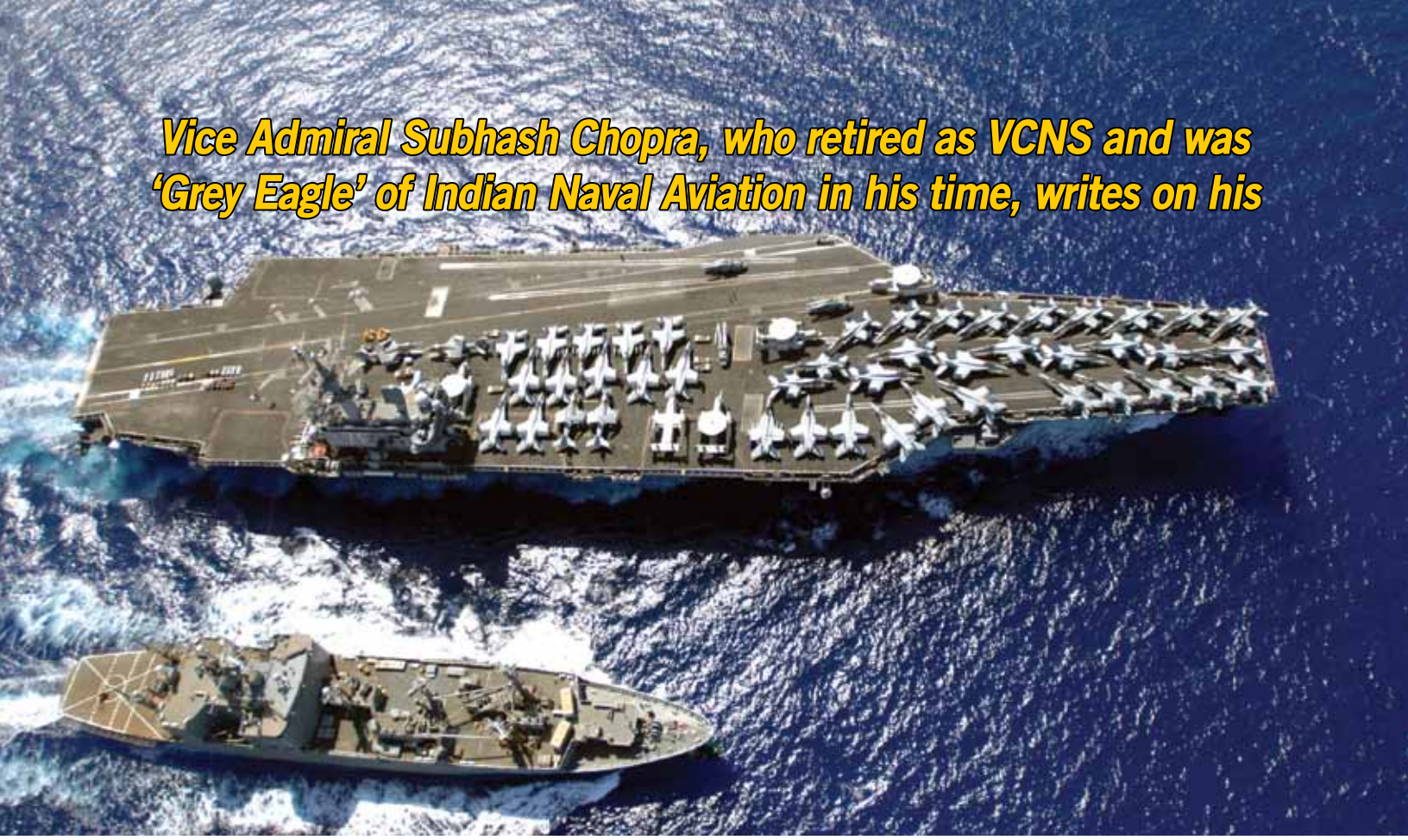
Russian participation at Defexpo 2016 was spearheaded by the shipbuilding industry, which remains confident that the decades-old partnership with India can be maintained even as New Delhi has looked beyond Moscow for arms procurement in recent years. To begin with, and perhaps most importantly, Vladimir Drozhzhov, deputy head of the Russian Federal Service for Military-Technical Cooperation (FSMTC), stated that "prospects exist" for India to lease a second nuclear-powered submarine. The Indian Navy already operates an *Akula*-class (Project 971) nuclear attack submarine, as INS *Chakra*, under a unique lease arrangement with Russia, an arrangement that no other country has replicated. Discussions on a second lease have been underway for a number of years, but disagreements on pricing and lease terms mean that an agreement has remained elusive. It is understood that the Russians expect to lease a second *Akula*-class boat, while the Indian Government is pushing for the more advanced *Yasen*-class, the newest submarine type in service with the Russian Navy.

The Russian shipbuilding industry is already cooperating with India in areas beyond the submarine lease. India has approved second refits for four *Kilo*-class submarines, the first of which will reach Russia this summer, while a range of proposals are being evaluated to refit at least some of the remaining three boats in Indian yards. The United Shipbuilding Corporation, represented by a number of top executives at Defexpo, is also keen to cooperate on frigate construction, and hopes that the Indian government will order another tranche of *Talwar*-class vessels to be built in Russia and India. The Indian Navy already operates six such frigates, among the most potent in its surface fleet. However, it remains to be seen if the issue of the vessels' Ukrainian gas turbine powerplants will affect this procurement.

In an exclusive interaction with *Vayu*, Rubin Design Bureau CEO Igor Vilnit spoke at length on some of his firm's recent achievements and their relevance to India. He confirmed that Rubin has successfully tested a representative Air-Independent Propulsion (AIP) system on land, and is now preparing to test the system underwater. He expressed confidence that the submerged trials would go off as smoothly as they had ashore.

He also shed some light on the new *Kalina*-class conventional submarines, of which little is known at present. These boats are a further development of the troubled *Lada*-class, production of which will now be limited to just three boats. While the lead submarine, *Sankt Peterburg*, is already in service, the remaining two will be delivered in 2018 and 2019 respectively, before focus switches to the successor class. Vilnit described the *Kalina*-class as a refinement based on the changes suggested by the Russian Navy after extensive operations and trials with *Sankt Peterburg*. He confirmed that *Kalina*-class submarines would be designed from the outset as AIP-equipped vessels, which suggests these submarines would be inherently more capable than previous conventional submarines produced by Russia. Vilnit also stated that Rubin's proposal for the Indian Navy's Project 75(I) requirement would be based on the *Amur*-class (a *Lada* derivative), incorporating all the improvements that have been identified as necessary since *Sankt Peterburg* began operations, making it essentially a highly customised vessel with attributes of the *Lada*/*Amur*-class as well as the new *Kalina*-class boats.

Angad Singh



Vice Admiral Subhash Chopra, who retired as VCNS and was 'Grey Eagle' of Indian Naval Aviation in his time, writes on his

Dream Aircraft Carrier "Will it ever be built?"

The aircraft carrier is once more flavour of the season, with ten maritime nations across the world presently operating these, having a variety of aircraft and helicopter combinations. It is not my purpose to list their current assets and the tasks they are assigned but what is exhilarating is that after years of relative neglect by many navies of the world, the desire to acquire large-sized aircraft carriers is well underway. In fact, these big warships seem to be catching up on lost time. No longer will super carriers be exclusive preserve of the erstwhile Cold War powers. Size wise, "the bigger the better" pervades

US Navy graphic of the proposed Gerald R Ford-class supercarrier

current thinking, the essential objective being to project power and establish control over distant tracts of ocean for certain periods of time.

United States of America

At least six major maritime powers are designing and building some of the biggest aircraft carriers that the world has ever seen. We begin with the United States, that greatest proponent of maritime power projection, built around its Carrier Battle Groups. The US will shortly be completing a new supercarrier, the 100,000-tonne USS *Gerald R Ford*, lead ship of a new class of carriers that are planned to be built over the next few decades and remain in operational service with the US Navy till the end of the 21st century. USS *Gerald R Ford* is nearing completion and is planned to enter service in 2019. USS *John F Kennedy* and the new USS *Enterprise* will follow.

These ships will, in time, replace the present *Nimitz*-class supercarriers, which also displace around 100,000 tonnes. Ten of these were built between 1975 and 2009 and are currently in operational service with the United States Navy. All of them are nuclear-powered, with steam catapults and arrestor wires and capable of embarking 85 to 90 high performance aircraft. The carriers will have virtually unlimited endurance with their nuclear reactors requiring refueling only every twenty years or so. Their Air Wings are built around the Boeing F/A-18E/F Super Hornet plus support aircraft like the E-2 Hawkeye, and various helicopter types.

The *Gerald R Ford*-class will be equipped with the F-35C Joint Strike Fighter (JSF), which is currently in low-rate production. Beyond the new aircraft, the revolutionary equipment in the *Ford*-class carriers is the EMALS (Electro-Magnetic Launch System), which does not require massive steam storage space and so will make available large amount of below-deck space for other usage. These ships will also be equipped with Advanced Arrestor Gear (AAG), which will make the recovery of aircraft much safer and faster. EMALS and AAG are anticipated to substantially reduce launch and recovery stresses on airframes, and will thus commensurately increase their operational lives.

China

Next comes China, which nation, in one big leap, is likely to overtake many nations and virtually 'gate crash' into the supercarrier club. After years of being in denial about aircraft carriers, China surprised the world by rebuilding an aircraft carrier from the derelict hull of the ex-Soviet carrier *Varyag*. Reportedly now operational as the *Liaoning*, this 45,000-tonne ship is classified as a 'training carrier' as the Chinese have a long way to go before exposing this ship to oceans of the world. The Chinese have also collected a menagerie of four retired carriers: HMAS *Melbourne* from Australia, *Minsk* and *Kiev* from Russia, plus *Varyag* from Ukraine and they very nearly acquired the still-functional *Clemenceau* from France, but that deal fell through on price issues and supply of associated structural drawings.

Whilst refurbishing the *Varyag* may not have been a very difficult task, given China's industrial and technological expertise, development of doctrines and standard operating procedures for air operations at sea is a far bigger challenge for the PLA Navy, one that can really only be

PLAN carrier Liaoning underway, with J-15 fighters parked at the stern

surmounted after a long gestation period. This is perhaps one of the major reasons why China assigned *Liaoning* to a training role. The truth of the situation will only be revealed when the *Liaoning* makes an out-of-area appearance, perhaps to reinforce China's territorial claims in the South China Sea.

A cynical riddle used to be : "When is an aircraft carrier not an aircraft carrier?" The answer was : "When it is Chinese!" Well, this is no longer the case. Intelligence reports indicate that the Chinese are already building two entirely new aircraft carriers in STOBAR (Short Take Off But Arrested Recovery) configuration, displacing around 65,000 tonnes each, which, if the reports are accurate, could be operational by 2020. Even though the PLAN may have wanted to go for a CATOBAR (Catapult Assisted Take-Off But Arrested Recovery) design, which would have given them inherent flexibility of deploying larger and more capable aircraft, the technology for steam up. They might yet surprise the world by putting nuclear propulsion on their ships, although there is little intelligence available on this issue.

United Kingdom

The UK's Strategic Defence and Security Reviews (SDSRs) make for very interesting reading, owing primarily to a series of baffling flip-flop decisions over the years. No self-respecting maritime power wants to lose face even within the European Union, specially considering global trade, territorial and diaspora interests to look after. Given this reality, the British certainly rue the decision of slowing work on the two *Queen Elizabeth*-class carriers in 2008, owing to a cash crunch. The cost of delaying commissioning of these vessels, the largest ever built in the UK, actually added to the programme's financial burden, so they want back to work in real earnest, and HMS *Queen Elizabeth* is now slated to be delivered by 2017, as against the original target of 2015.

operations, but intended to be adaptable to CATOBAR. This prompted a decision in the 2010 SDSR to switch to CATOBAR and purchase the F-35C variant of the Joint Strike Fighter. Any naval architect will confirm that midstream changes are not only financially, but also structurally disastrous. When the final costs of the STOVL to CATOBAR conversion were revealed, the British Government quietly dropped the idea and elected to retain the original design configuration. In the 2015 SDSR, the Government also offered clarity on the choice of fighter, committing to a total of 138 F-35Bs (STOVL variant), with 42 of these to be in service by 2023, the year in which the *QE*-class carriers are expected to reach full military operational capability. The Royal Navy is also working on a unique Shipborne Rolling Vertical Landing (SRVL) that will allow F-35Bs to land at greater weights, eliminating fuel and payload 'bringback' limitations that exist in pure vertical landing scenarios.

Artist's impression of HMS Queen Elizabeth and HMS Prince of Wales conducting flight operations with F-35Bs

or electromagnetic catapults continues to elude the Chinese. Thus, the ski-jump on the bow remains the only option available at present. However, let no one doubt the uncanny ability of the Chinese to catch

This apart, the UK's dilemma was further aggravated by the choice of aircraft type to be deployed on the two new supercarriers, which were configured for STOVL (Short take off and Vertical landing)

India

India is the next major player with ambitions for supercarriers in the Navy. Having spent most of my service life planning, arguing, fighting and negotiating for carrier aviation,

INS Vikramaditya at the recent International Fleet Review off Visakhapatnam (photo: Angad Singh)

there is hardly any need for me to repeat this exercise. I do not claim any paternity to specific aviation projects – I worked as part of the team and supported all projects that helped Naval Aviation grow because even then we had visualised the shape of things to come. Naval challenges from China for sea control in the Indian Ocean were only a matter of time. The need to establish Indian maritime power projection capability in the Indian Ocean Region was at the very core of naval strategic thinking, which guided Chiefs of the Indian Navy, whom I had the good fortune to work under. I have been out of the Navy for over two decades yet there is no doubt whatsoever in my mind that this endeavour prevails in the present Naval hierarchy, in spite of continued budget limitations. Indeed the will to build a powerful Navy to exert India's diplomatic and military power in the Indian Ocean Region remains the Navy's primary objective.

At the country's independence the initial naval development plan emphasised that India's Navy must "achieve a position of pre-eminence and leadership amongst nations of South East Asia."

The Indian Navy has long held expertise and experience in operating aircraft at sea. We started with a CATOBAR carrier (INS *Vikrant*) and then moved on to STOVL (INS *Viraat*) and currently operate a STOBAR carrier (INS *Vikramaditya*) with a high degree of institutional excellence : a discernable success story. Even putting helicopters at the aft end of small warships is an achievement, the IN having initiated this at about the same time as other leading navies of the world and have remained at the forefront of helicopter operations at sea. Like they say, "we have seen it all and done it all," yet did not rest on our oars. Naval architects and shipbuilders have done India proud by embedding the aviation component in all our indigenous shipbuilding programmes.

Thus, having been part of those past times, I believe I have the right to dream a dream ! This dream is for a supercarrier, the kind that the Americans have covered oceans of the world with. There are, and always will be, smaller ship 'diehards' who do not subscribe to the idea of 'Sea Control' in universal terms. For them, a powerful weapon-packed 'Small Ship' battle group is more cost effective than more expensive Carrier Battle Groups, which consequently carry a big diplomatic and military stick and may attract regional envy – or even hostility. The latter seems to be of bigger concern now that China has also entered the maritime power projection debate with one aircraft carrier already existing. In strategic terms this has become a big game changer in the oceans of interest to India. If China needs the markets and mineral wealth of Africa and Middle East, so does India.

I was therefore very glad to learn that the Indian Naval Design Bureau has recently issued a Request For Information (RFI) to shipbuilders worldwide for the proposed IAC II (second Indigenous Aircraft Carrier), likely to be called INS *Vishal*. Meanwhile, IAC-I, or the new INS *Vikrant* has already been launched and is being fitted out at Cochin Shipyard. When she commissions and joins the Indian Navy in the next few years, she will be an iconic achievement by our naval planners, designers and shipbuilders. This will, however, still be a smaller STOBAR carrier at 40,000 tonnes, putting it in in the same class as INS *Vikramaditya*.

While for the present the fully operational INS *Vikramaditya* is an enormous source of strength and battle-worthiness, my dream is about a CATOBAR design of some 65,000 tonnes, with EMALS and AAG. Only a CTOL/CATOBAR aircraft carrier will meet the challenges that new Chinese carriers might pose in the Indian Ocean Region. Since our historical experience in aviation at sea far exceeds China's, it would be a matter of shame if they stole a march on us in this field.

The Future

It is gratifying, therefore, that the recent RFI issued by the Indian Navy virtually matches my dream of an Indian supercarrier! This would be a carrier displacing 65,000 tonnes, with over 30 knots speed, propelled by nuclear power, fitted with EMALS and AAG, and with adequate deck and hangar space to operate two squadrons of fighter aircraft, as well as ASW, AEW and SAR helicopters and other support aircraft, for an air wing of 50 to 60 aircraft. Such dream carriers shall be the epitome of excellence for our shipbuilding efforts. As a CATOBAR carrier, it will have

The future INS Vikrant afloat at Cochin Shipyard

many options for fighter aircraft, not the least the F-35C which would long have been in series production by the time this vessel enters service.

Since India is presently engaged in a paradigm-changing strategic partnership dialogue with the United States, two of the largest democracies in the world should not have any reluctance in seeking their help in planning and building such a ship at one or more of our shipyards, I do accept that such a plan will meet considerable criticism from a number of quarters, not the least from within the defence community itself, as was the case against acquisition of the aviation cruiser *Admiral Gorshkov* (now *Vikramaditya*) a decade ago.

Today's INS *Vikramaditya* with its squadron of fully operational MiG-29K aircraft is a testimony to our naval ingenuity and strategic tenacity. Many have already forgotten the adverse commentaries and tirades voiced against this decision. Today the inspiring sight of *Vikramaditya* launching and recovering aircraft at sea is as impressive a scene as was holding of the Tri-Service Commanders' Conference on board the carrier by the Prime Minister, at sea off the Western coast of India. Many of us still do not believe that we are already a regional power of some standing and should not allow the murky politics of our neighbours or any Chinese threat to pull us down. What is required now is to plan for tomorrow, without inhibitions, to build a supercarrier battle group that will sail us to the end of this century. Our ability to build world-class destroyers, frigates and amphibious ships is no longer in doubt. The carrier of our dreams will take some time to build depending on how well we negotiate a strategic deal with the United States, unhindered and unrestrained by experiences of the past.

Finally, I realise that as a nation we are not very comfortable with 'Strategic Alliances' and choose to remain isolated in a make-believe world of non-alignment, digging a lonely furrow, re-inventing and re-building a whole range of military hardware and thus falling behind even in the most basic of equipment. What we need is a national consensus to put aside our pride and do what is essential, 'Make in India' in any such manner.

"The Chinese are coming" but we are not going anywhere !

Ed : The present carriers of France and Russia, the Charles de Gaulle and Kuznetsov respectively, have not been covered in this article as they do not qualify as supercarriers, and the future aircraft carrier aspirations of both these countries remain relatively unknown.

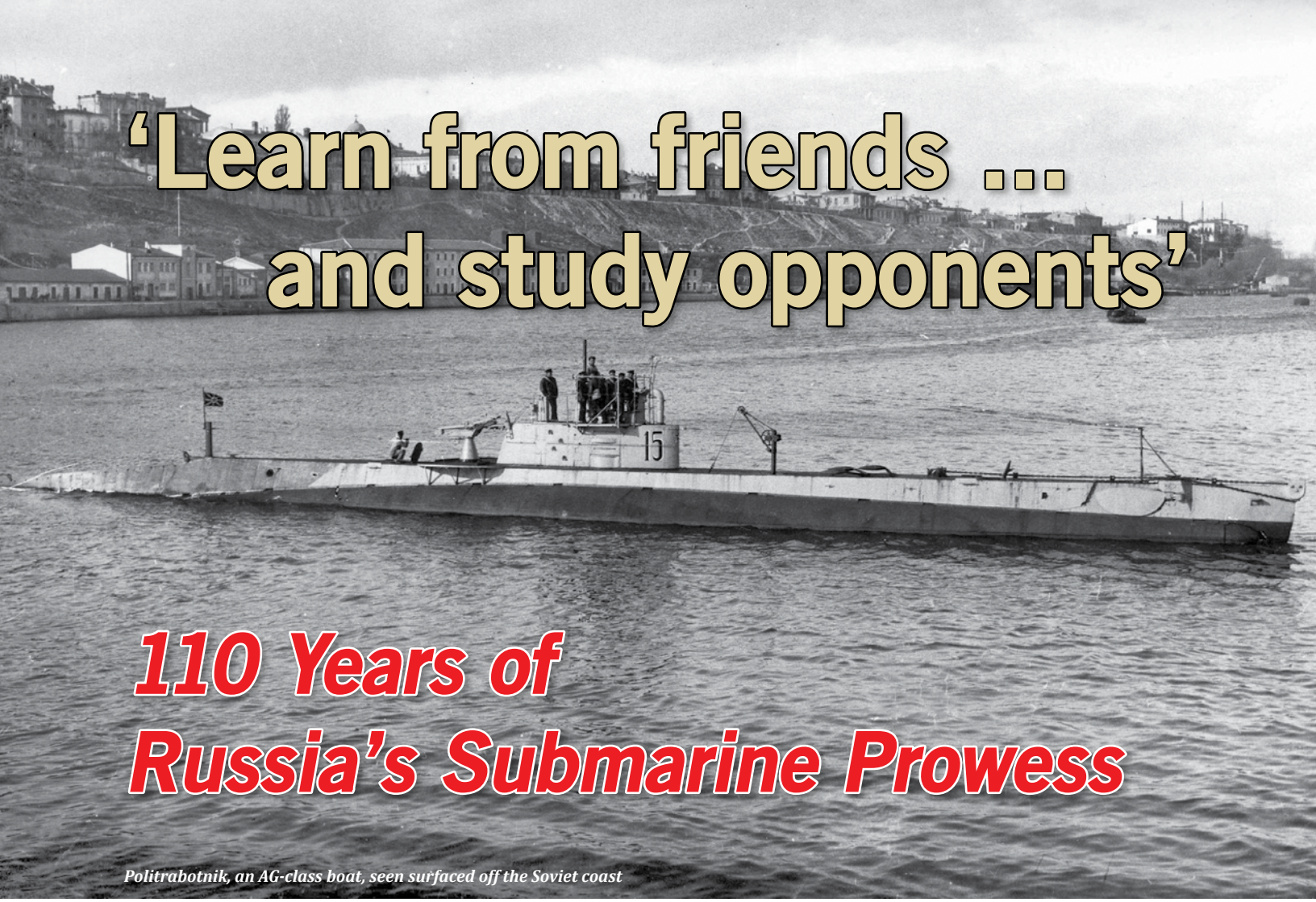
Vice Admiral Subhash Chopra

Admiral Chopra belongs to the first course of National Defence Academy (Joint Services Wing at Dehra Dun) who completed his Naval training at Royal Naval College, Dartmouth and various other establishments and ships in England before going to Air Force Flying College at Jodhpur for flying training. He subsequently qualified as flying instructor, won the Majithia Trophy and has taught flying in various Air Force flying academies.

He is a pioneer in aircraft carrier flying, a pilot with 3500 plus hours of flying to his credit including from the carrier INS *Vikrant*. He also commanded two Naval warships before taking over as Flag Officer Commanding the Western fleet. Following many staff jobs including as ACNS (Air) and Chief of Staff Western Naval Command, he was FOC-in-C Eastern Naval Command for three years and later took over as Vice Chief of Naval Staff before retiring from the Service in July 1990.

‘Learn from friends ... and study opponents’

110 Years of Russia’s Submarine Prowess



Politrabotnik, an AG-class boat, seen surfaced off the Soviet coast

This is the second part of a series on the history of submarine development. The previous article on ‘110 years of Russia’s Submarine Prowess’ (see Vayu II/2016) covered early attempts to produce a game changer in naval warfare that led to advent of the diesel-electric submarine. This article now focuses on the experience of Soviet designers as they strove to adopt global best practices in their work on more advanced vessels.

The collapse of the Tsarist regime, the February and October 1917 Revolutions, Civil War and invasions by foreign powers transformed the once-grand Imperial Russian Navy into a small military organisation. Formally, the Red Army’s naval component was established on 11 February 1918, when the Council of People’s Commissars issued its decree for creation of a socialist ‘*Workers’ and Peasants’ Red Fleet*.’ During the period between 1918 and 1937, naval elements of the Red Army were called by many names but for simplicity we will use the term ‘Soviet Navy,’ commonly used since 1938.

By 1919, twelve *Bars*-class boats were operating out of the Kronshtadt naval fortress off Saint Petersburg. They were facing a mighty opponent in the form of the British Royal Navy, which at the time was part of the Allied intervention in the Russian civil war. On 31 August 1919, the submarine *Pantera* detected foreign-flagged destroyers in national waters. After five hours of chase, she managed to get in position for attack while remaining undetected, and launched a pair of torpedoes, both of which struck and sank HMS *Vittoria*. For the revolutionaries, it was rather symbolic that a modern and capable surface combatant belonging to the top maritime power of the ‘Old World’ had fallen victim to the fledgling revolutionary forces. *Pantera* escaped unscathed the British ships hunting her and, having spent 11 hours 20 minutes submerged, made it safely to port. Her CO, Commander Alexander Bakhtin became the first Soviet navy submariner to be awarded the Order of the Red Banner.

Useful kits

During the period 1918-1924, the Soviet Navy underwater component reduced from twenty to fourteen serviceable submarines. The ruling political party did not show signs of concern, and its leaders even spoke of naval forces as "too expensive to have for a poor country." As strange as it may sound today, the Soviet government only sanctioned completion of certain partially constructed warships for the sake of their possible sale to Turkey! In particular, this applied to *Svetlana*-class light cruisers and *AG*-class submarines. In the end, however, these assets went to the Soviet Navy and served it well through peace and war.

Back in 1916, the Tsarist regime purchased kits of the Holland 602GF/L design – a very popular US submarine

The Soviet Morzh-class submarine Politruk (ex-Nerpa) and the AG-class submarines Shakhtyor, Kommunist, Marksist and Politrabotnik of the Black Sea Fleet in Odessa, sometime in the early 1930s

design of the time – for local assembly as the *AG*-class. Shortly after the Red Army drove anti-revolutionary forces from the Black Sea in 1920, the Soviet government ordered completion of *AG-23* and *AG-24* that were in a high degree of readiness at dockyards in the city of Nikolaev. Even though the dockyard staff dwindled to 1,700 workers, those who remained had been longing for work and were eager to fulfil this new assignment. The Soviet government considered completion of the *AG* boats as "a task of combat significance," making the dockyards work 24 hours a day. The first pair was commissioned in 1920, and the second pair in 1921-1923. In addition, *AG-21*, which had been assembled in 1918 but was ditched in 1919, was raised nine years later, repaired and pressed into service.

Through this programme, the local shipbuilding industry restored its largely lost or eroded skills. Even though the baseline Holland 602 design originated in 1911, the kits for Russia were manufactured in 1916 incorporating some changes to reflect early combat experience in WWI. Five *AG* boats formed the backbone of the rebuilt Black Sea Fleet. Following the devastation of the civil war, the fleet kept only one indigenously designed submarine. *Nerpa* (English: *Baikal Seal*) survived only because she had been subjected to major overhaul at Nikolayev dockyards. She stayed there for six years until 1923, when the work was finished and the submarine was renamed *Politruk* (Political Instructor).

About that time, three of the twelve surviving boats in the Baltic were disassembled for parts. This enabled the industry to perform major overhaul on the remaining nine without re-launching manufacture of out-dated instruments and mechanisms in use on the *Bars*-class. In the 1920s, most of the heritage dockyards and plants were loaded to 30-32% of their capacity due to shortage of orders and investment. The workforce of the Baltic Plant in Leningrad (as Saint Petersburg was called in Soviet times) shrunk to its lowest point of 2,638 in 1922. Contracts for repair and maintenance of *Bars*-class boats gave the industry some breathing space and helped regaining submarine-related skills.

Envisioning a new navy

Under initiative of the Navy's scientific-technical committee and its section for underwater sailing chaired by Alexander Garsoev, work commenced in 1923 on specifications to next-generation submarines. Former commander of Imperial Russian Navy submarines *Pochtovy*, *Minoga* and *Lvitsa*, Garsoev headed a commission staffed by experienced professionals who formed a common vision of the future submarine force. The commission suggested main classes of boats for the future navy. A displacement of 1,000-1,100 tons would be fine for their 'big boats' and 500-600 tons for 'middle boats' optimised for "on position" missions in the Baltic and Black Sea theatres.

Following discussions at various levels in 1925 the Red Army higher command acknowledged the necessity to develop a number of next-generation submersibles, and declared an "immediate need" for 27 boats to be constructed during the next five-six years. Cultivating a national school of submarine development – as opposed to

simple adoption of foreign designs – was among other stated goals. But this was easier said than done! Few of the nation's design and engineering teams survived. Those that did survive were short of qualified staff and funds. Worse, they did not do much of work on contemporary designs and classes of warships since 1917.

To catch up with recent developments and practices, the Kremlin dispatched a group of engineers on a tour of foreign submarine design and production facilities. In Italy, Soviet visitors were shown fewer dockyards that had been expected. They were further disappointed by a lack of desire from the Italian government and industry to cooperate on would-be joint programmes. The Soviets returned with only a few monographs (including some by acclaimed French designer Maxime Laubeuf) on sale in bookshops and some graphics (such as detailed cutaway drawings of an Italian submarine) acquired through personal dealings. As part of the three-month tour at the end of 1925, the Soviet delegation also went to Germany; however, at the time of the Weimar Republic, local companies did not produce submarines, only components.

TechBureau

1 November 1926 is something of a second birthday for the 'Central Design Bureau for Marine Engineering – Rubin,' Russia's oldest and most acclaimed team specialising in submarine development. The company traces its history to foundation of a Commission for Development of Submersible Vessels in December 1900. Twenty-six years later (and almost 90 years back) submarine designers resumed their work at the Baltic plant after an eight-year break. At the beginning, Technical Bureau No.4 (or simply "*TechBureau*") employed seven engineers and designers. Within three years, however, the workforce grew to over a hundred.

TechBureau was headed by Boris Malinin (1889-1949), who had been involved in manufacture, maintenance and repair of the *Bars*-class during Imperial and Soviet times. He recalled: "The period from November 1926 till June 1930 was the most intense and hard in my career as a submarine designer. We had to pursue several goals simultaneously. [First] To develop and produce a new class of submarine whose type had been previously unknown to us. [Second] To create, for immediate use, the theory of the submarine – and this was something that the Soviet Union lacked then. [Third] To train personnel and teach them the art of submarine development."

Malinin's first assignment was to prepare technical documentation on a thousand-ton submarine. He opted for a double hull design of riveted structure with water-tight bulkheads running across the hull – a major departure from Bubnov's designs ("the submarine of the Russian type" – *see Vayu II/2016*). Batteries were placed in a pressurised (watertight) compartment, which came equipped with a unit for burning hydrogen. A first in Russian practice, the submarine was outfitted with oxygen regenerators employing chemicals. These and other design solutions extended the duration of submerged sailing from 24 hours for the *Bars*-class up to 72 hours. The distance of underwater sailing rose from 25 to 150 miles, and endurance at sea to 28 days. Revised location and design of ballast tanks ensured shorter time to go underwater (30 seconds against two to three minutes for *Bars*). Instead of out-dated 18-inch torpedoes, the newer submarine would use brand-new '53-27' weapons from six 533-mm torpedo tubes in the forward and two in the rear sections. Artillery would comprise a 100-mm gun and a 45-mm semi-automatic antiaircraft cannon.

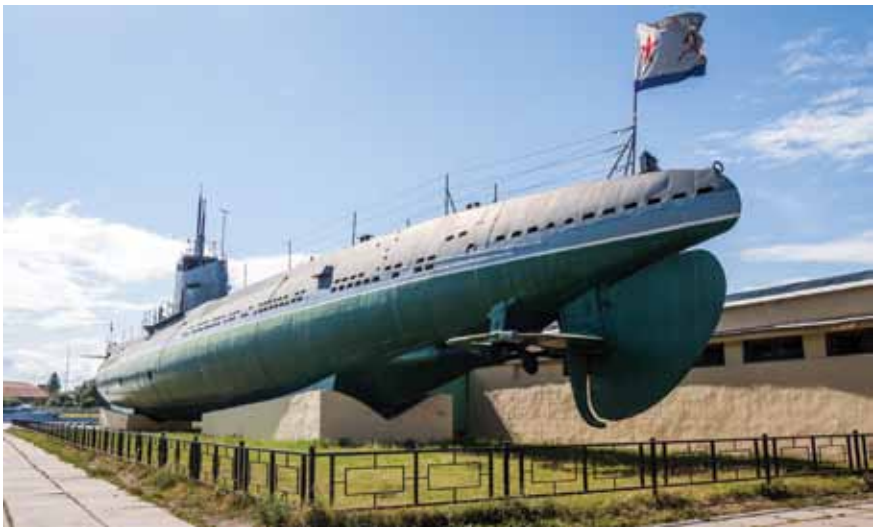
It is interesting to notice that the double hull first tried on *Dekabrist* of 1927-1930 origin remains in use on most of contemporary Russian submarine designs including Project 877EKM (*Kilo*-class) in service with the Indian Navy and the newest Project 636.3 (*Improved Kilo*) boats on order for the Russian Black Sea Fleet. Since then, however, the technical progress has gone further: working depth is three times deeper and underwater speed twice as fast. The *Kilo*-class comes with six 533-mm torpedo tubes in the nose (as *Dekabrist* did), but can also use them for land-attack or anti-ship missiles.

Series I

In February 1927, the Soviet government allocated funds for construction of six such boats. Their hulls were to be built using high-quality steel sheets originally stocked for *Svetlana*-class cruisers. This ensured the working depth of 75 metres compared to 45-50 metres for *Bars* and *AG*.

The lead vessel of the Series I, *Dekabrist*, was laid down at the Baltic Plant on 5 March 1927. A contemporary design from a

Boris Malinin on board the Bars-class submarine Volk



Narodovolets displayed as a museum in Saint Petersburg (photo: Angad Singh)

national team, she nonetheless incorporated a few foreign items. Diesel engines were imported from Germany under a customs label "Equipment for locomotives." Long-serving customs officials were not concerned – back in 1904, they saw the submarine *Fulton* being imported from the USA under the cover description of "Steam boiler." Even though these MAN engines had as much to do with railways as *Fulton* had to do with steam machinery, they gave the Soviet submarine industry a head start.

Sea trials began in May and soon revealed that *Dekabrist* was unstable (listing) when submerging and surfacing. In July 1930, Malinin was arrested on the charge of high treason, and confined to a "special design bureau" that used forced labour. There, he worked with former colleagues who had been arrested beforehand. Later in the year, the causes for listing were tracked down. Technical problems proved to be minor and were quickly resolved through installation of redesigned valves interconnecting main water tanks and additional bulkheads in them. *Dekabrist* went into commission in November 1930.

L1 (a Leninets-class boat)

Three sister ships were built at the Baltic Plant and three more at the Nikolayev dockyards. The latter's experience with

AG-class submarine Kommunist and gunboat Krasnaya Gruziya at sea

the *AG* series proved helpful: engineers and workers with the skills necessary were in place and eager to work. Through this project, the heritage manufacturers renewed relationships with vendors and suppliers in the home country and abroad. Thus, in the early 1930s the Soviet Union came to possess a workable shipbuilding industry able to produce contemporary submarine designs.

Shortly after completion of the Belomorkanal connecting the White Sea and Baltic Sea in 1933, the Soviet Navy used this 140-mile-long waterway to ferry some warships to the White Sea so as to re-establish the Northern Fleet. When in transit, *Dekabrist*'s sister-ship *Narodovolets* was "thoroughly inspected" by Josef Stalin. These well-built Series I boats ventured far into the expanses of the White and Barents Seas and became the first Soviet submarines to sail under Arctic ice fields. In the 1930s *Dekabrist* set something of a record by covering over 10,000 miles including 1,200 under water in the course of one calendar year.

Four boats took part in WWII and proved their merits in three operational theatres, sinking or damaging over a dozen enemy vessels. *Narodovolets* (D-2) stayed in active service for over a quarter century and then served as a crew training station till 1985, when it was decided to turn her into a war memorial in Saint Petersburg. The vessel was restored as a memorial and a museum on Vasilyevsky Island, not far from the Baltic and Admiralty Shipyards, and was opened to the public in 1994. Recalling the restoration work, Rubin general director Igor Vilnit said: "This was an assignment of major significance for employees of the design house as it enabled them to comb through the pages of history, refresh and enrich their knowledge of the heritage of their company and its vendors, and learn from the experience of previous generations of Russian shipwrights."

Nice catch!

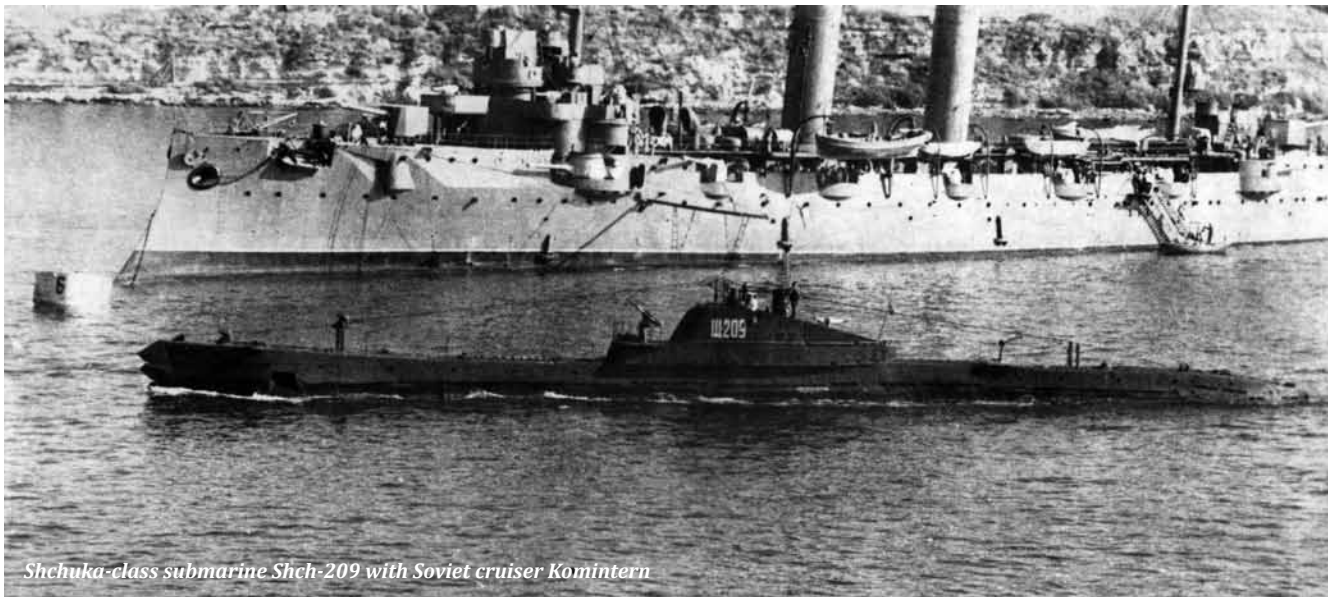
TechBureau managed to do well on their first design, but there were many things to improve on those that followed. This mostly applied to various on board systems and mechanisms. Some good samples came, literally and figuratively, from the bottom of the sea. A fishing net caught hold of something that turned out to be a sunken submarine, HMS L-55, which had been lost on a combat mission in 1919 in the Koporye Bay south of the Gulf of Finland when the Royal Navy crossed swords with Russian revolutionary seamen.

Commissioned in December 1918, she spent few months in service before being dispatched to the Baltic. On 4 June 1919, L-55 attempted a torpedo attack on Russian destroyers, but missed. Worse, her conning tower emerged above the sea level, and became target for the destroyers *Azard* and *Gavriil*. A huge explosion led to the belief that she had been destroyed by the destroyers' four-inch guns, but later it was found that L-55 had hit a mine.

After nine years in the water (June 1919 to August 1928), L-55 was raised. She still represented a relatively modern design. Most of her mechanisms were found in good shape. After extensive repairs, the submarine went into commission with the Soviet Navy in October 1931. Head of the Revolutionary Military Council, Marshal Kliment Voroshilov visited L-55 on several occasions. He praised the salvage party: "Thanks to your energy, skills and revolutionary enthusiasm, we got our hands on documents proving the facts of the foreign invasion and, at the same time, a technically advanced warship belonging to one of the most capable types in the British Navy."

L-55 carried 'experimental' status with the Soviet Navy. Many of her systems and mechanisms were of British origin, including Vickers diesels (replaced with more reliable Soviet 42BM6 diesels in 1934). Her four-inch artillery and 21-inch torpedoes were intact, and provided the Soviets with some vital samples for reverse engineering. Torpedoes especially proved very helpful, since local makers had been having troubles with indigenous designs.

Displacing 960/1,150 tons, L-55 was close in size to *Dekabrist*, which was 935/1,354. Malinin himself took part in restoration and reverse engineering efforts in order to learn more about the British ways of submarine making. Among other things, the Soviets adopted low-powered (24 horsepower) electric motors for economic sailing and low-noise "creeping" towards targets for their own submarine designs. The 2009 Rubin Yearbook reflects this in the



Shchuka-class submarine Shch-209 with Soviet cruiser Komintern

Schuka2 (Shch-201 of the Shchuka-class)

following observation: "When developing new designs, Malinin and his team used every chance to learn from experience of their colleagues in foreign countries, and think it over for better results."

Minelayers

The salvaged British submarine served the Soviets as a minelayer under the original designation. In part, this was for simplicity of documentation, and in part for the fact that she was indeed able to lay mines. Other '*L*' boats of the Soviet navy were derivatives of *Dekabrist* with reshaped (smaller) outer hulls and mine release pipes at the rear in lieu of torpedo tubes. The lead vessel, *Leninets* (English: Follower of Lenin) was laid down in September 1929. According to Soviet naval command, "The main task for *Leninets* is to protect the sea entrance to the red city of Leningrad from enemies."

In the early 1930s, the Kremlin gave orders to erect a new shipbuilding plant (No.199) in Komsomolsk-upon-Amur. It was meant to undertake final assembly of submarines for the soon-to-be-reborn Pacific Fleet using sections manufactured by heritage enterprises in the European part of the country.

The place was well away from the ocean coastline so that the plant could not be destroyed by the mighty Imperial Japanese Navy in case of a war. It was located on the banks of the river Amur, flowing into the Pacific. Thus, it also provided a way to ferry newly built submarines to naval bases of the Pacific Fleet. Incidentally, this same plant built INS *Chakra*, a Project 971I (*Akula*-class) fast-attack submarine in Indian Navy service since 2013.

In 1935 hull sections began to arrive by rail. Three years later L-11 and L-12 went into commission. Since the project in Komsomolsk lagged behind the original schedule, the Soviet government decided to make use of dockyards in Vladivostok, where Plant No. 202 assembled 11 *L*-class boats from 1936 to 1939.

The production run totalled 24 (Series II/bis, XI, XIII/bis), with the last hulls completed during WWII. They served with all four Fleets – Baltic, Black Sea, Arctic and Pacific – and proved themselves on mining missions and in torpedo attacks (including those performed by *L-12* and *L-19* against Japanese shipping in August 1945). *L-3* was the top scoring Soviet submarine in the Baltic by the number of enemy ships destroyed with mines and torpedoes (25 according to Soviet claims and 10 by German records).

Over course of the 1939-1940 events, Estonia became part of the Soviet Union, and provided its navy with *Kalev* and *Lembit* submersible minelayers (665/853 tons) built in the UK in 1935-1936. These were derivatives of the Royal Navy's *S*-class, very popular and successful British boats with production run of 62 in 1930-1945. *Kalev* and *Lembit* were very active during WW2, setting up minefields and torpedoing German shipping. Latvia, too, made its contribution to the growing Soviet Navy, but its French-built submarines *Ronis* and *Spidola* (390/514 tons, 1925-1927) were not as interesting to Soviet engineers. Besides, their service was short: both boats were blown up in June 1941 to prevent their capture by the Wehrmacht approaching the naval base they were in under repairs.

Submarine for mass production

Speaking on the occasion of laying down the lead vessel of Series III in February 1930, Chief of Naval Forces of the Workers' and Peasants' Red Army (the Soviet Navy commander) Romuald Muklevich said: "She gives us an opportunity to start a new era in our shipbuilding. With her help, we should gain the necessary skills and prepare the professional cadre for streamlined production."

Commissioned in 1933, *Shchuka* began a line of "medium" submarines. At 572/672 tons, *Shchuka* was notably smaller

Novorossiysk, a Project 636.3 (Improved Kilo) submarine of the Russian Navy, seen during her commissioning in 2014 (photo: Vladimir Karnozov)

than *Dekabrist* and *Leninets*. Her design incorporated best engineering solutions previously tried on Series I/II boats, Holland 602GF/L and *L-55*.

The production run came to 86, comprising Series III (4 built), V (12 built), V-bis (13 built), V-bis-2 (14 built), X (32 built) and X-bis (11+2 built). Both heritage and newly established dockyards across the country made their contribution. In particular, the class was selected for production at Red Sormovo Plant No. 112 in Gorky (now Nizhny Novgorod), which commenced submarine construction by laying down *Shch-304* in 1930. The plant completed six such boats over the entire decade.

Plant No. 202 in Vladivostok was at heart of the shipbuilding campaign aimed at rebuilding the Pacific Fleet. The first train loaded with submarine sections made in the European part of the country departed for the Far East in June 1932. The first hull was launched on the night of 29 April 1933, under high secrecy, as Moscow did not want Japan to learn of its submarine construction programme. *Shch-11* and *Shch-12* hoisted red flags in the Golden Horn Bay on 23 September 1933. The submarine was back, protecting the nation's naval fortress in the Pacific – Vladivostok had been under protection of the Imperial Russian Navy's first submarine squadron from 1905 to 1916.

In 1936 *Shch-117* covered 3,000 miles of Pacific waters in 40 days, demonstrating the *Shchuka*'s vastly improved endurance (double the type's design endurance). By 1940 Soviet Navy crews had mastered their boats well enough, and command began sending them out on patrols into Chinese and Japanese waters. *Shch-423* spent 73 days, including 56 in transit, to cover 7,227 miles (including 682 in icing conditions) between Polyarny and Vladivostok. Thus,

Key data on submarines mentioned in the article

	Laid down	Commission	Displacement surfaced/ submerged, tons	Length *width, m	Max speed under water, knots	Max speed on surface, knots	Crew members
L-55	1917	1919	960/1,150	77*7.7	9-10	14-17	38-40
Nerpa (*Bars*-class)	1911	1915 (recommissioned in 1923 as *Politruk*)	642/733	67*4.5	9	11	45
AG-23 (*Holland 602GF*)	1916/1917	1921	361/440	46*4.8	7.5-10	13	32
Dekabrist (*D*-class, *Series I*)	1927	1930	935/1,354	77*6.4	8-9	12.5-15.5	53
Leninets (*L class*)	1929	1932	1,038/1,330	79*7.2	8-9	12.5-14.5	55
Shchuka (*Shch*-class)	1930	1933	578/705	57*6.2	8.5	12.5	38
Kalev	1935	1936	665/853	60*7.2	8.5	13.5	38
Ronis	1925	1927	390/514	55*4.6	9	14	32
Project 636.3	2010	2014	2,350/ 3,950	74* 9.9	20	17	52

[Project 636.3 is the most recent of Russian navy diesel-electric submarines. Her figures are provided for comparison.]

she became the first submarine to have ferried from the North European part of Russia to the Pacific coast via the Northern Sea Route.

Shch-class submarines proved rugged workhorses in WWII, but suffered high losses: 31 out of 44 such boats were lost. Nonetheless, *Shchuka* was a simple, reliable platform suited for mass production. This ensured her success at a time when Soviet military strategists were putting a premium on quantity. The *Shch*-class became the most popular of Boris Malinin's designs conceived when the head of the TechBureau.

Tribute to Malinin

Malinin's boats were summoned to act against shipping to and from Finland during the Winter War between 1939 and 1940, with *Leninets* (L-1) laying mines, and *Shch*-class boats using torpedoes and artillery. They claimed several steamers and coastal protection vessels, thus opening the combat scores of Soviet-designed and built submarines. When Nazi Germany invaded the Soviet Union on 22 June 1941, the Navy had 213 submarines including 100 Malinin designed boats. By comparison, in 1926, when the shipwright was appointed head of TechBureau, the Navy had only 14 serviceable boats. From the first day of the Great Patriotic War (as WWII is known in Russia), the underwater component was repelling aggression in the Baltic and Black Sea theatres. On 23 June 1941, submarine *D-III* of Series I departed Polyarny on its first combat mission in Arctic waters.

Shch-307 opened the scores of the Soviet submariners against their German *Unterseeboote* opponents on 10 August 1941 by torpedoing Kriegsmarine *U-144*. During the war, the industry completed seven *Shch*- and five *L*-class vessels launched in 1940-1941. These include *L-20*, *L-21* and *L-22* launched in Leningrad, and completed in 1942-1943 at Plant No. 402 in Molotovsk (now Severodvinsk), which facility is now known as Sevmash, and is Russia's largest centre of underwater shipbuilding on the White Sea. Ultimately, a total of 116 submarines were commissioned in 1930-1946 to designs conceived by Boris Malinin.

Contrary to a common belief that the Soviets did everything in-house, the local shipbuilders were using every opportunity to improve their end-products through clever use of foreign expertise even at the time their country was politically and economically isolated. In plain words, the gist of the Soviet shipwrights' experience in the 1920s-1930s is this: to their predecessors' notion of learning from foreign collaborators to improve the product of your own, they added: "study your opponent!"

History shows that Malinin was eager to learn from his colleagues in other countries despite the fact they did not always want him to do so. He took part in the HMS *L-55* restoration and reverse-engineering efforts and made use of original German components and copies of German, Italian and British system specimens on home-grown submarines. This was being done with the understanding that local designs are good only when they are at the level of the best ones available elsewhere. The current generation of Russian shipwrights tries to keep their forebears' spirit of learning, innovation and flexibility alive in today's practice.

Vladimir 'Vovick' Karnozov

Electric motors, hp	Diesels, hp	Endurance, days	Torpedo tubes	Artillery	Comments
2*400 2*24	2*1,100	30	6	2*102mm (2*76 with Soviet navy)	Built for the Royal Navy, served the Soviets
2*350	2*250	10	4 (8 external removed in 1923)	2*75mm, 1*37mm	The only *Bars*-class sub to serve with Black Sea Fleet in 1923-1930
2*240-310	2*480		4	1*45mm	First sub completed under Soviet government order
2*525 (two-anchor design, 500+25hp)	2*1,100	28	8	1*100mm, 1*45mm	First Soviet designed and built sub
2*650 / 2*30	2*1,100	28	6 and 2 mine tubes	1*100mm	Minelayer, figures for Series II
2*400 2*20	2*685	20	6	1*45mm	Most numerous type of Soviet Navy subs in WWII
2*395	2*600	20	4 and 20 mines	1*40mm	Estonian boats built in UK
2*350	2*650		2 plus 4 external	1*76mm	Latvian boats built in France
1*5,500, 1*190, 2*102	2*2040	45	6	none	Modern sub in service with the Russian Navy

Flying against the Wind

Finger four formation of HAL Ajeets of No. 2 Squadron

Prof Prodyut Das advocates

An Indian Light Fighter – Redux

Market Research (MR) techniques usually result in products which meet a customer's requirements to a major extent. However, when it comes to combat aircraft, any application of MR is conspicuous by its absence ! The West prefers to promote their complex fighter specifications as being of 'universal standard', but this also acts as an entry barrier to competition.

However, in the Indian context, sufficient statistical data exists to enable a scientific approach to specifying combat aircraft requirements. As per the Government of India's new policy, the Private sector will shortly be given opportunities for involvement in combat aircraft development, but they must begin with intrinsic handicaps. Thus, the importance of Market Research and a statistical approach in designing"appropriate" fighters, rather than "just like" fighters.

The Folland/HAL light fighter was blooded in action during the September 1965 air war and again during December 1971, when eight squadrons of the type served with the IAF

In the South Asian arena, the air arms of India and Pakistan flew around 11,000 combat aircraft sorties during the wars of 1965 and 1971. These mainly involved 2nd and 3rd generation fighters but this is an extremely valuable resource base because we own every bit of that ! The Israeli Air Force flew about 14,000 fighter sorties in the 1967 and 1973 wars and the Arab Air Forces flew possibly as many. If we include the Sinai clashes of 1967-1973, the Iran-Iraq war, the Vietnam war and the various Gulf Wars, we are looking at a data base of some 100,000 sorties. Much of these, except the Syrian AF's very interesting experience with the MiG-17 and 19s is well known and much more can be gleaned.

Those sorties were flown by 2nd and 3rd generation fighters,operated by Air Forces having mixed background of training, operational doctrines - and traditions. The combatants varied from well matched to quite mismatched, and some actually asymmetric. Operating conditions varied from clear and infinite visibility over the Sinai to the sub-continental haze to Vietnam's overcast and cloudy conditions. A comprehensive statistical data base on which to formulate practical air staff requirements (ASR) is thus available. The 'West' is disinterested in such a study, being disdainful of developing and producing 'low cost' fighters. An Indian initiative in this direction may well set the trend for a proverbial (lightweight) cat amongst the pigeons.

What are the actual requirements?

The actual requirements that emerge will go against the 'hard sell' brochures.

The dog fighter is not dead. Fighter aircraft must be designed to win the air-to-air battle. However with SAMs taking over some of the CAP/point defence sorties such missions constitute perhaps just ten per cent of all sorties flown(and war losses).The essential task of combat aircraft remains ground attack,close support and interdiction under VFR conditions. Close Support also results in the highest losses-about 60-70%- *to low cost defences* but scant provisions are made at the design stage for survival or to minimise losses.

Statistically, there were perhaps only ten occasions, if that, in 100,000 sorties when a single-seat radar-equipped fighter located, engaged and destroyed a hostile aircraft at night using its own radar system. Work out the implications.

Even when opposing aircraft were capable of all-weather/Mach2/60,000ft altitude performance, there were thousands of occasions when air combat took place where the starting parameters were 450kts/10,000ft/VFR conditions, which then wound down to WW II parameters until one had to break out and run. One could well say that an aircraft's internal fuel capacity is more of an 'outcome decider' than the maximum AOA and other such high performance attributes.

BVRs/CCMs/Cannon

Beyond Visual Range (BVR) missiles are not new. Back during the Vietnam war years, they showed strict impartiality is what they knocked down, so much so that soon the SOP was for one fighter to go ahead to visually identify so that the following fighter could launch. This compromised the 'surprise' element which is the BVR's USP. The impartiality of BVRs about who is the 'enemy', continues till this day.

BVR advantages are a given but it is also important to ascertain :

- What were the numbers of BVRs launched-but missed-and under what parameters?
- Numbers of launchers that did a 'blue on blue'?
- As BVRs are heavy and 'draggy', how many had to be jettisoned at the beginning of close air combat to 'clean up' one's aircraft?

Thus, although CCMs are combat proven, and are definitely essential, no designer will repeat the 1960's mistake of deleting the fighter's integral gun. In fact for Asian theatres a reversal to multiple gun armament maybe warranted.

Sauce for the Gander?

If we transpose the above, mapping performance envelope of various generations, we get Figure 1 (below) which plots design speed and altitude capabilities of various fighter generations and matches this with what has actually been used in combat. BVR effective ranges with altitudes are also marked. It will be clearly noted that some of the 2nd generation fighters were, in every way, nearer and better placed in terms of performance, size and handling where the fight would actually take place rather than the ensuing 3rd, 4th and 5th generation fighters. Combat experience confirms this.

More comprehensive equipment adds 'global' versatility which is irrelevant to Afro-Asian-Latin American operators. From this baseline, we could conjecture as to what would happen if some of the 4th and 5th generation technologies were selectively adopted for redesigned 2nd generation air frames. It will be seen that such a redesigned 2nd gen. airframe, with more modern systems can be developed at low cost. Having worked on several system upgrade programmes, this new approach of an older airframe with new systems could well be the logical next step.

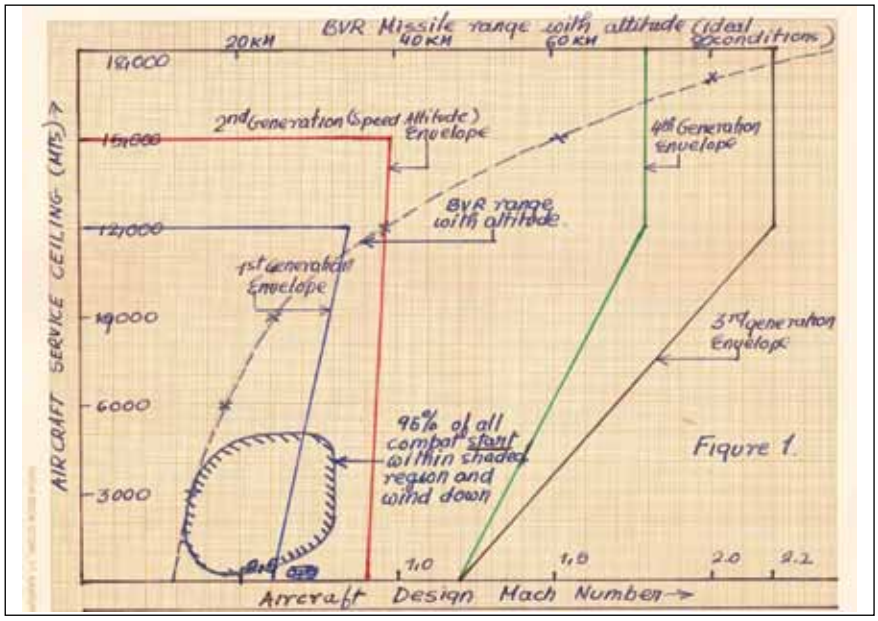


Figure 1

Why not 'copy' ?

There are sound economic reasons for 'copying' and this certainly makes sense to any 'honest' engineer. Wise copying provides 'the shoulders of a Giant' on which to stand upon, see faster and further. Much like the Chinese did, India's industry too could at the beginning base its designs on 'copies'. Examples of *makkhi* (squashed fly on a drawing) to *makkhi* exist in every language that engineers use but it is not always actually possible, or indeed useful, to do so. Copying has pejorative connotations but actually can be an art form. The Russian T-34 tank so shocked the opposing Germans that they actually proposed to copy the T-34 'makkhi to makkhi' until it was realised that the Germans would find it difficult to obtain vast supplies of aluminium required for the B2-34diesel engine's crankcase. The other story, although probably apocryphal, was that 'finish' of the T-34 was so 'poor', it would not pass the QC standards of the *Technische-Amt-Heer*! Seriously however, what the Germans did was in fact the highest form of copying. They minutely studied the T-34, absorbed its design philosophy and concepts and adopted these for their own. The resulting, quite superb PzKW V Panther had the sloping armour and the 'overhung' gun of the T-34 (something the 'West' was long hesitant to introduce) but retained the peculiar interleaved road-wheels the Germans were so fond of, doubtless for track metallurgy constraints. Between '*makkhi* to *makkhi*' and adapting the muse's 'philosophy', the possibilities of low cost product development are endless,cost effective, certain – and exciting.

For the Aeronautics Project Engineer/ Director, the reasons for copying are many and pressing :

Calculations and *wind tunnel data* are always optimistic. Having an actual aircraft on a hands-on basis e.g. Folland Midge/Gnat or BAC 221/Concorde is most reassuring and wiser.

Aerodynamics is literally skin deep. Under that skin even a tiny aircraft like the Gnat had 10,000 parts. Each has to be conceived, located, stressed, detailed and specified in terms of metallurgy and production. All this takes time which is saved even by broadly copying.

Production details : manufacturing, *jigs tools and fixtures*, *QC, heat treatment* all can be that much more rapidly decided upon.

Every design has its faults. It is easier to correct a known fault in the 'copied' aircraft than to identify a potential fault which will cunningly wait till flight testing before it reveals its horns. I have in mind the fin and tailplane of the HJT-36 which now requires much more time and 'fiddle' to correct.

Finally, certification authorities are conservative to the point of being superstitious! It helps every one if they have can 'see' something that has worked well before.

The reader will have noted that copying is not because of any lack in knowledge: copying is all about business wisdom and saving time. One can't/won't copy if one does not know or have the fundamental knowledge or wisdom. It is certainly

The Folland Midge was the company demonstrator before embarking on the Gnat fighter programme

not 'brainless'! The Designer has to have the brains–indeed wisdom–at every step to decide if the "Muse is relevant to his Ecology."

Now, does one need drawings of the original to copy? No ! Modern e-engineering tools and good old fashioned engineering 'horse-sense' obviates much of such needs. However, what will be needed are one or two of the 'muse airframes'.

So why the Gnat again ?

My ideal light fighter would be twin-engined, having the F-86 Sabre's pilot's visibility with the MiG-17's wing (AR 4!) modified to have the MiG-19's wing structural stiffness, perhaps the Su-7's wing section with its rounded L.E. which gave it superb low level manoeuvrability, the Hunter's forward fuselage married to a twin-engine rear fuselage from the MiG-19 and a *flak vierling* gun layout of the HF-24, all somehow blended with something of the Hunter's grace and immense strength ! Of such stuff are dreams made and it won't cost the earth! Of course, the HF-24 could have been the basis of an entire Air Force (AJT, LIFT, strike and interceptor), all in that one superb basic airframe. Nostalgia overwhelms one but this also makes sound sense !

It has to be emphasised that any of those 'best 2nd and 3rd generation airframes suitably modified will respond to 're-systeming' with current systems to create a 'best' or "most useful" fighter at *low cost*. The Gnat is only used as a convenient example of the nature of the effort required and the metrics of the improvements that can be expected.

Advantages of the Gnat

It was naturally stealthy, very difficult to see or even to hear which is very important in conflicts where the 'Mk.1 Eyeball and Ear model A' continue to be important sensors.

It has superb fighter characteristics : small size, high T/W, high AR, low power burn per 'G'. It was naturally area-ruled. Deliberately area-ruled aircraft e.g. Blackburn Buccaneer suffered excessive drag when operating at 'off design' speeds, which fighters do all the time. The reports of the HF-24 'coming alive' at high speeds and low level was probably partly due to the area ruling 'kicking in' as it were.

- It was structurally brilliant and very well engineered.
- The aircraft was modular: quite considerable surgery can be done on the airframe without involving a total redesign.

But, despite the good points, the Gnat had some grievous faults :

Totally unacceptable faults

- Poor ejection seat reliability and performance envelope
- Unreliable tail plane actuation
- The windscreen to rear pressure bulkhead distance did not permit pilots taller than 5'10" unless they agreed to leave their knees behind in case of ejection.

Unacceptable to very unacceptable faults

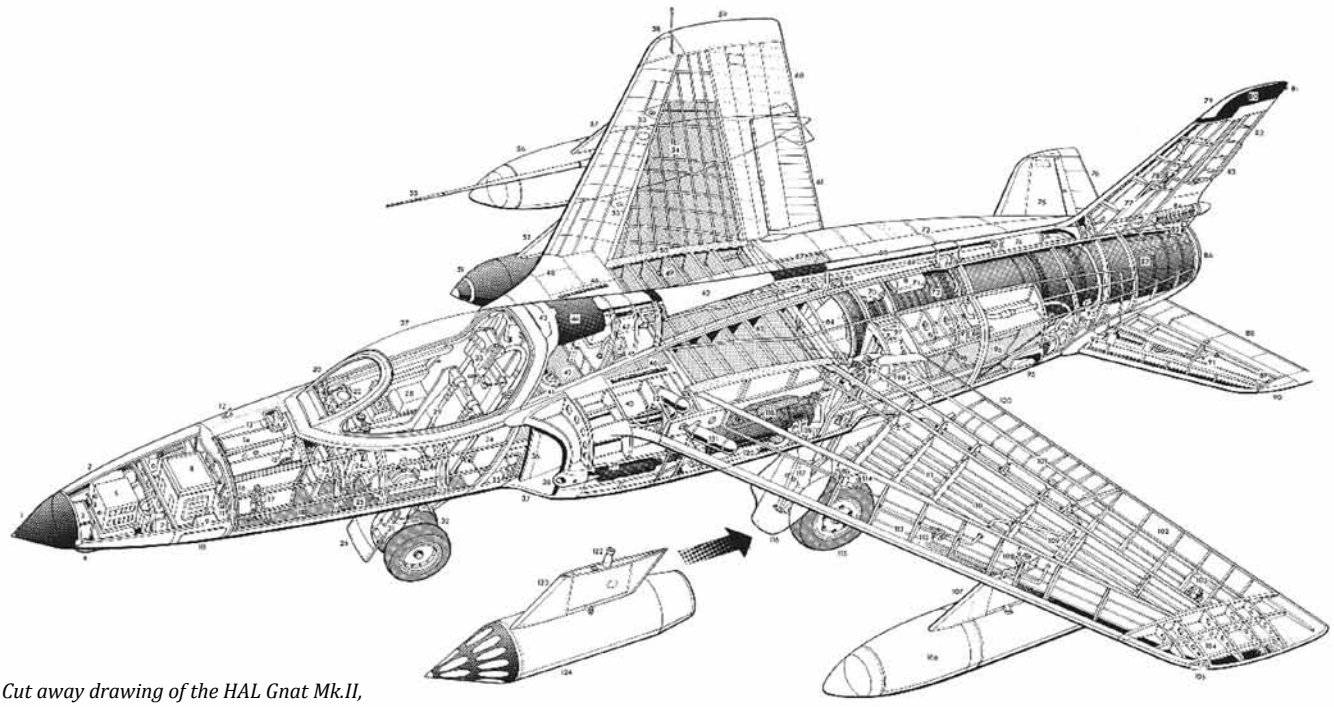
- Cluttered Instrument panel, made worse by the very cramped cockpit.
- Gun stoppages during combat
- Cracking of gun mounts in full fire out.
- Brake parachute would scrape the ground and collapse causing 'uncertainty' about reliable operation.
- No antiskid
- Very poor air-conditioning.The very low bleed pressure (65psi) and the bad location of the CAU (in the engine bay so that the brake fan's output cooled the engine bay) was to blame.

Idiosyncratic faults

- The severe nose up trim change on retracting undercarriage at take-off.
- Generator MFO too high resulting in high taxiing speed or battery going flat.

Operational shortcomings

- Inability to catch a 3rd Gen fighter or stay in the firing bracket long enough to shoot it down
- Inability to accommodate a CCM system.



Cut away drawing of the HAL Gnat Mk.II, officially known as the Ajeet

Our very Gnat – Redux

Thus our new engineering approach would be to avoid a thorough redesign to get a golden standard but instead aim to have a reasonable solution to the problems.

Engine : RR Adour 811/Honeywell 125 IN/ Motor Sich 222-25

Armament: 2 x Aden 30mm/ 2x GSh 30 AO 65 for ground attack /4x NS 23 Flak Vierling / 1x 23 mm GSh, 1xGSh-30-2, CCMs.

Cockpit & Displays: HUD, HOTAS, 5xMFD, GPWS, Lightweight Radar or Laser ranger, RWR, RAM, Health and usage monitoring system (HUMS) Radio altimeter,

Avionics: WAC, ADC, HMS, Mission computers, Radio Compass, Ring laser Gyro, Digital Map, IFF, Auto pilot, Self Protection Jammer.

Systems and Equipment

- Martin Baker Mk.16 light weight or KVD 36 seat.
- MDC
- Larger battery and hydraulic reservoir with fully duplicated hydraulics and electrical systems.
- Redesigned tail plane actuation system replacing the unreliable '*Chacha*' Hobson system.
- Windscreen to bulkhead distance increased to suit a larger pilot percentile population but not necessarily to 'International standards'.
- Glass cockpit
- Redesigned gun feed as per the Ajeet mods, which reportedly worked.
- Strengthened main forgings to take Aden/GSh 30 recoil which used to crack on full fire out.
- The use of two (smaller) parachutes for braking as in the Su-7.
- The introduction of a 'trimming' air brake to avoid change of trim on selecting air brakes or under carriage retraction.
- Redesign of Generator/ECU to tune MFO of the generator with the taxiing speed.

Type	AR	W/L	T/W	ID/T	Target Volume	Notes :
Folland Gnat	**3.6**	**237**	**0.71**	**0.20**	**1**	**As datum**
MiG-21 Bison	**2.2**	**354**	**0.64/0.87/1.14**	**0.39/0.32**	**2.8**	**Definitive version**
LCA Mk.1	**1.8**	**242**	**0.52/0.84**	**0.35**	**3.1**	**In Progress**
Adour Gnat (1987)	**3.6**	**303**	**0.6/0.9**	**0.24**	**1.2**	**Low cost Demonstrator**
Adour Gnat (1993)	**3.6**	**286**	**0.63/0.94**	**0.23**	**1.2**	**Introduces Composites, made to order accessories**
Gnat F125 (2008)	**3.6**	**267**	**0.75/1.2**	**0.18**	**1.2**	**Current engines e.g. Honeywell F125**
F-16 A	**3.2**	**408**	**0.64/1.15**	**0.244**	**4.4**	**Target vol. shows the price paid for versatility.**
JF-17	**3.7**	**372**	**0.48/0.95**	**0.23**	**4.4**	**But affordable**

Key :
AR Aspect ratio
W/L wing loading in clean combat weight with full internal fuel kg/M²
T/W Thrust to weight in kg/kg at above weight. Two ratios give full military and A/b thrust/weight ratios.
ID/T Percentage of power consumed at S/L ,3.5 G turn at clean combat weight.
Target Volume indicates the target the aircraft presents to AA defences. Span x length x height (Folland Gnat is taken as unit volume).
The simple table above accurately reflects why that the Folland Gnat gave the MiG-21 Bis a hard time in DACT sorties. The MiG-21 had to use its afterburner to disengage. Such a move would be ill advised against the F.125 whose figures (above) are with two CCMs. These would find the large IR signatures of the F-16/MiG-21/JF-17 very tempting indeed !

Table 2

The Adour Gnat (1987)

Alert readers will immediately note that these are based on standard equipment fitted to the Hawk Mk.132 and Jaguar Darin III standards.

Our new Gnat's airframe would be modified by lengthening and deepening it to accommodate the HMS, the new engine and the ejection seat. The wing has been slightly increased in area whilst keeping the same section plan form and twist etc. The sketches (on page 87) shows the Adour Gnat and the Folland Gnat profiles to the same scale. Table1 includes a 'target volume' i.e length x span x height which is an approximation of the target the aircraft will present to the enemy,using the Folland Gnat as a unit volume. The small target of the Adour Gnat is noticeable. The dimensions are provisional and the project engineer will have to work like a bespoke tailor with his nips and tucks. The aircraft shown has about 900 litres additional fuel in the centre fuselage and about 80 litres in the forward avionics bay.

The Adour Gnat (1987) is the philosophy of 'cheerful pessimism': things kept simple as possible but if they don't work, we will soon find out and fix them! The layout is conventional so FBW problems don't hold up the programme i.e. if required it can be flown without FBW until that is debugged. It also follows the philosophy of 'de-optimise locally to optimise globally';It uses standard supplies and rotables as with the Jaguar/Hawk's engines hydraulics, brakes, wheels, ECS and electricals, etc to save time and money. Because the design closely follows the Gnat's, development cost and time would be low. The prototypes would be built using 'knife and fork' methods and standard metal rolled sheet and extruded stock. Forgings could be replaced by those machined from solid items or open die forgings or even crankshaft quality SG iron where possible. Naturally all tooling and production methods would follow the Gnat /Ajeet's practice.

A great thing is that, like the Gnat, the biggest of the sub-assemblies are small in size which would reflect on the tooling costs. This aircraft will be the trials aircraft rather like the Folland Midge and would be similarly used for concept evaluation. The nomenclature '1987' means that this aircraft could well have been on the flight line by 1987 as it only uses technology that was already available in India in 1983 but just look at the performance figures! The basic empty weight would be 2,850 kgs as compared to the 2,160kgs of the Folland Gnat. *[Ed's Note :1983 was the year when the LCA project was sanctioned].*

The Adour Gnat (1993)

Provided the Adour Gnat (1987) attains 90-95% of its predicted performance – and operators are interested–the next step would be to design an improved version using optimised made-to-order accessories where indicated e.g. brakes, wheels, tyres etc. This would also be the time to see if composites can be brought in. Composites can save about 180 kilos on an airframe of this size but the strategic implication of this material has to be understood. About FBW one has to be even more circumspect. In a small fighter like this, weight of the system has to be carefully assessed against the gain in trim drag. For example the pitch inertia would be one seventh of the LCA's which itself is a rather small aircraft! A compromise would be the fitting of a single channel FBW which would take inputs from the Air Data Computer, the G meter, the ASI and select strain gauges embedded in the airframe to let the pilot know where he is on the V-n diagram. This aircraft could have been operational in 1993.

The Honeywell Gnat F125

This is the version that could be built today using the Honeywell F125IN engine. Alternative engines are the latest Adour or that dark horse, the Motor Sich AI 222-25 although Russia–Ukraine politics are a factor. It may be interesting to develop three proposals, each using US, UK and Russian/Ukrainian aggregates so that can get equipment whose 'philosophies' they are used to, thus easing logistics. The weight savings with the Honeywell engine gives rise to the possibility of developing 'heavy and light' versions of the fighter, but the terms are relative. The 'heavy series' would be optimised and equipped for frontline close support and interdiction behind enemy lines. This aircraft would be equipped with MiG-27 style cockpit armour, fuel tank and lines 'inerting', heavy GSh 30 or GSh 30-2 cannon, armoured control and fuel lines which would give it very relevant protection and slash aircraft losses to air defence systems. The figure (below) shows the side view which also emphasises the commonality between the variants. The variants will weigh in between 2,400 kilos for an AD version with a single underbelly 23mm GSh to about 2,850 for a dedicated '*Shturmovik*-type' aircraft with armour protection and using 30mm Aden. The GSh 30-2 is lighter than a pair of Adens by about 90 kilos.

Assessment : Gnat F125 vs. the F-16

The term 'Gnat F125' is used to describe the generic version irrespective of which set of equipment and engines is adopted as the differences would be marginal. The table 2 is self-explanatory and I will confine myself to the discussion in which the Gnat F125 is compared with the F-16 as a typical threat.

The table shows that the Gnat F125 will be a challenge to the F-16 even in one-to-one

[Sketches by the author]

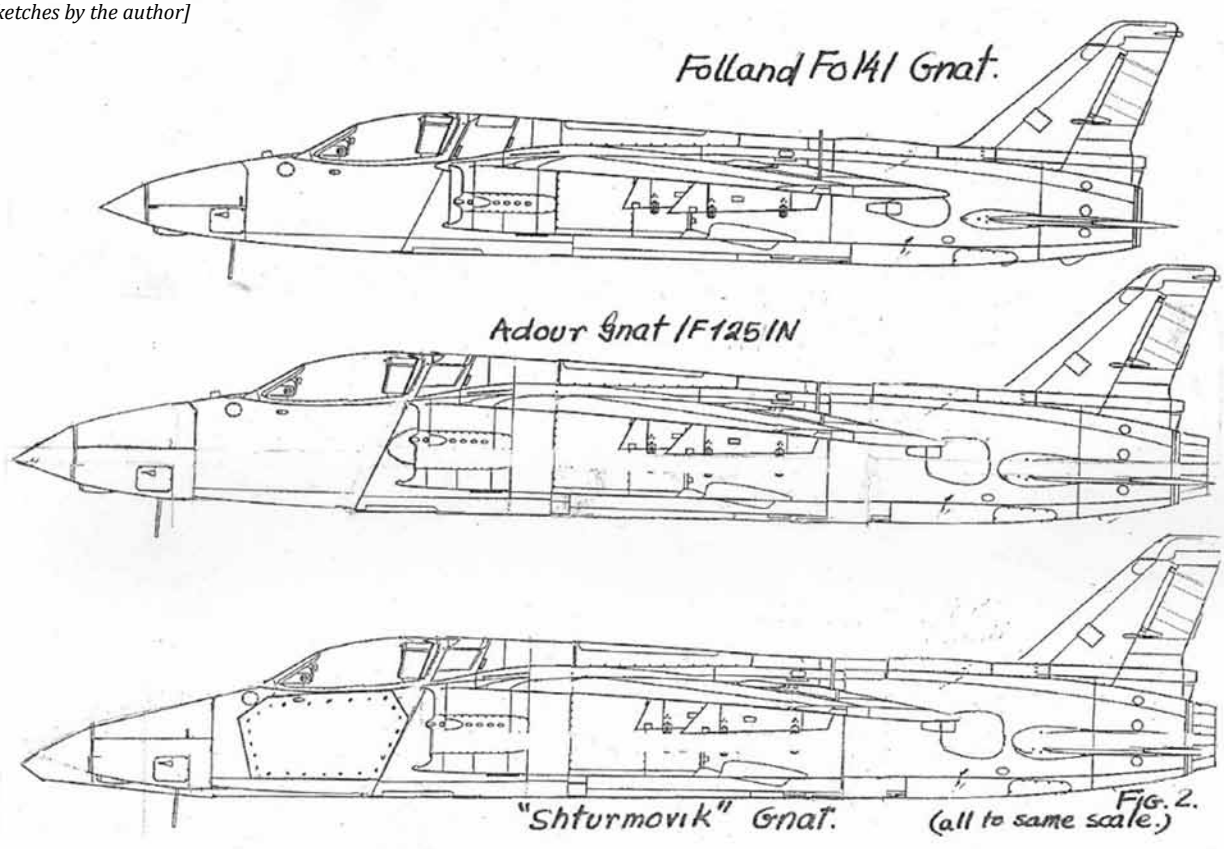


Fig. 2. (all to same scale.)

The F-16 'light weight' fighter has been in service with 28 leading Air Forces of the world, including Turkey (above) and Pakistan

air cobat. In 4 vs 4 or 2 vs 2 the advantage will be with the smaller aircraft. In straight line performance, the F-16 will gain.

The Gnat F125's acceleration levels from M 0.6 to M 0.9 *whilst retaining CCMs* will show startling improvement over the Gnat, enabling the type to prevent a 3rd or 4th generation fighter from breaking off at will. The Folland Gnat's mach limits were 0.91 at LL and 0.98 at higher altitudes so it is reasonable to expect M=1 at all altitudes though if it is *genuinely required* the wiser course would be to design a 6% wing. Fortunately such a change is easy thanks to the Gnat's 'modular' structural design.

General flying characteristics will still be very much 'hot rod' like the original Gnat although the Gnat F125 will not have the 'hair trigger' feeling of the original because of increases in damping and inertias in all axes but will still very much remain a Gnat in spirit.

In the strike role, the Gnat F125 would carry upto 3,000 kilos, typically 4x500 kg. bombs plus 125 rounds/barrel for the 30mms and 2 CCMs over a 180-220nm radius lo-lo-lo with the usual reserves.

At high altitudes, 10,000mts head on BVR case at 100 kms apart, the F-16 will have a clear advantage in reach. However, given the small size and signatures of the Gnat the F-16's detection range and the AMRAAMs will, however, be about 10% that of conventional size fighters. One is reminded that the Mirage 2000's radar would detect a Gnat only at ranges when the bigger Mirage 2000 was itself WVR!

At low altitude, the head on firing window of the missile will be reduced. Chances of a BVR kill will be small and the BVR may well have to be jettisoned.

In ground attack, the F-16 will have twice the payload range but will suffer four times the hits from SA/AAA of the same intensity. The Gnat's life cycle delivery will thus be more than the F-16's because apart from the pilot's efficiency and aggression, the Maths will increase its survival.

Compared with the Tejas LCA, the Gnat F125 would be much lower in cost but just as good in most tactical situations, with better close combat abilities. The LCA will be somewhat better in all weather profiles which is negligible in terms of numbers.

Still, there is no magic. The Gnat is merely optimised for its most probable role and thus excels and clearly shows that there is place for such a 'concept warplane' in the inventories of even fairly sophisticated Air forces.

Development efforts required

Aircraft development does not require huge resources but series production does. One of the reasons why the Gnat has been selected for this study was that it required very little resources to develop. The genesis of Folland Aircraft is of interest. The firm was founded in 1940 and had never built a complete production aircraft before let alone a jet aircraft. Its resources were a total area of 53 acres, covered space, including offices and factory of 46,000 sq. mts.

There were about 800 personnel, including design strength of 150 yet the Gnat flew within 4 years of 'go ahead', using then prototyping technology. With the use of modern CAE and CAM plus the use of sound engineering and project management methods, manpower and capital requirements could be even further reduced. The time line for development could be approximately 0-15 months for project studies studying alternatives : Adour engine with British accessories, Honeywell's 125 engine with US accessories and Motor Sich AI 222-25with Russian or Ukrainian accessories.

Further, 16-50 months for prototype flight as 'Company demonstrator'; 51-54 months for flight trials, review of data and analyses ; 55-70 months: definitive pre-production machines with progressive introduction of 'heavy' and 'light' series fighters.

Price of the Bird

The tentative project costing, possible vendor/subcontractor identification would depend on suppliers of rotables for project partnership. The price of weaponry has little relation with the actual cost of producing it. In India the true cost of production has been masked by operating inefficiencies of PSUs and weird taxations and customs duties, not to mention the earlier Government's myopic R&D policies.

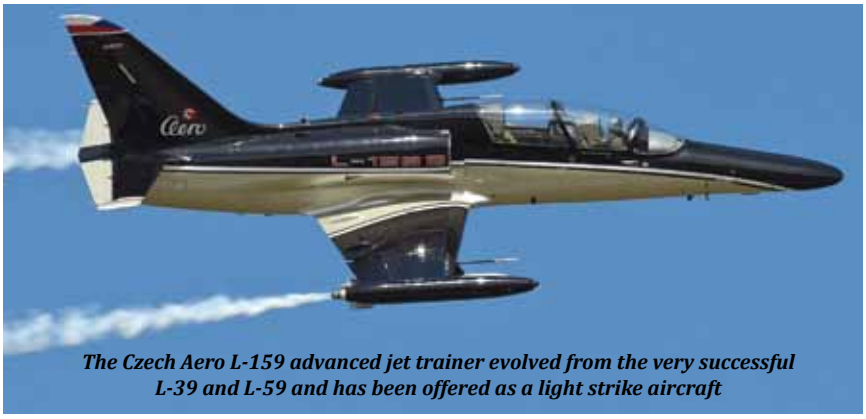
The massive world market

The world market for this type of fighter could well be said to be a staggering 12,000 in number! Currently the only types on offer are either watered down versions of 4th

The Korean T.50 advanced jet trainer has also excellent light fighter attributes

The Textron Air Land Scorpion is a proposed American light attack and Intelligence, surveillance and reconnaissance (ISR) jet aircraft

The Hongdu L-15 Falcon is a Chinese supersonic training and light attack aircraft



The Czech Aero L-159 advanced jet trainer evolved from the very successful L-39 and L-59 and has been offered as a light strike aircraft

generation aircraft or Advanced Jet Trainers. It is tempting to think of the IAF as a launch customer but this may actually be fatal for any Private Sector pioneer to even think about this, as the 'decision cycle' time of the IAF is financially unsustainable. It would be OK to keep the IAF in the loop, give it full opportunity of being a launch operator but the main market will be amongst the Asian, South American and African air arms.

This concept will be laughed to scorn but astute companies like Textron are already investing. Still, cap in hand and shuffling my feet, I would say that Textron got the balance a little wrong by being too much 'Cessna-based'. Their Scorpion has first generation aerodynamics with fourth gen systems. Also the aircraft lacks 'glamour' and 'glamour" is essential for a Combat aircraft to sell! Just my personal opinion but Textron's strategy is absolutely right and the strategy is awaiting the world prize(s) : the (s) because the strategy can develop a range of appropriate combat equipment! It is inevitable that even bigger air arms will actually have the sense of a Gnat F.125 concept in their hearts.

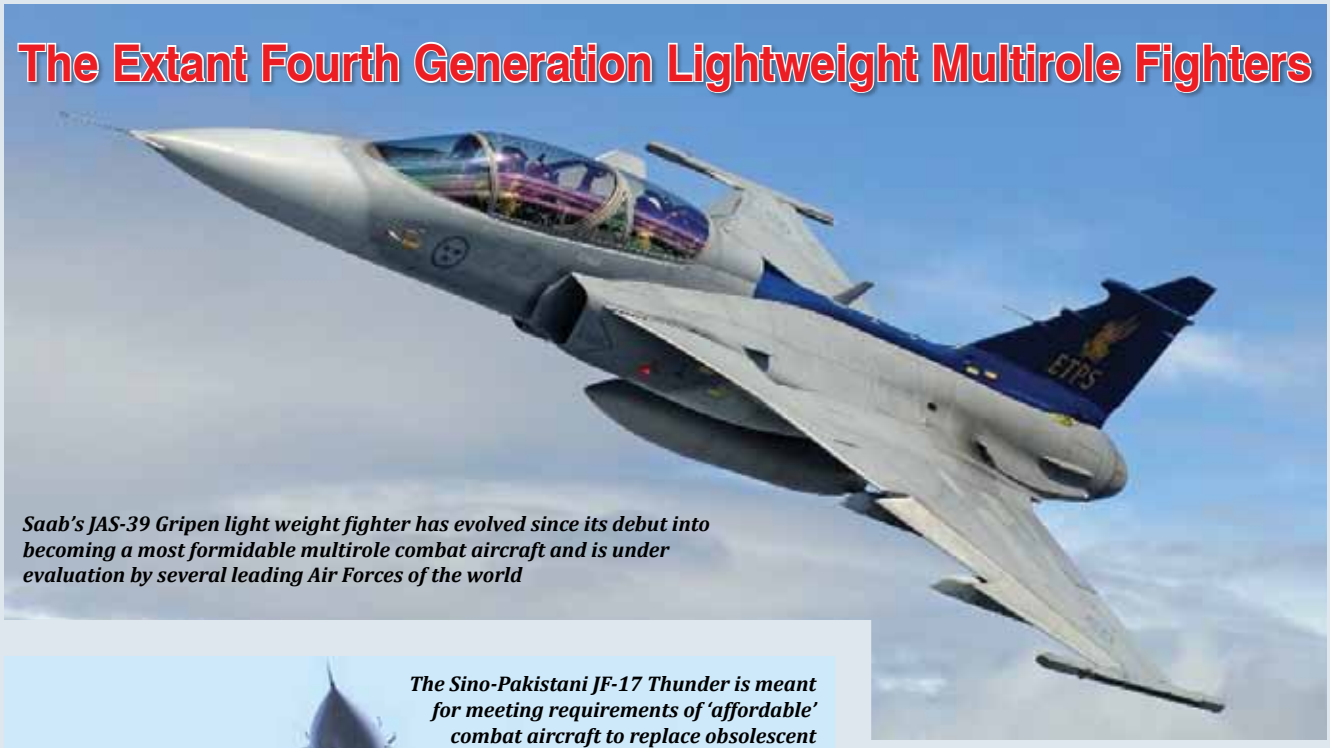
Such a well-strategised aircraft development programme is very predictable and manageable within cost. India has the resources–both human and legacy equipment–not to speak of the enterprise to develop a remarkable range of combat aircraft of great potency, yet very affordable. The then Government's decision to anoint a yet-to-exist organisation with no production facilities to develop 4th generation warplanes defies logic. The psychological impact of such knee–jerk decisions must not cloud our vision of real potential of the Indian industry in supplying pertinent – and very affordable – fighters to India and the world.

Here, I rest my case but reiterate that modern airframes are unsuited for the most likely combat conditions, which reduces their effectiveness and battle outcome. Reprise of 2nd generation airframes matched with later gen systems will produce marketable fighters, which is the way to go for Indian private companies. India has considerable upgrade knowledge and access to many excellent 2nd generation airframes. This is an exciting potential.

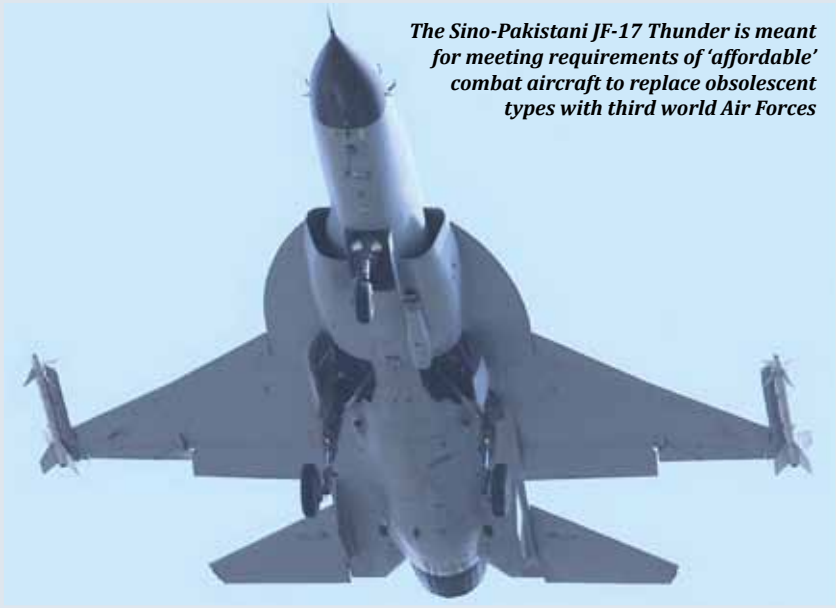
The approach in handling such a project would be akin to an 'armed reccee': success at each sub stage will farther exploration.

The 'Gnat Redux' could well go into service within 6-7 years. All that is needed is faith and the 'Go Ahead' decision!

The Extant Fourth Generation Lightweight Multirole Fighters



Saab's JAS-39 Gripen light weight fighter has evolved since its debut into becoming a most formidable multirole combat aircraft and is under evaluation by several leading Air Forces of the world



The Sino-Pakistani JF-17 Thunder is meant for meeting requirements of 'affordable' combat aircraft to replace obsolescent types with third world Air Forces

There are today three light weight multirole fighters in operational service, or nearly so. Surely, Sweden's Saab JAS-39 Gripen has set the standard and its performance and capabilities are hard to emulate. The earlier model 'A' was followed a decade later by the model 'C' and the model 'E' was rolled out as this Issue goes to print.

The Sino-Pak JF-17 Thunder is a relatively new comer but is being produced in quantity at PAC Kamra, with nearly 70 aircraft serving in frontline fighter squadrons of the PAF.

The Indian Tejas light combat aircraft has been long in the making, with initial operational clearance recently received and the first trials unit expected to be formed later in 2016.

The Tejas light combat aircraft (LCA) is described as the world's 'lightest' fighter extant but has yet to enter operational service with the IAF

RED STAR OVER SYRIA

The Su-24M is the spearhead of Russia's bombing campaign in Syria, shown here dropping an OFAB 250-270 fragmentation bomb

Russia cranked up its military role and changed tactics in Syria after the downing of a Russian AF Su-24 by Turkey in November 2015. Six months later, this event and its aftermath could well offer the most significant prospect for peace in the region.

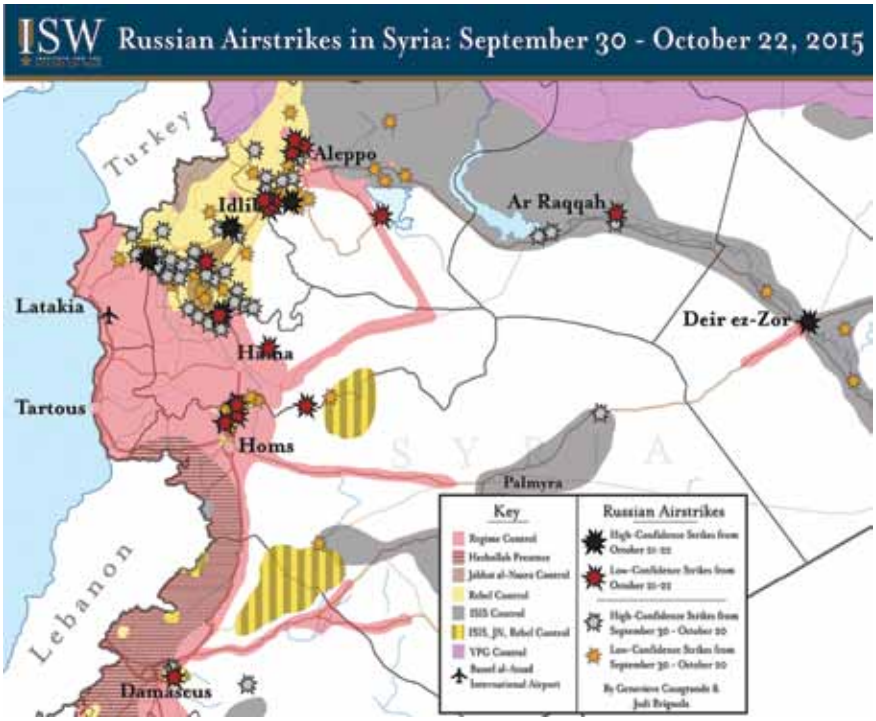
At tip of the Kremlin's designs for domination in Syria and the Middle East has been might of the resurgent Russian Air and Space Forces. The RuAF has effectively blocked any further direct foreign intervention in Syria and contributed significantly to Moscow's efforts to reassert its military might as a counterbalance to American power after years of post-Soviet decline. By utilising the RuAF's hard power, President Putin is gaining increased leverage over the US and its Arab allies in Syria, forcing them to accept Russia's presence, which will ultimately weaken efforts towards hastening

A Russian Su-34 fighter-bomber lands at Hmeymim after completion of a PGM delivery mission on 1 October 2015. The Su-34 is the most modern strike aircraft in the RuAF.

the exit of the Assad regime. While Moscow has predicated its intervention in Syria on supporting the Bashar al-Assad regime's fight against 'terrorism,' the expansion of its military muscle indicates that Russia's plan goes far beyond fighting Syrian rebels and the Islamic State. Moscow is sending a clear message to the US and NATO, that Russia is in control in Syria and the best bet for peace in the region. Moscow has since then recharged the stalled SyAA ground offensive by change in tactics of offensive air support, supply of advanced ground weaponry and induction of Russian SF operatives amongst the Syrian and Iranian ground elements, thus adding a meaningful push to its proxy war.

'The Syrian Express' : Russian Air Force deployment in Syria

The RuAF Aviation Group's deployment to Syria, called the 'Syrian Express,' started in July 2015, when Russian freighters loaded with infrastructure and material assets, as well as Russian Naval Infantry personnel of 810th Independent Coastal Brigade (from Sevastapol) arrived at the Tartus Naval base from their Black Sea bases. Hmeymim AFB in Latakia was prepared to house a Russian Expeditionary force, with huge construction work noted there. Airfield defences were established with Pantsir S1 (SA-22 'Greyhound') gun/ missile systems, BTR-82A APCs, T-90 tanks and rocket/ tube artillery systems. At the same time an airlink was established with Il-76 and An-124 aircraft, operating out of Chkalovsky, Mozdok and Krymsk AFBs in Russia. The Russians used the route over Caspian Sea, Iran and Iraq, since the US successfully convinced some European nations to not permit overflight authorisation. These aircraft deployed twelve Mi-24P 'Hind-F' and four Mi-8AMTsh 'Hip' helicopters (from the 562nd Army Aviation Base at Tolmachevo). On 18 September, four Su-30SM 'Flanker' fighters (from the 120th Mixed Aviation Regiment at Domna) landed at Hmeymim. The next day, ten Su-25SM and two Su-25UB 'Frogfoot' ground attack aircraft (from the 960th Attack Aviation Regiment at Primorsko - Akhtarsk) deployed at the Latakia, followed by twelve Su-24M/M2 'Fencer' strike aircraft (from the 6980th Guards Air base, Chelyabinsk-Shagol) on 20 September. On 26 September, six Su-34 'Fullback' strike fighters, hiding in the 'radar shadow' of



The first phase of the Russian bombing campaign concentrated on destruction of immediate threats near Latakia to safeguard Russian bases, as well as elimination of command and control infrastructure of rebels and the Islamic State all across Syria

accompanying Tu-154 and Il-76 aircraft touched down in Syria. The air corridor with Russia is maintained by numerous Il-76, An-124 and Tu-154s, flying over two main routes, one over Georgia and Armenia and the other over the Caspian Sea, before passing over Iran and Iraq into Syria.

Commencement of Russian air strikes

The first RuAF air strikes began on 30 September 2015, around the cities of Homs and Hama, targeting anti-Assad forces; as well near Raqqa, against the Islamic State. During the first phase of this bombing campaign, an average of 50 sorties were flown by day and night in October (with every sixth sortie flown at night), targeting command and control centres and other support infrastructure of the Syrian rebels and Islamic State. For hitting rebel targets, the RuAF used Su-24, Su-25 and Su-34 aircraft with free fall OFAB-250-270 high explosive/fragmentation bombs, Betab-500 concrete piercing munitions, RBK-500 cluster bombs, FAB-500M54/62 high explosive bombs, KAB-500S satellite guided bombs and Kh-25ML (AS-10 Karen) laser-guided missiles. The Su-25SM has a combat radius of 230 km, the Su-24M 560 km and the Su-34 has a radius of action of 1,100 km.

For limited close air support, the RuAF uses Mi-24P helicopters armed with 30mm cannon, 80mm rockets and free fall bombs. These are utilised in low-level missions in support of SyAA operations. The Russians used the Su-35SM as an aggressive patrol platform initially. It was during one such mission on 3 October, that a Su-35SM, armed with R-77 and R-73 AAMs, violated Turkish Airspace on an escort mission and locked onto two TuAF F-16Cs with its radar. Post this incident, Russia and Turkey worked on measures to reduce flight of armed fighters near the border north of Latakia and the RuAF stopped Su-30SM fighter escort missions on bombing runs. This had a significance outcome in the coming days.

In mid-October 2015, concurrently with the offensive in Hama and Idlib, SyAA and Iranian/ Hezbollah forces launched a large-scale offensive in the northern Latakia countryside. These attacks were meant to wrest strategic positions away from the rebels to safeguard the vital Russian bases of Tartus and Hmeymim against rebel offensives. By late October, these attacks had seized only 200 square kilometres of territory, far lesser than the initial objectives. The deficiencies of the Syrian Army's capability to wage war after five years of

attrition in combat manpower lay open. Moscow realised that a total victory was not possible for Assad and a diplomatic solution may well be an answer towards a permanent solution. But Assad had to be bolstered with modern weaponry. US military intelligence detected a shipment of T-90 tanks, 152-millimetre Msta-B guns, BM-27 Uragan and BM-30 Smerch rocket launchers to Syria, which were to be part of the SyAA's 4th Assault Corps. Moscow's decision to add artillery to the battlefield indicates a number of key developments, including the Kremlin's growing influence in planning and executing Syrian military operations. Clearly, Russia was taking over the conduct of ground war in Syria, which would have far reaching effects on the resolution of the conflict in the coming days.

Cruise Missiles over Syria

The world was astounded when on 7 October, twenty four ship-based 3M14T Kalibr-NK cruise missiles were launched from Russian Navy *Gepard*-class frigates and *Buyan*-class corvettes from the Caspian Sea. These missiles flew for 1,500 km, flying over Iraq and Iran, before impacting designated targets in Northern Syria. Though four of them were apparently lost over Iran, for Russia it marked the first use of such a weapon system and an apt capability demonstration of the type. As a result of the cruise missile strike, majority of civilian airline operators effectively started to avoid Syrian airspace.

Russian ISR assets in Syria

The effectiveness of the Russian campaign in Syria depends largely on effective intelligence feeds. Russian Intelligence, Surveillance and Reconnaissance (ISR) assets deployed in Syria, along with spy satellites in space, have been gradually boosted since the start of the air campaign. The Russian MOD has up to 10 intelligence gathering Persona-S (EO) and Liana-S (SIGINT) military satellites. In Syria, the RuAF's ISR platforms consist of an IL-20M (ELINT/SIGINT and EO surveillance) and an An-30 EO photography asset. For tactical recce and battle damage assessment (BDA), the Orlon-10 UAV is commonly used. It has an endurance of up to 10 hours, range of 120 km and an operational ceiling of 5,000m. It carries optical and thermal cameras. Other UAS include the Pchela-1T drone and the Granat-4 UAV. The hand launched Eleron-3SV UAV is used by Russian Spetsnaz personnel on the frontlines of Syria. It weighs 4.3 kg and has a flight endurance of 2 hours, with ceiling of 5,000 metres. All UAV operations are carried out from forward Syrian airfields in support of ground operations. Still images and video footage from ISR assets are downlinked to end military users and also relayed via satellite to the Russian MoD's National Defence Command Centre at Moscow. Here imagery is analysed and targets allocated. BDA assessment is also done here. These assets played a key role in pinpointing the downed Russian WSO after a Su-24 was shot down by the Turkish AF on 24 November.

Russian Navy Buyan-class corvettes launching Kalibr-NK cruise missiles in the Caspian Sea on 7 November. A Gepard-class frigate is seen in the foreground.

Need for a Peace Process

The Russian air strikes that had begun in Syria on 30 September 2015 had tipped the balance of power on the Syrian battlefield between government and opposition in President Assad's favor, thus upending the strategies of the US, opposition groups backed by the US, and European allies to drive Assad out of power. On 23 October, John Kerry of the US, Sergey Lavrov of Russia, Adel al-Jubeir of Saudi Arabia, and Feridun Sinirlioğlu of Turkey met in Vienna and agreed to hold a broader meeting on Syria on 30 October. Participating in the 30 October Vienna talks were: the US, UK, Russia,

Iran, Turkey, China, Egypt, Iraq, Saudi Arabia, UAE, Qatar, Oman, Lebanon, Jordan, France, Italy, Germany as well as the European Union and the United Nations. Iran took part in international Syrian peace negotiations for the first time; the move to invite Iran had been made by Russia and initially met resistance from the USA and Saudi Arabia. Russia and the US also remained at odds on the future political role of Syrian president Bashar al-Assad. The US maintained that Assad should have no role in Syria's future, while Russia maintained that Assad should not be forced out and that Syrian elections should decide who would rule Syria.

The Kremlin realises that an incisively negotiated peace process under the shadow of Russian Military deployment will help keep Bashar Al Assad in power

On 14 November 2015, against the backdrop of a series of terror attacks in Paris, France, multinational talks (including Iran) resumed in Vienna. The US critically softened its stand on Assad, as John Kerry suggested, "the Syrians would decide the fate of Assad."

Operation 'Reprisal'

On 31 October, a Russian Metrojet Airbus A321 airliner heading from Sharm el Sheikh to Saint Petersburg was blown out of the skies over the Sinai Peninsula in Egypt, killing all 224 people on board. It was quickly identified as a terrorist strike by the Islamic State in retaliation to the Russian bombing campaign in Syria. As soon as Moscow confirmed the role of IS in the bombing, it launched '*Operation Reprisal*.' The RuAF's Long Range Aviation (LRA) arm swung into action as part of this operation to launch Tu-160, Tu-95MS6 and Tu-22M3 long-range strategic bombers against targets in Syria. It brought a sharp intensification of airstrikes, for the first time involving heavy bombers operating out of their home bases. This marked the second phase of the Russian air campaign in Syria, wherein the Russian Military could undertake saturation/carpet-bombing strikes anywhere in Syria. The economic infrastructure of the Islamic State and Syrian Rebels and their supply routes were the major targets of this phase of Russian bombing.

On 17 November, twelve Tu-22M3 'Backfire' bombers staged from Mozdok AFB in South Russia to undertake a 2,200 km bombing mission to pound targets in Raqqa and Deir al Zawr areas in Syria. Each carried a bomb load of twelve OFAB-250-270 bombs. In addition, these aircraft carried 34 Kh-15 air-to-surface cruise missiles, which were launched from Iranian airspace. The Backfires were complemented by five Tu-95MS6 'Bear' and six Tu-160 'Blackjack' long-range bombers, which flew 9-hour missions over 6,500 km from their home base at Engels, to launch 83 Kh-555 and new Kh-101 ALCMs against Islamic State oil production targets. The Kh-555 is a derivative of the Kh-55 (AS-15 Kent) and has a range of 2,000 km with an 800 kg warhead. The Kh-101 is a newer ALCM, with low observable features and a range of 5,500 km with a 400 kg warhead. This missile employs terrain-contour matching (TERCOM) guidance, updated with INS/GPS and TV scene matching in the terminal phase. The heavy bomber effort was supported by increased air effort for the day from Hmeymim AFB and a total of 127 sorties were flown, striking 160 targets. The campaign remained intense over the next three days, with 126 sorties flown on 18 November, 126 on the 19th and 143 on the 20th. In a very long range mission demonstration on 20 November, a pair of Tu-160s took off from Olenegorsk in the Kola peninsula, flew over the Barents Sea and the Norwegian Seas, then flew parallel

Tu-160 launching a Kh-555 ALCM over the Mediterranean Sea on 20 November, escorted by a Su-30SM from the Russian Aviation Group. This Tu-160 was part of a two aircraft formation that carried out a 16-hour flight profile to prove new capabilities for the Russian Long Range Aviation fleet

During the second phase of its strike using the Syria-based Aviation Group and Russia-based long-range bombers, the Russians targeted economic centres and supply routes of the Islamic State and Syrian opposition in November 2015

to the Norway coast till the Atlantic Ocean, passing close to the UK before continuing southwards to enter the Mediterranean Sea. These aircraft launched 4 Kh-555s each off the Syrian coast and continued to complete the loop via Syria, Iraq, Iran and finally back to Engels AFB, completing a marathon sortie lasting 16 hours and covering more than 13,000 km.

The massed employment of long-range bombers between 17 and 20 November pursued three objectives for Moscow. The first was to showcase the vastly increased conventional strike potential of Russia's strategic bombers. The second was the propaganda effect demonstrating Putin's pledge to punish ISIS, which was responsible for the downing of the Metrojet. Moscow bellowed that it was the first player to target the IS economic infrastructure, which was seen positively by the European Union, especially in wake of the Paris attacks. The third objective was for the LRA fleet's ability to test and ratify its conventional strike and ALCM launch capability. In all, the RuAF bombers achieved all stated objectives and were seen as a valuable tool for projecting Russia's power globally.

Shootdown of the Russian AF Su-24M

On that fateful 24 November 2015, a Russian Air Force (RuAF) Su-24M 'Fencer' (bort number 'White 83'), piloted by Lt Col Oleg Peshkov and his WSO Capt Konstantin Murakhtin, was operating out of Hmeymim AFB in Latakia. It was armed with four OFAB 250-270 free fall fragmentation bombs and was carrying out bombing runs as part of a two-ship formation on the Kepir-Motlu-Zahiya axis over Syrian Turkmen rebel targets from an altitude of 6,000 metres. At 0920 h, during one of its attack runs, it inadvertently entered Turkish airspace in the Hatay Yalyladogi district of Hatay province. This violation was duly noticed by a flight of Turkish Air Force (TuAF) F-16C Block 40 Vipers. These 181/ 182 Filo F-16s of 8 AJU (8th Brigade) were on a combat air patrol (CAP) inside Turkey and had been tracking the Su-24s on their APG-68 pulse doppler radars for some time. The Vipers, airborne from Diyarbakir AFB in Turkey, had clear instructions to shoot down any marauding aviation asset violating Turkish Airspace from the Syrian side. The Fencers were ostensibly warned at least ten times on the international Guard frequencies (121.5 and 243 Mhz) to turn back. Since the start of the Russian air campaign in Syria on 30 September 2015, there had been border violations by the RuAF, apparently due to the proximity of the Syrian rebel targets and their supply lines close to the Turkish border. The RuAF had violated Turkish airspace in the same region on 3 and 4 October, with at least one RuAF Su-30SM having locked onto TuAF F-16C/Ds with its 'relatively unknown' Bars-R phased array radar for well over 5 minutes. The Russians later apologised for this violation and blamed it on bad weather and a navigational error. These infringements, along with the an effective RuAF bombing campaign against Turkish interests in Northern Syria, made the Turks up the ante with an aggressive multi-layered CAP profile along the 1,200 km border. As the Russians settled into a routine with their daily bombing 'milk runs,' they soon found out that the Turks were in no mood to give them any quarter.

At 0924hrs, the F-16s noticed one of the Su-24s entering Turkish airspace again, seemingly paying no heed to their warnings. The 'unidentified' jet was fast entering the doppler slot on the F-16 mission lead's radar, near the 12 o'clock position. The F-16 fired his most effective weapon under the circumstances. 17 seconds was the amount of time it took for the AIM-9X Block II Sidewinder AAM mounted on the TuAF F-16C Viper to cue and lock on to the Russian jet with its mid-wave IR FPA seeker, fire its Mk 36 rocket motor propelling it to Mach 4+ towards the target and at the optimal range, duly activate its laser proximity fuse, which promptly exploded the 9.36 kg annular blast fragmentation warhead in its preset spread. The Su-24M, which had penetrated up to a distance of approximately one mile into Turkey, was back over Syrian territory when the Sidewinder missile fatally struck its tail, causing the aircraft to catch fire and go out of control. Peshkov and Murakhin ejected safely from the stricken jet in their Zvezda K-36D seats. Local reports indicate that the aircraft crashed 4 km inside Syrian territory, in rebel held mountainous territory near the town of Babyirbucak. This incident gained further notoriety when the rebels of the 'Grey Wolves' militia shot Oleg Peshkov dead as he was descending by parachute. The rebels later released a video that purportedly showed the body of the pilot. The downed WSO meanwhile landed safely in no man's land and set a course on foot toward Syrian Army positions.

Within 15 minutes of the shootdown, the Russians launched a Combat Search and Rescue (CSAR) mission comprising two Mi-8ATMsh helicopters carrying Russian Naval Infantry operatives. They were aided by real time imagery from Russian Persona spy satellites and Orlon 10 drones as they

penetrated six kilometres behind enemy lines to zero in onto Murakhtin's Personnel Locator Beacon (PLB). Two Mi-24P escort gunships gave top cover for the mission. While the WSO was being picked up by the detached team from the Mi-8 (bort number Yellow 252), this helicopter was engaged with heavy gunfire by Jabahat an Nusra rebels, killing Private Alexander Posynitsch, a Russian Naval Infantryman guarding the helicopter. A rebel BGM-71A TOW ATGM subsequently destroyed Mi-8. The marooned rescue team with the WSO, battling heavy opposition from the rebels, linked up with members of Syrian 35 SFR and Hezbollah SAG operatives, who had brazenly penetrated rebel lines on the ground to link up with the Russians in an operation supposedly masterminded by Iranian General Qasem Soleimani, Commander of the Quds Force. The Russians were subsequently picked up by another helicopter, after escorting Mi-24s had saturated rebel positions with 80 mm rockets and 30 mm cannon fire. Thus ended the action packed day for the Russians, with some succor salvaged from the successful CSAR operation behind enemy lines.

Why the Russian Su-24M was unescorted and did not pay heed to the TuAF's warning calls, why it didn't receive any threat warning on the onboard SPO 15LM Radar Warning Receiver (RWR), is anybody's guess. The possibility that the Turks mistook the RuAF Su-24 for a Syrian Arab Air Force (SyAAF) type in absence of any communication response is very real. However, it is almost inevitable that in a geographically small, complex and multi-layered conflict, once aircraft from different nations starting flying combat missions in close proximity, problems will abound.

The Russian military escalation

One day after the Su-24 shootdown on 24 November, Lt Col Oleg Peshkov was posthumously declared 'Hero of the Russian Federation,' while Capt Muratkin and Private Posynitsch were awarded the 'Order of Courage.' While restraining itself from a military response aimed at Turkey, Moscow decided to escalate its military involvement in Syria with induction of strategic system and newer battlefield tactics.

Moscow deployed the most potent SAM system in its arsenal, the S-400 Triumf (SA-21 'Growler') to Syria. This was deployed at Hmeymim AFB by 26 November. With an engagement range up to 400 km, the S-400 can cover airspace over most of Syria as well as parts of Turkey, Israel and Jordan, and has helped enforced a virtual 'no fly zone' for NATO and other Western aircraft over the theatre. The S-400 is supported by the S-300F Fort (SA-N-6 'Grumble') LRSAM on the Russian Navy's *Slava*-class cruiser *Moskva*, deployed off the Syrian coast in the Mediterranean Sea. In addition, all strike sorties began operating with Su-30SM fighter escorts. On the ground, Russia pumped in potent equipment including the T-90 Tagil tank, 2S3 Akatsiya 152mm self propelled howitzers and the deadly TOS-1A Solnitsata rocket launcher. The state of the art Russian ground combat assets that poured into the Syrian cauldron surprised frequent decriers of Russia's 'tinpot' military. Russian aircraft dropped smart bombs on Syrian rebels, while its cruise missiles and heavy bombers blasted rebel targets from hundreds of miles away. How could this be? Whatever happened to the "degraded" Russian military, non-performers, who had embarrassed themselves in Chechnya and Georgia? Clearly the West had missed a generation leap in the war-making infrastructure of Moscow.

After the Su-24M shootdown, Moscow deployed the potent S-400 'Triumf' SAM system to Latakia, and the Slava-class cruiser Moskva, equipped with S-300F 'Fort' LRSAM to the Mediterranean Sea, providing an unassailable multi-tier air defence capability for its expeditionary force in Syria

Change in RuAF tactics

The RuAF started dedicated Close Air Support (CAS) Missions from December onwards. This crucial change in tactics came in tandem with the availability of the SyAA's 4th Assault Corps, including the elite 4th Armoured Division, which was ready for combat after induction of fresh troops and Russian equipment. It was embedded with Russian Spetsnaz and Iranian Revolutionary Guard Corps (IRGC) operatives, who would be key in ensuring the firepower and tactics available to the SyAA soldiers would be used in an efficient manner. Gains made in Latakia, as well as insulating Damascus in the south from the rebels in November, ensured that the SyAA was ready to assault the formidable rebel bastion of Allepo in the North.

In the first week of December, the 4th Assault Corps besieged the outskirts of Allepo in a planned manner and made gains with the support of RuAF strike aircraft. Between 5 and 8 December, Tu-22M3 heavy bombers carried out carpet-bombing missions in the outskirts of Allepo, Deir ez Zor and Raqqa. On 8 December, four Kalibr-PL cruise missiles were fired at Deir ez Zor from a submerged Kilo-class submarine (Pr.636 boat *Rostov-on-Don*) in the Mediterranean Sea, validating another cruise missile delivery mode. The number of Su-34 aircraft was doubled to 8 on 6 December. A few days later, the Mi-24P complement was bolstered by arrival of at least two more Mi-35Ms. More Su-24s also deployed to Syria. The total RuAF Aviation

Group strength in Latakia, Syria grew to between 50-60 aircraft, with an average of 60 missions being flown per day in support of the Syrian Army. By 25 December, the Russian air force had conducted 5,240 sorties in Syria, including 145 sorties by LRA assets. Additionally, Russia employed dozens of Kalibr and the Kh-series cruise missiles.

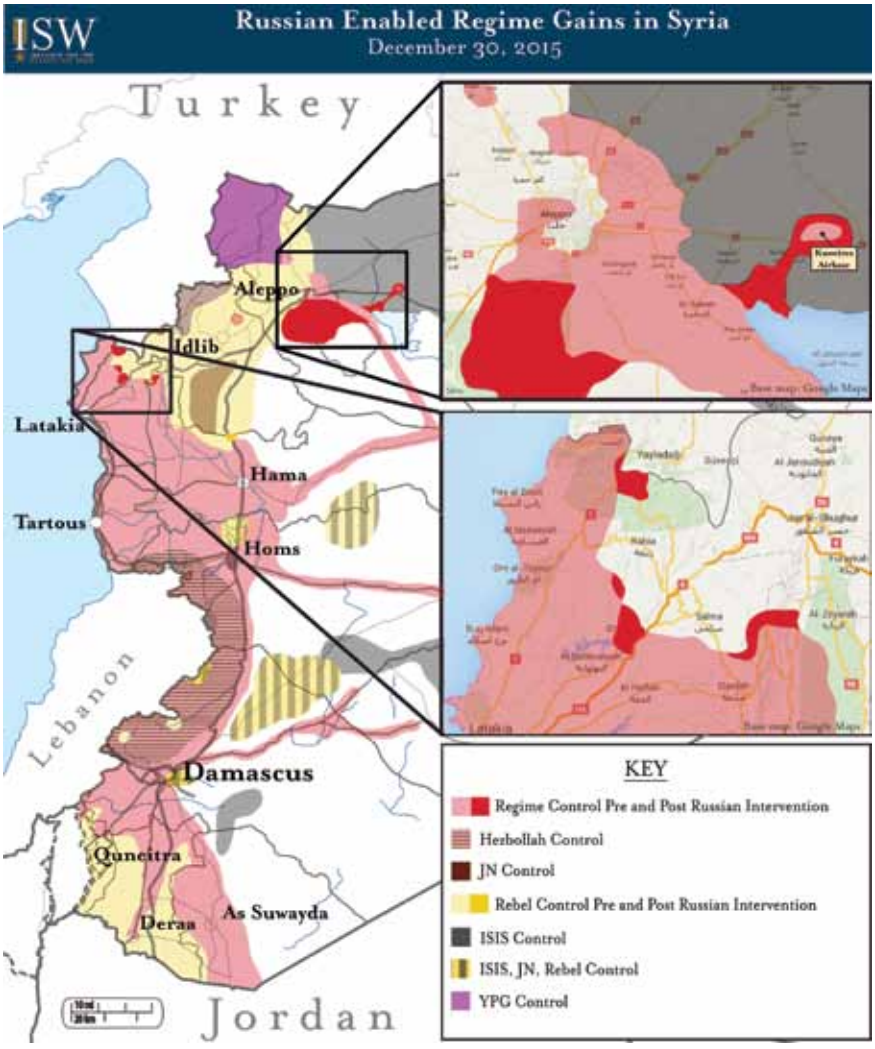
On 20 December, the Army captured the strategic town of Khan Tuman, along the Aleppo-Damascus Highway, cutting the primary rebel supply route from the provincial capital of the Idlib province, toward the provincial capital of the Aleppo province. The overall effectiveness of Russian advisors, IRG troops on the ground, as well as the close Russian air support has been noted as part of the main array of factors leading to a revitalised advance by government forces. Noteworthy was the first-time use of the T-90 tank by the 4th Armoured Division. These tanks performed well against a host of rebel ATGMs including the TOW II system, their Shtora Active Protection System (APS) and Kontakt-5 Explosive Reactive Armour (ERA) performing well against US-supplied missiles. The Russians may also have deployed their own T-90 tanks, to validate their more advanced Arena APS.

On 18 December 2015, the UN Security Council unanimously passed a resolution endorsing the International Syria Support Group's (ISSG) transitional plan of 30 October and 14 November, approving the principles of the Vienna process resolution. It acknowledged the role of the ISSG as the central platform to facilitate the United Nations' efforts to achieve a lasting political solution in Syria. While the major powers remained divided on who should represent the Syrian opposition; no mention was made of the future role of Syrian President Bashar Assad. The changing dynamics of the Syrian war were apparent and Moscow had played a lead role in getting this concession.

Dawn of the New Year

On New Year's Day 2016, heavy fighting was reported as Syrian government forces backed by Russian air strikes advanced into the southern city of Al-Shaykh Maskin, which had been held by the rebel since 2014. The Syrian government's offensive that had started on 28 December 2015

In Phase 3 of its bombing campaign from December 2015, the Russians deployed maximum resources for Close Air Support (CAS) missions in support of the Syrian Arab Army. Shown here are a pair of Su-25s firing unguided rockets



and completed by the end of January 2016, was said to be the government's first major assault in southern Syria since Russia joined the fight. Shaykh Maskin fell on 25 January, allowing government forces to strengthen their hold on Deraa province, while cutting off rebel factions from key supply lines from Jordan. With gains made in the south, the SyAA proceeded further with its Aleppo operation in the North.

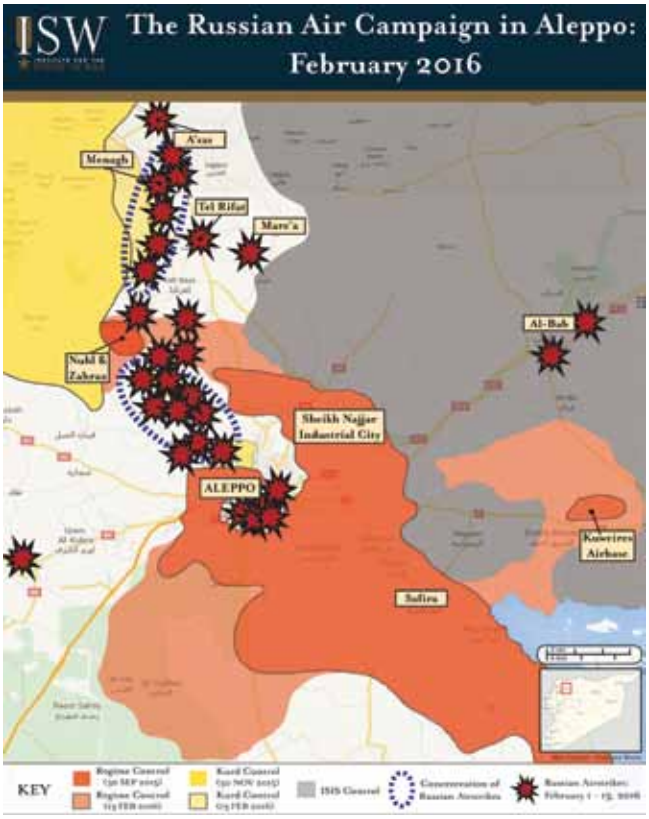
The Tu-214R is the most advanced ISR platform in service with the Russian Federation. It has been recently deployed to Syria, in all probability to validate its systems against the best of NATO and Israeli sensors in Middle East

Besides the frenzied CAS campaign, the New Year was characterised by deployment of modern Electronic Warfare (EW) assets by Russia. The Krasukha-4 system was deployed around the Aviation Group's base. This broad-band multifunctional jamming system is designed to neutralise Low-Earth Orbit (LEO) spy satellites such as the US Lacrosse/Onyx series, airborne surveillance radars and radar-guided ordinance at ranges between 150km to 300km. The Krasukha-4 system works by creating powerful jamming emissions on operating radar frequencies and other radio-emitting sources. This would help mask the Russian electronic emissions to some extent from the plethora of NATO and Israeli airborne/ ground EW platforms. Russian Kamov Ka-52 'Hokum-B' attack helicopters were deployed to Hmeymim airbase for CSAR and protection duties in mid-January. Interestingly, the first Ka-52 deployment was also an opportunity for the Russians to test its KRET Vitebsk Electronic Warfare Suite. The Vitebsk EW suite is designed for protection of aircraft and helicopters from anti-aircraft missiles and has also been seen on a Mi-8 operating at Hmeymim.

In end-January 2016, Russia also deployed four Su-35S fighters, presumably equipped with *Khibiny* electronic countermeasures (ECM) systems, to its Latakia base, marking the type's first combat deployment. By 1 February, the aircraft had begun conducting missions in Syria. On 15 February it was reported that the Kremlin had deployed its most advanced ISR platform, the Tu-214R, to Syria. Though still under development, this gives Russia a great opportunity to test the various systems on the aircraft. Also deployed to Syria in early 2016 were a number of Forpost UAVs (Israeli IAI Searcher IIs), providing a significant boost to tactical ISR for Russian and allied forces.

Analysis of Russian Aviation Group tactics

While the Russian Aviation Group deployed to Syria is highly diverse and adaptable to assorted missions, it is not larger than a complement of aircraft on the decks of a single US aircraft carrier. So what gives the Russian doctrine the edge over Western forces in Syria? In a nutshell, it is tight and precise coordination between the air strikes and operations of non-Russian ground forces under a single (Russian) command centre. Russian strategists reject the Western practice of training local ground forces as a waste of time and money. They have opted to more realistically adjust their aerial tactics to suit SyAA, Hezbollah and Iranian ground forces. Another salient point is *focus*; RuAF air strikes are carefully calibrated and designed to systematically destroy the rebel military chain of



Russian airstrikes in February targeted rebel supply routes north of Aleppo to isolate them from their Turkish and Saudi Arabian benefactors

command and infrastructure, whereas US led coalition airstrikes against the Islamic State are much sparser and hardly make a meaningful dent on the IS ability to wage war.

The Russian campaign's first phase concentrated on rebel command and control locations and support infrastructure. Then they knocked out economic assets and supply routes as part of the second phase. The lack of dedicated MANPADs support with the rebels has certainly helped, although the RuAF follows strict anti-SAM protocols. Starting in December, the RuAF changed tactics and stepped up local air strike support, which is reaping benefits for the ground forces in a big way, much to the chagrin of the Western observers.

UN-mediated Peace Talks

In early February 2016, intensive Russian strikes contributed to the success of the SyAA's offensive operation to the northwest of Aleppo, which severed a major rebel supply line to Turkey. On 1 February, the United Nations announced the formal start of UN-mediated peace talks for Syria in Geneva. The Syrian opposition was facing its greatest challenge to date on both the political and the military level. The timing of the Aleppo offensive, in parallel with the UN's Geneva peace talks, was no coincidence, as Aleppo is the major stronghold of the 'moderate' Syrian opposition. The opposition made a number of demands for joining the talks with the regime, such as lifting the siege on blockaded cities and stopping the use of heavy weapons and missiles, to which the Russian Foreign Minister responded by asserting that Russia would not halt its airstrikes in Syria until "armed groups are defeated." These events led the UN's special envoy for Syria, Staffan de Mistura, to announce on 3 February

the suspension of the Geneva peace talks. His announcement came on the same day the regime forces were able to split the northern countryside from the city of Aleppo and cut the rebels' supply lines to Turkey. The Russian strategy was to isolate Aleppo, the hub of 'moderate rebel' power, and then go back to the negotiating table, allowing Moscow to present itself as a vanguard against the Islamic State in the eastern desert, and Jabhat al Nusra in Idlib.

On 22 February in Munich, world powers agreed to seek a nationwide cessation of hostilities in Syria. The ceasefire would not apply to the battle against the Islamic State (IS), Al-Nusra Front, or any other terrorist organisations as designated by the UN. The 17-member International Syria Support Group (ISSG) also agreed to accelerate and expand aid deliveries, clearly hoping that this truce will be a stepping-stone to a broader ceasefire. ISSG reiterates its aim of an agreement on political transition – to include elections and a new constitution – within six months. Following the ISSG pronouncement, Russia also announced the establishment of a coordination centre to reconcile the warring parties in Syria at its Khmeimim airbase in Latakia Governorate, on 23 February.

Through deft diplomacy, Russia gave up little and gained a lot – regardless of whether Moscow bets on a military solution or a diplomatic one, it will pocket most of the gains of the ceasefire agreement. As pressure in Syria's north eases and regime control spreads, the incentives to push out Assad and reform the regime will shrink. Truce and talks should ideally have come as a package. Instead the vision for a military solution to defeat the radicals is remains firmly the cards.

Changing Tack

On 15 March 2016, President Vladimir Putin surprised the world by abruptly declaring that Russia would withdraw the bulk of its considerable Air Force inventory task force from Syria, ostensibly owing to the fact that the partial ceasefire between regime forces and moderate opposition groups seemed to be holding. Over the next few days, dozens of Su-25s, Su-24s, and Su-34s were seen flying out of Latakia and returning to heroes' welcomes in Russia.

However, while a large part of fixed wing combat aviation assets have indeed been rotated back home, this is far from a true drawdown, as large amounts of equipment and personnel were transported into Syria as the fighters were leaving. The force mix and capabilities which Russia is now deploying to support President Bashar al-Assad's war effort has not in fact decreased, but has merely changed. The combat-proven Mi-35 Hind helicopter gunship detachment has been significantly enlarged, and has been joined by more modern Mi-28 (NATO reporting name 'Havoc') and Ka-52 (NATO reporting name 'Hokum') for the first time. In addition, the air-superiority-focused Su-30 and Su-35S fighters remain in-theatre.

Symbolic of the change in tack, Russian Mi-28 and Ka-52 attack helicopters make their debut in Syria

The implication of this change in force structure is clear : now that the Assad-opposition ceasefire is in place, Russia has shifted focus back to the Islamic State. The recent recapture of Palmyra from IS forces was a noteworthy achievement for the Syrian Army and their Russian air and technical support. In the mobile warfare around Palmyra, low-flying helicopter gunships are more effective and relevant than they were during siege operations against opposition-held cities. Still, these new Russian assets face increased risk. More Russian aircrew might be lost, since even modern helicopters are vulnerable to shoulder-fired man-portable air defence systems (MANPADS) including Chinese HN-5 and FN-6 systems, used by various factions in Syria. As if to underscore this, a Mi-28 crashed near the city of Homs on 12 April, reportedly due to Controlled Flight Into Terrain (CFIT). Although the Russians are reasonably well trained in attack helicopter operations and operate under anti-SAM protocols, their relative inexperience in combat increases the risk of accidents.

While the Mi-28, roughly analogous to the American AH-64 Apache, is well suited for close air support and indeed has been proven in this role during anti-IS operations in Iraq, it is the unconventional Kamov Ka-52 – which is making its combat debut with this Syrian deployment – that is the more noteworthy of the two. First, and most obvious, the Ka-52 joins a host of other Russian platforms ranging from air superiority fighters, cruise missiles, and battle tank model that are being deployed in Syria as an opportunity to showcase them to potential export customers.

Secondly, and more revealing about Russia's strategy for the on going conflict in Syria, the presence of the Ka-52 indicates a larger and more robust Special Forces presence on the ground in Syria. While the Mi-28 is the Russian Army's standard attack helicopter, the Ka-52 is specifically assigned to Russian Special Forces as their organic air support, which points to the fact that Russian Special Forces operations in Syria are expanding and becoming increasingly more kinetic.

Meanwhile, the situation on the ground remains highly volatile. Even with a partial ceasefire in place, Aleppo remains a major battleground and the IS and al-Nusra threats cannot be downplayed. With Moscow doubling down on its alliance with Assad and Syrian government forces, no meaningful progress will be made in the region unless it is directly in Russia's interests.

Sameer Joshi

The author is a former IAF fighter pilot with over 4,000 flying hours on both civil and military aircraft, as well as combat experience in the 1999 Kargil Conflict. He is a keen student of military history and aerospace technology. He recently authored a book, 'Air Warrior Tales of the 1965 War,' which was released by the IAF in September 2015.

(Graphics on pages 96, 101 and 102 Courtesy 'Institute for the Study of War' ISW)

AAF Mi-17 at the battle front

The Afghan Air Force Today

According to a report submitted to US Congress, current status of the Afghan Air Force (AAF) includes 161 fully trained pilots, not counting those who are in training to transition to another aircraft type. The latter includes the first batch of nine pilots converting to the A-29 Super Tucano at Moody AFB, Georgia.

The AAF has 91 aircraft, comprising a fixed-wing complement of four C-130H Hercules and 24 Cessna 208B Grand Caravans, while rotary-wing assets are 49 Mi-17s, one Mi-35 (with four more given by the Indian Government), ten MD530F Cayuse Warriors and three HAL Cheetals. Additionally, the AAF uses six Cessna T182T Turbo Skylanes. Scheduled acquisitions still to be delivered comprise two more Cessna 208Bs, 20 A-29B Super Tucanos, seven Mi-17s and 18 MD530Fs.

To date, 12 of the AAF A-29s have been delivered to Moody AFB for training Afghan pilots and maintenance personnel. With the first pilots now qualified on the type, the first four aircraft were scheduled to be delivered to Afghanistan in January 2016, complementing the Mi-35 in the air support role. The remaining A-29s from the order for 20 will be delivered to Moody by May 2016, before being delivered to Afghanistan when further pilots and maintenance personnel graduate. Eight A-29s are expected in country by the 2016 fighting season, increasing to 12 by the 2017 campaign season. Full operational capability with 20 airframes, 30 pilots and 90 maintenance personnel is expected to be achieved by the end of 2018.

The Cessna 208Bs are largely used in the light cargo and personnel transport, casualty evacuation and human remains recovery roles. The type is also being employed in a basic ISR role, but this is only in the early stages of development. The US *Train, Advise and Assist Command-*

A-29 (Embraer Super Tucano) of the AAF

Mi-17s of the AAF

Armed MD530F of the AAF

Air (TAAC-Air) is working to expand the aircraft's employment envelope to develop a soft field landing capability. This will enable it to take over some Mi-17 operations, freeing up the latter for other missions.

The Mi-17 remains the workhorse of the AAF, but is unable to meet all of the ground forces demands, primarily because of lack of availability due to maintenance down time and challenges in training maintenance personnel. Currently, 14 of the type are configured with a fixed forward-firing capability and seven of those can also fire rockets. To alleviate strain on the fleet, in September 2015 coalition advisors awarded a contract for rotary-wing airlift to provide cargo, personnel and human remains movement for the Afghan National Defence and Security Forces.

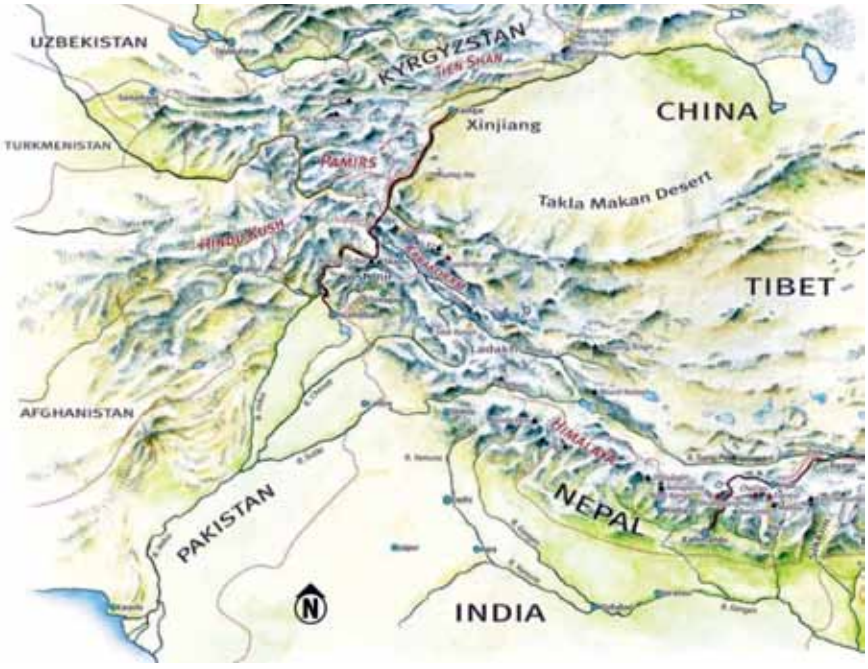
Following a second round of deliveries in June 2015, the AAF now has ten armed MD530Fs operating from Kabul, each with a fixed forward firing capability, comprising FN Herstal M3P. 50 calibre machine guns, installed in the company's Heavy Machine Gun Pod. Six more weaponised MD530Fs are due for delivery in early 2016 and the US has approved a requirement for a further 12, which will be delivered later in 2016.

The Special Mission Wing (SMW) is separate from the Air Force and its aircraft are not included in the above total. Its assets comprise 29 of 30 authorised Mi-17-V5s and 17 of 18 authorised Pilatus PC-12/47Es. The Wing is dedicated to providing expeditionary reach for the Afghan Special Security Forces (ASSF) for its counter-terrorism and counter-narcotics missions. The SMW supports ASSF helicopter assault force raids and provides overwatch, ISR, resupply and casualty evacuation for ASSF operations. It currently has three fully operational units: 1 and 2 Squadrons are based at Kabul, while 3 Squadron is at Kandahar.

There are several women pilots with the AAF including Lt Niloofar Rahmani (above)

Hinds of the Hindu Kush

The Mi-25/35 in Afghanistan



The Pamir knot, pivot of the mighty mountains of South and Central Asia

In late December 2015, India delivered the first of four Mi-25 attack helicopters to Afghanistan, marking the first time New Delhi has transferred explicitly offensive weaponry to Kabul. This, however, is not the first time these formidable machines—known in the West by the deceptively gentle NATO codename 'Hind' (a female deer)—are entering action in the Hindu Kush. The Hind in its various variants has been active in Afghanistan for well over three decades, starting in the late 1970s when the USSR supplied early model Mi-24As to the Government of the Democratic Republic of Afghanistan, which had been established in 1978 after President Mohammad Daoud Khan of the short-lived Republic of Afghanistan was ousted from power by the communist People's Democratic Party of Afghanistan (PDPA). The Soviet-backed PDPA received Mi-24As in April 1979, to deal with anti-communist Mujahideen guerrillas. Afghan pilots were

Mi-35s over Afghanistan

reportedly well-trained and effective, but the Mujahideen were equally competent and claimed their first Mi-24 in July 1979.

With the PDPA's hold on the country loosened and the situation in Afghanistan growing worse through the year, the USSR intervened on 25 December 1979, formally committing troops to the war and starting what would be known as the Soviet-Afghan War.

The Mi-24 was operated extensively during the decade-long War, primarily to strike at Mujahideen fighters. There was little to no armour available to the guerrillas so the gunships used cannon and rockets to devastating effect against relatively 'soft' targets. The rebels called the Hind *Shaitan-Arba* (Satan's Chariot), while the Soviet troops held it in great esteem because it could loiter over the battlefield and provide fire as needed, while strike jets of the era had much more limited endurance.

The favoured munition during the Soviet-Afghan War was the 80-millimetre S-8 rocket, since the 57 mm S-5 had proven too light to be effective against dug-in targets. Extra rounds of rocket ammunition were often carried internally so that the crew could land and self-reload in the field. The 23 mm gun pod, heavier than the nose-mounted YakB 12.7 mm Gatling gun, was also popular for its increased hitting power at longer ranges. In addition, the Mi-24 could carry ten 100 kg iron bombs for attacks on camps or strongpoints, while harder targets could be dealt with a load of four 250 kg or two 500 kg iron bombs.

That Soviet combat experience in the War continues to influence Mi-24 operations today, both in Afghanistan and elsewhere. The Hind's troop-carrying

An IAF Mi-35 with underwing stores clearly defined (photo: Angad Singh)

Afghan Air Force Mi-35 over a fertile patch of agricultural land in Afghanistan

capacity was swiftly disregarded, as operations in the thin air of the Hindu Kush severely restricted payload. In fact, the troop compartment armour was often removed entirely to free up payload capacity for fuel and munitions. However, Soviet Hinds did carry a technician in the crew compartment to handle a light machine gun in a window port, effectively acting as an extra line of defence when the pilot and WSO were occupied with their primary target.

Besides escorting helicopter-borne assault packages and providing tactical fire support to ground operations, Mi-24s also protected convoys, performed strikes on pre-designated targets, and engaged in 'hunter-killer' sweeps. In the latter role, the Hinds operated at a minimum in pairs, but were often in groups of four or eight. When the Mujahideen began to restrict their movement mostly to night-time so as to avoid the gunships, the Soviets responded by training their crews for night-fighting, which they grew quite adept at.

Upgraded Mi-24s of the Polish Army's Independent Air Assault Group at Bagram Airfield

The Hind was, particularly in the first few years of the War, nearly invulnerable in the air. The primary air-defence weapons available to the Mujahideen early in the war were heavy machine guns and anti-aircraft cannon, but anything smaller than a 23 mm shell did not do much damage to a Mi-24. The cockpit glass panels were resistant to 12.7 mm (.50 calibre) rounds, and the helicopter as a whole was quite resilient to battle damage.

The rebels also used a variety of Soviet-made shoulder-launched, heat-seeking missiles (MANPADS) and American Redeye shoulder-launched SAMs, which had either been captured from the Soviets or their Afghan allies or were supplied from Western sources. The combination of the limited capabilities and poor condition of these early types of missiles, along with poor training, meant that they were not very effective. The RPG-7, originally developed as a basic antitank rocket, eventually emerged as a reasonably effective weapon to counter the Hind, but the Mujahideen did not pose a truly serious threat to the Mi-24 until US-supplied FIM-92 Stinger missiles reached Afghanistan in 1986.

The heat-seeing Stinger locked on to exhaust emissions and was resistant to flares, making it overwhelmingly effective against the Hind, particularly in the period immediately following the introduction of there missiles to the theatre. The Soviets were forced to introduce heat dissipaters to decrease the Mi-24's exhaust signature, and had to quickly modify their tactics to counter the Stinger. From relatively unencumbered flight at any altitude, Hind crews changed to 'nap of the earth' low-level flying, popping up only in order to aim and engage targets with rockets or cannon.

In addition to the Mujahideen, the dusty and often hot environment was rough on helicopters and also took its toll. The harsh conditions necessitated development of the now-distinctive hemispherical PZU intake filters that are a common sight on nearly all Mi-24 variants (and indeed many other Mil helicopters) in the present day.

Not all Hind stories ended simply, however, and a number of Mi-24s (along with other aircraft, both fixed- and rotary-winged) found their way to Pakistan during the War, mostly under control of disillusioned Afghan crews, unhappy at having to fight their own countrymen. At least three confirmed incidents of Hind defections are recorded. On 13 July 1985, two Mi-24Ds landed in Miranshah, with the pilots and crewmen immediately requesting asylum. Then in 1989, a few months after the end of the Soviet-Afghan war, a single Mi-24D crossed over once more, this time landing at Qila Abdullah, in Baluchistan. In another incident, a pair of Soviet-crewed gunships found themselves in Pakistan as the result of a navigation error. In each instance, the gunships were appropriated by Pakistani authorities, some later being operated by the Pakistan Army and others passed on to interested third parties, such as China, the USA, and other Western powers. Pakistan's unique history with the Hind, and indeed some operational familiarity with the type, will no doubt have contributed to an August 2015 agreement with Pakistan procuring four Mi-35s, modern evolution of the venerable 1970s gunship from Russia.

After the Soviet withdrawal in February 1989, Mi-24s remained in operation with the Soviet-backed forces in Afghanistan. Meanwhile, Afghan Mi-24s in the hands of the Taliban gradually became inoperable owing to lack of spares, support and skilled maintenance manpower. From the mid-1990s through to the US-led invasion of Afghanistan in 2001, the only operational Hinds in Afghanistan belonged to the embattled Northern Alliance, which had Russian support and access to spares. Paradoxically, the Northern Alliance was led by the charismatic Ahmad Shah Massoud, nicknamed 'The Lion of Panjshir' for his prowess as a Mujahideen commander who had been particularly effective against Soviet forces during the War.

After the events of 11 September 2001, a hastily assembled coalition of nations led by the USA invaded Afghanistan with a view to ousting the Taliban and establishing a democratic government in Kabul. For a few brief years, the distinctive sound of the Hind's rotors ceased to be heard over the Hindu Kush, until two parallel events restored the enduring link between Afghanistan and the Hind. In 2008 the Czech Republic donated six refurbished Mi-35s to the fledgling Afghan National Army Air Corps (ANAAC), and in August that same year, the Polish Army deployed their Mi-24s to Bagram as part of ISAF operations in the country.

Poland's Mi-24 fleet was in Afghanistan between 2008 and 2013, completing eleven rotations and providing invaluable combat experience to the Polish Army Aviation

Mi-24 of the Afghan Air Force

crews. Pending a modern replacement, the Hind remains Poland's most capable combat helicopter, although the fleet of ageing helicopters has only basic targeting equipment and limited compatibility with precision guided munitions. The Polish Army was forced to (re)learn many of the harsh lessons that Soviet forces did in 1979, as they struggled to deal with the prevailing hot-and-high conditions and mountainous terrain.

Less than six months after arriving in-country, the Polish Independent Air Assault Group (IAAG) moved from Bagram to Forward Operating Base (FOB) Ghazni, where they would remain for the remaining four years of their time in Afghanistan. From Bagram's relatively manageable 4,895 ft (1,492 m) elevation, the Hinds were forced to operate at Ghazni's elevation of 7,216 ft (2,200 m) above sea level. The helicopters were limited only to rolling take-offs and landings from the tiny 1,328 ft (405 m) runway at the FOB. The Polish crews developed a special technique to ensure safety : accelerating down the runway on the nosewheel, maintaining a 10-12° nose-down attitude for the entire run. The increased speed allows the main rotor and short stub-wings to generate additional lift, enabling the struggling gunship to get airborne at a speed of 54 to 81 kts (100 to 150km/h) at the runway end. On particularly hot days, the Hinds had to take off with reduced fuel loads to ensure safety, but limiting their endurance. The Polish Mi-24s were flown without exhaust mixers, carried around half their maximum payload, and had the wingtip ATGM launchers removed, all in order to handle the punishing Afghan conditions.

Like the Soviets, the IAAG Mi-24s used a mix of 12.7 mm YakB machinegun, 23 mm gun pods and rockets. Unlike the Soviets, however, the Poles were limited to 57 mm S-5 rockets, and ran into the same limitations that had forced the Soviets to switch to the heavier 80 mm S-8 rockets thirty years earlier. The light 1950s-vintage rockets were simply unable make an impact on anything other than soft targets, and in many cases Polish Hind crews were forced to hand over fire support tasks to Polish Rosomak armoured vehicles equipped with the 30mm Bushmaster II cannon.

Meanwhile, the ANAAC slowly worked up its own attack helicopter capability with their handful of Hinds, and began live firing exercises in May 2009 in order to escort Mi-17 transport helicopters on operations in restive parts of the country. In 2010, the ANAAC was formally re-designated as the Afghan Air Force (AAF) by then-President Hamid Karzai, although the roles and responsibilities of the new entity remained largely unchanged. Security assistance from the USA saw the AAF begin to receive MD Helicopters MD 530F Cayuse Warrior light attack helicopters from December 2011 onward, with some 18 or so delivered to date. However, in September 2015, senior AAF officers questioned the suitability of these aircraft, noting their limited combat capability, and issues with endurance as well as performance in the demanding hot-and-high conditions of the Hindu Kush.

Seen inside the enormous hold of an IAF C-17, the first of four Mi-35s being transported from India to Afghanistan


An Indian Air Force Mi-35 gunship helicopter with full stores armament (photo: Angad Singh)

Indian Hinds

Maintenance of the AAF's venerable Hinds continued to pose a unique challenge, and by mid-2015, only one Mi-35 remained operational. The AAF was stuck in the unenviable position of desperately needing a powerful close air support (CAS) platform to keep Taliban and other anti-government forces at bay, but having none available. Then, acting with uncharacteristic boldness and speed, it was India that stepped up to fill this urgent void. In a few short months, agreements were in place to transfer four Indian Air Force Hinds to Afghanistan, and by December 2015, all four had made their way to Kabul, transported by IAF C-17 Globemaster IIIs. The arrangement also covers training of Afghan personnel by India, and follows an earlier donation of three HAL-built Cheetal light helicopters and associated training and support to Afghanistan in early 2015.

The Indian aid appears to be only the beginning of a resurgence of sorts for the Mi-35 in Afghanistan : in October last year Afghan President Ashraf Ghani directly approached Russia for purchase of three more Mi-35s as part of a larger request for military aid. The complex history that binds the Hind to Afghanistan seems fated to continue.

Angad Singh

Robotic Aerial Warriors

General Atomics Aeronautical Systems' Predator/Gray Eagle-series aircraft family

Having provided immense impact in operational theatres worldwide with earlier versions, Predator XP is the latest in a long line of GA-ASI Remotely Piloted Aircraft (RPA) systems that carries the Predator name, beginning with the highly successful RQ-1 Predator aircraft first flown by the United States Air Force (USAF) in 1995. Currently in production, Predator XP has an endurance of 35 hours and can ascend upto 25,000 feet. The aircraft has been updated with state-of-the-art technologies, including an Automatic Take-off & Landing System (ATLS) capability, redundant flight control surfaces, enhanced avionics, and triple-redundant flight control computers.

Predator XP is equipped with both Line-of-Sight (LoS) and Beyond-Line-of-Sight (BLoS) data link systems for over-the-horizon operations. Additionally, it may be integrated with multiple Intelligence, Surveillance & Reconnaissance (ISR) sensors, including state-of-the-art Electro-Optical/ Infra-Red (EO/IR) cameras and GA-ASI's Lynx Multi-Mode Radar (MMR) which features a state-of-the-art Synthetic Aperture Radar (SAR) mode that offers all-weather, day/night performance for a wide-area search capability. Its Ground Moving Target Indicator (GMTI) mode provides a quick and easy method for locating moving vehicles. The radar's new Maritime Wide Area Search (MWAS) mode provides the capability to complete a variety of maritime missions successfully, including coastal surveillance, drug interdiction, long-range surveillance, small target detection, and search and rescue operations. Predator XP also is equipped with an Automatic Identification System (AIS) for identifying maritime vessels.

Predator XP's ATLS allows the aircraft to be launched and recovered without any operator interaction and is based upon GA-ASI's Gray Eagle ATLS which has conducted tens of thousands of take-offs and landings successfully. GA-ASI's Claw integrated sensor payload control and analysis software is available with Predator XP and features moving-map displays, enables cross-cueing of all onboard sensors, pre-mission planning, and post-mission sensor data analysis and exploitation. Offering excellent ISR capabilities, Predator XP is now available to support a variety of overland and maritime ISR missions worldwide.

An essential element of the United States Army's Aviation Modernisation Plan, GA-ASI's Gray Eagle Unmanned Aircraft System (UAS) is an innovative and technologically advanced derivative of the combat-proven Predator and offers a reliable, affordable, low-risk, and compelling next-generation tactical UAS solution to meet challenging service requirements for persistent Reconnaissance, Surveillance, and Target Acquisition (RSTA) and attack operations. Gray Eagle has an endurance of 25-hours, speeds up to 167 KTAS, can operate up to 29,000 feet, and carries 488-kg of internal and external payload. The aircraft can carry multiple payloads aloft, including EO/IR with laser designation, Synthetic Aperture Radar (SAR), communications relay, and four Hellfire missiles.

Compared to the Predator predecessor, Gray Eagle's Heavy Fuel Engine (HFE) supports the Army's "single fuel in the battlefield" concept and provides increased horsepower and significantly improved fuel efficiency, utilising either jet or diesel fuel. To enhance reliability, Gray Eagle features a fault-tolerant control system and a triple-redundant avionics system architecture, similar to the systems integrated in the battle-proven Predator B. Designed with airworthiness as a primary consideration, Gray Eagle is engineered to meet and even exceed manned aircraft reliability standards. Under direct operational control by Army field commanders, standard roles include wide-area Intelligence, Surveillance & Reconnaissance (ISR), convoy protection, Improvised Explosive Device (IED) detection & defeat, Close Air Support (CAS), communications relay and weapons delivery missions. As previously mentioned Gray Eagle features an ATLS while the Improved Gray Eagle (IGE) is a next-generation advanced derivative of

Predator XP

Predator C Avenger

the battle-proven Gray Eagle Unmanned Aircraft System (UAS).

IGE delivers long-endurance UAS surveillance, communications relay and weapons delivery missions in support of the war fighter. The aircraft delivers an advanced UAS capability for the Army, adding greater endurance and more payload carriage, with increased reliability. First flown in July 2013, IGE builds upon the successes of its Gray Eagle predecessor, delivering upgraded, game-changing capabilities for army soldiers abroad by providing extended surveillance coverage, along with the ability to self-transit to distant locations.

IGE is engineered with a Max Gross Take-off Weight (MGTOW) of 4,200-lb, utilising a high-performance diesel engine compared with the Gray Eagle›s GTOW of 3,600-lb with a 160 hp diesel engine. The incorporation of IGE's deep belly design and 500-lb centreline hard point allows for 860-lb of internal fuel load, with an optional external fuel pod that can accommodate an additional 450-lb. Use of this extra fuel supports Army Reconnaissance, Surveillance & Target Acquisition (RSTA) missions in excess of 50 hours. In October 2013, IGE flew nearly two days straight during endurance flight testing at GA-ASI's El Mirage Flight Operations Facility in Adelanto, California.

IGE's internal payload capacity, combined with its increased engine horsepower, provides growth capability for an improved airworthiness design, with the potential of incorporating lightning protection, damage tolerance, and Traffic Collision Avoidance System (TCAS) features. As usual, IGE features an ATLS.

Designated MQ-9 Reaper by its USAF and Royal Air Force operators the turboprop-powered, multi-mission Predator B Remotely Piloted Aircraft (RPA) was developed with GA-ASI funding and provides significantly greater capabilities than Predator. First flown in 2001, Predator B is a highly sophisticated development built on the experience gained with the company's battle-proven Predator RPA and is a major evolutionary leap forward in overall performance and reliability.

Featuring unmatched operational flexibility, Predator B has an endurance of over 27 hours, speeds of 240 KTAS, can operate up to 50,000 ft, and has a 3,850 lb (1,746-kg) payload capacity that includes 3,000 lb (1,361 kg) of external stores. Twice as fast as Predator, the aircraft carries 500-percent more payload and has nine times the horsepower. It provides a long-endurance, persistent surveillance/strike capability for the war fighter. An extremely reliable aircraft, Predator B is equipped with a fault-tolerant Flight Control System (FCS) and triple redundant avionics system architecture engineered to meet and even exceed manned aircraft reliability standards. To enhance engine performance and fuel efficiency, particularly at low altitudes, Predator B is powered by the flight-certified and proven Honeywell TPE331-10 turboprop engine, integrated with Digital Electronic Engine Control (DEEC). LoS data-link operates in C-Band whereas BLoS data-link operates in Ku-band in addition to Satellite Communications (SATCOM).

The aircraft is highly modular and is configured easily with a variety of payloads on its seven external stations to meet mission requirements. Predator B is capable of carrying multiple mission payloads to include EO/IR sensors, Lynx MMR, multi-mode maritime surveillance radar, Electronic Support Measures (ESM), laser designators, and various weapons packages. A new variant, Predator B ER, has been designed with field-retrofit table capabilities such as wing-borne fuel pods and a new reinforced landing gear that extends the aircraft's already impressive endurance from 27 hours to 34 hours while further increasing its operational flexibility. Later in 2016, the aircraft will evolve again when its wingspan will increase from 66 feet to 79 feet to hold the fuel that was previously stored in the fuel pods. This configuration will enable 42 hours of endurance.

Next-generation jet powered Predator C Avenger first flew in April 2009. Its unique design featuring a retractable EO/IR gimbal, reduced signature, and speed increases its survivability in higher threat environments and provides potential customers with an expanded quick-response armed reconnaissance capability. The high-speed, multi-mission Avenger is a long-endurance, medium-to-high-altitude Remotely Piloted Aircraft (RPA) system that can perform wide-area surveillance, time-sensitive strike missions over land or sea, and a host of other challenging military missions. The aircraft has much higher operational and transit speeds than current Predator-series aircraft, resulting in quick response and rapid repositioning for improved mission flexibility and survivability.

The jet-powered aircraft is equipped with a Pratt and Whitney PW545B turbofan engine capable of producing 4,800 lb installed thrust. The engine is designed for greater fuel economy and features class-leading fuel consumption components. Avenger can operate at speeds up to 400 KTAS, a maximum altitude of 50,000 ft, and 18 hours endurance. Its significant payload capacity enables it to carry multiple sensors on six external hard points, while its internal weapons bay can house 3,500 lb of precision munitions and can be employed in "swarm" tactics. Later in 2016, an extended range variant of Avenger will be available which will feature a 76 ft wingspan and increased fuel capacity that will increase the aircraft's endurance to 20 hours.

Sayan Majumdar

Predator B RPA

Bomber for the 21st Century

The US Air Force's new Long Range Strike Bomber (LRS-B) will be known as the B-21, the designation intended to reflect the first new bomber of the 21st century. The selected design, by contendor Northrop Grumman, is very similar to the company's earlier B-2A Spirit, which is currently in USAF service. Contract for the LRS-B is in two parts, including EMD and options for production of the first 21 aircraft. The EMD phase has an estimated value of $21.4 billion, but the total cost is classified.

Challenges to the selection decision were raised by Boeing and Lockheed Martin but a review "found no basis to sustain or uphold the protest." Further, "the technical evaluation, plus the evaluation of costs, was reasonable, consistent with the terms of the solicitation and in accordance with procurement laws and regulations." Northrop Grumman will resume work on LRS-B and the USAF is planning to procure 100 of the new bombers to replace its ageing fleet of B-1B Lancers and B-52 Stratofortresses. During a 'State of the Air Force' briefing at the Pentagon on 7 March, AF Secretary James revealed the names of the seven top-tier suppliers for the B-21 programme: the engines will come from Pratt & Whitney, while BAE Systems, Spirit Aerosystems, Orbital ATK, GKN Aerospace and Janicki Industries will also be major sub-contractors.

Uncertainty on F-16s for PAF

Even though the US Defence Security Co-operation Agency (DSCA) had notified US Congress of the planned sale of eight F-16 Block 52s to the Pakistan Air Force, which was subsequently approved, there have been sustained objections from lawmakers which has brought in uncertainties about this deal going through. The contract is estimated at $600.04 million, including equipment, training and logistics support. Major Defence Equipment (MDE) in the contract will be two F-16C Block 52 aircraft with the F100-PW-229 increased performance engine and 14 Joint Helmet Mounted Cueing Systems (JHMCS). The estimated cost of the MDE element is $564.68 million.

Also included are eight AN/APG-68(V) 9 radars and eight ALQ-211(V)9 Advanced Integrated Defensive Electronic Warfare Suites (AIDEWS) which are among non-MDE items, with spares, support, training and logistics also included. Pakistan has previously

taken delivery of 12 F-16C Block 52s and six F-16Ds Block 52s in addition to earlier F-16A/B models. A mid-life upgrade (MLU) of all 41 of the surviving F-16A/Bs was carried out by Turkish Aerospace Industries (TAI), which commenced in 2011 and was completed in 2015.

Reacting to the controversy, Pakistan's Sartaj Aziz has stated that if the US does not subsidise the F-16 deal, via foreign military funding (FMF), "Pakistan will opt for fighters from some other place" but he did not specify any options.

Eurofighter Typhoons for Kuwait

The Kuwait Ministry of Defence and Finmeccanica, which leads commercial activities in Kuwait on behalf of the Eurofighter consortium, has signed a contract for the supply of 28 Typhoons to be produced in Italy. The contract, part of an inter-governmental agreement between the two countries, was signed in the presence of the Italian Defence Minister Roberta Pinotti and her Kuwaiti counterpart, Gen. Khaled Al Jarrah Al Sabah and includes logistics, operational support and the training of flight crews and ground personnel, which will be carried out in cooperation with the Italian Air Force. The contract also provides for the upgrade of ground-based infrastructure in Kuwait which will be used for Typhoon operations.

The Eurofighter Typhoon for Kuwait, which will be provided in its most advanced configuration, will be equipped with the cutting-edge new E-Scan radar (Electronically Scanned array radar). The radar is developed by the European EuroRADAR consortium, also led by Finmeccanica.

Chinese fighters in the South China Sea

China has continued deployment of People's Liberation Army Naval Air Force (PLANAF) fighters to Woody Island in the Paracels. Recently involved have been Shenyang J-11BHs and Xian JH-7s, which followed earlier posturing when PLA HQ-9 surface-to-air missile systems were deployed on the island. The PLANAF has also previously deployed Shenyang J-8IIs to the island, which is also claimed by Taiwan and Vietnam.

Predator B for Spain

Spain has ordered the Predator B/MQ-9 Reaper remotely piloted aircraft system (RPAS) from General Atomics Aeronautical Systems Inc (GA-ASI) to support its airborne surveillance and reconnaissance requirements. The Spanish Armed Forces' system will comprise four aircraft, each with MTS-B electro-optical/infrared (EO/IR) sensors and GA-ASI's Block 20A Lynx multi-mode radar. The acquisition, which includes two Block 30 ground control stations (GCS) plus SATCOM and line-of-sight (LOS) data link capabilities is being made through a Foreign Military Sales (FMS) agreement.

Swiss consider new fighters

Switzerland is once again to evaluate options for a new fighter for the Swiss Air Force, two years after the 22 Gripen Es then selected to replace the F-5E/F fleet, was suspended in May 2014 when the electorate rejected such plans in a national referendum. The Federal Department of Defence will begin preparatory work for the acquisition in 2016 and after studies and testing, a proposal will be submitted to parliament in 2017 for approval. Switzerland's ageing F-5s need to be replaced as of the current inventory of 54, only 30 are still operational. Its remaining 31 F-18 Hornets also need replacement and will be nearing the end of their useful life in 2025. The new fighter acquisition programme will begin in 2017, with a type selected in 2020 and purchase proposals submitted to parliament in 2022. Delivery would then begin in 2025.

22 more Hawks for Saudi Arabia

Saudi Arabia has signed an agreement with BAE Systems for 22 Hawk Mk. 165 advanced jet trainers, which doubles the number under contract, adding to the 22 ordered under a deal announced in May 2012. The order also includes associated ground equipment and training aids and forms part of an enhancement to the Kingdom's pilot training capacity. The first of the initial batch of new Hawks made its maiden flight from Warton, Lancaishire on 16 September 2015 and four more have since flown; deliveries are anticipated later in 2016.

First Oman Typhoon

BAE Systems has begun final assembly of the first Eurofighter Typhoon for the Royal Air Force of Oman (RAFO) at its facility in Warton, Lancashire. BAE Systems has a long-standing relationship with RAFO through its operation of both the Jaguar fighter and an earlier variant of the BAE Systems Hawk. "Assembly

of the first RAFO Typhoon is progressing well and we are on target for first deliveries of the jet as planned," stated Martin Taylor of BAE Systems. The contract signed in 2012 comprises an initial batch of 12 Typhoons, plus eight Hawk Mk. 166 Advanced Jet Trainer (AJT) aircraft.

Indonesia orders Su-35S

Indonesia is to order ten Sukhoi Su-35S fighters from Russia. The Indonesian Air Force (TNI-AU) in fact wants a full squadron strength of 16 aircraft but the available budget was only sufficient to fund ten Su-35s, to replace the TNI-AU's ageing F-5E/F Tiger IIs. Indonesia's Defence Minster had announced selection of the Su-35S for the requirement on 21 September 2015, at which time the purchase of 16 aircraft was to be staggered to spread the costs, with an initial buy of eight.

Israel's F-35I's C4 Systems in production

With system definition, prototyping and testing phases completed, Israel Aerospace Industries' (IAI) is producing the Command, Control, Communications and Computing (C4) systems developed for the 'Adir' F-35I, Israel's variant of the Fifth Generation Fighter F-35. The system, developed exclusively for the

F-35I by IAI's Lahav Division is part of IAI's cutting edge 'tactical C4 architecture' introducing unique force multipliers in the modern, networked battle space. The induction of advanced systems of this type with the Israeli Air Force combat fleet will enable it to better manage, and rapidly field networked applications that interface with core services over proprietary protocols developed especially for the Israeli Air Force.

Using generic communications infrastructure based on the latest Software Defined Radios (SDR), IAI's new C4 system developed for the Adir will provide the backbone of the Israel AF's future airborne communications network, dramatically improving over legacy systems currently operating with the current fleet of 4th Generation aircraft (F-16, F-15). "Based on open systems architecture the new system enable rapid software and hardware development cycles that will also provide more affordable modernisation and support of systems over the platform's life cycle, as systems are required to meet rapidly changing operating environment."

David's Sling for the Israeli Air Force

After a series of trials of the David's Sling aerial defence system, Israel's Missile Defence Organisation (IMDO) together with the US Missile Defence Agency (MDA) has begun delivering major components of the system to the Israeli Air Force. David's Sling, which was developed by Rafael Advanced Defence Systems Ltd. and Raytheon USA, completed its final milestone test in December 2015. The first phase of delivery is being conducted by a team from IMDO, along with the defence industries, led by Rafael Advanced Defence Systems. At this stage, the delivery of the radar, interception and command and control systems will take place. In the near future, the process of testing all of the system components and the final declaration by the Air Force that the system is operational will occur.

The prime contractor for David's Sling Weapon System is Rafael, with Raytheon Missile Systems as a sub-contractor. The MMR is developed by Elta, a subsidiary of Israel Aerospace Industries. The BMC, known as the Golden Almond, is developed by Elisra, an Elbit subsidiary.

BAE Systems and Babcock to service UK Hawks

BAE Systems and Babcock will jointly provide a range of services for the Royal Navy and Royal Air Force to support Hawk TMk.1/1A and T2 aircraft operations at RAF Valley in Anglesey, North Wales, RAF Leeming in North Yorkshire and Royal Naval Air Station (RNAS) Culdrose in Cornwall. The servicing contracts cover aircraft maintenance, fleet management and technical and engineering support for the jets, which is in addition to modification and obsolescence management along with the maintenance of master documentation.

Hungarian Gripens mark their tenth anniversary

Ten Hungarian Air Force JAS39 Gripens formed the figure 'ten' in their formation flypast at a ceremony at Kecskemét Air Base, Hungary, to celebrate ten years of Gripen operations. The first five of a total of 14 Gripens for Hungary had arrived in the country in March 2006.

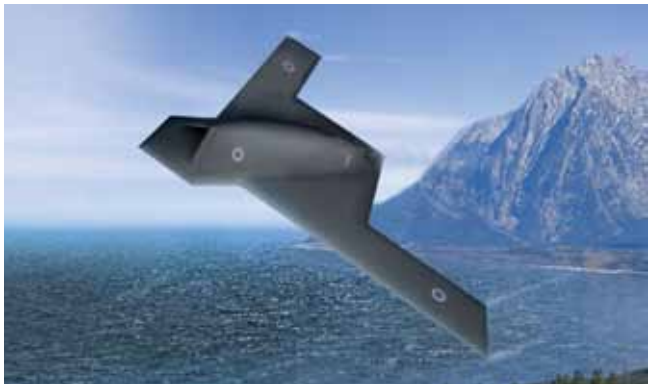
Mitsubishi X-2 makes maiden flight

The Mitsubishi X-2 fighter technology demonstrator aircraft conducted its maiden flight from Nagoya International Airport on 22 April 2016. The jet performed basic operations during the flight including climbing, descending, and circling, and the aircraft was reported to be "extremely stable" with handling identical to pre-flight simulations. The aircraft is small by contemporary standards, having a length of 14.2m and a wingspan of 9.1m, and is powered by two IHI Corporation XF5-1 low-bypass turbofans.

The X-2, formerly designated ATD-X, is purely a technology demonstrator, focusing on key development areas including stealth, thrust vectoring, advanced sensors and datalinks. It will not be developed into an operational fighter aircraft, but will help the Japanese military and industry build expertise for future programmes. Mitsubishi Heavy Industries has been working on the programme for seven years with 220 domestic companies. Japan's Acquisition, Technology and Logistics Agency is also playing a major role in the programme.

Anglo-French FCAS

It is reported that the UK and France will invest in joint development of the Future Combat Air System (FCAS) and construct prototypes for a next-generation of unmanned aircraft. The go-ahead for the next $1.54bn phase of the project was announced during the biennial UK-France Defence Summit in Amiens, France attended by UK Prime Minister David Cameron and Defence Secretary Michael Fallon. The two countries had



already agreed to explore FCAS options and launched a two-year, £120 million feasibility study on FCAS, which began in November 2014 and focused on defining potential concepts and technologies. The next phase will prepare for full-scale development of unmanned combat air systems (UCAS) demonstrators by 2025. It will centre on a versatile UCAS platform that could serve as the basis for a future operational capability at some time beyond 2030.

This Anglo-French collaboration will also analyse the future air combat environment, including how manned and unmanned systems might operate together. Companies expected to be involved in the programme include BAE Systems, Finmeccanica Airborne and Space Systems Division and Rolls-Royce in the UK, along with Dassault Aviation, SNECMA/Safran and Thales in France.

Finmeccanica's new-generation anti-missile countermeasures

The Royal Air Force has successfully carried out initial evaluation of Finmeccanica's BriteCloud decoy, a new-generation anti-missile countermeasure featuring breakthrough technology developed in the UK. " The tests demonstrated the effectiveness of the BriteCloud decoys against the kind of modern threats that could be encountered by pilots and proved the maturity of the technology."

"Modern radar-guided missiles are able to defeat the traditional chaff countermeasures that have been in use since WW2. BriteCloud was designed to beat 21st century threats, with its innovation centring on the miniaturisation of advanced jamming technology. The final product is a battery-powered Digital Radio Frequency Memory (DRFM) jammer in a completely self-contained unit,

reduced to the size of drinks can. The decoy is therefore small enough to be ejected from fighter aircraft in exactly the same way as a flare, allowing pilots to lure even the most up-to-date RF-guided missiles and fire control radars away from their aircraft."

During the tests, which took place in the USA in October 2015, a number of fully functional decoys were launched from a Tornado GR4 aircraft as it was tracked by ground-based advanced RF threat systems. The decoys performed as planned, automatically detecting threat radars and jamming them with the decoy's embedded DRFM jammer.

First Norwegian AW101 in maiden flight

First of 16 AgustaWestland AW101 helicopters for the Norwegian Ministry of Justice and Public Security (MoJ) performed its maiden flight on 21 March 2016 at Yeovil in the UK. This marks a major milestone and the start of the flight test programme that will lead to initial aircraft deliveries to the MoJ, for operation by the Royal Norwegian Air Force in 2017; aircraft deliveries to continue through to 2020.

In December 2013 the Norwegian Ministry of Justice and Public Security signed a contract for 16 AW101 helicopters plus support and training, to meet the Norwegian All Weather SAR Helicopter (NAWSARH) requirement based on a new generation aircraft. Each aircraft is provided with an advanced SAR equipment package including a multi-panel AESA (Active Electronically Scanned Array) surveillance radar system from Finmeccanica Airborne & Space Systems Division, built at the company's Edinburgh 'Centre of Excellence' that provides 360° coverage. The large cabin doors and rear ramp provide easy access for personnel, survivors and equipment into the 27 m^3 cabin which has stand-up head room.

AW159 helicopters for Philippine Navy

The Philippine Navy have ordered two AgustaWestland AW159 helicopters to be built and delivered from the Finmeccanica Helicopter Division's Yeovil plant in 2018. The two helicopters will be equipped with sophisticated state-of-the-art mission equipment and sensors, primarily dedicated to anti-submarine warfare and anti-surface warfare roles. The helicopters will also be capable of performing other roles including search and rescue, maritime security and maritime surveillance.

Singapore's requirement for new helicopters

Singapore is to shortly select new generation helicopters for its Air Force and Navy and has downselected Airbus and Leonardo-Finmeccanica to replace its ageing Aerospatiale AS332M Super Puma platforms *(see above)*. Both European manufacturers will compete for the requirement to provide a dozen new helicopters to replace the 18 Eurocopter Super Pumas that have been fielded by the Republic of Singapore Air Force (RSAF) since 1985. Airbus Helicopters is expected to offer its recently relaunched H215/H215M (Super Puma), H225/H225M (already in service with the RSAF as the AS532 Cougar), or NH90 (Airbus Helicopters is the major stakeholder in the multinational programme), while Leonardo-Finmeccanica's chief medium-twin offering is the AgustaWestland AW149.

First A321 produced in the USA

The first Airbus A321 produced at the US Manufacturing Facility flew for the first time at Brookley in Mobile, Alabama, on 22 March and landed back after in a flight lasting 3 hours and 26 minutes during which tests were performed on systems, engines and structure performance.

"We've come to an exciting milestone in the production of any aircraft, but this one is particularly special," said Daryl Taylor, Vice President and General Manager of the Airbus US. Manufacturing Facility. "We're creating a new centre of commercial aircraft production in the US. This is just the first of many aircraft to come." The A321 will be delivered to JetBlue airlines.

Airbus selects Rockwell Collins

Airbus has selected Rockwell Collins as a lead supplier of High-Bandwidth Connectivity (HBC) for the Airbus A320 single-aisle family of aircraft, and long-range A330 and A380 aircraft. Under the terms of the agreement, airlines purchasing Airbus aircraft can select HBC from Rockwell Collins to meet the growing demand for high-speed connectivity. As a lead supplier, Rockwell Collins will collaborate with Airbus to develop and deploy both a linefit and retrofit HBC system to ensure an end-to-end managed SATCOM solution.

"Airbus's HBC selection builds upon Rockwell Collins' extensive amount of next-generation systems it supplies the aircraft maker." Numerous Rockwell Collins systems are standard on the Airbus A350 XWB and options for the A320 and A330 aircraft families. Most recently, Rockwell Collins was selected by Airbus to supply its Electronic Flight Bag interface and communications unit, which is part of its Secure Server Router portfolio, as options on A320s and A330s.

Thales HBC solutions selected by Airbus

Thales has been selected by Airbus as lead supplier for HBC solutions to be deployed on A320, A330 and A380 aircraft in linefit and retrofit mode. "Thales' High Bandwidth Connectivity solutions will provide passengers the bandwidth they need to enrich their travel experience and airlines with the connectivity solution that satisfies their operational requirements." In addition to the already selectable GX Connectivity solution for A350s, this agreement enables Thales to become linefit offerable for connectivity products and related VAR services on all legacy Airbus platforms, presently and in the future.

H175 fleet exceeds 3,000 flight hours

Just after a year of operations, NHV have reached 3,000 flight hours with their H175 fleet. Early in February, the first H175 that entered service in December 2014, reached the 1,000 flight-hour milestone essentially in oil and gas offshore transportation.

NHV was launch customer for the new super medium helicopter and has since taken delivery of six aircraft from 16 on order. The H175 is currently in operation at two of NHV's bases in the demanding North Sea environment: Den Helder in the Netherlands and Aberdeen in northern Scotland. So far, the NHV fleet of H175s has completed 1,500 flights and carried approximately 22,000 passengers.

"Despite the challenging market environment, 2015 proved to be a successful year for the H175 which registered 36 orders and was endorsed by key oil and gas players such as Milestone and Bristow." During the last 12 months, the capabilities of the aircraft have also been expanded through a flight envelope extension in hot and high conditions. The Public Services version was also launched last year following a 7-unit order from Hong Kong operator GFS, with deliveries planned in 2017.

Turbomeca offer S-76C+ engine upgrade programme

Turbomeca (Safran) will introduce an engine retrofit programme to enable Arriel 2S1-powered S-76C+ operators to upgrade to the Arriel 2S2 S-76C++ model. This engine upgrade will be conducted alongside an airframe retrofit program provided by Sikorsky Aircraft, a Lockheed Martin company. Upgrading to S-76C++ configuration with Arriel 2S2 engines will deliver improved mission capabilities including greater take-off and cruising power, reduced pilot workload and higher payload. Around 12,000 Arriel units have been produced, of which 700 are Arriel 2S1 and 2S2, collectively logging 45 million flight hours. Ranging from 650 to 1000 shp, the Arriel engine family powers over 40 different helicopter types.

Garuda Indonesia order RR Trent - powered A330neo

Rolls-Royce has received an order worth $1.2 billion for Trent 7000 engines and TotalCare service support from Garuda Indonesia, to power 14 Airbus A330neo aircraft. The Trent 7000, exclusive power plant for the A330neo, is the seventh member of the Trent family which has become "the engine of choice" in the wide body market over the last 20 years. The Trent 7000 is scheduled to enter service in 2017, the order replacing an existing order for seven A330-300 aircraft powered by Trent 700 engines.

Finmeccanica Helicopter contracts with China and Japan

Finmeccanica's Helicopter Division have announced new contracts for 26 helicopters with operators in China and Japan, valued at approximately 80 million Euro and highlight Finmeccanica's strong presence and growth in the Asian Emergency Medical Service (EMS) and public utility helicopter markets.

Specifically for China, a contract for 25 AgustaWestland AW119Kx single engine helicopters has been signed with deliveries expected to start by June 2016. This contract includes a comprehensive support and training services package and is part of

a framework agreement for 60 AW119Kx aircraft to be acquired through 2017. The helicopters will be operated by Kingwing General Aviation Co. Ltd and will be used in China for Emergency Medical Service (EMS) missions. In Japan the company Shizuoka Air Commuter Corporation has ordered a GrandNew helicopter in air ambulance configuration for use in the Niigata Prefecture, as part of the national helicopter air ambulance programme across all Japanese prefectures.

Maiden flight of the Ka-62

First prototype (OP-1) of the medium multirole Ka-62 helicopter, powered by Safran Ardiden 3G engines and built by Russian Helicopters' Progress Arsenyev Aviation Company (part of State Corporation Rostec), flew on 28 April 2016. The prototype will enable evaluation of the Ka-62's overall performance and test its main power supply systems and avionics. The helicopter was flown by test pilots from the Kamov Design Bureau, which is the main developer of the Ka-62. The Ka-62 is designed for a wide range of tasks, which include transport, rescue and use in the oil and gas sector. "The Ka-62's high power to weight ratio allows to operate it in a wide range of altitudes and climates."

Airbus Safran Launchers JV

Airbus Group and Safran have signed an agreement for the second and final phase of their 50:50 joint venture, Airbus Safran Launchers. Both companies will contribute to the current joint programme with industrial assets dealing with civil space launchers and military launchers. Under first phase of the JV, Airbus Group and Safran created a joint programme company with their respective civil programme contracts and major participations related to civil launcher activities. In this second and final phase, industrial assets and military launchers will be integrated in the joint-venture.

AW609 TiltRotor in ground run

Third prototype (A/C3) of the AgustaWestland AW609 TiltRotor completed its first ground run at Cascina Costa, Italy, marking a critical milestone as the programme advances its testing and plans a resumption of flight testing activities. Aircraft AW609 A/C3 began restrained ground run testing with all engines and systems operating in preparation for FAA certification flight testing this summer at the company's Philadelphia facility. Taking off and landing vertically, the AW609 is capable of flying within an envelope that includes cruise conditions up to 275 knots, at an altitude of 25,000 feet in a pressurised cabin, for missions with ranges up to 1,000nm with available fuel options.

AW189 fleet surpasses 10,000 hours

The global fleet of 26 AgustaWestland AW189 super medium twin engine helicopters, in service with customers across four continents, has exceeded 10,000 flight hours. This milestone, achieved less than two years after the first aircraft delivery, marks a major commercial and operational milestone for the helicopter in the all-new super medium category, aimed at meeting long range, large capacity requirements "with unprecedented levels of cost effectiveness compared to larger and heavier helicopter models in the market."

AW189s are in service in Europe, the Middle East, Asia and North America with leading operators in UK, Denmark, Malaysia, Qatar, United Arab Emirates, Vietnam and USA. "The AW189 has also established itself as the bestselling aircraft in this specific class among competing types, with over 150 units sold so far, including firm orders, options and framework contracts, to over 20 customers in 14 countries. Also, the new helicopter features the largest number of dedicated configurations in its market, covering various roles including offshore transport, search and rescue, executive/private transport, firefighting and disaster relief." Additional AW189s are to be delivered in several other countries including Russia, China and Brazil.

ERA signs EMS platform development for the AW609 TiltRotor programme

Finmeccanica has signed a Memorandum of Understanding (MoU) with Era Group Inc, one of the largest helicopter operators in the world and the largest civil operator of AgustaWestland helicopters, for development of an Emergency Medical Service (EMS) variant of the revolutionary AgustaWestland AW609 TiltRotor. The signing of the agreement marks another important milestone for the development of the world's first commercial tiltrotor, with some 60 orders already logged for the AW609 involving several missions including search and rescue, offshore transport, executive/private transport and homeland security.

Sagem's JIM-LR infrared binoculars

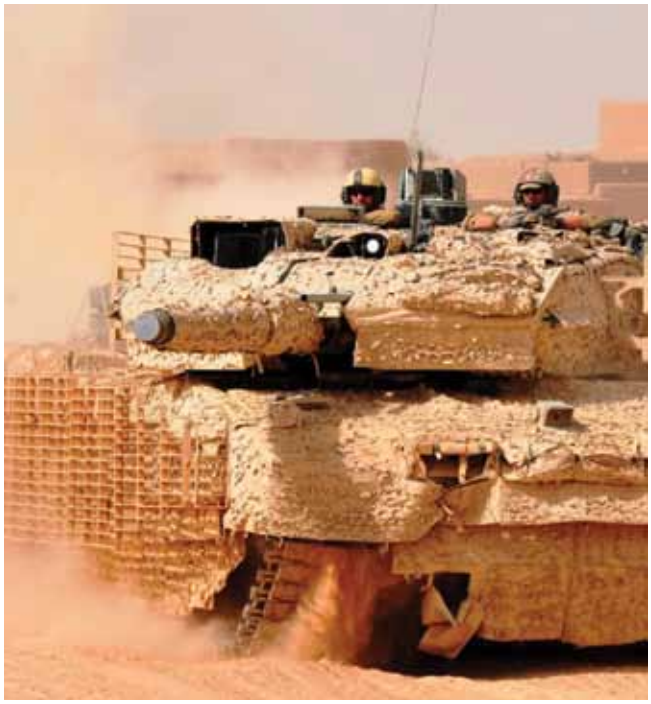
Sagem (Safran) has received a new order for more than 200 JIM-LR long-range multifunction infrared binoculars from an "undisclosed" NATO army. The order will also include remote-control terminals, and will be added to the JIM-LR units already deployed by the country.

This latest success follows JIM-LR orders recorded by Sagem at the end of 2015 for both export markets and in France as part of the JIR-TTA-NG1 programme, consolidating Sagem's leadership in the portable optronics market segment.

Sagem's JIM-LR is a high-performance tactical optronic (electro-optical) device, designed for surveillance, intelligence, zone protection and target designation missions. The highly integrated JIM-LR groups a number of functions in a single unit: day/night (thermal) vision, rangefinding, laser pointer, magnetic compass, image and video recording, GPS and data transmission.

Airbus DS Optronics' retrofit sights for AFVs

The Optronics product line of Airbus DS Electronics and Border Security (EBS) have introduced easily integratable sensor solutions to increase combat efficiency and to extend the product life cycles of armoured vehicles. The Attica-GL (Gunner Leopard) and Attica-GM (Gunner Marder) fulfills missions effectively at day or night and despite detrimental weather conditions. These will replace the obsolete thermal imager WBG-X, which is currently used in the main battle tank (MBT) Leopard and the infantry



fighting vehicle (IFV) Marder. As of December 2015, WBG-X can no longer be fully serviced.

Attica-GL and -GM alike follow a 'plug & play' approach. With identical mechanical and electrical interfaces and space, these upgrade solutions can easily replace WBG-X. Both provide the user with the same long ranges and offer the same night sight performance. This facilitates combined arms operations. While the systems are not interchangeable, the high commonality of parts makes for easier logistics.

BAE to refurbish CV90s for Sweden

The Swedish government has awarded BAE Systems a contract to refurbish 262 Combat Vehicles 90 (CV90) for the Swedish Army, which includes refurbishing the chassis and upgrading the vehicle's survivability and turrets, as well as enhancing combat system performance. These efforts will increase the vehicles' lifespan in support of Army capabilities with deliveries beginning in 2018 and running through 2020.

CV90 is a family of Swedish tracked combat vehicles designed by FMV, BAE Systems Hägglunds and BAE Systems Weapons Systems, with more than 4 million engineering hours contributing to the development of this advanced Infantry Fighting Vehicle (IFV). The Swedish version of the IFV is outfitted with a turret equipped with a 40 mm auto-cannon. The Swedish Army has a fleet of 509 CV90s. Other countries currently using the vehicle are Norway, Denmark, Finland, Estonia, the Netherlands, and Switzerland.

DCNS 'Future Submarines' for Royal Australian Navy

The Australian Government has selected DCNS as its preferred international partner for the design of 12 Future Submarines for the Royal Australian Navy. As the Australian Government stated "The decision was driven by DCNS's ability to best meet all of the Australian Government's requirements. These included superior sensor performance and stealth characteristics, as well as range and endurance similar to the *Collins*-class submarine. The Government's considerations also included cost, schedule, program execution, through-life support and Australian industry involvement."

"This success has been made possible thanks to the strong teamwork between the French Authorities, DCNS and our industrial partners," stated DCNS Chairman and CEO, Herve Guillou.

Royal Thai Navy selects Thales

Thales has announced two significant contracts for the supply of a full spectrum of Above-water and Underwater solutions for the Royal Thai Navy (RTN). Thales will modernise the *Bang Rachan*-class Minehunters and supply the combat, navigation and communication suite onboard the newly ordered *Krabi*-class Offshore Patrol Vessel. As prime contractor, Thales will be responsible for the revised vessel design, repairs and modernisation, the procurement of equipment and the platform integration. The upgraded ship will be equipped with new solutions, including a machinery control system, navigation systems, upgraded communications capabilities, Sonar TSM 2022 MkIII with M-CUBE command and control (C2) and a multi-influence signature range to manage RTN ships' signatures.

MBDA's coastal missile systems for Qatar

MBDA has signed a Memorandum of Understanding for the supply of a coastal defence system for the Qatar Emiri Naval Force (QENF). These coastal missile systems can deploy two different munitions, Exocet MM40 Block 3 and Marte ER (the Extended Range version of the Marte missile), reflecting the maturity and versatility of these munitions. The system can work in autonomous mode with its own radar, or alternatively by data-linking to a higher level within a wider coastal surveillance network.

Raytheon teams with Finmeccanica, CAE USA and Honeywell for next-gen trainer

Raytheon is offering an integrated, next-generation training solution for the US Air Force's Advanced Pilot Training competition. Raytheon is the prime contractor, with principal partners Finmeccanica, CAE USA and Honeywell Aerospace. "The success of our nation's future pilots depends on a comprehensive trainer to prepare them to take full advantage of the capabilities unique to advanced 4th and 5th generation fighters," stated Rick Yuse, president of Raytheon's Space and Airborne Systems. "Our affordable, low risk, open systems solution combines a proven aircraft with a suite of fully integrated training technologies. Our team is best positioned to bring the essential experience, capabilities and core competencies together to meet the United States Air Force's mission requirements."

Nearly 45,000 pilots and crew have earned their wings on the training systems designed, developed and fielded by this Raytheon led-team. This solution combines the T-100, an advanced variant of the Aermacchi M-346, with a leading-edge Ground Based Training System. "The T-100 offers dynamic kinetic performance, while also delivering an embedded, tactical training system that immerses pilots in realistic mission scenarios," stated Filippo Bagnato, managing director of Finmeccanica Aircraft Division. "The M-346, the basis for the T-100, is already operational and preparing pilots around the world for the challenges of today's complex fighter platforms."

Robust sales achieved by DCNS

FREMM Tahya Misr for Egypt

The DCNS Group's earnings stabilised at €3.039bn for the year 2015, comparable to the earnings for 2014 reporting period, because of robust international sales, which, exceptionally, represented half of the 2015 earnings as a result of the very rapid delivery of the FREMM frigate to Egypt, and by the Brazil and India submarine programmes as well as the Malaysian surface-vessel programme. Rest of the turnover was from major French national programmes, essentially the FREMM and Barracuda programmes, as also the service activities which came to more than €1bn.

Important milestones are commissioning of the first Indian *Scorpene* submarine, transfer of two LHDs to the Egyptian Navy, maintenance of Saudi Arabian frigates and Malaysian submarines plus delivery of strategic equipment for the Brazilian submarine programme. Also, critical are delivery of the *Languedoc* multi-mission frigate (FREMM) to OCCAR, intended for the French Navy, transfer of *Le Suffren*, the first *Barracuda*-class nuclear attack submarine (SSN), onto its launch system for vessel finalisation, preparation of the major technical shutdown of the *Charles de Gaulle* aircraft carrier, pursuit of the IAM51 ROH adaptation for the SSBN *Le Triomphant* and start of that for the SSBN *Le Téméraire*;

Raytheon's new GaN Patriot radar

Raytheon has funded, developed and built a new Gallium Nitride (GaN) powered Active Electronically Scanned Array main antenna for the combat-proven Patriot Air and Missile Defence System. Raytheon's GaN-based AESA main array is a critical step on the path to a GaN-based AESA radar with full 360-degree capability. In 2015, Raytheon demonstrated 360-degree capability with its GaN-based AESA pilot array. The new main AESA array is a bolt-on replacement for the current antenna, measuring roughly 9' wide by 13' tall and oriented toward the primary threat

Raytheon's GaN-based AESA Patriot radar will work with future open architecture such as the Integrated Air and Missile Defence Battle Command System. It retains backwards compatibility with the current Patriot Engagement Control Station and is fully interoperable with NATO.

FAA certifies PurePower PW1400G-JM to power Irkut's MC-21

Ongoing testing for Pratt & Whitney's PurePower PW1400G-JM engine

The Federal Aviation Administration has certified Pratt & Whitney's PurePower PW1400G-JM engine to power Irkut's MC-21 aircraft. With this milestone, Pratt & Whitney now has three certified PurePower Geared Turbofan (GTF) engine variants. "This milestone is another huge step forward for the PurePower engine programme, which brings unmatched operational benefits including double-digit reductions in noise, emissions and fuel burn, making for greener skies," stated Greg Gernhardt, President, Commercial Engines Programmes, Pratt & Whitney. "The technology behind the GTF engine is a game-changing force in the aviation industry for all the right reasons and we are excited that the PW1400G-JM engine is moving one step closer to powering Irkut's MC-21 aircraft and providing the renowned benefits for which this engine is so highly regarded."

"We would like to congratulate Pratt & Whitney on the certification approval of its PurePower engine, which will be installed on MC-21 Family Aircraft," said Oleg Demchenko, President, Irkut Corporation. "The engine increases the competitiveness of our aircraft since it offers tangible cost savings to our airline customers due to the enhanced fuel burn efficiency while simultaneously benefitting the environment." The PurePower engine family has completed more than 58,000 cycles and 35,000 hours of testing as of mid-May 2016.

Among customers, Irkut considers Iranian airlines to be a potential buyer of MC-21 airliners. "Iran is among the countries that Irkut Corporation considers as potential customers of the MC-21 aircraft," the spokesperson stated on the sidelines of the Singapore Airshow held earlier this year. He noted that Russian Industry and Trade Minister Denis Manturov stated that discussions about the possible involvement of Iranian aircraft building infrastructure in the production of components for the MC-21s, with the subsequent purchase of such aircraft, were ongoing. "MC-21 is making ground in many countries of the world. However, the

MC-21 mockup at the previous Farnborough Airshow

Artist's impression of the MC-21 in flight

corporation is currently focused on its initial Russian customers," the spokesperson noted.

The Irkut MC-21-300 narrowbody airliner is expected to commence flight tests towards the end of 2016. Earlier, the first flying prototype was expected to perform its maiden flight in the second quarter of 2016. The MC-21 is being developed, and will be manufactured, by Irkut Corporation, a part of the United Aircraft Corporation (UAC). In early December 2015, it was reported that Irkut had completed assembly of the first prototype's fuselage, to be followed by wing-body mating. The MC-21-300 is the baseline model of the MC-21 family; its certification is slated for 2017-18. This version will seat 160-211 passengers. The MC-21-200 shortened version is expected to seat 130-176; its certification is set for 2019-20. Russia plans to sell up to 1,000 MC-21 airliners within the next 20 years.

Raytheon's TOW for Jordan

Jordan's Ministry of Defence has signed an agreement with the US Department of Defence to acquire tube-launched, optically tracked, wireless-guided, or TOW, missiles made by Raytheon. TOW is in service in more than 40 international armed forces and integrated on more than 15,000 ground, vehicle and helicopter platforms worldwide.

Thales Scorpion HMCS for Spanish EF-18s

The Spanish Ministry of Defence will equip the EF-18 with 80 Thales Scorpion Helmet Mounted Cueing Systems (HMCS). These HMCS will be installed in the aircraft during the course of 2016 and 2017, once the operational qualification phase and air-to-air (A2A) and air-to-ground (A2G) tests have been completed. Scorpion is a 'force multiplier' system offering full colour symbology (navigation, intelligence, combat, etc.) for both night time and day time missions, in addition to target cueing in potentially degraded visual environments, therefore easily allowing target designation and allocation of points of interest with the aircraft's sensors. Thales will be responsible for the viability study, testing phase, integration with test aircraft, qualification support and integration in the fleet.

MBDA'S Spear missile secures UK development contract

The United Kingdom's Ministry of Defence (MOD) has signed a contract worth over £400M with MBDA for the Weapon Development Phase of the SPEAR air to surface, precision strike missile. This contract will further advance MBDA's Spear weapon design and builds on a successful series of technical milestones during the preceding Assessment Phase. The Spear missile is being developed to meet the UK's Selective Precision Effects At Range Capability 3 (SPEAR 3) requirement for the UK's F-35 aircraft, with the option to equip the Typhoon aircraft. Spear will precisely engage long range, mobile, fleeting and re-locatable targets in all weathers, day or night, in the presence of countermeasures, obscurants and camouflage, whilst ensuring a safe stand-off range between the aircrew and threat air defences.

Airbus Helicopters Selected for UKMFTS

Airbus Helicopters in the UK has been selected by Ascent as the Aircraft Service Provider for the UK's Military Flying Training System (UKMFTS). The contract, worth £500 million over 17 years, will see Airbus Helicopters deliver aircraft and an integrated support solution over the course of 18 months, ready to start training in April 2018. This will involve the manufacture of aircraft in addition to developing the support infrastructure and training initial crews and maintenance personnel. As part of the contract, Airbus Helicopters will supply a fleet of H135 and H145 capable of delivering the 28,000 hours per year necessary to meet the training requirement.

H145

Dassault supplies last of Falcon 50 Surmars

The French Navy has taken delivery of the last of its four Falcon 50 Surmar (Maritime Surveillance) aircraft. The four Falcon 50 Surmar aircraft, previously used for government transportation missions, have undergone transformation work at Dassault Aviation's Mérignac site to install a search radar, an optronic system, a new cockpit and observation windows. Including the first four aircraft delivered early in the 2000s, the French Navy now operates a fleet of eight Falcon 50 Surmar aircraft.

Belgian Sea Kings

58,000 hours of Koksijde Rescue

On 2 March 2016, the Belgian Air Force organised a Media Day to commemorate two Sea King milestones at the Koksijde air base: 58,000 flying hours and 3,185 SAR scrambles of Belgian Sea Kings, and 40 years in service of the Belgian Sea Kings. This report is filed for *Vayu*.

On 8 November 1976, five Westland Sea Kings Mk.48s flew from RNAS Culdrose in the UK to their new home base at Koksijde, to serve primarily as the main SAR helicopter type in the Belgian Air Force (*Belgische Luchtcomponent*). The tail numbers of the five Belgian Sea Kings are RS01, RS02, RS03, RS04, and RS05. Over the past 40 years, the five helicopters have accumulated a total of 58,000 flying among them, serving with 40 Squadron of the Belgian AF. However, at the moment only three Sea Kings remain operational. RS01 left service and was flown to a museum in 2008, and RS03 was mothballed in 2013 in a hangar at Koksijde, although it can be made airworthy with 4-6 weeks of maintenance if needed. Today, Belgium's Sea Kings handle the country's SAR needs for 19 weeks in a year, while the remaining 33 weeks are handled by the type's successor, the NH90 Caiman. The Sea King will eventually be entirely replaced by the NH90 Caiman, but their final retirement depends on crew training and the remaining economical life of the airframes. 2018 has been mentioned as the type's final year of flying, but financial decisions may well change that.

Now that the UK has all but stopped Sea King operations, the Belgians anticipated that the Westland factories would cease production of spare parts. To assure spares

supplies, a retired yellow RAF SAR Sea King was flown to Koksijde in late 2015, to be cannibalised as needed. At the moment there are 2.5 Sea King crews available for flying duties, while training of future Sea King crews has been stopped in favour of the NH90.

58,000 Hours

Major (pilot) Peter Vandenbroucke is a former commander of 40 Squadron, and will remain in service at the unit to lead the retirement of the Sea King in the next three years. He spoke about the large number of flight hours – just over 58,000 – accumulated by the small Belgian Sea King fleet. Of the original five helicopters, three helicopters are presently operational with 40 Squadron. RS01, with 10,585 hours in service with the Belgian Air Component, was phased out on 17 December 2008, and is now preserved at the Aviation Museum in Brussels. The helicopter flew to the museum, and the landing of its final flight took place on the square in front of the museum in the centre of Brussels! The other non-operational Sea King is RS03, which has flown a total of 11,851 flying hours. This helicopter was taken out of service on 29 August 2013, and is currently in storage at Koksijde itself. RS03 is has not been formally written off yet, and is cocooned to preserve it in a near-airworthy condition. If necessary, this helicopter can be made ready to fly again after a comprehensive overhaul period of four to six weeks.

RS02 has the most flight hours of all the Belgian Sea Kings, at exactly 12,000, and is currently operational with 40 Squadron. The remaining two operational helicopters are RS04, with 11,950 flight hours, and RS05, with 11,623 flight hours. The latter is well-known on the European air show circuit, and sports a distinctive black colour scheme dating back to the 25th anniversary commemoration of the Sea King, celebrated in 2001. However, RS05 will receive a new special scheme for the 40th anniversary commemorations later this year.

Sea King Missions

For a small country with a relatively short coastline, the 40 Squadron conducts quite a large number of scrambles, although the frequency has been decreasing owing to fewer active fishing boats in the North Sea. Better safety and security measures at sea have also contributed to a reduction in heavy accidents. Over the years, the Belgian Sea Kings conducted 3,185 scrambles. These scrambles were flown by the different helicopters as follows: 523 times by RS01, 694 times by RS02, 618 times by RS03, 680 times by RS04 and finally 670 times by RS05. A total of 1,712 people were winched out of the water or from boats with hoists. Over 75 per cent of all scrambles took place for emergencies at sea, some 12 per cent over land, and another 12 per cent for Medevac. The Medevac mission consists not only of transporting people, but also transport of donor organs that need to be flown quickly to a hospital.

The Future

Belgian Sea Kings, despite their age and reduced numbers, are currently assigned to SAR duties for about a third of the year (19 weeks). The rest of the year is handled by the new NH90 Caiman, which will eventually take over completely from the Sea Kings in 2018. Withdrawal of the Sea King began in 2015, when the first pilots converted to the NH90, and further training for the Sea King fleet ceased. While the NH90 is qualified to take over all of Belgium's SAR responsibilities, the Sea Kings are kept airworthy with a small cadre of aircrew in order to provide the time required to train adequate numbers of new NH90 crews. There are currently five operational pilots flying the Sea King, translating to 2.5 crews available the type in Belgian service. The NH90, on the other hand, already has 4.5 crews qualified for operational duties.

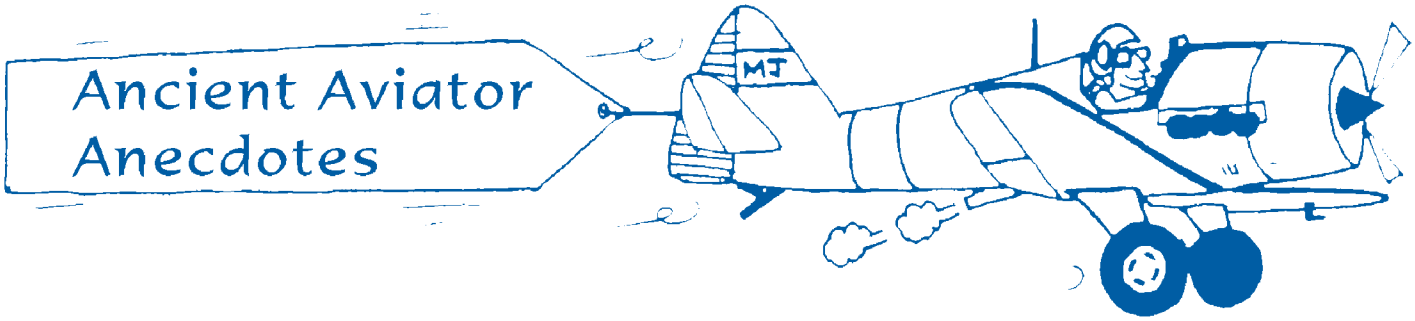
Commemoration

The year 2016 is the 75th anniversary of the Belgian Air Force, and as part of larger celebrations of this milestone, a SAR Meet will be held at Koksijde air base later this year, bringing together many veterans of 40 Squadron, including the surviving members of the aircrews that flew over the first five Sea Kings from the UK in 1976. The SAR Meet will be organised from 10 to 14 October 2016, and will honour the 40th anniversary of the Sea King and the 45th anniversary of the Allouette III in Belgian service.

Text and photos:
Joris van Boven/Sentry Aviation News and Alex van Noije

The old .....

.... and the new



A Pilot's Profile in Numbers
or
"How To Cover 35 ½ Years in 480 Words"

Hawker Hunter F.6 of the RAF, the Mark adopted by the IAF

Both the Indian Air Force and he were born in 1932, six weeks apart. In early 1951 he joined 50 other aspiring flight cadets who formed No. 58 Pilots Course at No. 1 AFA. After 18 months of flying training he was one of the 30 who earned their wings and were commissioned into the flying branch in 1952. As a Pilot Officer he was allotted service number 4346 and, along with 13 of his course mates, was posted to the CTU for fighter conversion. This was the first of his 20 postings in the next 34 years. After serving in eight ranks, he took premature retirement in 1986.

As a bachelor officer (1952-56), he had five postings in four years, and as a married one he moved on postings 15 times in 30 years. Of his 20 postings, seven were to staff/non-flying assignments, covering a collective total of 10 years. The other 24 years were spent in flying and command appointments on 12 air bases, of which nine were in Western Air Command and three in Training Command. He served in three fighter squadrons: Nos. 7, 3 and 20. He raised and commanded two new units for the IAF, one non-flying in 1957 and the other an OTU in 1966, three ranks apart. He attended six non-flying courses in India and one abroad in the UK. As CO/Station Commander/AOC/Commandant, he commanded seven units – two training and five operational – across five ranks.

In thirty-five and a half years he flew a total of 4,261 hours on 22 different aircraft types (piston/jet, single/twin-engine and rotary-wing aircraft) and survived two major flying accidents. He attended two professional flying training courses in India and one abroad in the USA. As a CO, his unit in one case and squadron in the other won the WAC Inter Squadron Weapons Meet twice. As an individual, he received the WAC Arjun a trophy twice for rocketry from two different aircraft types, 14 years and four ranks apart. He was decorated twice, once in peace and once in war.

Of his 30 coursemates commissioned 64 years ago, 15 'octopilots' survive; four of them settled abroad in two countries and 11 in six different locations in India. Married in 1956, he recently celebrated his 60th wedding anniversary. His family of two children and six grandchildren are currently spread over four continents on both sides of the equator. Co-incidentally, this numerical encapsulation of events in the 21st century, turns out to be the 84th in the 'Ancient Aviator Anecdote' series, being recounted by the author now in his 84th year!

Roots, Leaves and Protocol

Adampur is one of the oldest and largest air bases in our Air Force. On promotion to air rank, I was posted to command it during 1978-79. With four MiG and one Pechora squadron, together with the population of a small township, there was never a dull moment either with operations in the air or support/administrative activities on the ground. Among the many memories of my two-year tenure there, I do recall my first experience of high-level protocol.

I was informed that, on a particular date, the Prime Minister of India, along with the Defence Minister, the Chief Minister of Punjab and the AOC-in-C WAC would all arrive at my air base within a short space of time. The two civilian dignitaries from Delhi were thereafter to transfer from VIP aircraft to rotary wing aircraft and airlifted to a helipad in Jalandhar. As per SOP, I would of course receive the AOC-in-C who would in turn receive the Raksha Mantri (RM). Meanwhile the Chief Minister (CM) would arrive by road and, along with the RM, would receive the Pradhan Mantri (PM). At the Jalandhar helipad, the PM and the RM would be received by the Home Minister of the State. Later in the afternoon, the movement would be reversed, i.e. Jalandhar helipad to Adampur

tarmac by helicopter and then Adampur to Delhi by VIP aircraft.

For reasons of safety the PM and the RM never fly in the same aircraft. I was made in charge of the entire exercise with responsibility to make and execute all arrangements to receive, transfer, see-off and ensure security at our tarmac and the helipad, for which two representatives from the IB would also be present but incognito! Administrative arrangements included refreshments on the tarmac if required (vegetarian snacks only) and standby lighting in case the return was delayed beyond sunset. Though the three helicopters were parked no more than 100 yards from the deplaning aircraft, in view of the PM's age, cars were to be deployed.

The Corps Commander at Jalandhar was a good personal friend and assured me that I had only to position the Air Force personnel and equipment for control and flight safety at the helipad and he would provide 'boots-on-the-ground' to seal and secure the helipad at Jalandhar and our tarmac at Adampur. On the actual day the arrival went off as planned except that the PM desired no refreshments, decided to walk from the aircraft to the helicopter and requested me to accompany him. The entourage followed slowly behind us in procession!

The PM asked me general questions about our air base and then some personal ones ("native place ?") and places I had travelled to in the Air Force. I told him I was born in Anand (in his home State) and served in all areas except the East. In those days the only helicopters we had were the light Chetaks. The VVIP sat in front alongside the two pilots, with up to three of his personal staff in the rear. After helping him to strap up in his seat, he smiled, thanked me and said, "Your roots are in Gujarat but the leaves are elsewhere." I wasn't sure how to respond but simply saluted as he lifted off.

The return took place in fading light but went off as planned. After the departure of all the visitors, I sat relaxing in our Mess and shared the PM's enigmatic comment with my senior staff. Our Chief Administrative Officer, who has a great sense of humour, had his own interpretation. "Sir," he said, "the PM was only observing that though you are from Gujarat, you spend your leaves in other places!" We all burst out laughing at this explanation.

Air Chief Marshal Idris Hassan Latif

Idris *Bhai*

Air Chief Marshal IH Latif, PVSM was commissioned into the (then) Royal Indian Air Force in 1942 and is my senior by a decade in both age and year of commission. This ex-Chief of Air Staff (CAS), Governor of Maharashtra and Ambassador to France is too well known to require any introduction. His life story has been most effectively penned in the book 'The Ladder of his Life' by an author who knows him best – his wife, Bilkees Latif. These recollections are therefore not about his public persona but my personal observations of and interactions with the human being behind the public figure, for near 50 years.

First a disclosure: Idris Latif was never my commanding officer. We first met in the late 1950s when, as a young Flt Lt QFI, I was posted to a Palam-based squadron to look after the flying practice of staff officers on the strength of Air HQ and (then) HQ Operational Command. I was required to carry out air tests, brief visiting aircrew and give dual checks. Wg Cdr IH Latif was one of them who came regularly and I was deeply impressed with his utterly polite and friendly attitude towards even very junior officers like myself. In the mid-1970s, as a Gp Capt, I was in command of the air base in Hakimpet and very involved in the induction of the Polish-origin Iskra trainer aircraft. Air Mshl IH Latif was then the AOC-in-C of Maintenance Command, which had one of their logistics units on my station. He flew down personally to check if I needed any logistics/technical help, and if so, I was to call him directly. In the late 1970s, as AOC Adampur, I had a most pleasant visit from Air Chief Marshal and Mrs Latif and never felt any pressure from having the CAS on my air base, quite in contrast to my one earlier experience of having the CAS visit my station!

In 1980, while attending the RCDS in London, I was at the Farnborough Air Show seated in the cockpit of an F-16 fighter in the static display, being briefed by their company representative, when I glanced up and saw the CAS of the IAF standing, patiently awaiting his turn. I immediately began to leave the aircraft but he most courteously waved me back. Later, along with our AAs in London and Paris, we had a delightfully informal lunch with families. On my return to India, I was posted to DSSC Wellington where, following the CAS' annual address and visit, he listened patiently to my plans and was most supportive of the improvements I hoped implement and initiate in our Air Wing there. In 1983-85, as an Air Vice Marshal, I was Commandant of the Air Force Academy when His Excellency the Governor of Maharashtra was the Reviewing Officer at one of our bi-annual Graduation Parades. As was the procedure I had drafted his speech for him. With great humility and charm he asked me if I minded his deviating from the draft and went on to deliver a very effective extempore address. In January 1985 both His Excelleny and his Begum were gracious enough to attend the marriage reception of my daughter in Mumbai and almost failed to recognise me in a *kurta-pajama* !

Since we both retired in Hyderabad we meet frequently at social and professional events as he continues to take interest in the welfare of air veterans. Our personal relationship is more informal now that we have shed our uniforms. One of our mutual Hyderabadi civilian friends once called me up inviting us to a dinner he was hosting for 'Idris *Bhai*' – the very first time I had heard the CAS so addressed! I asked him what time the chief guest was due, as I would need to reach before him as per service etiquette. He laughed and cheerfully enquired as to whether I had not heard of Hyderabad's '*Late Latifs*?' I assured him that I had, but this was one Latif who would never be late – and he wasn't! Among the senior air officers I met and interacted with in the IAF, my icon for humane attributes and *tehzeeb* continues to be 92-year-old Idris *Bhai*.

Air Vice Marshal (R) Cecil Parker MVC

25 Years Back

From Vayu Aerospace Review Issue III/1991

What Now, Air Force ?

The IAF has a vast fleet of MiG-21s of different series approaching phase out, originally planned to commence by 1980-81, starting with the MiG-21FL bought in 1966-67. The IAF had highlighted the requirement for replacement of the Gnat/Ajeet by a Light Combat Aircraft (LCA) which was proposed to replace the MiG-21FLs and M/MFs in the tactical role. Over 10 squadrons were to be re-equipped by the LCA. The original projection was for light weight, agile, economical tactical aircraft with an ordnance capacity of 2 tons and a radius of action of 150-200nm It was to have good manoeuvrability for low level air combat,with emphasis on agility, low cost and an availability in large numbers by the early 1990s. The LCA programme really got going in 1985 and the latest and most optimistic estimates are that the LCA may be available by the year 2001 !

Eurofighter and Rafale

It is relevant to compare the LCA story with two contemporary fighter aircraft which are being developed at the same time by France and the European Consortium i.e. the French Rafale and the Eurofighter Aircraft (EFA). The former first flew in 1986, four years after inception while the latter too flew in 1986, four years after 'go ahead'. Operational clearance is expected in the early 1990s with series production to commence thereafter.

Soviets offer new combat aircraft

In unceasing efforts to keep the Indian Air Force mounted on Soviet-origin fighters, the Mikoyan, Sukhoi and Yakolev bureaus have offered a range of new types, both those under development or variants of existing fighters.The Mikoyan OKB have proposed the MiG-35 which is a developed version of the MiG-29 for multi-role purposes.The Sukhoi Su-37 has been offered as an alternative to meet the IAF's light combat aircraft (LCA) requirement. The Su-37, hitherto unknown to the 'outside world', is assessed to be a true multi-role aircraft, incorporating fourth-generation powerplant, avionics and weapon-systems, giving it strike capability in all weather, plus retaining performance attributes for interception and air defence.In another development, the Yakolev bureau have offered the recently revealed Yak-141 V/STOL fighter primarily to meet the Indian Navy's requirement for a carrier-borne supersonic multi-role fighter.

The new INS *Delhi*

The launching of INS *Delhi*, first indigenously designed guided-missile destroyer marks progress in the Navy's ambitious Project-15, which includes the induction of the heaviest warships, with the most modern weapon-systems to date, into the Navy. Three more ships in this class have already been sactioned, including the INS *Mysore* which awaits launching next. The 6,500-tonne ship is to be equipped with surface-to-air and surface-to-surface guided missiles, but the weapon fit is yet to be finalised. Besides, the vessel is expected to house two Sea King Mk.42B helicopters for ASW/ASV roles.The INS *Delhi,* built to be the lead ship under Project-15, is likely to be commissioned only by the end of 1995 and not 1994 as scheduled earlier.

ALH first flight by end 1991

The first prototype of HAL's Advanced Light Helicopter (ALH) will be rolled out in October 1991 with first flight planned for November-December. Stating this at Bangalore just before the Paris Air Show, RN Sharma, Chairman HAL disclosed that HAL was developing two ALH prototypes, the second helicopter being programmed to fly in the first quarter of 1992.

Indian Airlines A320

According to IA sources, the remaining twelve Airbus A320s on order for Indian Airlines will be delivered by the end of 1992 or in early 1993. Of the total order for 31 A320s, 19 were delivered (with one lost in February 1990) and this new generation airliner was unfortunately grounded while technical (and other) investigations were carried out. The A320 was cleared for 'limited service' after nearly a year but these aircraft continue to be under-utilised. Indian Airlines are to procure another A320 simulator from Canada to expedite training of IA personnel.

PSLV Programme

HAL's Aerospace Division has fabricated and supplied the titanium alloy propellant tank for the PSLV PS4 engine. This engine was ground tested for full duration on 23 February 1991 by the Department of Space at Mahendragiri near Kanyakumari. With its successful testing an important milestone has been reached for the launch of the PSLV scheduled early 1992.

Air Marshal NC Suri next CAS

Air Marshal Nirmal C Suri has been appointed as the next Chief of Air Staff, IAF. During his career spanning nearly four decades with the Indian Air Force, the Air Marshal has held a variety of important command and staff appointments in the field, at Command and Air Headquarters from the command of a fighter Squadron to that of Vice Chief of Air Staff, including Director of Air Defence and Director of Intelligence at Air Headquarters. In April 1987, he took over as Air Officer Commanding-in-Chief, Central Air Command and a year later in March 1988 was appointed Vice Chief of the Air Staff.

RN Sharma is Chairman HAL

Mr RN Sharma has taken over as Chairman, Hindustan Aeronautics Ltd from 2 May 1991. At HAL he has contributed significantly towards design, development and production management of avionics and radars. He headed the Avionics Design Bureau at HAL, Hyderabad Division and became the General Manager of the Division in December 1984. In December 1986, he was appointed as the Managing Director of the Accessories Complex consisting of Lucknow, Hyderabad, Korwa and Kanpur Divisions of HAL.

Tale Spin

The Grand Marshal

In honour of the Marshal of the Air Force on his 97th birthday, the Air Force Station at Panagarh has been named after him, the first such by the IAF.

Still, the choice of this relatively less known air base in West Bengal has evoked some comments as it would perhaps have been far more appropriate to name either Ambala (which he commanded in 1947) or Hindan (which he created in 1966), after the legend–in–his-lifetime, Arjan Singh DFC.

On other side of the Radcliffe line, the PAF has named Chaklala after AM Nur Khan, Sargodha after ACM Mushaf Ali Mir, Shorkot after Sqn Ldr Rafiqui (1965 war), Mianwali after MM Alam (1965 war) and Mauripur at Karachi after Air Cmde Masroor Hussain.

Sheria Faisal (named after Saudi King Faisal) was earlier Drigh Road where, in fact, the Indian Air Force's first unit ('A' Flight) with Wapitis was raised in April 1933.

The USAAF Connection

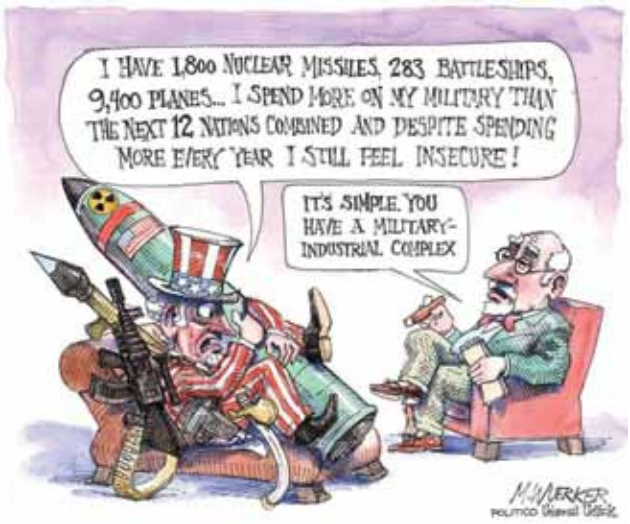
As for Panagarh itself, this airfield was built during World War II for use by the United States Army Air Force's 10th Air Force, whose B-24 Liberator heavy bombers and other types were deployed here. In disuse thereafter for over a quarter century, Panagarh was 'reactivated' in 1971 for operation by IAF Su-7s during the air campaign over East Bengal (soon to be Bangladesh). Panagarh is now to house the IAF's new C-130 squadron.

However, during WWII the USAAF had a near score of airfields in eastern India, including that at Chhara (Purulia) on the Bihar-Bengal border, and as mentioned in Air Chief Marshal PC Lal's memoirs when, leading his fighters of No.7 Squadron, they ran into severe weather conditions and landed at the first airfield they saw – only to be put under close arrest by US soldiers! It later transpired this was one of the 'secret' bases from where American B-29 Super Fortress bombers were to carry out long range, strategic bombing of Japan's mainland.

The rest is history.

Desi Military–Industrial Complex

In ending the public sector's monopoly over aircraft and defence equipment production, the Indian Government has proposed involvement of the private sector for building aircraft, ships, howitzers and so on. At the same time, the FDI cap in defence has been raised to 49% so as to address India's defence procurement challenges.



(Contributed by Mahin Malik)

Will India one day emulate the United States of America ?

Happy Birthday !

After an IAF Sukhoi Su-30 shot down an unidentified flying object over Barmer in Rajasthan earlier this year, the intruder turned out to be a large (10 foot diameter) helium-filled balloon. It was soon established that this UFO from across the border in Sind did not carry any 'dangerous payload' but had 'Happy Birthday' written across it.

Must have been quite a party !

愚人节快乐 !

To those who do not read Mandarin, the Roman Chinese for the above is *Yuren Jie Kuaile* which means 'Foolish Man Festival' or 'Happy April Fool's Day' in rest of the world ! China's official news agency stiffly states that the occasion "does not conform with our nation's cultural traditions, nor does it conform with the core values of socialism".

However, this was greeted with a collective guffaw suggesting that in China, every day is April Fools. "You speak lies every day, use government policy, data, to trick the people in every way. What's up? What's down ? What's wrong ? What's right? We're on to you."

Afterburner

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