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Cover : US Army soldier at Ranikhet during Exercise Yudh Abhyas 2014 (photo: Angad Singh)

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Defence Budget 2016

A burgeoning military pension bill created by the 'One Rank One Pension' (OROP) scheme has caused an unprecedented cut in the modernisation outlay of the defence ministry, leaving less money available for buying new equipment for the armed forces. It is the first time that defence pensions have overwhelmed money allocated to modernise the armed forces, with the ministry seeing an 8.5% reduction in the capital outlay. It was also the first occasion that a finance minister did not mention 'defence allocation' even once during his speech.

The reduced allocation for modernising has also cast a shadow on the growth potential of the fledgling private sector in defence that relies only on government orders. Uncertainty has also emerged over several pending acquisitions such as the Rafale jet deal. It is another matter that the ministry has also failed to spend funds allocated for buying new equipment, over Rs 11,595 crore, or 13.4%, of the defence acquisition outlay has been returned this financial year.

The government last year approved the OROP plan, a long-awaited demand of retired military personnel to equalise pension payments despite the huge fiscal burden. If pensions are included, the increase in defence allocation is over 9%. But if pensions are excluded, allocation in the overall defence budget has risen barely 1.16% from a year ago. This will not even suffice to meet the inflationary pressures and the increase in salaries this fiscal.

From *Economic Times*

Power play in Indian Ocean

While competing claims in the South China Sea grab the headlines, the strategic framework being laid out around the Indian Ocean by India and China is going unnoticed. Jostling in the Indian Ocean is more about how China and India place themselves at a strategically advantageous position in the region. China's phenomenal economic miracle necessarily extends its footprint into the Indian Ocean, to protect its sea lanes for energy supplies and trade. In pursuit of its strategic interests, China finds a ready partner in Pakistan. Their relations, known for their endurance, are expanding in scope. Common adversaries, mutual interests and prudence have cast their relationship into an "iron friendship".

The military component of this relationship has also come to assume a vital strategic dimension. China now provides half of Pakistan's military hardware and has demonstrated a willingness to transfer technology to Pakistan. China sees growing cosiness between India, the United States and Japan threatening its sea lanes, especially the energy choke points at the Hormuz and Malacca straits, in the Indian Ocean as well as in the South and East China seas. China watches India's military overtures to Mauritius and Seychelles with concern. Recent reversals in Chinese influence in Myanmar and Sri Lanka have been to India's advantage. Of particular anxiety to China is India's potential military build-up in the Andaman and Nicobar archipelago just north-west of the Strait of Malacca, from where India can project its power into the strait and beyond Pakistan, despite modernisation of its navy, will find it difficult to tackle India's formidable naval arsenal alone. Hence its dependence on China.

India's maritime doctrine reflects the thinking of Indian historian and diplomat KM Panikkar that the Indian Ocean is Indian. In a 1945 essay, he recognised Vietnam's importance in controlling China's entry into the South China Sea and the Indian Ocean. This forethought underlines modern-day Indian attempts to develop security relations with Vietnam. India's building of a satellite station in Vietnam to eavesdrop on China is no comfort to the Chinese.

China, which had built Gwadar Port, was displeased when, to manage the port, Pakistan picked Singapore's PSA in 2007 in competition with the Chinese and Dubai bids. Since Pakistan's own defence is closely tied to Chinese interests, Defence Minister Ahmed Mukhtar went public in a Financial Times report in May 2011, disclosing that "we have asked our Chinese brothers to please build a naval base at Gwadar".

Transferred to China Overseas Port Holdings Company in February 2013, the port remains civilian in nature, for now. But regular visits by Chinese vessels to Karachi and Gwadar allow the People's Liberation Army-Navy (PLA-N) to get acquainted with the local operating environment, in partnership with the PN. This interoperability and technological synchronisation will be an equaliser for China in a tussle to control the region. In this Indian Ocean chessboard, if China obtains naval facilities at Gwadar, China in one stroke positions itself to defend its own energy supplies passing through the Indian Ocean choke points, especially Hormuz. A bridgehead at Gwadar eases China's "Malacca Dilemma" through the projected overland supply lines to western China. The recent news of China setting up a naval base in Djibouti, on the African side of the Indian Ocean, is a pointer to China's future strategy.

Pakistan's enfeebled economy, internal discord and growing isolation make it increasingly dependent on China. Pakistan, therefore, considers a strengthening of China's position its own. It is most likely that Pakistan, seeking that elusive sense of equality with India, would facilitate China's presence in the region. The two navies are strengthening relations due to the changing international environment. China is helping Pakistan modernise and enhance its naval capacity. But despite all this modernisation, Pakistan alone will find it difficult to tackle India's formidable naval arsenal that is to include aircraft carriers and nuclear-powered submarines. Hence China.

As geopolitical alignments are changing, strategic interests are drawing China into the Indian Ocean and India into the South China Sea. This tug of war between the two biggest countries, projected to be the two leading economies of the world by mid-century, could potentially be damaging for ASEAN interests. Placed in the middle of the two, ASEAN has the historic opportunity to be the moderator and to promote the peaceful rise of China and India for the larger good of the region and beyond. This is a challenge, which ASEAN leadership must embrace.

From *The Straits Times*

The Challenge for India

Three recent events underline India's efforts to highlight its growing maritime interests and ambitions in order to secure them unilaterally and in partnership with others. The first was the quiet release of the Indian Maritime Security Strategy (IMSS) titled *Ensuring Secure Seas* in October. The second was the holding of the combined senior commanders' conference, with top officers

from all three services, on board INS *Vikramaditya*, the Indian Navy's latest aircraft carrier and its largest platform, in December. The last and most recent was India's hosting of its second International Fleet Review (IFR) at Visakhapatnam in early February.

While the pomp and circumstance as well as the photo-ops of the IFR, which attracted naval vessels from 50 countries, predictably, created the biggest splash, its significance is best understood in tandem with the 185-page IMSS-2015. Although the document is simultaneously comprehensive, conservative and cautious, it conveys one key message: India is now willing to provide "net maritime security" either by itself or in cooperation with other navies in its primary and secondary areas of interest, which now extend from the west coast of Africa to the south-east Indian Ocean, "including sea routes to the Pacific Ocean". One instance of this cooperation was the IBSAMAR V exercise conducted with Brazilian and South African ships off the coast of Goa just after the IFR.

While the document dutifully records the various maritime initiatives announced by Prime Minister Narendra Modi, including *Project Mausam*, *Blue Chakra* (from the *Ashok Chakra* on the Indian flag) and SAGAR (Security and Growth for All in the Region), it does not explain how they relate to each other or how they would be operationalised.

Curiously, in his uncharacteristically lacklustre speech on the occasion of the IFR, Modi recited the *Blue Chakra* and SAGAR mantra but made no mention of the IMSS-2015, which could tie these various initiatives together. Instead, he announced the decision to host the first Global Maritime Summit in April without elaboration.

Clearly, despite articulating its intentions and working with several other nations, India faces formidable internal and external challenges in securing its interests at sea. While the IMSS-2015, despite its limitations, is a good beginning, it will come to naught unless there is buy-in and coordination at the highest level to ensure its implementation.

From *MINT*

Flying Against Logic

Ratan Tata's comments favouring scrapping of the so-called 5/20 norm for airline operators merits serious consideration by the country's policy makers. The chairman emeritus of Tata Sons has rightly criticised the rule that requires an Indian carrier to have a minimum of five years of domestic running experience and at least 20 planes in its fleet to operate international flights. Tata may have business interests in seeing that this rule goes. His group, after all, is a co-promoter of two relatively new airline ventures — Air Asia India and Vistara — whose operations are impacted by the 5/20 rule. But that does not diminish the strength of the basic argument that he is making of how the entrenched carriers are using "monopolistic pressures" and "lobbying" to retain the rule.

Business interests apart, it is consumer interest that is the real issue here. In a liberalised economy, the government cannot dictate the fares that airlines charge from consumers. All it can do is ensure a regulatory environment that allows competition. The 5/20 norm clearly undermines this by circumscribing new entrants and foreclosing the benefits that would accrue to consumers by way of cheaper tickets, better services, newer routes and seamless travel. The supposed rationale behind the rule is to ensure that only credible airlines — with recognised records of safety, experience and financial strength — are allowed to operate. This argument would effectively shut out even ventures that have established international carriers as co-promoters. This is the case with the two Tata joint ventures, and also others that may be wanting to set up similar JVs.

Related to this is the fact that in today's world, making distinctions between domestic and international operations of airlines makes no sense. There are many overseas Indian workers living in hinterland Indian towns, using domestic flights to connect to metro airports for international travel. These consumers, mostly from less well-off backgrounds, stand to gain from airlines offering seamless connectivity at competitive rates, including through leveraging their international network and plying specific, hitherto under served routes. At the end of the day, it is all about lowering the barriers of entry in aviation or, for that matter, any business. The NDA government should lay to rest the controversial rule as part of its much-awaited civil aviation policy.

From *The Indian Express*

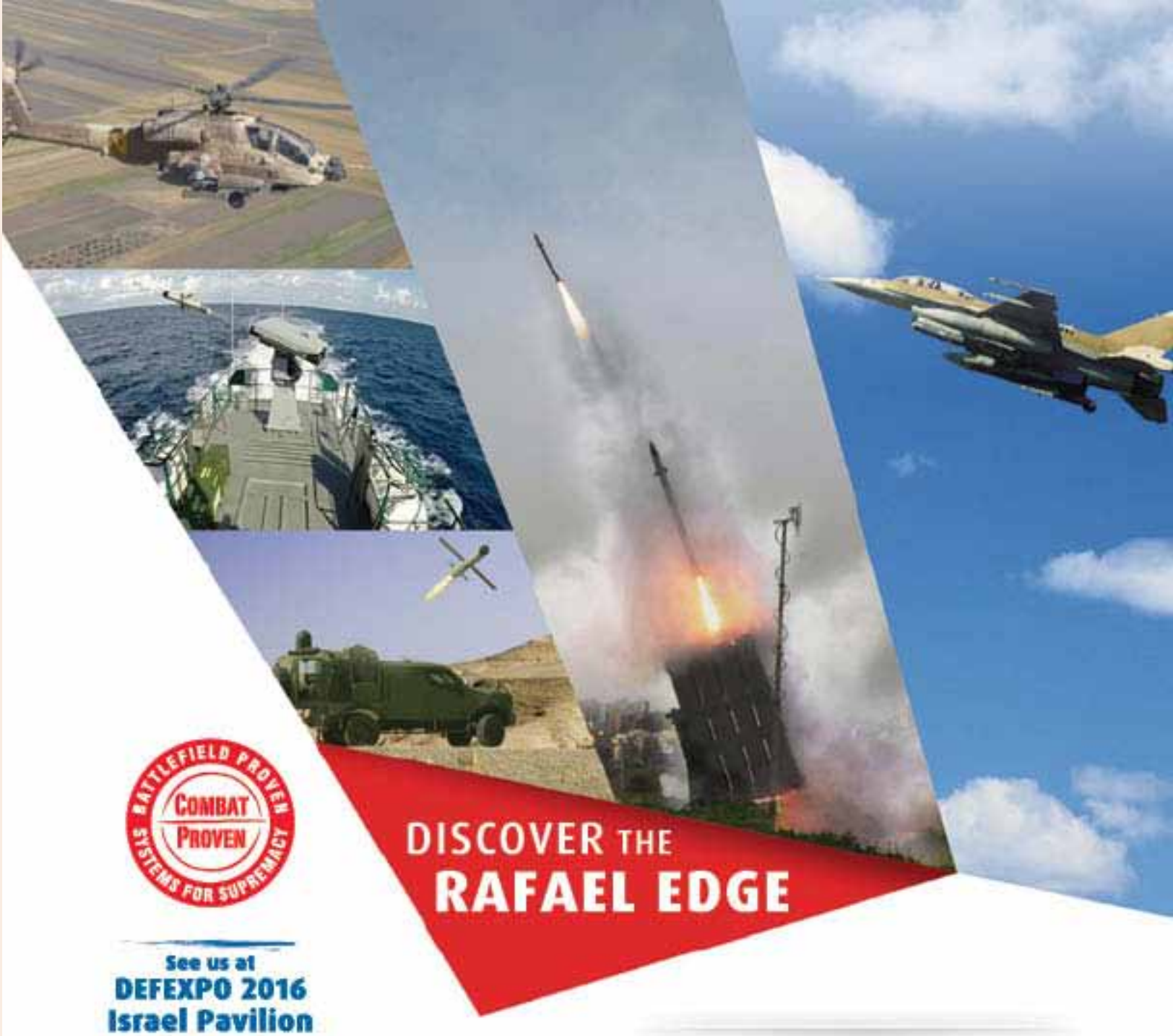
Deeply Disappointing

The US government's decision to sell eight F-16 fighter jets at half price to Pakistan is deeply disappointing. The deal comes at a time when there's mounting evidence of Pakistan's double game on terror. From revelations of convicted Pakistani-American terrorist David Coleman Headley to former Pakistani President Pervez Musharraf's recent candid assertions, links between terror groups like Lashkar-e-Taiba (LeT) and Pakistan's ISI-military complex can no longer be denied. Add to this Pakistan's clandestine patronage of the Haqqani network that works to destabilise the Afghan government.

Against this backdrop Washington's assertion that the F-16 deal will aid Islamabad's counterterrorism operations is utterly unconvincing. F-16s are of little use against terrorists. As Pakistan's former US ambassador Husain Haqqani has warned, they will be used against India instead. What's truly inexplicable is that the US continues to militarily aid Pakistan when the latter is supporting elements that directly threaten American interests, especially in Afghanistan. Plus, Islamabad's non-proliferation record is highly dubious and it has been building up its nuclear arsenal at a rapid pace.

Military transfers at this point will encourage Pakistan to step up its sponsorship of terror, insecurity in south Asia and proliferation of nuclear arms – as the more it does so the more rewards flow to its military – while the India-Pakistan peace process becomes collateral damage. Those are precisely the reasons why US lawmakers like senator Bob Corker, chairman of the Senate foreign relations committee, have refused to clear the F-16 deal. Washington can't possibly lead a global charge against terrorist safe havens while supporting the same forces that sustain extremist elements. New Delhi must step up its lobbying against the deal, and work with American lawmakers opposed to it to scuttle it for good.

From *The Times of India*



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Chinks in the Armour

Air Marshal Brijesh D Jayal believes that the military leadership's mindset has to be 'de-bureaucratised'

As the festivities marking the end of the nation's 67th Republic Day drew to an end, one was left not with a spirit of bounden pride as one recalled during one's younger days but with a feeling of mixed emotions. The solemn ceremony with the prime minister along with the three service chiefs paying homage at the Amar Jawan Jyoti is a moment of collective reflection and a befitting beginning to the celebrations. Befitting, because it also signifies an umbrella of unlimited liability provided by the individual soldier, sailor and airman that assures the nation security for continued progress. One does wonder, however, if in those two minutes of homage, the prime minister heard the silent plea of the martyrs reminding him of his party's grand electoral promise to give to them a permanent memorial of their own.

When this was followed, as it was this year, by a young widow, Bhavna Goswami, standing in dignified composure in front of the supreme commander of the armed forces whilst the citation for the posthumous award of Ashok Chakra to her late husband, Lance Naik Mohan Nath Goswami, of the Special Forces was read out, it is difficult for the very large majority to fathom what spirit and motivation drive such men to certain death in the line of duty. Yet, it is this breed of military men and women and their exploits that must provide the oxygen of inspiration to our younger generation to give to the nation and not to count the cost.

Between these inspiring and emotional opening stages and the last strains of Gandhiji's favourite hymn, *Abide with Me*, played by military bands in the closing stages of the Beating Retreat followed by their march into the sunset to the tune of *Sare Jahan Se Achcha*, there was much for the nation to celebrate, but more importantly to ponder.

That all is not well in civil-military relations within our democracy has been the subject of a fairly wide-ranging debate for many years now. That no effort has been made by successive civil dispensations to alter the *status quo* is also no longer a secret. What perhaps is not so well appreciated is that such an unstable relationship in an otherwise vibrant democracy is unsustainable without rupture in the long run, and to those with a keen eye, initial signs of this fatigue are beginning to show. Basking in the superficial pomp and ceremony of military pageantry, like the one just seen, and believing that all is well are a delusion that the nation may some day come to regret.


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In the midst of celebrations came reports that the defence minister had asked the Central Bureau of Investigation to enquire into allegations of corruption levelled against two serving major generals by-passing the normal in-service procedures, presumably because the service itself had failed to act on the earlier allegations. These general officers were part of a select three of a panel of 33 major generals who had reportedly made the grade to be promoted to the rank of lieutenant general. The special promotion board that took the decision consists of the senior-most army commanders along with the chief. It speaks volumes that the defence ministry has withheld approval of even their recommendations. Clearly, there must be strong reasons for doing so.

Whether or not the allegations against the two general officers being investigated are valid is for the CBI and the defence ministry to verify. But two vital questions follow. Now that there is a shadow of impropriety on their part, where does it leave the professional judgment of the very top echelons of the army on whose shoulders rest the morale and quality of our war-fighting? Further, the fact that the defence minister has found fit to pursue this investigation and hand it over to an agency outside the armed forces sends a stark message to the rank and file that all is not well at the highest echelons of the army in particular and the armed forces in general.

Matters only get more curious when it emerges that both these general officers were awarded the Ati Vishisht Seva Medal in the Honours and Awards list of 2015, a process like that of the service promotion board that is not only highly competitive but also must pass muster through many layers of command. Once again, it will now be for the investigative system to determine whether or not these awards are deserved, or the system vitiated.

A glance at this year's Republic Day Honours and Awards list does leave one somewhat uncomfortable. Of the 187 distinguished awards to army personnel, some three-fourths go to star ranks. Of these, the three-star ranks were privileged to have received nearly one fourth. With such a distinguished performing senior leadership, one wonders why serious allegations of wrongdoing in purchases, land deals, promotions and even manipulation of lines of succession keep cropping up?

Morale and motivation in the armed forces are the bedrock on which the likes of Lance Naik Goswami are willing to sacrifice their lives, and on which our uniformed men and women strive to give their all for the country. Aptly, these qualities do not feature in training and operational manuals or in the respective armed forces Acts. They are determined solely by faith and trust between the led and those chosen to lead which is best signified by the Chetwode credo : 'The safety, honour and welfare of your country come first, always and every time. The honour, welfare and comfort of the men you command come next. Your own ease, comfort and safety come last, always and every time.'

This credo engraved on the central hall of the Indian Military Academy is the guiding beacon not just for the gentlemen cadets but for all officers of the armed forces. It is this spirit that has seen the nation brave external and internal threats thus far, and it is this spirit that is now under serious assault from within. Not surprisingly, a recent editorial was constrained to comment, "The army is, or should be, one of the institutions commanding the highest respect in the country. But the behaviour of its officers, their persistent pursuit of their own interests, their lapses in discipline, and even of integrity among some of them, is reducing the army to an object of ridicule. This can only spell danger for the nation."

Military historians have recorded concerns harboured by independent India's leadership about maintaining civilian control over the armed forces. This paranoia has stymied an ideal model of political control over the military from evolving, patterned somewhat on the lines of other liberal democracies. Instead, a convoluted model of bureaucratic control over the military has taken firm root. The bureaucracy now holds complete sway without being accountable for the administrative and operational consequences of this unfettered authority.

Over the years, unseen to the public eye, this has resulted in the degeneration of morality and ethics of some in the military leadership as well as the seeping of the civilian bureaucratic mindset into the military hierarchy. The bureaucracy as an institution is *status quoist* and malleable, and would bend to suit the occasion. The military, on the other hand, is bound by rigid norms and discipline enforceable by special service Acts, codes, ethics and honourable traditions. The bureaucratisation of the military mindset, where being on the right side is more important than believing what is right and cultivating the right godfathers matter more than service to the nation and those one commands, thus comes at a great cost to the institution of the military.

Tradition and merit are the first casualties of this culture, which is manifesting itself in benign ways as well. As far as one can recollect, the Republic Day march past has always included military veterans who have traditionally received an enthusiastic and grateful applause. Their absence this year leaves one wondering if the system is now at odds with its veterans. More importantly, the veterans of tomorrow may not take kindly to this slight. Finally, Beating Retreat is a traditional military function and full of significance to the military. Introducing police bands and playing around to reduce it to entertainment is, to this writer's mind, a sacrilege to military tradition.

In a refreshing departure from tradition and on directions of the prime minister, the venue for the combined commanders' conference last year was moved away from bureaucracy-driven Delhi to the operational environs of INS *Vikramaditya*. Addressing the commanders, the prime minister emphasised that the nation looks to its armed forces to prepare for the future, that the forces and the government need to do more to reform their beliefs, doctrines, objectives and strategies, and that the need is for military commanders, who not only lead brilliantly on the field but are also looked upon as leaders, to guide our forces and security systems into the future.

These are valid security imperatives. But none of this is possible unless the military leadership's mindset is first 'de-bureaucratised'. Towards this, the nation needs to arrive at its unique model of civil-military relationship. As has often been argued in these columns, the way forward is to start on a clean slate and set up a Blue Ribbon Panel to guide the nation to this model. One wonders if the prime minister is willing to bite this bullet ?

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Admiral Arun Prakash on

The IFR 2016 : Foreign policy by other means ?

India's first citizen, President Pranab Mukherjee, was accorded a rare honour by the Indian Navy on 6 February 2016. Embarked on the 'Presidential Yacht', Mukherjee, who is also the Supreme Commander of India's armed forces, reviewed a fleet of nearly 100 warships, submarines and merchantmen, anchored in neat columns off Vishakhapatnam harbour. As he passed each ship, the crew doffed their caps and rendered the traditional 'three-cheers' (the Hindi version is *teen jai*). Amongst those paying this mark of respect were ships and sailors from many foreign navies, while overhead, Naval aircraft flew past in formation.

The fleet review's provenance is essentially British, and it was instituted in the 15th century to enable the monarch to formally inspect his/her Navy and to convey to friends and adversaries alike its readiness for war.

In India, ceremonial reviews have been held once in each President's tenure, with Mumbai as the traditional venue. On occasions when foreign ships and delegations are invited, it becomes an International Fleet Review (IFR). Because Mumbai harbour is constricted by space and depth of water, and owing to dense winter haze and smog, the IN decided to shift the venue to the east coast. In 2006, for the first time, President APJ Abdul Kalam reviewed the fleet off Vishakhapatnam, whose deep water and open sea frontage allowed thousands to obtain a ringside view of ships and aircraft from the Ramakrishna beach.

I had the privilege of being at the helm of the IN at the time and Dr Kalam had, typically, conveyed to me that (against his physician's advice), immediately after the review, he would like to sail in a submarine. The Supreme Commander's 'wish' being 'our command' the submarine *Sindhurakshak*, (which was to meet with a tragic accident in 2014), was readied, but a major hurdle faced us; the IN lacked a submarine rescue facility – and it still does. The US Navy, graciously, came to our help and promised to keep an airborne submarine rescue facility in instant readiness for the duration of the President's underwater sojourn. Needless to say, Dr Kalam thoroughly enjoyed his six-hour dived passage on the *Sindhurakshak* and insisted on investigating every corner of the submarine.

The last IFR, in 2001, had seen 29 foreign navies participating, but this time around it was a much grander affair, with many more overseas guests – both warships and delegations. The decade and a half elapsed since the last such occasion has seen the IN gain substantially in numbers, capability and most importantly, in professional standing amongst maritime forces worldwide. No foreign observer would fail to notice the impact of the revolution in military affairs (RMA) on the IN. It is manifest in the recent induction of a large aircraft-carrier with supersonic fighters, a nuclear attack submarine, advanced long-range missiles and torpedoes, phased-array radars, airborne early-warning helicopters, modern anti-submarine warfare (ASW) patrol aircraft and unmanned aerial vehicles. Much of this was on display at Vishakhapatnam.

Navies, unlike armies and air forces, have a substantive role to play in peacetime, as handmaidens of diplomacy. The Indian Navy's active outreach to its counterparts internationally, has been a powerful catalyst in strengthening old relationships and creating new ones. For the IN, 'foreign cooperation' has wide connotations and covers a range of activities that include, bilateral exercises, joint patrols, port-calls and flag-showing deployments that enhance rapport, inter-operability, goodwill and understanding.

Apart from being an elaborate ceremonial and 'coming out' party for a rejuvenated IN, IFR 2016 was also a medium for its message: 'United through Oceans.' This huge international gathering of young sailors and officers as well as senior leaders, of all major and regional navies, provided an invaluable opportunity to strike bonds of friendship at the personal, professional and service-to-service levels. In this context, the presence of Chinese navy ships in Vishakhapatnam was to be welcomed.

India has been trying to give substance to its vision of the Indian Ocean Region (IOR) as a unified and cohesive geo-political space by creating multi-lateral forums. Two examples are the Indian Ocean Rim Association (IORA), formed in 1994 and the Indian Ocean Naval Symposium (IONS), initiated by the navy in 2008. So far, both these bodies have seen limited success. Borrowing from Clausewitz, we hope that IFR 2016 will enable India to more effectively 'pursue foreign policy by other means'?

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India-Japan Relations : Prime Minister Shinzo Abe's Visit

The foreign and security policy of India, like that of any other country, is shaped and influenced by geopolitics, geo-economics, geography, history, cultural parameters, and most importantly, vital national interests. The changing economic, military and strategic environment in and around South Asia, South East Asia and East Asia has had its effects, with India trying to reach out for new avenues for exercising greater mobility and flexibility in the regional sector for the conduct of its foreign policy including in its 'Act East' policy. All these aspects, including related security issues, have their impact on India-Japan relations with profound policy ramifications.

After the mutual warmth in the 1950s during the Nehru era, India and Japan drifted apart during the Cold War. Prime Minister Shinzo Abe during his first landmark visit to India in August 2007, however, traced his personal affinity towards India to the sentimental visit of his grandfather and prime minister of Japan, Nobusuke Kishi, who arrived in India during 1957 to a friendly reception from Jawaharlal Nehru. In recent times, this was followed with the meeting in Tokyo on 1 September 2014 between Prime Minister Narendra Modi and Prime Minister Shinzo Abe and subsequently Abe's visit to India from 11 to 13 December 2015, pledging to realise the full potential of India-Japan Strategic and Global Partnership "for continuing progress and prosperity for their respective people and for advancing peace, stability and prosperity in Asia and the world". Elevating the relationship to a Special Strategic and Global Partnership, they called their meeting "the dawn of a new era in India-Japan relations". Both sides also agreed to build complementary skills and resources to build a strong partnership to promote economic and social development, capacity-building and infrastructure development in other interested countries and regions.

In this context, the high profile memorandum of cooperation on the high-speed US$ 12 billion export credit of the Shinkansen Bullet Train system between Mumbai and Ahmedabad to be financed with a very minimal Yen loan of 0.1 percent has been signed. Japan will create facilities to support Japanese companies investing in India to further Prime Minister Modi's *Make in India* objective. The two sides also voiced support for 13 big infrastructure projects to be financed by ODA loans such as Metro projects both in Chennai and Ahmedabad and road network connectivity in India's Northeastern states.

The rise of China in recent years has compelled Japan to re-evaluate its own long-term options in Asia that many expect would inevitably become Sino-centric for maximising Chinese national interests. The focus of both New Delhi and Tokyo is on widening the window of flexibility and opportunity in their conduct of foreign and security policies in Asia rather than seek an impossible containment of China that would provide no benefits to any party either in the short term or long term. With China's assertive foreign policy challenge in the East and South China Seas in mind, Modi and Abe have underscored certain principles in sync with the norms of international law: the importance of the United Nations Convention on the Law of the Sea, peaceful resolution of disputes without use or threat of use of force as stated under the UN charter, freedom of navigation and overflight and unimpeded lawful commerce in international waters. Modi and Abe have called upon all littoral states in the region to avoid unilateral and provocative actions in the South China Sea that could exacerbate tensions in South Asia, South East Asia and East Asia.

The two countries welcomed the significant progress in negotiations on the Agreement for Cooperation in the Peaceful Uses of Nuclear Energy and subsequently sealed a deal. The legal and technical work that remains to be done relates essentially to Japan's internal bureaucratic procedures

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and certain technical and legal issues. They directed their officials to further accelerate the negotiations with a view to concluding the Agreement at an early date, and strengthen the two countries' partnership in non-proliferation and nuclear safety. While Prime Minister Abe commended India's efforts in the field of non-proliferation including the affirmation that goods and technologies transferred from Japan would not be used for delivery systems for WMD, Prime Minister Modi appreciated the decision of the Government of Japan to remove six of India's space and defence-related entities from Japan's Foreign End User List. They also looked forward to enhanced trade and collaboration in high technology.

Both sides also affirmed their commitment to work together for India to become a full member in the four international export control regimes: Nuclear Suppliers Group, Missile Technology Control Regime, Wassenaar Arrangement and Australia Group, with the aim of strengthening the international non-proliferation efforts.

As Asia, the world's largest continent, undergoes major transformation in terms of power configurations, India and Japan are acutely aware of the need for political and security cooperation between the two countries for ensuring order, stability and equilibrium among the region's great powers. Both Modi and Abe pledged to work together to strengthen connectivity between SAARC and ASEAN. Both India and Japan also affirmed the promotion of political dialogue including Japan-India-US trilateral cooperation, and security cooperation such as joint maritime exercises and continuation of 2+2 dialogue, a formal bilateral framework between their foreign and defence ministers. They also discussed several important bilateral as well as regional and global issues. In view of economic opportunities and geo-strategic compulsions between India and Japan, one hopes that under Japan's Prime Minister Shinzo Abe's stewardship and that of India's Prime Minister Narendra Modi, the same momentum would be carried forward in 2016 and beyond toward a new paradigm of mutual benefit on a win-win proposition.

Dr Mohammed Badrul Alam,
Courtesy CLAWS

Report of the Expert's Committee

Amendments to DPP 2013 and Formulation of Policy Framework

The Committee which was set up under Chairmanship of Mr Dhirendra Singh, former Secretary for Defence, and including Mr Satish B Agnihotri, Air Marshal S Sukumar, Lt Gen AV Subramanian, Rear Admiral Pritam Lal, Dr Prahlada, Col KV Kuber, Mr Sujith Haridas, Mr Sanjay Garg (JS (DIP), MoD and Mr Subir Mallick (JS &AM(LS), of the MoD, submitted its draft report in mid-2015.

This went into public domain in July 2015 and has been discussed and debated extensively, including in various open forums since then. The Defence Minister Mr Manohar Parrikar has announced that, after its clearance by the DAC, the DPP 2016 will officially be notified in early April 2016, emphasising that the new defence procurement policy "will give priority to indigenously made defence products and boost the 'Make in India' initiative."

The reality is that for more than 15 years, the Government of India has considered the entry of private industry into defence production but in spite of that, indigenous defence manufacturing remains dominated by the defence public sector undertakings (DPSU) and the Ordnance Factories Board (OFB), which jointly have some 80-90% share.

Local manufacture of defence equipment is at the heart of the 'Make in India' programme, but the country continues to import nearly 60% of its defence equipment. Of late, private Indian companies have shown increasing interest in the defence equipment business and have applied for industrial licences from the ministry of commerce to locally manufacture military equipment, including aircraft and warships. Companies such as Bharat Forge Ltd, the Tata Group, Larsen & Toubro Ltd, the Godrej Group and the Mahindra Group are looking ahead for substantial opportunities and some already have major stakes. Anil Ambani's Reliance Group and the Adani Group's Adani Defence Systems & Technologies Ltd are the latest to enter the field.

Strategic Partnership Model

The Strategic Partnership Model (SP) is being recommended for creating capacity in the private sector "on a long term basis" and is to be above and beyond the capacity and infrastructure that presently exists in the public sector. The Government will constitute a 'Task Force' to lay down the criteria for selection of Strategic partners in six segments :

Aircraft : fighter, transport and helicopters and their major systems; ***Warships*** of stated displacements and submarines and their major systems ; ***Armoured Fighting Vehicles*** and their major systems/weapons; ***Complex weapons*** which rely on guidance systems, to achieve precision hits, which may include anti-ship, air defence, air to air; air to surface, anti-submarine, land attack; ***Command, Control, Communication and Computers, Intelligence, Surveillance, Target acquisition and Reconnaissance (C4ISTR); Critical materials*** (Titanium alloys, Aluminium alloys, Carbon composites, Nickel / Cobalt alloys etc.)

The ***Committee on Strategic Partnership*** has been chaired by Dr AK Aatre, former SA to the Defence Minister and DG DRDO whose recommendations are presently being considered for approval by the Cabinet Committee on Security (CCS) which will have the final say on which company will be "qualified". The scope under the 'Make' category would be broad based, considering that lead developers, either from the DPSU or the private industry would have support from the DRDO. Some 'large projects' would have DRDO as the lead developer with support from the industry as co-producer which has several implications.

An intriguing scenario : could ADA select a private company to productionise the Tejas LCA which has gone into series production at HAL's Bangalore Complex ? Time will soon tell !

DPP 2016 : An Appraisal

In order to provide the necessary thrust to improving the defence manufacturing environment and lend impetus to the defence acquisitions in India, the *Committee of Experts for Amendments to DPP 2013 Including Formulation of Policy Framework ('Committee')* was formulated by the new Government on assuming office in mid-2014 and this committee submitted its findings and recommendations to the Government on 23 July 2015. In clear departure from the norms of secrecy followed hitherto for all such reports by Government nominated committees, this report was put on the public domain by hosting it on the Ministry of Defence (MoD) website.

Evidently the endeavour was to obtain maximum feedback. Having carried out the necessary iterations based on the feedbacks received, the Acquisition Wing of MoD fielded the revised Defence Procurement Procedure (DPP) 2016 for approval by the Defence Acquisition Council (DAC), the apex decision-making body of the MoD on 11 January 2016.

The new DPP, less one chapter, was sought to be notified some two months after incorporating certain corrections. Based on the report from a task force headed by former DRDO chief V K Aatre, the chapter on the selection of 'Strategic Partners' would be notified separately while the MoD would promulgate a separate policy document on the 'blacklisting' of foreign firms and the role of middlemen in defence deals.

Highlights of the new DPP

A new category 'Buy Indian', for 'Indigenously Designed, Developed and Manufactured (IDDM)' platforms, has been introduced which will be the highest priority category to process defence capital procurements. This new category is further subdivided into two sub-categories


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- *First subcategory* mandates 40% domestic content for a domestic design.
- *The second* mandates 60% local content if the design is not Indian. However, it is mandatory that the domestic companies eligible under this category must have majority Indian control and should be operated by an Indian national.

In addition to building a technology base in the country, the government, via the Department of Defence Production (DDP) has proposed to fund R&D efforts. For the 'Make' category, the new DPP will permit government funding up to 90 per cent of developmental costs to private companies to promote research and innovation.

The 'Make' category will consist of three sub categories:

Make-I will involve 90 percent government funding for development cost and provision to reimburse remaining 10 percent.

Make-II is proposed to be industry funded, but with a clause that 100 percent refund will be granted for successful prototypes in case the procurement does not fructify within two years.

Make-III has been structured for MSMEs, and shall be applicable for projects with cost less than Rs 3 crore, other provisions remaining same as for the Make-II category.

It is emphasised that only firms with majority stake and controlled by resident Indians will come under the 'Make' categories.

The new DPP has addressed the delays in acquisition processes by cutting down on the existing time lines. The validity of the Acceptance of Necessity (AoN) has been brought down to six months from the earlier one year, implying that Service Headquarters will have to issue the Request for Proposal (RFP) that much faster.

The RFPs will comprise enhanced performance parameters for additional capabilities over and above the essential parameters. 'Vendors' which meet them will be provided additional credit scores while evaluating their product cost.

Moving away from the phobia of single vendor situations, the new DPP permits accepting bids even if there is only one supplier, however a proper justification for the same would be required.

And lastly, the threshold for applicability of offsets has been raised from the current Rs 300 crore to Rs 2000 crore. This implies that only those foreign OEMs which conclude contracts for over Rs 2,000 crore will have to plough back at least 30% of the contract value into Indian enterprises as offsets. In other words, deals with contract values less than Rs 2,000 crore will be exempt from the offsets obligation.

An Appraisal on raising threshold of offsets

The Upside : The MoD has proposed a new DPP to facilitate the capital defence procurements, making it convenient for foreign arms companies as well as encouraging the Indian private sector to take nascent steps into defence manufacturing. While raising the threshold for the applicability of the offsets, the MoD has lauded itself claiming that the same is likely to provide the much desired flexibility to foreign arms majors as the stifling offset limit has now been relaxed from the existing limit of Rs 300 crore to Rs 2,000 crore.

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Justifying the raising of the threshold value for offsets, the Defence Minister himself stated during the conduct of the DAC meeting that "We currently have signed offsets worth USD 5 billion and another USD 8 to 10 billion is in pipeline. We may not be able to absorb all of this. Moreover, offsets also increase the cost of the product by 14-18 per cent."

There is no denying the fact that offsets have been a reason for delays in finalisation of defence contracts while also at times some of the foreign OEMs shied away from responding to Indian RFPs comprising offset obligations, as they found these as cumbersome and at times beyond their capability to fulfill. This was owing to a plethora of reasons, the inability of Indian defence industry to absorb the offsets being the prime reason quoted by these OEMs. This major policy change announced by the MoD is likely to lend the much required momentum to the capital defence acquisition in terms of more responses to the RFP by foreign OEMs, earlier fructification of contracts as also bringing down the cost of the contract, as OEMs are known to load the cost of offsets on to the cost of the main project itself. Another significant advantage that is expected out of this raising of threshold is that the minimum offset obligation is likely to be Rs 600 crore. The enhanced minimum value of offsets from Rs 90 crore to Rs 600 crore will facilitate harnessing of certain niche technologies as part of the offset obligation, which OEMs may not have offered for the earlier lesser value offset projects.

The Downside : The counterpoint to the above listed advantages of the change in the offset policy threshold value warrants a review. The world over, offsets have influenced the course of weapons and equipment procurements and have accordingly impacted the growth of the global defence industry. Countries like Saudi Arabia, Brazil and Israel have had the threshold value much lower than that presently in India and have achieved substantial successes in their offset programmes. India at Rs 300 crore, has one of the highest threshold values world over but with the result that it ends up losing the advantage of offsets for all procurements with the value below $ 55 million. For a country which is aiming for 'Make in India' and the related development of MSMEs/ SMEs, surrendering the offset advantage by raising the threshold value further to Rs 2,000 crore, is simply not logical.

Recently, a large number of Indian companies, including MSMEs, have shown interest in the defence production business and have applied for industrial licences from the ministry of commerce to locally manufacture military equipment, relying heavily on the offset provisions to further their business ventures. However, the raising of the threshold for applicability of offsets to Rs 2,000 crore has raised the minimum value of offset obligation to Rs 600 crore, which virtually rules out the MSMEs from becoming Indian partners for the offset contracts, as an offset obligation of such high values will be with beyond these enterprises. This implies that the offsets will become a domain only for large and runner major ventures such as Bharat Forge Ltd, Reliance Industries Ltd, the Tata Group, Larsen & Toubro Ltd, the Godrej Group, the Mahindra Group, Reliance Group and Adani Defence Systems and Technologies Ltd, which have enormous resources.

The prime aim of defence offsets was actually to leverage capital acquisitions to develop India's defence industrial base (DIB) and in turn promote research and development in the defence sector. Since its inception in 2005, the Indian Defence Offset Policy has undergone a number of iterations and has matured over a period of time into becoming a constructive and focused policy, structured to leverage capital acquisitions to develop India's defence industry by fostering development of internationally competitive enterprises. An endeavour should have been made to iron out whatever hitches that still persisted rather than raising the threshold to a level where most of the procurements would fall beyond the purview of the offset obligation. As per the analysis carried out by the Weapons and Equipment Directorate, the Army's 52 per cent of Indian Army procurement projects are below the Rs 500 crore value. This figure is likely to increase to approx 80 to 90 per cent, if these include Indian Army projects which cost under Rs 2,000 crore. This implies that Indian Army procurements would attract nearly negligible offset contracts.

Caution certainly needs to be exercised, as the lure of a 'signature campaign' of the present Government's 'Make in India' campaign could well eclipse the future of the Defence Offset Programme. While 'Make in India' holds a lot of relevance in sectors other than defence, the imperatives for 'Make in India' in defence production has a connotation that is actually at variance to the economic advantage of this campaign. While in non-defence sectors, the objective of 'Make in India' will be purely economic, the prime objective in defence is self reliance and economic advantages and job creations come only as related benefits. Also what needs to be understood is that niche technologies, which include designs and the source codes of defence equipment are most closely guarded secrets and no original equipment manufacturer (OEM) would normally part with these. The 'Make in India' initiative remains at nascent stages and the rules of its implementation are still to be firmed out. The Indian offset programme on the other hand has been through a number of iterations since 2005 and matured to an extent in the provisions as given in the revised DOGs of 2012. The most important issue in offsets is the provisions of safeguards against the OEM offering low end technology in the form of either multipliers in offering transfer of technology or the buyback clause.

A relook at the threshold

Strengthening of the Defence Industrial Base (DIB) must take a structured approach which involves clear understanding of the kind of capabilities to be built up and the technologies required for the same, which is followed by in-house R&D, seeking transfer of technology from foreign OEMs as part of acquisition contracts or offsets and simultaneous setting up of the infrastructure and the training of the work force The Indian Offsets Programme has catered for all the above tenets and has matured over the years and is focused at strengthening of Defence Industrial Base (DIB) to promote self reliance in defence production. Now, especially when Indian defence industry has started taking infant steps towards indigenisation and the building blocks in terms of SMEs & MSMEs were relying heavily on securing of some offset contracts, denuding them of the same may not be a very appropriate step. Thus, raising of the threshold to a level where the offsets will be rendered inapplicable for most of the procurements, needs a serious relook.

Anuraag Chhibber
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Indian Defence Budget 2016-17

The allocation for Defence in the national budget presented to Parliament on 29 February 2016 is Rs 2.58 lakh crore (US $38 billion) which works out to be 1.7 per cent of the GDP but in addition there is considerable allocation for pensions. The defence allocation for 2016-17 is in fact 4.87 percent higher than last year's 2.46 lakh crore (US $ 36.2 billion but which, considering the exchange rate then, would be equivalent to US $ 39.9 billion). Experts opine that with the funds being made available to the armed forces, it will be difficult to finance key modernisation programmes, including acquisition of new fighters, next generation submarines, variety of helicopters, missiles, artillery guns and so on *(photo below of Finance Minister Arun Jaitley with Prime Minister Narendra Modi)*.

In his interaction with select media on 4 March, Defence Minister Manohar Parrikar was confident that the Government of India would sign contracts worth Rs 1 lakh crore ($14.9 billion) in the next six months but on the continuing delays concerning finalisation Rafale contract the Minister stated that negotiations would continue "until we get the price we want."

CCS clears purchase of two more Phalcon AWACS

On 1 March, the Cabinet Committee on Security (CCS) cleared acquisition of two additional Airborne Warning and Control System (AWACS) platforms worth Rs 7,500 crore ($1.1 bn). This is a follow-on order under the tripartite contract with Israel and Russia that delivered three Il-76-based IAI Elta Phalcon AWACS aircraft to India in 2009-2010.

The Il-76 Phalcon AWACS platform (also sometimes called A-50EI) plays a significant role in Indian Air Force's Network-Centric Operations, being able to detect aircraft, drones and cruise missiles from a range of 400 km. In addition to the three arrays comprising the EL/W-2090 L-band early warning radar located in a fixed radome, these aircraft have electronic intelligence (ELINT) and communications intelligence (COMINT) capabilities that intercept electromagnetic signals. The aircraft is used for command and control of friendly fighters, monitoring troop movements and build-up, and early detection of any aircraft, civil or military.

The CCS also cleared a proposal for the induction of a fourth BrahMos missile regiment and two more of Pinaka regiments for the Indian Army.

IAF has "lowest combat power in decade"

In a damning revelation, it has been reported that "the Indian Air Force is now at its lowest combat strength in more than a decade." According to sources, the IAF's senior leadership has informed the government about the gravity of the situation, with another three squadrons, a mix of MiG-21s and MiG-27s, phased out on 1 January 2016. This leaves the IAF with only 33 squadrons, well short of the government mandated 42 squadrons needed to oppose a simultaneous two-front confrontation with China and Pakistan.

Obsolescent MiG-21s (above) and MiG-27s continue to make up bulk of the remaining squadrons with a total of 11 units operating these types. A further 11 squadrons are equipped with the Sukhoi Su-30MKI, while there are six Jaguar squadrons and three squadrons each of the Mirage 2000 and MiG-29. Availability of the latter two types is also low at the moment, as both fleets are taken off line for comprehensive upgrades. The IAF aims to have 272 Su-30MKIs in service by 2020, and the MoD has set a 2018 deadline to begin production of 100 improved Tejas Mk.IA light fighters. Neither of these steps, however, will be enough to offset aircraft retirements planned over the same time period.

Private sector involvement in new fighters for IAF

Defence Minister Manohar Parrikar has stated that the Indian private sector will be involved in supplying new fighters to the Indian Air Force. This was post the 'Make in India' Conference at Mumbai in mid-February and Mr Parrikar amplified that "through a proper process, we might select few aircraft to make in India". He did not offer details on the type but said there would be at least "one and perhaps two (aircraft types)," specifically stating that this would not involve HAL.

In a blunt statement the next day, Mr Parrikar stated that there was a "deadlock" on the issue of the Rafale's price, 36 of which are under negotiation with Dassault for supply to the IAF. Well informed MoD sources are quoted as saying that "the difference between what France is demanding and what India is willing to pay is too large to bridge easily – about 25 per cent".

Parrikar for cancelling "non-relevant acquisitions"

The Defence Acquisition Council has asked the three Services to review and cancel all pending acquisition proposals that have lost "contemporary relevance". Defence Minister Manohar Parrikar, who chaired the DAC meeting on 24 February 2016, reviewed the progress of acquisition projects approved by it. It was found that since June 2014, when the NDA government came to power, 81 acquisition projects worth Rs 1.5 lakh crore ($23 billion) have matured, much of this is under the 'Make in India' category.

Parrikar said 314 pending acquisition projects lost relevance as technologies had changed. These projects came up to the council but were not cleared. After taking over as the Defence Minister, Parrikar had promised changes in approach to acquire weapons and equipment. Of these projects, 86 are in final stage of clearance and Parrikar has asked the services to speed up matters and get these cleared over the next four or five months. Almost all Defence purchases typically take over at least five years to fructify and go through several phases starting from tendering to equipment and technical trails and commercial negotiations etc.

Tejas fires first BVRAAM

Building on recent flight envelope (G-limit) expansion achievements, the LCA programme achieved a milestone on 5 February, when aircraft LSP-7 (KH2017), piloted by Gp Capt Madhav Rangachari, fired a beyond-visual-range (BVR) Rafael Derby missile for the first time. The aircraft was operating from Jamnagar for the missile firing trials, having only recently returned from the Bahrain International Air Show held in January. This initial test was an unguided firing of the missile while flying straight and level. As further testing is carried out, additional capabilities will be validated, including target engagement at varying ranges, target speeds and target manoeuvring capabilities, as well as clearance of an expanded weapons release envelope, so that the Tejas can fire the missile while manoeuvring, and across a wide range of speeds. BVR trials are part of the LCA programme's test campaign toward Final Operational Clearance (FOC), with integration and firing of the aircraft's cannon as well as a short-range missile, the Rafael Python, still pending.

India, Russia revive FGFA discussions

In a major development in the Fifth Generation Fighter Aircraft (FGFA) programme, India and Russia have reportedly restarted talks on co-development and co-production of this futuristic fighter. A Russian delegation was in New Delhi during February 2016 to hold negotiations on the FGFA as well as the Kamov 226T helicopter project. FGFA talks have resumed after Moscow reportedly agreed to reduce India's share of development costs to $3.7 billion from an earlier figure of $5.5 billion. The Russian government "will also ensure technical know-how is transferred to India along with three prototype Sukhoi T-50 fighters built under the PAK-FA *(Prospective Airborne Complex of Frontline Aviation)* programme run by Russia as its own fifth-generation project."

The talks had been stalled since January 2015, after Russian and Indian engineers had completed a preliminary design for the FGFA and India had already paid nearly $300 million. India's objections were related to high development costs, given that prototypes were already built and flying in Russia, as well as technology transfer issues. This held up India's commitment of $5.5 billion toward the next phase of the programme. The revised $3.7 billion figure is said to cover an expanded development effort involving India, as well as an increased work share for production.

Additional contract for 48 Mi-17V-5 helicopters

Russia's Rostec State Corporation, parent company of Russian Helicopters, announced in February 2016 that it expects to close a new contract for 48 additional Mi-17V-5 helicopters for the Indian armed forces. A commercial proposal was presented earlier

that month and a firm order is expected this year. Between 2011-2015, Russian arms export agency Rosoboronexport had already supplied a total of 151 units of the Mi-17V-5, produced at the Kazan Helicopter Plant and assembled in India at No. 3 Base Repair Depot (3 BRD) Chandigarh. The 151 already-delivered Mi-17V-5s have been replacing ageing Mi-8 helicopters, and the additional order is expected to supplement older Mi-17 variants in service.

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Lockheed Martin offer F-16 production in India

"We are ready to manufacture F-16 in India and support the 'Make in India' initiative," stated Phil Shaw, chief executive of Lockheed Martin India Private Ltd. However, he did not commit to any time frame or offer any more specifics, presumably because those are to be decided in government-to-government talks.

Lockheed Martin currently manufactures one F-16 a month from its plant in Marietta, Georgia, and has a series of contracts and joint ventures in India with over 1,000 employees. The company has supplied six C-130J Super Hercules aircraft to the IAF, and will begin delivering another six from next year.

(photo: Angad Singh)

IAF to procure 8 aerostat radars

The Indian Air Force has plans to procure up to eight aerostat radar platforms to bolster low-level air and sea surveillance. The procurement process, which has been on hold for the past few years, comes after terrorist strikes in Mumbai and lately, the Punjab. An RFI issued by the Ministry of Defence with a deadline of 24 February seeks a batch of four, six or eight aerostat systems, which can be deployed at an altitude of 15,000 feet and above, have network-centric compatibility so that they can be integrated into the IAF's Air Command and Control System along with other assets and possess electronic warfare capabilities. The IAF has earlier procured two Aerostats from Israeli firm Rafael at a cost of Rs 338 crore and inducted them into service in 2007 and 2008.

Ex-IAF Mi-35s in Afghanistan

According to a US military spokesman, the three Mi-35 attack helicopters donated by India to Afghanistan "have made a big

difference in the offensive against militants. They do have three Mi-35s from India. They'll have a fourth one coming in pretty soon that will add to their inventory as well and that'll make a great difference," General John Campbell told the House Armed Services Committee during a Congressional hearing on Afghanistan.

HTT-40 prototype rolled out

Prototype of HAL's basic turboprop trainer, the HTT-40 was rolled out from the ARDC hanger at Bangalore on 2 February 2016. Indicative of HAL's fast track approach is the fact that first ground runs of the Honeywell TPE 331-12B engine with a rating of 1100 shp began on 15 February and over the next 7 days some 40 ground runs were carried out, in presence of OEM representatives. According to HAL sources, recovery factor of the intakes was 99.1%. First flight of the HTT-40 prototype is planned for late March or early April 2016.

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Multiple defence deals with Israel

There is tangible progress towards formalising a number of defence deals with Israel worth $3 billion before Prime Minister Narendra Modi visits Tel Aviv this year. The pacts include the acquisition of 164 laser-designation pods or Litening-4 for IAF fighters plus 250 advanced Spice precision stand-off bombs.

Some headway has been made over the stalled negotiations for an initial Rs 3,200-crore contract for 321 Spike anti-tank guided missile (ATGM) systems and 8,356 missiles. "There was a major difference (of opinion) in the ATGM project cost between the Israeli commercial bid and the much-lower price benchmarking done by the MoD. Over 20 contract negotiation committee meetings have been held till now... the effort now is to close the gap," said a source. The Army desperately needs third-generation ATGMs, with a strike range of over 2.5-km and fire-and-forget capabilities, to equip all its 382 infantry battalions and 44 mechanised infantry units.

In October 2014, the Modi government had selected the Israeli Spike ATGM over the US Javelin missile system, but the actual contract has not been progressed. The project involves an initial off-the-shelf induction, followed by large-scale indigenous manufacture by Bharat Dynamics Ltd (BDL) to equip the Indian Army. The proposed MR-SAM project between DRDO and Israeli Aerospace Industries (IAI) too, "will be massive."

Private Sector to manufacture ammunition

On recommendation of the Committee on Strategic Partnership, the Government is likely to clear the manufacture of 7 types of ammunition for procurement from the private sector. This includes main gun ammunition for T-72 MBTs, FH-77 howitzers, grade BM-21 multi-barrel rockets as also electronic fuses.

The Ordinance Factory Board (OFB) have been unable to meet the requirements, and the Government's step is consequential to the armed forces 'warning' that half the 170 types of ammunition held by the Army would not last beyond 10 days of intense war fighting.

BAE Systems select Mahindra as M777 partner

BAE Systems has down-selected Mahindra as its business partner for the proposed in-country Assembly, Integration & Test (AIT) facility for the M777 Ultra Lightweight Howitzer. India and the United States have been in discussions for a Foreign Military Sale (FMS) of 145 M777A2 howitzers for the Indian Army. In 2015, BAE Systems developed and submitted a US Government-supported proposal offering a higher degree of indigenisation on the M777 weapon system, including a commitment to establish AIT capabilities in India in partnership with a domestic company.

The selection follows a detailed assessment of Mahindra's ability to fulfil the requirements and provide value to the M777 India programme and in the future, grow its capability as a strategic partner for BAE Systems in India. Dr Joe Senftle, Vice President & General Manager, Weapon Systems, BAE Systems stated, "As a founding partner of defence manufacturing in India, BAE Systems is pleased to partner with Mahindra on our offer to develop an AIT facility in India. The facility is a fundamental part of the M777 production line. A domestic AIT facility will enable the Indian Army to access maintenance, spares and support for the M777 locally. We will continue to support the two Governments to progress to contract agreement so that we may begin the process of 'Make in India' for M777."

Israeli-Indian JV for small arms in private sector

Punj Lloyd Ltd has established a 51:49 joint venture with Israel Weapon Industries (IWI) to produce firearms in India. IWI has already supplied weapons such as the Tavor assault rifle and Uzi submachine gun to security forces in India, and is an established player in the field. The JV will initially manufacture components for export to Israel, where they will be finished and assembled. The second phase will see complete guns made in India to meet domestic demand.

Manufacturing of small arms in India is presently only undertaken by public sector firms, even though the Cabinet had agreed in 2001 to allow private companies to also enter this area. Punj Llyod, L&T and Bharat Forge were among the first companies to be granted firearm manufacturing licences by the DIPP in 2001-02. Production, however, never began because the Home Ministry did

not grant clearance. Industry estimates peg the opportunities of on going programmes for small arms in internal and national security at over Rs 3,000 crore.

Tata Motors and Bharat Forge bid for FICV programme

Tata Motors, Bharat Forge and General Dynamics have partnered to bid for the $11 billion (Rs 78,000 crore) project to develop and build ICVs for the Indian Army under the MoD's *Future Infantry Combat Vehicle* (FICV) Programme. Tata Motors have confirmed that Bharat Forge would manufacture guns, ammunition and other firepower elements of the planned Future ICV. Baba Kalyani, Chairman and MD of Bharat Forge said that Tata's vehicle engineering expertise will be leveraged for the drive system, while General Dynamics' extensive combat vehicle development and manufacturing experience "would also be useful." The alliance has brought the number of bidders for the programme down to nine from ten.

On 15 February, nine Indian companies submitted proposals to the MoD for designing, developing and manufacturing a Future Infantry Combat Vehicle. The FICV is to be an amphibious, tracked, armoured vehicle, operated by a crew of only three and armed with anti-tank guided missiles, to replace the Indian Army's fleet of 2,610 obsolete Russian BMP-2s. The ten firms that received Expressions of Interest (EoIs) for the programme from the MoD in July 2015 are Larsen & Toubro (L&T), Tata Power (Strategic Engineering Division), Tata Motors, Mahindra, Bharat Forge, Pipavav Defence, Rolta India, Punj Lloyd, Titagarh Wagons and OFB. Of these, Bharat Forge and Tata Motors have partnered (*see item in this issue*), making a total of nine bidders for the project. Each of the bidders is free to tie up with a foreign technology partner for know-how and technical assistance, but the prime contractor for the programme must be Indian and the FICVs are to be built in-country. The selection process is likely to take about 12 months from the date the bids were submitted.

According to reports, the MoD will choose the two "best proposals" from the private sector bidders while the public sector Ordnance Factory Board (OFB), being a DPSU, will be automatically selected for the development phase. These three selected development agencies (DAs) will each develop a FICV prototype, with the defence ministry paying 80 per cent of the cost. The prototypes will be extensively tested and evaluated before one is selected for series production, with a requirement of 2,600 FICV projected.

Indo-China joint tactical exercises in Eastern Ladakh

The first Joint Tactical Exercise between Indian and Chinese troops was conducted in the Chushul-Moldo area on 6 February 2016 as part of ongoing initiatives being taken by India and China to ensure greater interaction between troops stationed along the LAC, to foster peace and tranquillity at the border. The exercise, *Sino-India Cooperation* 2016, focused on joint response to Humanitarian Aid and Disaster Relief (HADR) situations. The Indian Army team of thirty personnel was led by Colonel Ritesh Chandra Singh, while the Chinese delegation was headed by Colonel Qu Yi. Lasting an entire day, the joint exercise was based on a situation of a national disaster occurring on the border and the subsequent coordination of rescue mission by joint teams of both countries. The exercise complements the annual *Hand-in-Hand* series of India-China joint exercises, and the recently conducted border troops Joint Exercise in Sikkim.

Saab and Kalyani Group announce JV

Swedish defence firm Saab and Kalyani Strategic Systems Ltd (KSSL) have announced preparations for a joint venture company in India for the Short-Range Surface to Air Missile (SRSAM) and Very Short Range Air Defence (VSHORAD) programmes. The joint venture will be involved for production and delivery of these air defence systems to the Indian defence forces.

RBS70 NG VSHORAD

Production in India will comprise sub-systems and systems for SRSAM and VSHORAD with Saab aiming to transfer production as well as development knowledge to India.

"I am glad to announce our contribution to *Make in India* through our agreement with KSSL and the Kalyani Group to establish a joint venture company in India for the Air Defence Programmes. The JV is already under preparation within both companies, and will be ready to launch soon," said Görgen Johansson, head of Saab business area Dynamics. To ensure production quality, orders for missile parts have already been issued to KSSL and production-readiness reviews are ongoing. Saab and KSSL are already planning for the technology transfer for different packages within the programmes.

International Fleet Review 2016 at Visakhapatnam

The Indian Navy's Eastern Command at Visakhapatnam hosted an International Fleet Review (IFR) between 4 and 9 February 2016. This was the 11th fleet review in Indian history, but only

the second time that the event was open to foreign participation as well. The Navy's first IFR was conducted in Mumbai in 2001. Over fifty delegations from various countries attended the week-long event, while 24 foreign warships joined over 50 Indian ships and submarines at anchorage and were reviewed by the President and Prime Minister of India on 6 February. The proceedings also included an Operational Demonstration by the Indian Navy, a multinational parade down Vizakhapatnam's Beach Road, and a final Passing Exercise by all the assembled warships at the conclusion of the Review *(see article 'United through Oceans' in this issue).*

INS *Vikramaditya* visits Male

The Indian Navy's aircraft carrier INS *Vikramaditya*, accompanied by destroyer INS *Mysore* and tanker INS *Deepak* visited the Maldives in mid-February "to reaffirm India's abiding commitment to be 'the net security provider' in the IOR". According to observers, "India is slowly but surely cranking up its military maritime diplomacy with *Project Mausam* to effectively counter the ever-expanding Chinese strategic footprint in the entire

IOR." From the Gwadar port in Pakistan to Hambantota in Sri Lanka, China has assiduously forged deep linkages with several IOR countries with an eye on the future. The strategically-located Maldives, in particular, has emerged as a key area in the ongoing geopolitical jostling.

After a hiatus during the internal power struggle in the 1,190-island archipelago, India's bilateral ties with Maldives are definitely improving once again with some quiet diplomacy, with Indian foreign secretary S Jaishankar travelling to the country in February as PM Modi's special envoy, Maldives President Abdulla Yameen Abdul Gayoom has announced his intention to re-start a multiparty dialogue in his country. On the bilateral defence front, India also assured visiting Maldivian defence minister Adam Shareef of its continuing commitment to step up its military training and maritime surveillance as well as supply of Dornier 228 patrol aircraft and helicopters to the archipelago. There is also a plan underway to assist Maldives in setting up 10 coastal surveillance radar system (CSRS) stations in tune with overall policy to provide military aid and help in "capacity-building" of IOR countries.

India-US aircraft carrier JWG meet

The second meeting of the Joint Working Group on Aircraft Carrier Technology Cooperation (JWGACTC), constituted under the Indo-US Defence Trade and Technology Initiative (DTTI), was organised in India 15-18 February 2016. An 11-member delegation from the USA, headed by Rear Admiral Thomas J Moore, Programme Executive Officer, Aircraft Carriers (USN), visited various defence and industrial installations in India, including the Shore Based Test Facility at Goa, Bharat Electronics Limited (BEL), Bangalore, and Cochin Shipyard Limited, Kochi. The delegation also visited the first Indigenous Aircraft Carrier (IAC-1 or INS *Vikrant*) being constructed at CSL.

The concluding session of the Joint Working Group was held on 18 February in New Delhi, co-chaired by Vice Admiral GS Pabby, Controller Warship Production and Acquisition with Rear Admiral Moore. The JWG is primarily aimed at cooperation on India's second indigenous carrier (IAC-2, to be named INS *Vishal*), which will be larger and more capable than either INS *Vikramaditya* or INS *Vikrant*, and will likely be built in the Catapult-Assisted But Arrested Recovery (CATOBAR) configuration, incorporating American technology such as electromagnetic aircraft catapults.

Indian support for Chabahar port project

The government of India has approved a $150 million credit line for the development of Iran's Chabahar port. The port in southeast Iran is central to New Delhi's efforts to circumvent arch-rival Pakistan and open up a route to Afghanistan, where it has developed close security ties and economic interests.

Under the agreement signed last year between the two countries, India will equip and operate two berths in the first phase of development at Chabahar Port and extend a credit line of $150 million through its external lending arm. Both berths will commence operations within 18 months of the signing of a final contract.

The Cabinet has also authorised the Shipping Ministry to form a company in Iran for implementing the Chabahar Port Development Project and related activities.

Interceptor Boat gifted to Seychelles

On 22 January, the DG CG, Vice Admiral HCS Bisht, presented a high speed Interceptor Boat to the Seychelles Coast Guard at a formal ceremony in Mahe, Seychelles. The President of Seychelles, James Michel, was present for the occasion. The boat, constructed by L&T Shipyard Mumbai, is capable of speeds up to 45 knots and has an endurance of 500 nmi at 20 knots. The boat has been re-named as SCG *Hermes* (ex-ICGS C-405,) and the designated Seychellois crews have received three weeks of training on the boat in India, and will receive a further five weeks with the Indian afloat support team at Seychelles.

Indo-Seychelles Joint Training *Exercise Lamitye*

The seventh Indo-Seychelles joint training exercise in the *Lamitye* series was conducted between 15 and 28 February 2016 at Victoria, Mahe Island, Seychelles, with an aim to improve interoperability between both armies in joint counter insurgency and counter terrorism operations. The Indian contingent comprised an infantry platoon and representatives from the Special Forces. The Seychelles People's Defence Forces (SPDF) was represented by the Tazar Special Forces unit and Seychelles infantry. *Exercise Lamitye*, which means 'Friendship' in Creole, has been a bridge between the Armed Forces of India and SPDF since 2001.

The exercise culminated in a large scale field training operation called 'Sea Hunt,' involving cordon and search operations enmeshed with hostage rescue and anti-piracy tasks at Cape Ternay, with realistic scenarios extending over two days in an urban insurgency environment.

Multinational Field Training *Exercise FORCE 18*

A multinational Field Training Exercise (FTX) *FORCE 18*, the largest ever conducted on Indian territory, took place between 2-8 March 2016 near Pune, in the Army's Southern Command area. The exercise involved armies from the 'ASEAN Plus' nations, consisting of the ten ASEAN States (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam) and eight which make up the 'Plus' (India, Australia, China, Japan, New Zealand, Russia, South Korea and the USA).

The exercise focused on Humanitarian Mine Action and joint Peacekeeping Operations. In the work-up phase for the exercise, over 28 foreign instructors were trained by the Indian Army. At the exercise opening ceremony, Lt Gen Bipin Rawat, head of Southern Command, highlighted the importance of the ASEAN Defence Ministers Meeting (ADMM) Plus forum in meeting regional aspirations for peace and security, as well as addressing issues related to mitigating the effects of land mines that continue to plague many South East Asian nations. He added that *FORCE 18* would build common understanding and interoperability amongst the 18 participating countries. Over 80 senior foreign officers and Indian dignitaries from the MoD and MEA attended the closing exercise of *FORCE 18* on 7-8 March 2016.

Indo-Nepal *Exercise Surya Kiran IX*

The Indo-Nepal Combined Military Training Exercise *Surya Kiran IX* was conducted between 8 and 21 February 2016 at Pithoragarh, Uttarakhand. An Infantry battalion under the Indian Army's Panchshul Brigade and the Shree Rudra Dhoj Battalion of the Nepalese Army participated in the exercise. Soldiers familiarised themselves with weapons and equipment used by both countries, and analysed groupings, drills and tactics while operating in a counter terrorism environment. The exercise also included training for area domination, cordon and search, seek and destroy and also aspects of disaster management.

The joint exercise gave the two armies "an excellent opportunity to understand and learn from each others' experiences. They were

able to evolve combined tactical procedures and drills in counter terrorism operations, jungle warfare and disaster response." The final two-days field exercise covered a mock cordon and search operation in a village based on a pre-defined scenario. The exercise was 'observed' by Major General Shekhar Singh Bansyat from the Nepal Army and by Brigadier Rakesh Manocha from the Indian Army.

Exercise Naseem Al Bahr

Two vessels from the Royal Navy of Oman (RNO) participated in the five-day exercise *Naseem Al Bahr* off Goa, before proceeding to the east coast of India for the International Fleet Review at Visakhapatnam. Initiated in 1993, *Exercise Naseem Al Bahr* has matured over the years, increasing in scope, complexity of operations and level of participation. The 2016 edition was tenth exercise in the series, and included a number of joint training operations such as surface firing, force protection, anti-piracy and flying operations. The Indian Navy was represented at the exercise by *Talwar*-class guided missile frigates INS *Trikand* and *Trishul*, along with a number of Fast Attack Craft, patrol aircraft and helicopters. The Royal Navy of Oman sent a *Khareef*-class corvette, RNOV *Al-Shamikh*, and an *Al-Ofouq*-class patrol vessel, RNOV *Al-Seeb*.

CSL launches final *Aadesh*-class Fast Patrol Vessel for Coast Guard

On 29 January Cochin Shipyard launched the 20th and last of the *Aadesh*-class Fast Patrol Vessels (FPVs) for the Indian Coast Guard, ICGS *Ayush*. CSL had earlier delivered the 16th FPV in the series to the Coast Guard on 12 January, two months ahead of schedule. The remaining vessels are likely to be delivered within 2016 itself, ahead of the contractual March 2017 deadline.

"India is the fastest growing aviation market in the world"

India, has been judged as the fastest growing aviation market in the world, with an increase by 20.2 per cent, year on year. The relentless pace is driven by low fares, rising demand in smaller cities and steady growth in domestic tourism. Airlines in India flew 81 million passengers in 2015, and in 2016, this is expected to grow to 100 million passengers. Aided by a 24 per cent reduction in jet fuel prices average air fares on domestic routes have fallen 14 per cent to around Rs 4,500. This has led to a spurt in demand from leisure travellers and small and medium enterprises. The overall sector-wide occupancy rose to 82.5 per cent in 2015 from 76.4 per cent in 2014.

Jet-Etihad India's "fastest growing airline"

UAE national carrier Etihad and Jet Airways have emerged as "the fastest growing airline in India," following the partnership that has allowed the two airlines to collectively use Abu Dhabi as a hub to connect Indian travellers to the rest of the world. DGCA data on international traffic for the 2015 calendar year has Etihad flying 2.4 lakhs passengers in and out of India. Its partner Jet Airways, which remained the single largest airline here in terms of international passenger carriage, carried 70.7 lakh flyers in and out of India in 2015, up 27% from previous year's figure. After the Jet-Etihad tie-up, the top 10 airlines by international passenger carriage have four Indian and six Gulf carriers.

"No forcing of unviable routes"

The Supreme Court of India has sought to know if there was a policy allowing carriers to skip uneconomic routes, expressing displeasure with airlines ignoring "unviable routes." The court was hearing an appeal of Air India in the matter of Simla to where the airline had stopped operations since 2012. At present, airlines are free to decide on the routes based on commercial considerations and there are no guidelines that compel airlines to fly to any specific route. However, under the route dispersal norms, airlines should deploy 10 per cent of their metro capacity to category-II routes, essentially to Jammu & Kashmir, the NE states, Lakshadweep, and Andaman & Nicobar Islands, which are known as category-IIA routes.

"States like Himachal Pradesh, which are without air connectivity, are a telling comment on the state of regional aviation in the country. The court's comment need to be taken in the right spirit as it concerns public interest." The biggest viability gap funding Air India gets is in the form of tax payer-funded equity infusion," stated Kapil Kaul, CEO India of Centre for Asia Pacific Aviation (CAPA).

15 domestic airports still unoperational

Fifteen airports built by the Airports Authority of India (AAI) at a cost of Rs 438.4 crore are yet to receive their first scheduled commercial flight in over a decade. The costliest of these is at Maharashtra's Gondia, former aviation minister Praful Patel's home city, which itself cost Rs 207.6 crore. Airports at Jaisalmer and Simla, built at Rs 44.5 crore and Rs 39.1 crore respectively, have also to receive regular passenger flights for a decade. Three of these 15 airports are civil enclaves, meaning places where a passenger terminal has been built in a defence airfield. These include the border towns of Pathankot, Bikaner and Jaisalmer.

Mumbai-Dubai "busiest international route in 2015"

The Mumbai-Dubai route was India's busiest international city pair in 2015, with 21.5 lakh people flying between the two destinations. Delhi-Dubai followed as the second busiest sector with 17 lakh people flying between the two cities last year, according to the Directorate General of Civil Aviation (DGCA).

The other international city pairs that saw big passenger loads were London-Delhi, Bangkok and Abu Dhabi to Delhi and Mumbai and Chennai-Colombo. In 2015, Sri Lankan Airlines, a member of the British Airways-led One World, carried almost 13 lakh people into and out of India, more than mega carriers like Lufthansa (11.1 lakh) and Singapore Airlines (11.9 lakh) owing to the connections it provides from Colombo to Indian passengers.

First Bell 407GXP sold in India

The first Bell 407GXP helicopter sold in India is to Premair, an air charter management company, to be outfitted for corporate and VIP transport. Derived from the Bell 407GX platform, the Bell 407GXP has an additional 22.5 kg of payload capability, coupled with a new Rolls-Royce M250 engine that improves performance and fuel efficiency while high performance. The aircraft is also equipped with new avionics features such as a hover performance calculator improvement, as well as a transmission TBO extension of +500 hours that is expected to lower maintenance costs.

Bell Helicopter's Managing Director India, BS Singh Deo, with Premair's Director of Operations, HS Waraich

GoAir selects Rockwell Collins for 72 A320neos

GoAir has selected Rockwell Collins' advanced avionics, including MultiScan ThreatTrack weather radar and GLU-925 Multi-Mode Receiver (MMR) to equip 72 Airbus A320neo aircraft, with deliveries to begin later this year. Multi Scan Threat Track goes beyond hail and lightning prediction within a thunderstorm cell and alerts pilots to these significant threats adjacent to or above the cell. In addition, the new radar is the first in the industry to feature two levels of turbulence detection, severe and ride quality, which more accurately informs flight crews of the type of turbulence in their path.

Bell 412EP delivered to Uttar Pradesh

Bell Helicopter has delivered the first Bell 412EPI to the Government of Uttar Pradesh for use in VIP transportation throughout the region. "We have had a long-standing relationship with the Government of Uttar Pradesh for more than 20 years, and the Bell Helicopter team is proud to deliver one of the most reliable and versatile helicopters on the market," said Sameer A Rehman, managing director of Bell Helicopter, Asia Pacific.

The Bell 412 is a multi-mission capable aircraft and the upgraded EPI offers an advanced flight deck and glass cockpit designed to improve pilot situational awareness and enhance safety. The aircraft can operate in a variety of mission sets including search and rescue, corporate transport, utility and military operations.

Kannur airport "inaugurated"

The fourth commercial airport in Kerala at Kannur, in northern Malabar, was "inaugurated" by Chief Minister Oommen Chandy on 29 February 2016. For this purpose, a Dornier 228 from the Indian Air Force station at Yelahanka, near Bangalore, made a symbolic landing and take off from the 3,050 metres long runway. Once commercial flights begin, this will facilitate travelers from Kannur, Kasaragod, Vadakara, Mahe and other places including Kodagu travelling to the Gulf.

Bharat Forge titanium flap-track forgings for Boeing 737s

Boeing and Bharat Forge have announced the first shipment of titanium flap-track forgings made by an Indian supplier for Boeing's 737NG. Bharat Forge will also supply forgings for the 737 MAX, scheduled to enter into service in 2017. The companies will continue to address opportunities to expand Bharat Forge's work in support of Boeing and its supply chain partners around the world. Bharat Forge also intends to expand its capabilities to offer higher value machining and manufacture of assemblies. "Shipment of the first titanium forging from India is a significant step towards building a capable and competitive supply chain in India for Boeing. This is yet another proof point of Boeing creating an aerospace ecosystem in India," observed Pratyush Kumar, President, Boeing India.

Appointments

Vice Admiral Sunil Lanba takes over as FOC-in-C Western Naval Command

Vice Admiral Sunil Lanba took over Western Naval Command (WNC) as the Flag Officer Commanding-in-Chief (FOC-in-C) on 31 January 2016 from Vice Admiral SPS Cheema at a ceremonial parade held at INS *Shikra*. Vice Admiral Lanba, a specialist in Navigation and Direction, an alumnus of Defence Services Staff College and the College of Defence Management, Secunderabad, has had operational and staff experience over a career spanning more than three decades. He has served as Navigating Officer of the corvette INS *Sindhudurg* and frigate INS *Dunagiri* and has also commanded four frontline warships: the minesweeper INS *Kakinada*, frigate INS *Himgiri*, and destroyers INS *Ranvijay* and INS *Mumbai*. His staff assignments

include Fleet Operations Officer of the Western Fleet and Chief of Staff, Southern and Eastern Naval Commands. He has also been the Flag Officer Sea Training, Flag Officer Commanding Maharashtra and Gujarat Naval Area, Commandant, National Defence College and Vice Chief of Naval Staff. He was Commander-in-Chief of the Southern Naval Command at Kochi, prior to heading Western Naval Command.

Vice Admiral Girish Luthra is FoC-in-C Southern Naval Command

Vice Admiral Girish Luthra took over as Flag Officer Commanding-in-Chief of the Southern Naval Command from Vice Admiral Sunil Lanba on 30 January 2016. A navigation and direction specialist, the officer has served in many operational and staff billets afloat as well as ashore in a career spanning more than three decades. He commanded the corvette INS *Khukri*, frigate INS *Talwar* and aircraft carrier INS *Viraat*, besides serving as Flag Officer Commanding, Western Fleet, during 2011-12.

His staff appointments include Deputy Naval Attache at the High Commission of India in London, Principal Director Naval Plans and Assistant Chief of Naval Staff (Policy and Plans) and Director General of Naval Operations. He was deputy chief of Integrated Defence Staff (Operations) at IHQ, Ministry of Defence (Navy) at Delhi prior to being appointed as the FOC-in-C (South).

New DG for Coast Guard

DG Rajendra Singh PTM, TM, has taken over charge of the Indian Coast Guard (ICG) as the 22nd Director General of the service, being the first regular Coast Guard officer to have been thus appointed, succeeding Vice Admiral HCS Bisht, AVSM, who is now Commander-in-Chief of the Eastern Naval Command.

DG Rajendra Singh is an alumnus of Garhwal University, Dehra Dun and joined the ICG on 29 December 1980 as an Assistant Commandant in the General Duty cadre. In a career spanning over three and half decades, he has held various key

operational and staff appointments, including the rare distinction of having commanded all classes of ICG ships. As Inspector General he has commanded both the Eastern and Western regions of the Coast Guard.

Vice Admiral Bimal Verma is C-in-C, Andaman & Nicobar Command

Vice Admiral Bimal Verma took over as Commander-in-Chief of the Andaman & Nicobar Command (CINCAN) on 29 February 2016, succeeding Vice Admiral Pradeep Kumar Chatterjee, An alumnus of the RIMC and NDA, he was commissioned in the Indian Navy on 1 January 1980, specialising in Communication and Electronic Warfare. He has commanded amphibious platforms such as INS *Shardul* and *Magar* and destroyers INS *Ranjit* and *Mysore*. His key ashore appointments include Principal Director Naval Operations at IHQ MoD (Navy), Naval Attache in Tehran, and Captain Local Work-up team (LWT) at Visakhapatnam. He has also been Flag Officer Doctrines & Concepts, Flag Officer Commanding Maharashtra and Gujarat Naval Area, Assistant Chief of Naval Staff (Information Warfare & Operations) and Flag Officer 'Alternative Operational Base' project. At the rank of Vice Admiral, he served as Chief of Staff, Eastern Naval Command where he coordinated the recently concluded International Fleet Review 2016.

Vice Admiral HCS Bisht is FOC-in-C Eastern Naval Command

Vice Admiral HCS Bisht took over as Flag Officer Commanding-in-Chief, Eastern Naval Command from Vice Admiral Satish Soni on 29 February 2016. He has served as Fleet Gunnery Officer of the Eastern Fleet at Visakhapatnam, commissioning CO of the missile corvette INS *Kora* and Commander of the stealth frigate INS *Tabar*. His training/staff appointments include Training Commander, Naval Gunnery School (INS *Dronacharya*) at Kochi,

Director, Naval Intelligence at NHQ, and Defence Attaché at the High Commission of India in Singapore. The Admiral served as Assistant Controller of Carrier Projects at Naval Headquarters, was Chief of Staff, Southern Naval Command, Flag Officer Sea Training at Kochi, Flag Officer Commanding Eastern Fleet, Assistant Chief of Personnel (HRD) at NHQ, Controller Personnel Services (CPS) at IHQ MoD (Navy), and Director General of the Indian Coast Guard.

Vice Admiral Atul Kumar Jain is Chief of Staff, Eastern Naval Command

Vice Admiral Atul Kumar Jain took over as the Chief of Staff, Eastern Naval Command on 27 February 2016. Commissioned into the Navy on 1 July 1982, and after specialisation in Gunnery and Missile Warfare, he served as Gunnery Officer aboard missile destroyers INS *Ranvijay* and *Ranvir*. Vice Admiral Jain has commanded missile corvettes INS *Nirghat* and *Khukri*, and destroyers INS *Rajput* and *Mysore*. He was also the commissioning Executive Officer of INS *Brahmaputra* and the Fleet Operations Officer of the Eastern Fleet. In October 2011, he was appointed as the first Flag Officer Commanding Karnataka Naval Area, Karwar. Thereafter, he took over command of the Eastern Fleet and also served as Chief of Staff, Southern Naval Command. He had been serving as Controller Personnel Services at IHQ MoD (Navy) at the rank of Vice Admiral, prior to taking over as Chief of Staff, ENC.

Lieutenant General Balwant Singh Negi is GOC-in-C Central Command

Lieutenant General Balwant Singh Negi formally took over as General Officer Commanding-in-Chief Central Command on 1 January 2016. Before taking over the present charge, Lieutenant General Negi has held the prestigious appointments of Commandant Indian Military Academy Dehra Dun and GOC XIV Corps in Jammu & Kashmir.

An alumnus of the Rashtriya Indian Military College, National Defence Academy and Indian Military Academy, Lieutenant General BS Negi is a highly decorated officer with an illustrious career of 37 years. He was commissioned into the Assam Regiment in December 1978 and has had extensive operational contributions both in the North East and in Jammu & Kashmir.

Lt Gen Bipin Rawat takes over Southern Army Command

Lieutenant General Bipin Rawat took over as the General Officer Commanding in Chief, Southern Command from Lt Gen Ashok Singh. Prior to his current assignment, Rawat was General Officer Commanding Maharashtra, Gujarat and Goa Area located in Mumbai. He was commissioned in the 5/11 Gorkha Rifles and has vast experience in high altitude warfare and counter insurgency operations. General Rawat has also commanded a Multinational Brigade in a *Chapter VII mission* in the Democratic Republic of Congo and is a Graduate of Defence Services Staff College, Wellington, the Higher Command Course at Fort Leavenworth, USA.

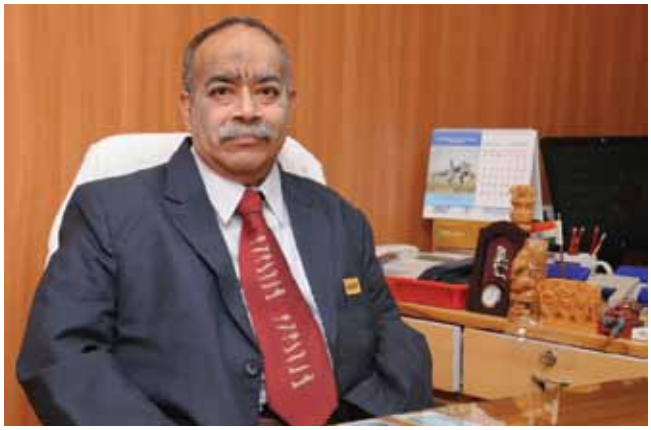
Lieutenant General Suresh Sharma is DG BR

Lieutenant General Suresh Sharma has taken over as the 24th Director General Border Roads (DGBR). Commissioned into the Corps of Engineers he has held various staff, instructional and command appointments. Some of his important assignments include Command of an Engineer Regiment during 'Op Parakram', Staff Officer of an Infantry Brigade on the Line of Control, Colonel Administration of an Infantry Division and Brigadier Administration of a Strike Corps.

He was Chief Operations Officer and advisor to United Nations Mission in Bosnia & Herzegovina. The General Officer has also tenated the prestigious appointment of Chief Engineer (Indian Navy and Coast Guards), Mumbai and later commanded the Bengal Engineer Group & Centre, a premier training institution of the Indian Army. The General Officer was Command Chief Engineer South Western Command and has been elected as Colonel Commandant *The Bengal Sappers and Military Survey* from 1 August 2015. Before taking over as Director General Border Roads, he was Director General Combat Engineers at Army HQ.

CV Ramanarao becomes Director (Finance), HAL

CV Ramanarao, General Manager (Finance) took over as Director (Finance) of HAL on 1 February 2016. Ramanarao joined HAL as Finance Officer in 1985 and with experience in financial management, accounting and internal control, has contributed in providing proactive leadership in developing and utilising corporate resources to drive and deliver financial and business growth. He has been instrumental in developing robust corporate governance, risk management and supply chain management policies in HAL covering system audit, costing and others.



Indian defence SMEs launch DIIA

Key Indian defence industry Small/Medium Enterprises (SMEs) have initiated the Defence Innovators & Industry Association (DIIA), an industry body with a focus on "accelerating indigenous design and development" in the Indian defence sector. DIIA members and associates came together at New Delhi to discuss and deliberate upon various policy matters relating to the defence industry. Defence Minister Manohar Parrikar inaugurated the association on 25 February.

DIIA will provide a platform for like-minded organisations to collaborate and co-operate in bringing success to the 'Make in India' initiative. The Association hopes to promote the intense R&D efforts made by MSMEs to indigenise defence equipment, and to convert these efforts into contracts that will not only help the companies sustain themselves but also aid the nation in attaining self-reliance in defence. DIIA presently has 27 members from across defence verticals such as avionics, simulation, telecommunication and robotics. Membership is open to Indian companies registered under the Indian Companies Act with majority equity holding and *de facto* and *de jure* control by 'Indian Resident Citizens'.

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"INDIAN ARMY IN FULL READINESS"

In his interview, Chief of the Army Staff General Dalbir Singh, reviews the Army's achievements and various initiatives taken for enhancing capabilities of the Indian Army

On completing one and a half years at the helm of the Indian Army, could you enumerate the areas where you have translated your vision into action?

COAS : At the outset, I wish to state that in the face of emerging threats and challenges, the Indian Army remains fully committed towards realising the vision of a secure, stronger and powerful India and continues to fulfill its role as a vital pillar of national security.

The achievements in the last one and a half years are attributed to collective efforts of all ranks of the Army. Positive response of the government towards sensitive defence related issues has further improved our capability and prowess. The Indian Army's contribution towards ameliorating various disaster situations are already known. On the operational front, we have maintained moral ascendancy on

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all our borders, guided by well-reasoned and thought out strategies.

My operational focus has been concentrated on key vital areas to include force modernisation, making up critical deficiencies and infrastructure development. Force modernisation is being carried out by speeding up long pending projects to channelise our efforts. Towards this, we have prioritised our requirements into critical, important and essential areas. The cases are being pursued accordingly. Efforts are also being made for ensuring that critical deficiencies in our equipment and ammunition are made up at the earliest. Concurrent with this, we are focusing on infrastructure development, which is the key to our operational preparedness.

What are the major operational achievements of the Army during your tenure till now?

COAS : On the operational front, we have maintained moral ascendancy on all our borders through proactive and dynamic tactical operations guided by well-reasoned and thought out strategies.

In the disturbed areas of Jammu & Kashmir, we have kept up the tempo of operations against terrorists through credible intelligence and ground level synergy with the state police and Para Military Forces, disallowing operating space to them.

Similarly, in disturbed areas of the North East, synergised intelligence-based ops have contained the perpetrators of violence to a large extent despite the abrogation of ceasefire by NSCN (K) and subsequent violent activities.

While we have carried out our operations with diligence, we have dedicated enough efforts to engage with locals of disturbed areas through Operations *Sadbhavna* and *Samaritan*.

Our successful conduct of flood rescue and relief operations in Kashmir and later in Chennai, as well as during the earthquake in Nepal are well known.

T-90 main battle of the 70th Armoured Regiment

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SECURING THE FUTURE

What is the update on network centricity? How much has been achieved?

COAS : Indian Army's efforts to develop indigenous net centric capability begins with the soldier on the ground and goes on to advanced terrestrial and space-based elements. We have a well defined road map to make our Armed forces net centric by 2020. To achieve this, a large number of communication networks and application development projects are at different stages of execution.

Project 'Network for Spectrum' (NFS), the next generation high capacity network with Central Data Centres (CDC) will provide the communication backbone integrating the sensors and the shooters. Applications like Command Informational and Decision Support System, Artillery Combat Command and Control System, Battlefield Surveillance System, Operational Informational System and Management Information System are at advanced stages of implementation. These will empower the commanders at all levels to have information dominance and thereby enable them to make quick and accurate decisions as well as correct application of force.

An update please on border roads along the Line of Actual Control (LAC).

COAS : There has been rapid infrastructural development along the Tibet Autonomous Region and in areas along the India-China border. Integrated HQ of MoD (Army) is seized of the security needs of the country. Necessary steps as required, have been initiated for ensuring that national security concerns are adequately addressed through development of infrastructure, including roads and forward airfields, as well as operational capabilities of the Army to secure the desired national security objectives. Strategically important road infrastructural requirements along the LAC are being developed in a phased manner.

India is considered an Information Technology (IT) Superpower. However, the Services reportedly have neither absorbed IT holistically nor are capable of meeting the emerging cyber threats. Please comment.

COAS : It would be incorrect to state that there is poor absorption of Information Technology in the Army. Penetration of Information Technology and Information Technology enabled functions and services in the Army, is high. To ensure high level of Information

Contingent of the Assam Regiment on parade

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T Suvarna Raju, CMD

Seventy five years ago, Seth Walchand Hirachand, a visionary industrialist, dreamt of India having its own dynamic industry in aerospace and defence. Soon an aircraft company took birth in Bangalore in 1940 thanks to the support provided by the then Government of Mysore.

With humble beginnings in manufacturing and overhauling of American aircraft, Hindustan Aeronautics Limited (HAL) has come a long way with 20 production divisions and 10 R&D centers spread across India employing over 31,000 people. The Company has made strides from overhaul and licence manufacturing to indigenous design and development of aircraft, helicopters, accessories and aerospace systems. HAL has produced nearly 3,900 aircraft and 4,550 aero-engines till date.

Last 75 years, HAL did go through various trials and tribulations. Today, it is truly a force behind India's Defence Forces, poised to surge ahead with confidence and attain greater heights in the coming years.

Technology absorption by new inductees, we have ensured Basic and Advance levels of Information Technology training as part of syllabi for Basic Military Training at Recruitment Training Centres as well as in Officers Training Academies.

Information Technology Laboratories and Computer Training Laboratories (CTLs) have been established at training centres as well as in all formations.

Further, some 40% of the Army's strength is being trained in Middle Level Information Technology Courses per year and additional 25% of strength is being trained per year in Advanced Information Technology Courses including Information Technology Project Management, Advanced Computing and Advanced Cyber Security Techniques.

As regards Cyber Security, we have adopted holistic measures to defeat cyber threats to our systems and networks. An Army Cyber Group is already functional which deals with all cyber related threats and conducts cyber audit of the entire Indian Army.

Finally, Sir you are well known for rigorous physical training that you undergo on a daily basis. Have your commitments as COAS come in the way of your physical fitness schedule?

COAS: Physical fitness is an integral and most essential component of soldiering. It instills pride as well as enhances battle proficiency. Although my commitments leave me with little personal time, I believe, where there is a will, there is a way. I personally maintain a basic fitness routine to keep myself healthy and fit.

If I don't find adequate time in the morning, I find some time for exercise in the evening or even at night.

Courtesy : Sainik Samachar

Threats and Readiness

Addressing the media on eve of Army Day 2016, General Dalbir Singh, Chief of the Army Staff, asserted that "the Indian Army is in full readiness and at the beck and call of the nation to respond to any challenge to India's security and integrity". The Army Chief assured the nation that the Army is ready to discharge any duty assigned to it in regard to protecting the interests of the nation.

"The Indian Army is one of the finest and most disciplined armies of the world. Whenever called upon to perform any duty anywhere in the world under the aegis of the United Nations, it has set a glorious record of service".

"In modern times, security environment has become complex and dynamic. The threat to our security and territorial integrity is much more than one can imagine. The threat is from many quarters and it has many dimensions. Cyber threat, the creation of a technological revolution in modern times, cannot be underestimated. The Indian Army has the capability to undertake any action if it is aimed at protecting the interest of the country".

Indian Army Special Forces

'Queen of the Battlefield'

Artillery : the Battle Winning Factor in Kargil

Major highlights of all actions in *Operation Vijay* was comprehensive destruction of enemy defences and suppression of enemy artillery forcing them to vacate their positions leaving behind a large cache of arms, ammunition, equipment and stores. The suppression of enemy small arms and artillery fire reduced our own casualties considerably. The role of Artillery in the battlefield, as the destructive and decisive arm was indeed written in golden letters in *Operation Vijay*.

India's success in *Operation Vijay* was not achieved without major sacrifices. Three officers and 32 soldiers of the Regiment of Artillery laid down their lives in the true spirit of their motto, *Izzat-O-Iqbal* ('Honour and Glory'). Pakistan lost an estimated 69 officers and 772 other ranks (OR), mainly from the Northern Light Infantry (NLI). Over 1,000 Pakistani soldiers were wounded.

The young company commanders and Forward Observation Officers led from the front by personal example and thus motivated their troops to perform outstanding acts of gallantry. For this exceptional and exemplary valour and grit in heroic battles in Kargil, the Chief of the Army Staff honoured 11 Infantry battalions, three units of Regiment of Artillery namely 141 Field Regiment, 197 Field Regiment and 108 Medium Regiment and two Reconnaissance and Observation Squadrons of Army Aviation with special award of Unit Citations.

By honouring these Regiments the Army acknowledged the vital part played by all the units of the Regiment of Artillery in fight to re-capture Indian territory from Pakistani intruders. Regardless of the controversy over its induction, the 155mm/39 Bofors FH77B howitzer performed remarkably well and was mainstay in the operations. Its maximum range of 30 plus km enabled deep strikes on enemy gun positions, administrative installations, ammunition dumps, and headquarters, besides neutralising forward positions held by the intruders. By moving these guns, along with 105mm field guns, 130mm and 120mm mortars and 122mm BM-21 Grad Multi Barrel Rocket Launchers (MBRLs) to forward gun positions for 'direct' fire on enemy localities, literally under the nose of the enemy and thereby inviting enemy retaliation onto themselves, the gunners exhibited great courage in battle. The gun positions came under heavy enemy counter-bombardment from time to time, often causing casualties. But the gunners there stood fast and continued to respond to the requirements of the Battery Commanders and Observation Posts. It was unique in the history of 286 Medium Regiment that all its 18 guns barrels wore out their life within 25 days since *Operation Vijay* commenced. They continued to fire as extensively with newer guns that they received from 163 Medium Regiment while the operations were continuing.

The Kargil conflict once again established that artillery firepower plays a major part in achieving victory on the modern battlefield. Accurate artillery fire reduces the enemy's defences to rubble. Sustained artillery fire gradually wears

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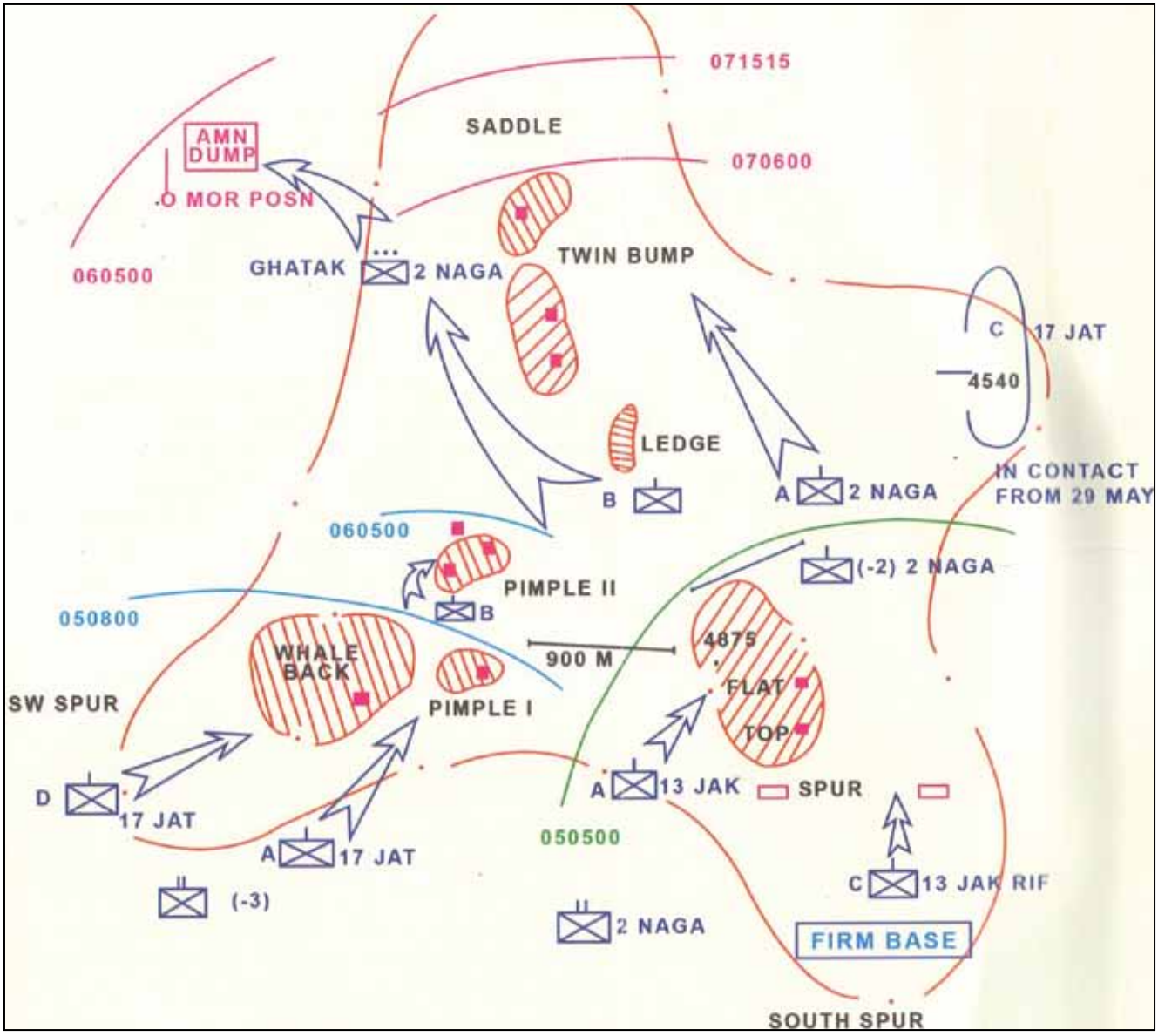
the enemy's resistance and ultimately breaks their will to fight. By systematically degrading the enemy's fighting potential before a physical assault is launched, the artillery helped reduce the casualties suffered by assaulting infantrymen. Throughout the offensive phase of Kargil conflict, artillery was called upon to respond to emerging situations and it did so with alacrity and telling lethality.

Indian Army artillery fired over 250,000 shells, bombs and rockets during the Kargil conflict. Approximately 5,000 artillery shells, mortars and rockets were fired daily from 300 guns, mortars and MBRLs while 9,000 shells were fired the day Tiger Hill was regained. During the peak period of assaults, on an average, each artillery battery continuously fired over one round per minute for 17 days. Such high rates of fire over long periods had not been witnessed anywhere in the world since World War II. Even during World War II, such sustained artillery firing was not common at all. The men at the guns had blisters on their hands from carrying and loading shells and cartridges. Few of them got more than a couple of hours of sleep a day, they had no time for not meals and were often under enemy artillery fire, yet they carried on relentlessly. Last but not the least artillery was, in fact, the prime killer since 80 per cent of the casualties suffered by the enemy were on account of artillery fire.

There were limited gun areas available for conventional deployment. Perforce, recourse had to be taken to split the batteries, often in twos and threes. At places there was a height differential of almost 40 to 50 feet between the first and sixth gun of a battery. On the other hand, there were places when guns had to be deployed wheel-to-wheel.

In sober analysis, while all arms and services contributed significantly to the concerted effort to evict the Pakistan Army regulars from Kargil victory was gained by the indomitable courage and selfless devotion of Indian infantryman with the overwhelming firepower of the artillery and the Indian Air Force.

Courtesy: MoD



Capture of Point + 4875 during July 1999

Lt Gen BS Pawar, former ADG (Army Aviation) on

Indian Army Aviation

An Arm of the Future?

In November 2015, the Indian Army Aviation Corps (AAC) completed 29 years of existence after its formation on 1 November 1986. However, at the end of these three decades, it continues to fly the obsolete and virtually vintage fleet of Cheetah and Chetak helicopters, even as it faces a muddled and confused Government policy on ownership of attack helicopters. The AAC has seen no progress on acquisition plans for Tactical Battle Support Helicopters (TBSH) to enhance tactical lift capability and support special operations while to induct fixed-wing aircraft in its inventory seems a distant dream. The present trend and growth trajectory leaves one wondering whether the Army Aviation is actually on the path to becoming the Indian Army's decision arm or, as sometimes referred to, 'Arm of the future'?

Still, a positive development has recently taken place with regards to replacement of the obsolete Cheetah/Chetak fleet with Russian Ka-226T helicopters, as per the Government-to-Government agreement signed by Prime Minister Modi during his visit to Russia in December 2015. Modalities for the same are yet to be worked out but as per reports, HAL will be involved in licence production.

The HAL Cheetah has served with the Army (and Air Force) for the past four decades

It was on 12 October 2012 that the Government, after vacillating for decades, finally took the call on the crucial issue of ownership and operations of Attack Helicopters (AH) in India's armed forces. That announcement by the MOD clearly stipulated that the *entire* AH fleet would

Kamov's Ka-226T has been selected for production in India

be owned, operated and maintained by the Army. Although protracted in coming, the decision was a welcome step and expected to have a major impact on war fighting in the Tactical Battle Area (TBA). It would be pertinent to mention here that the case for inclusion of AH to be part and parcel of the army dates back to 1963 when Gen JN Chaudhary, the then COAS stressed the requirement for a separate air wing for the army. He had emphasised that efforts at increasing the fire power and mobility of the army would not be complete without an integral aviation element comprising light, medium, heavy as well as armed/attack helicopters.

However, it took another 23 years for the army, with Government intervention, to finally break away from the Air Force and form an independent Army Aviation Corps in November 1986. Still, the organisation sanctioned was nowhere near what had been envisaged in 1963, totally lacking the wherewithal to be a full fledged aviation arm of the future, primarily due to non availability of armed/attack and utility helicopters in its inventory. It is ironic that it took so very long since the birth of the Aviation Corps to get the MOD to decide on the ownership issue of AH. This lethal weapon system, as part of army's inventory, will greatly enhance its capability, making it a battle winning factor in future conflicts.

As a consequence of this decision, it was logically assumed that the 22 Apache Longbow attack helicopters being procured from the US by the Air Force, were to be part of Army Aviation. This assumption was based on the basic premise that the two units of Mi-25/Mi-35, presently held with the Air Force, are actually army assets and are also operationally controlled by the Army. In fact, a few army aviation pilots are also posted to these units. The new Attack Helicopter (Apaches) being acquired are for the replacement of these vintage Attack Helicopters. It therefore came as a rude surprise when the previous Government stated that the 22 Apaches being acquired would remain with the Air Force ! This decision of the erstwhile Defence Minister Antony defies logic and seems purely based on considerations other than military. However, to placate the army, the same Government gave an in principle approval for Army's requirement of 39 Apaches for its Strike Corps ! In the current environment of 'Make in India' it is doubtful whether this proposal will ever come about leaving Army Aviation bereft of a lethal force multiplier which has the ability to play a crucial role in any future conflict in the plains.

There are related developments : an armed version of HAL's Advanced Light Helicopter (ALH), named the Rudra has already commenced induction into the army with a unit currently under raising. Though not a typical attack helicopter, it has an array of comparable weapon systems and includes a gun, rockets, air-to-air and anti-tank guided missiles (ATGM). However the present fleet of Rudras being inducted are without an integrated ATGM which renders the Rudra, in its present form, to be only a gunship and not an armed/attack helicopter as was envisaged. The air-launched version of the *Nag* ATGM being developed indigenously (Helina), is nowhere on the scene – it is required to arm both the Rudra and the Light Combat Helicopter (LCH), which is under development and it is important to note that this project has been going on for more than a decade and has not yet fructified.

The AH-64 Apache Longbow attack helicopter

The Rudra units are to form part of Holding/Pivot Corps constituting a formidable offensive punch to the field force commander. Seven to eight units of Rudra are planned for induction into the Army in the coming years as per the perspective plan. In this context, development of the LCH by HAL is expected to be a mile stone achievement. The LCH aims to 'gate

crash' the exclusive club of the state-of-art light attack helicopters, which includes Eurocopter's Tiger, Bell's AH-1Z Viper and China's Zhisheng 10 (Z-10).

The LCH is a derivative of the ALH and the Rudra and is designed to operate in an anti-infantry and anti-armour role with capability to operate at high altitudes (16,000 feet), a distinct advantage over other attack helicopters. Unlike the Rudra, the LCH will have tandem-seating cockpit and stealth features, but will carry the same weapons package as with the Rudra. This helicopter is expected to enter service by 2017. The LCH units will be the main punch of the manoeuvre force commander and will be inducted into the Army Aviation Corps to operate in support of ground forces both in the plains and mountains. The Army has plans to induct 114 such machines into its inventory.

The employment of Attack Helicopters, fully integrated with Army Aviation units and fighting alongside – and above – the infantry will also give a new meaning to close air support in the TBA. There is indeed a need to look afresh at the concept of close air support in the TBA and the role of attack/armed helicopters in the same. The present concept of close air support is a relic of World War II, driven by range limitations of surveillance, target acquisition and engagement capability of land-based platforms. The availability of unmanned aerial vehicles missiles and long range artillery platforms (40-120 km) has changed all that, as today's surface-based platforms can cover the entire TBA, and also brings into focus the role of attack and armed helicopters in providing intimate close air support in the TBA. In Afghanistan, troops on the ground have been much more comfortable with the intimate support provided by attack/armed helicopters in their operations, owing to visibility, proximity and response-time factors.

HAL's Rudra is an armed version of the Advanced Light Helicopter (ALH)

The Light Combat Helicopter (LCH) has been designed for operation at high altitudes and is to be inducted in considerable numbers by the Indian Army

The essential mission of Army Aviation is to fight the land battle and support ground operations, operating in the TBA as a combined arms team expanding the ground commander's battlefield in space and time. Its battlefield leverage is achieved through a combination of reconnaissance, mobility and fire power that is unprecedented in the history of land warfare. Its greatest contribution to battlefield success is the ability it gives the commander to apply decisive combat power at critical times virtually anywhere on the battlefield, in the form of direct fire from aviation manoeuvre units (attack/armed helicopters) or insertion of overwhelming strength inground forces at the point of decision (utility/lift helicopters). The key assets required for the above manoeuvre, attack and assault helicopters, must be at the immediate call of the field force commander and ideally piloted by men in olive green who fully understand the ground situation. This will ensure optimum utilisation of this battle winning resource, which has been the basic rationale on which rests the army's case for ownership of these assets. It is therefore difficult to understand that the MOD, in making its decision, has side-stepped this issue of ownership of the helicopter aviation assets in its entirety, with the army's requirement of tactical and heavy lift capability being excluded from the policy decision.

The army's modernisation and restructuring thrust moving towards a capability-based force, envisages integral lift capability of a Company at the Corps level, a Battalion at Command level and a Brigade at Army level. Accordingly, the resources for this capability in terms of tactical and heavy lift helicopters have been planned for induction as per the Army's Perspective Plan. The tactical lift class of helicopters

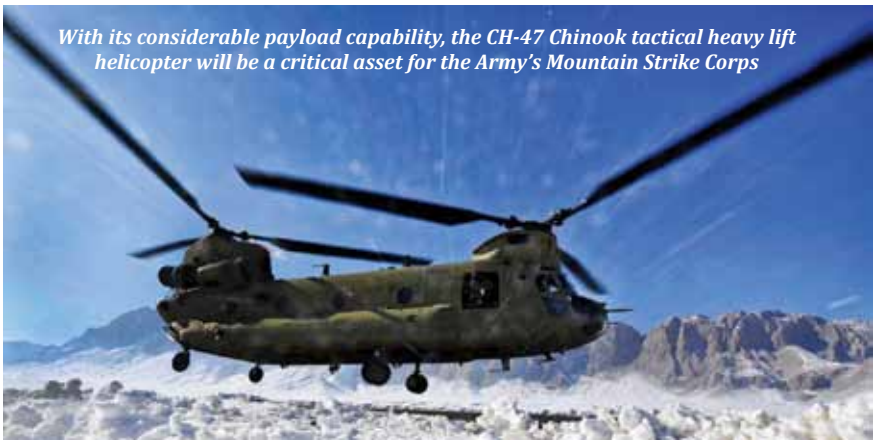
The HAL LCH during high altitude trials in the Himalayas

(10-12 ton) are required for special operations. In fact, the case for acquisition of tactical class of helicopters has been ongoing for the last 10-12 years with HAL too being involved in this project, but no headway has been made owing to stonewalling by the Air Force on the issue of "ownership".

It would be pertinent to mention that the army's plans for the induction of the Ultra Light Howitzer (ULH) into the artillery (trials for which have been completed and induction is likely soon), had actually triggered the requirement for heavy lift helicopters, which would be capable of

Boeing CH-47 Chinook with underslung Ultra Light Howitzer

The Dhruv ALH is serving with several units of the Army Aviation Corps



With its considerable payload capability, the CH-47 Chinook tactical heavy lift helicopter will be a critical asset for the Army's Mountain Strike Corps

lifting the ULH in the mountains as well provide heavy logistical support, especially on our eastern borders where infrastructure is woefully inadequate. Based on this army requirement, the Air Force set in motion the process for acquisition of this class of helicopters for which was the American CH-47 Chinook was down selected, instead of the Russian Mi-26. This will give a major boost to the heavy lift capability with the Chinook already having proved itself as a logistical warhorse in Iraq and Afghanistan. However, by not addressing the ownership aspect related to assault helicopters, the MOD has left the issue unresolved, thereby allowing festering wounds and turf wars to continue between the two Services, this being quite unfathomable.

Unlike the Air Force, Army Aviation units with their helicopters are located close to their operational areas and alongside formations affiliated to, especially at the Corps level. During war, these units will require to operate from forward composite aviation bases, involving security, maintenance, fueling and arming facilities. The employment philosophy dictates the need to develop organisations that enhance aviation capabilities to support the concept of operations of field commanders and be tailored to meet the evolving operational requirements – hence the concept of Aviation Brigades with each Corps and not at rear airbases as in the case of the Air Force.

For dominating the tactical battle space of the 21st Century, the roles that Army Aviation needs to perform in support of land battle requires equipment, personnel, aircrew but also organisations that enhance the overall goal and capability of the land forces commander. The need is for dedicated aircrew who are not only proficient in flying but are associated full time with army manoeuvres, operational thinking and ground tactics, as well as spending time in the field. The present structure is not suitable for the short, swift and limited wars, envisaged in the future.

While the transformation process has been set into motion by MOD's decision to transfer attack helicopters to the Army, much needs to be done on the issue of the ownership of the lift/utility component of helicopters. Experience of other nations clearly illustrates that each Service needs a viable integral aviation component for it to retain the capability to include air encounters as part of its own armoury. The control and ownership of tactical/heavy lift helicopters by the Indian Army is an operational imperative owing to the need for integration of all elements of Army Aviation (combat and combat support) into a cohesive combat organisation; then and only then will the Army Aviation Corps be anointed as the 'Arm of Future'.

Although 22 examples of the Apache AH-64D Longbow Attack Helicopter have been ordered by the Government of India, these are reportedly to be operated by the IAF although another 39 examples are an option for the Army Aviation Corps

VAYU on-the-spot report:

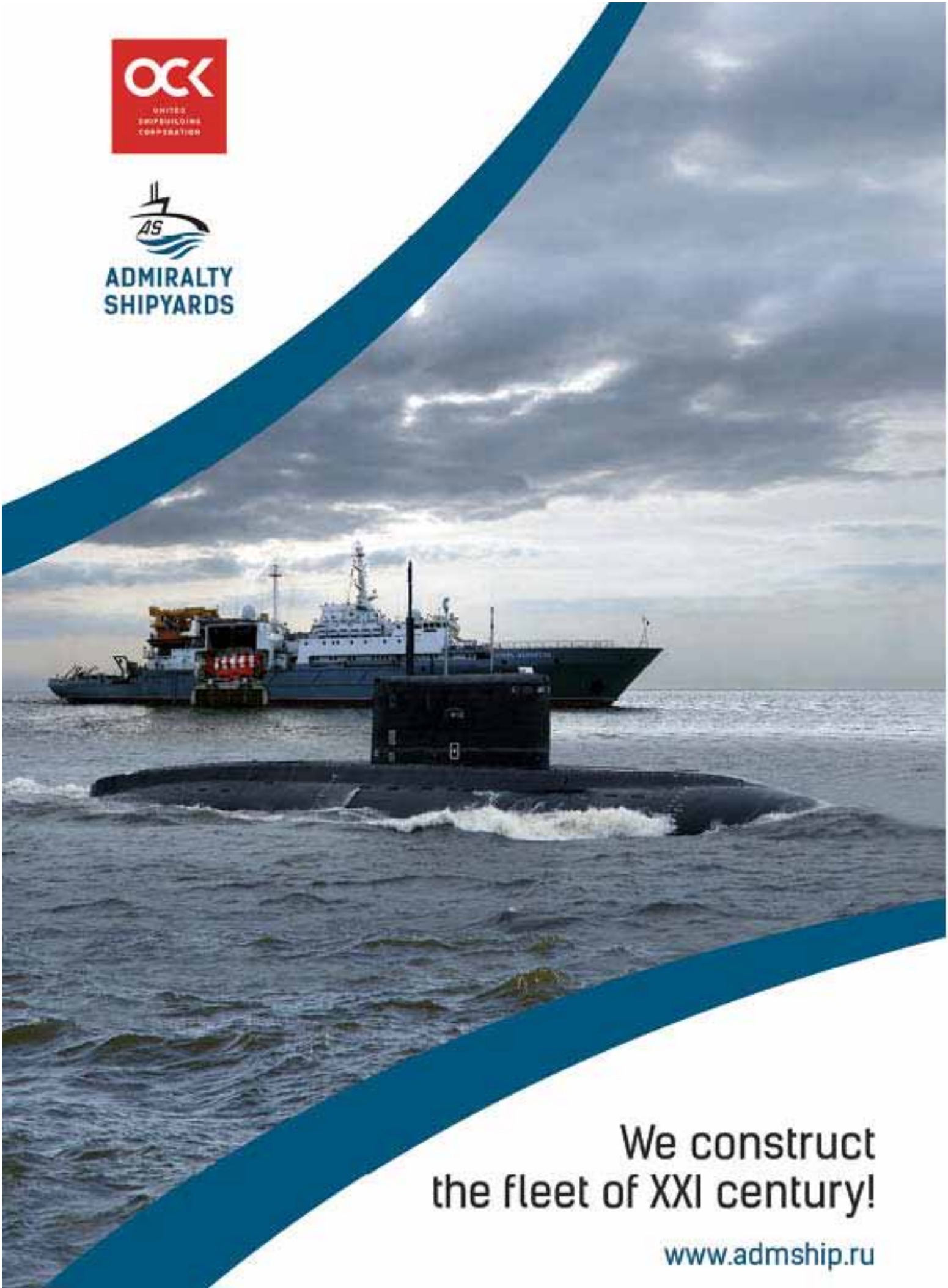
'United Through Oceans'

The International Fleet Review 2016

For a week in early February 2016, the Indian Navy's Eastern Command hosted a historic gathering of warships and naval delegations from around the world. Even as Iranian and American warships lay anchored a stone's throw from another in the Bay of Bengal off the city of Visakhapatnam, Vietnamese, Indian and Chinese officers rubbed shoulders in an atmosphere of uncommon conviviality ashore. "Not many countries can make something like this come together," remarked one Royal Navy officer, appreciatively.

Indeed, India is one of the few countries to regularly conduct national fleet reviews, usually once in every President's term of office, so as to allow the Supreme Commander of the Armed Forces an opportunity to review the country's prowess at sea. The International Fleet Review (IFR) 2016 is the 11th fleet review in Indian history, but only the second

The President, Prime Minister, Defence Minister, Navy Chief and FoC-in-C ENC on board INS Sumitra during the flypast (photo: Indian Navy)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Foreign warships at IFR 2016

Country	Ship	Type
Australia	HMAS *Darwin*	*Adelaide*-class frigate
Bangladesh	BNS *Somudra Joy*	*Hamilton*-class cutter
Brazil	BNS *Amazonas*	*Amazonas*-class corvette
China	PLANS *Liu Zhou* PLANS *San Ya*	Type 054A frigate
France	FS *Provence*	FREMM frigate
Indonesia	KRI *Usman Harun*	*Bung Tomo*-class corvette
Iran	IRIS *Alvand*	*Alvand*-class frigate
Japan	JS *Matsuyuki*	*Hatsuyuki*-class destroyer
Malaysia	KD *Lekir*	*Kasturi*-class corvette
Maldives	MCGS *Huravee*	*Trinkat*-class patrol vessel
Mauritius	MCGS *Barracuda*	*Barracuda*-class patrol vessel
Myanmar	UMS *King Aung Zeya*	*Aung Zeya*-class frigate
Oman	RNOV *Al-Shamikh* RNOV *Al-Seeb*	*Khareef*-class corvette *Al-Ofouq*-class patrol vessel
Russia	RFS *Epron*	*Prut*-class submarine rescue/salvage vessel
Seychelles	SCGS *Topaz*	*Trinkat*-class patrol vessel
South Africa	SAS *Spioenkop*	*Valour*-class frigates
Sri Lanka	SLNS *Sayura*	*Sukanya*-class patrol vessel
Thailand	HTMS *Saiburi*	Type 053 frigate
United Kingdom	HMS *Defender*	Type 45 destroyer
United States	USS *Antietam* USS *McCampbell*	*Ticonderoga*-class cruiser *Arleigh Burke*-class destroyer
Vietnam	*Đinh Tiên Hoàng*	*Gepard*-class frigate

time that India has taken the opportunity to open the event to navies of the world, with the first such event having been hosted in Mumbai in 2001. As highlighted by more than one foreign delegate in Visakhapatnam, it is a mark of India's inclusive approach to the maritime domain that a number of naval ensigns found themselves in unlikely company for those few days in Vizag.

Over 50 delegations from various countries attended the week-long event, while 24 foreign warships joined over 50 Indian ships and submarines at anchorage and were reviewed by the President and Prime Minister of India on 6 February 2016.

Indian Navy ships at the review included one or more examples from almost every class in service, including training ships, sail ships and a trio of *Kilo*-class submarines. Notable absentees were the *Akula*-class nuclear attack submarine INS *Chakra*, and the *Shishumar*-class (HDW Type 209) submarines. Without doubt the two aircraft carriers, INS *Vikramaditya* and INS *Viraat*, took pride of place as flagships of the review, with this event being *Viraat*'s last operational outing with her complement of Sea Harrier fighters before she is retired and converted to a museum later this year. Among other prominent Indian participants was INS *Kolkata*, the most modern guided-missile stealth destroyer in the Navy, INS *Kamorta* and *Kadmatt*, the two newest ASW corvettes in service, and all three *Shivalik*-class stealth frigates.

President Pranab Mukherjee and Prime Minister Narendra Modi reviewed the fleet from the *Saryu*-class patrol vessel INS *Sumitra*, which served as the Presidential 'yacht,' and was accompanied by the remaining three patrol vessels of the class, *Sumedha*, *Saryu* and *Sunayna*, with various dignitaries, foreign delegates and media persons embarked (including *Vayu*!). The review included a SAR demonstration with a HAL Dhruv ALH from INAS 322 'Guardians' and also a flypast by every naval aviation asset except the Kamov Ka-28.

The flypast began with a trio of HAL Chetak light helicopters trailing the Indian flag, the Naval Ensign and the IFR flag, which were then followed by a series of three-ship helicopter formations : Navy Chetaks, Coast Guard Chetaks, Sikorsky

A Chetak flying the IFR flag heralded the Op Demo


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A surfaced Kilo-class (Project 877 EKM) submarine at the fleet review

UH-3H Sea Kings, Westland Sea King Mk.42Cs, HAL Dhruvs, and Kamov Ka-31s. The fixed-wing flypast was led by four Navy Dornier 228s, which were followed by another four Coast Guard examples of the same type. Then came a single Il-38SD Sea Dragon from INAS 315 'Winged Stallions,' which was followed by the newest ASW/patrol aircraft in the Navy, a Boeing P-8I from INAS 312A 'Sky Lions.' The fast jets closed out the flying for the day, with a four-ship Sea Harrier formation from INAS 300 'White Tigers' leading the way ahead of an impressive five-ship Hawk formation from the locally based INAS 551 'Phantoms.' The final formation was

Indian diving support vessel Nireekshak (foreground) with Russian ship Epron in the background

USS McCampbell was one of two US Navy warships at the review

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a formation of four single-seat MiG-29Ks flying in low and fast just as the Presidential yacht came abreast of their 'mothership,' INS *Vikramaditya*.

As the review column left the fleet behind and sailed back toward port, three *Kilo*-class submarines representing the Navy's 'Silent Service' surfaced and sailed past the four patrol vessels before disappearing into the distance.

Speaking from the Presidential yacht after conclusion of the review, President Pranab Mukherjee stated, "Navies the world over have conducted fleet reviews to symbolise their loyalty and allegiance to the nation and strengthening bonds between the sailors and the State. IFR 2016 does that much and much more. IFR 2016, while focusing on the prowess of the Indian Navy, has brought together Navies from across the globe here on Indian shores, signifying our common desire to use the seas to promote peace, cooperation and friendship as also develop partnerships for a secure maritime future."

Indeed, partnerships both mature and developing were fully evident during the week in Vizag. The US Navy, keen to support its burgeoning relationship with the Indian Navy in consonance with America's focus on the Indo-Asia-Pacific region sent two warships for the review and a band for the International City Parade. On the other hand, casual observers might have been surprised by the seemingly low-key nature of Russia's participation at the event, given the scale of collaboration between the two countries. However, the sole Russian vessel in attendance, the *Prut*-class submarine rescue/salvage vessel *Epron*, had already been operating in Indian waters since October 2015, supporting sea and weapons trials for India's first indigenous nuclear submarine, the *Arihant*. India does not possess a submarine rescue capability, necessary for deepwater diving trials and risky weapons tests involving underwater firing of missiles and torpedoes, and there are few countries with these vessels that would be allowed to participate in such sensitive activities.

The review column, with INS Saryu nearest to the camera, heading back to port

The Indian Navy Op Demo and International City Parade were conducted the day after the fleet review. First, Indian Navy capabilities were showcased, including flight operations from both aircraft carriers, with MiG-29K afterburners visible in the distance through the sea haze off the coast. A marine commando assault and extraction with Sea King helicopters and a simulated amphibious landing were also demonstrated, before arguably the most impressive flypasts anywhere in India in recent memory. First, a Sea Harrier came in low over the beach before stopping to dramatically hover in front of the VIP box, where the Prime Minister, Navy Chief and other dignitaries were viewing the proceedings. Then two MiG-29Ks streaked low along the coast dispensing flares, followed by a composite formation of a P-8I flanked by a pair of MiG-29Ks and a pair of Hawks, also accompanied by flares. After the flypasts a Hawk and a MiG-29K made rocket attacks on a floating target just off shore.

With the demonstrations complete, a team of skydivers parachuted onto the beach with a copy of a book on '*The Maritime Heritage of India*,' which was formally released by the Prime Minister. He also spoke on the relevance of the Fleet Review itself, saying that "oceans are the lifelines of global prosperity," and that over "90 per cent of global mercantile trade is carried on the oceans." He cited a range of threats to global maritime commerce, including

A Sea King Mk.42C hovering over the beach during the marine commandos assault demonstration

Last hurrah? INAS 300 'White Tigers' Sea Harrier hovering in front of the VIP box

sea-borne terror, piracy, natural disasters, and man-made environmental disasters. Gently underscoring maritime tensions in the IOR and beyond, the PM also addressed the importance of freedom of navigation and emphasised cooperation instead of competition in international waters. In response to the changing global scenario, the PM highlighted the fact that India is set to host the first-ever Global Maritime Summit in April 2016, with an aim to "strengthen the vibrant trade, investment, technology and commercial linkages between India and other maritime nations."

As dusk gave way to night-time, all Indian warships in the bay switched on their lights and launched multi-coloured flares in perfect synchronisation, signalling the start of the International City Parade. The

Amphibious assault demonstration with Indian Army T-72 tank

MiG-29Ks dispensing flares over RK Beach

INS Ranvir and INS Nirbhik with decorative lights and launching flares

INS *Vikramaditya* and the other by INS *Viraat*. Many ships with embarked organic aviation assets performed 'cross deck' landing operations aboard vessels from other countries in addition to the customary 'passing exercise,' or PASSEX, conducted at the end of the review, prior to the dispersion of the multinational fleet to their home waters. In addition, Indian Navy sailing vessels were also part of the review and conducted a separate 'Sail in Company' at the conclusion of the event.

No matter their disparate national interests or geographical spheres of influence, for a few days in February 2016,

The CNS, Admiral RK Dhowan, presenting a memento to Defence Minister Manohar Parrikar at the International Maritime Conference, as former CNS Adm DK Joshi (retd) and FoC-in-C ENC, Vice Admiral Satish Soni look on (photo: Indian Navy)

Indian Navy contingent led the way down Vizag's Beach Road, followed by marching formations from nearly all participating nations.

The International Maritime Conference, organised by the National Maritime Foundation with the theme 'Partnering Together for a Secure Maritime Future,' was an overlooked highlight of IFR 2016. The two-day conference, held on 7 and 8 February, had eminent speakers from around the world sharing suggestions and ideas on "the importance of the maritime domain and how best to harness its opportunities and address its challenges." Hundreds of uniformed officers in attendance participated in lively discussions, enriching each session with their own recommendations and questions, and if even some of the effects of this enormous multi-national event make their way to each of the fifty countries that attended, it will have been the most valuable event of the entire Fleet Review.

On the morning of 9 February, the 75-odd ships in the bay weighed anchor and split into two groups, one led by fifty of the world's Navies rubbed shoulders in Visakhapatnam, shared ideas, learned lessons, and swapped stories – truly '*United Through Oceans*.'

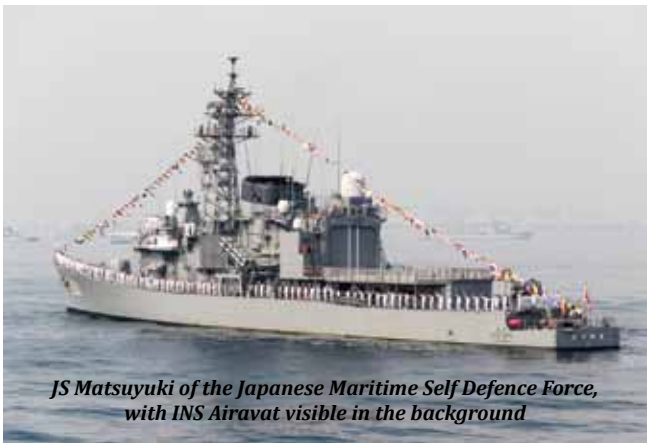
Angad Singh

(all photos by the author unless otherwise noted)

Vietnamese frigate Đinh Tiên Hoàng, with embarked Kamov Ka-28 helicopter

Panorama of Indian and International

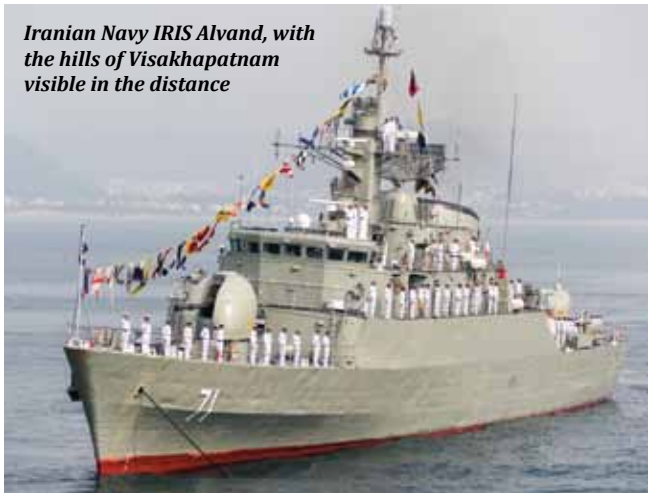
INS Viraat at her final fleet review, with INS Ganga and INS Beas in the background. Two Sea King Mk. 42B and a Sea Harrier are seen on deck



JS Matsuyuki of the Japanese Maritime Self Defence Force, with INS Airavat visible in the background

HMAS Darwin with embarked Sikorsky Seahawk – this very frigate also attended India's first IFR in 2001

Bangladeshi frigate BNS Somudra Joy and Brazilian Navy corvette Amazonas at anchorage



Iranian Navy IRIS Alvand, with the hills of Visakhapatnam visible in the distance

Naval Ships at IFR 2016

The review column sails past INS Vikramaditya and INS Viraat

French FREMM frigate Provence seen with Chinese PLAN Type 054A frigate Liu Zhou and Australian HMAS Darwin

Malaysian Navy frigate KD Lekir, with the South African Frigate SAS Spioenkop seen in the background

INS Kolkata at the review, with Rajput-class destroyer INS Ranvir and Godavari-class frigate INS Ganga visible in the background

Royal Navy Type 45 air defence destroyer HMS Defender, with Westland Lynx HMA.8

Indian Navy Talwar-class frigate INS Tarkash moored alongside USS McCampbell and a number of merchant vessels

Pride of the Indian Navy, INS Vikramaditya with two HAL Chetaks and a MiG-29K on deck

With the US Navy on board USS *Antietam*

The US Navy is leading the proverbial charge when it comes to security cooperation aspects of the increasingly close Indo-US relationship. Nowhere was this more evident than at IFR 2016, with the USA sending two frontline warships and the US Navy band to Visakhapatnam. US Chief of Naval Operations Admiral John M Richardson, making his first visit to India, also attended the event. The *Ticonderoga*-class air defence cruiser USS *Antietam* (CG-54) and *Arleigh Burke*-class guided missile destroyer USS *McCampbell* (DDG-85), both forward based at Yokosuka, Japan, were among the largest vessels anchored off Vizag, eclipsed only by the two IN aircraft carriers.

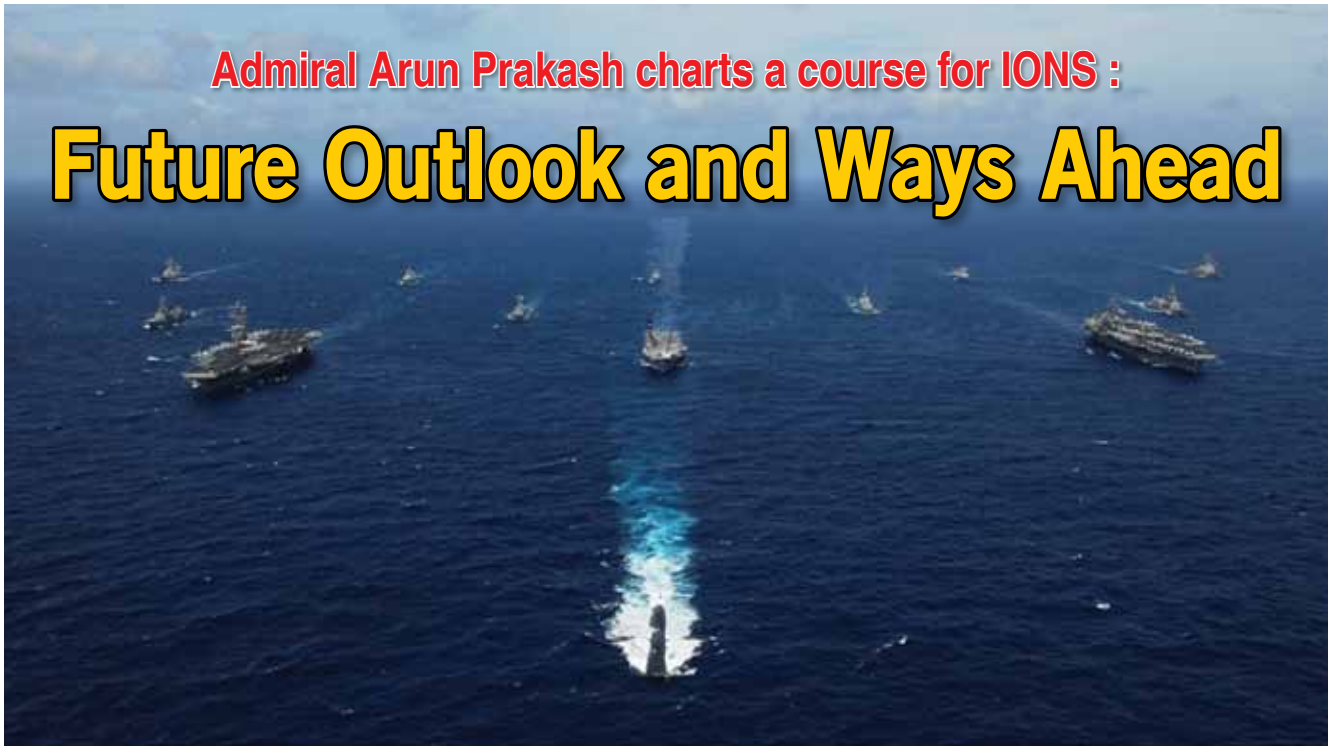
Vayu was invited to tour *Antietam* after the fleet review, before it sailed back to Japan.

Named after the American Civil War Battle of Antietam, the bloodiest single-day battle in American history, the enormous 9,800-tonne cruiser was arguably the most heavily armed ship at the entire event, boasting two 127mm guns, eight RGM-84 Harpoon AShMs in inclined launchers, and an incredible 122 Mark 41 vertical launch (VLS) cells! Although the vessel's primary role is to host the air warfare commander and act as the principal air defence ship in a USN Carrier Strike Group (CSG), the 122 VLS cells give it incredible flexibility in employing a range of missiles such as the BGM-109 Tomahawk long-range land-attack missile, all variants of the vertical-launch Standard Missile (SM) family, RUM-139 anti-submarine rocket (ASROC), and quad-packed surface-to-air Evolved Sea Sparrow Missiles (ESSM). All these munitions are controlled by the Lockheed Martin Aegis Combat System, at the heart of which is the AN/SPY-1 electronically scanned radar. The ship also includes two Phalanx close-in weapon systems (CIWS) and a range of flare and chaff launchers as a 'last line of defence' against incoming threats.

Key elements of USS Antietam's combat capability are its Mk 41 VLS cells and AN/SPY-1 radar, one array of which is seen here on the forward superstructure

As a means of extending the vessel's horizon and expanding its combat capability, USS *Antietam* sails with two multirole Sikorsky (now part of Lockheed Martin) MH-60R Seahawks, used chiefly for ASW and ASuW, with a secondary SAR and casevac/medevac role. The helicopters, operating as Detachment 3 of Maritime Strike Squadron 51 (HSM-51) 'Warlords,' are equipped with a Raytheon AN/AAS-44 forward-looking infrared (FLIR) turret, Telephonics AN/APS-147 or 153(V) multi-mode radar, Raytheon AN/AQS-22 dunking sonar, Lockheed Martin AN/ALQ-210 Electronic Support Measures (ESM) and a comprehensive countermeasures suite that includes the Alliant Techsystems AN/AAR-47 Missile Approach Warning System, BAE Systems AN/ALQ-144 infra-red countermeasures system and BAE Systems AN/ALE-39 chaff and flare decoy dispenser. The MH-60R can launch torpedoes or fire AGM-114 Hellfire missiles, and a new AShM of greater range and lethality is already under consideration.

MH-60R of HSM-51 Detachment 3, showing key sensors, including MAWS, FLIR turret and search radar



Admiral Arun Prakash charts a course for IONS :

Future Outlook and Ways Ahead

IONS was founded in New Delhi in 2008, as an Indian Navy initiative with India as chairman. Since then, its chairmanship has rotated to the UAE, South Africa and Australia. In Dhaka, the chairmanship of IONS passed from Australia to Bangladesh.

As one dwells on the future of the Indian Ocean Naval symposium (IONS) and explores the avenues open to this young organisation, there is need to approach the task with a degree of caution. Looking at the future is a hazardous undertaking and one is reminded of the American baseball hero Yogi Berra, who once complained: "It's tough to make predictions; especially about the future, because the future ain't what it used to be!"

Avoiding prognostication, I shall try to share a few thoughts on some geo-political and historical issues relating to the Indian Ocean, before pulling the strands together to see how IONS can become a nucleus and engine of regional cooperation.

Let us, first of all, note that the unusual level of attention that the Indian Ocean has been receiving, in western writings and discourse, is a direct outcome of Asia's growing economic prosperity. The 500-year long era of Western domination of Asia, which commenced with the arrival of Vasco da Gama in 1498, is now in a state of terminal decline, owing partly to Europe and America's economic travails, but mainly because of the economic, political and military rise of Asia. Most Asian navies are growing whereas most European navies are actually contracting.

Focus on the Indian Ocean

One of the persons instrumental in this re-orientation of focus has been American analyst Robert Kaplan. Through his widely read writings and speeches, he has been urging his countrymen to view the Indian Ocean through a new lens, and advocating a radically different approach to this part of the world. He posits, that the 'Greater Indian Ocean', an area extending from the Horn of Africa to Indonesia, is taking centre-stage in world affairs, and goes on to predict that the region would see many global struggles playing out; it is here that the fight for democracy, energy-independence and religious freedom will be lost or won.

There are dire warnings too. Kaplan senses that the Indian Ocean is "where the rivalry between the US and China in the Pacific interlocks with the regional rivalry between China and India." At the same

time, British analyst Thomas Barnett points out that "No ocean is in need of strategic stability more than the Indian Ocean, since the navies of six nuclear powers, US, Russia, France, UK, China, India and Pakistan ply in these waters."

There is a saying "you cannot look ahead without looking back." Let me, therefore, dwell briefly on the historical significance of the Indian Ocean as a unifying factor, on our neglect of this region and on why we must not allow history to be repeated.

The Indian Ocean as unifying factor

In the 1940s Indian historian KM Panikkar challenged western discourse, when he asserted that it was not the Mediterranean, but the Indian Ocean, which had seen the world's first oceanic sailing activity. This was because the reliable winds that accompany the two monsoon seasons made sailing in the Arabian Sea and Bay of Bengal safe and predictable. It enabled Indian, Arab and Chinese seafarers to undertake voyages, criss-crossing the Arabian Sea, in sturdy ocean-going ships, using sophisticated navigational techniques; thousands of years before the Greeks, Romans and Phoenicians ventured into the Mediterranean.

Looking eastwards, the spread of Hinduism and Buddhism from India to SE Asia provides evidence of sustained seaborne interaction, across the Bay of Bengal, for centuries. The coming of Islam, in the 7th century, provided further impetus to seafaring, because it encouraged intermingling and co-existence, communal prayer and haj pilgrimages. Having carried trade, religions, cultures and people, across thousands of nautical miles, the waters of the Indian Ocean have, thus, been a strong unifying factor for this region.

This invocation of history is to remind one that firstly, we, who live around the Indian Ocean, are heirs to a common, ancient maritime heritage,and secondly, that we became victims of colonialism because we failed to unite as an Indian Ocean community and safeguard our interests against foreign interlopers. Another question that we need to reflect upon is, as to why the Indian Ocean Region, despite its importance as a major maritime thoroughfare, has remained an inconsequential entity in international relations.

An Indian Ocean identity

Essentially, this was due to the fact that the core interests of colonial powers that dominated the region lay in Europe. The importance of this region was downplayed since it was seen merely as a cross-road for shipping traffic. Even in the heyday of the Raj, the British saw the Indian Ocean as a collection of sub-regions like Southern Africa, East Africa, Middle East and the Far East.

The US, which succeeded Britain as the predominant Indian Ocean power, remained focused on security of Middle East oil, and the containment of Communism through a system of treaties and alliances. America remained fixated on the Atlantic and the Pacific, and aggravated the marginalisation of the IOR by dividing it between three of its geographic Combatant Commands; PACOM, CENTCOM and AFRICOM, whose tri-junction lies in the heart of the Indian Ocean.

However, a major share of blame for this situation must be accepted by us who live in the IOR. Not only has the level of intra-regional trade and political interaction remained low, but we have invariably gone beyond the IOR to seek partners. This paucity of common interests and lack of inter-dependence is the reason why more recent attempts to create pan-IOR organisations like the *Indian Ocean Rim Association*, have not been entirely successful. As the largest IOR nation and economy, India must accept its share of the responsibility for this situation.

Finally, we must note that the world around us is not standing still. Asia's rapidly evolving economic and geo-political realities are creating new relationships. A clear symptom of this is the emergence of the term, 'Indo-Pacific', which recognises the coupling of these two oceanic regions. The US 'Pivot to Asia' has thrown up yet another new term: the 'Indo-Asia-Pacific', which is said to span an expanse from the West Coast of the US to the East coast of Africa. To my mind, these terms are representative of specific geo-political interests of nations. Before accepting or rejecting them, we need to consider whether they conflict with the concept of an integrated IOR and its maritime security.

INS Vikramaditya with support ship and frigate

IOR 'Hotspots'

As we cast our gaze into the future, it is appropriate to also take note of the current 'hot-spots' or issues that impede synergy

and cooperation in the IOR, because they also have potential for conflict. As it shapes mechanisms for maritime cooperation, it is possible that IONS could also contribute its share to confidence-building in three possible areas:

- Firstly; we have territorial disputes, on land as well as offshore, which have defied resolution for decades. In this context, we have heard repeated and well-deserved praise for amicable manner in which Bangladesh, India and Myanmar settled their maritime dispute through the UN Court of Arbitration. It is a good example for others to emulate.
- Secondly; there are nuclear weapon states in the IOR which have or will deploy warheads, on shore-based as well as sea-going platforms. We must note that, in the absence of arms-limitation negotiations or confidence-building dialogues, this represents an unstable situation which needs to be addressed by navies.
- Lastly an unstated naval arms race has been in progress across the IOR for some time. Insecurities, tensions and mistrust have led to accretion of warships, submarines and aircraft in national inventories. Enhanced naval activity, especially in disputed areas, increases the chances of an incident and calls for active risk-management.

Finally, we frequently hear that the 'Blue Economy'promises to be a panacea for many of our problems. However, we must beware that unless we can find equitable methods of sharing the technologies for undersea-exploitation as well as the riches of the seabed, there is a huge potential for EEZ and other disputes in this area.

I am aware that issues of this nature lie beyond the charter of IONS, but they do impact the regional security dynamics and IONS needs to recognise the risk of inter-state tensions and potential conflict in the IOR. American strategist Admiral Mahan has been frequently mentioned in this gathering. His views on the role of sea power and sea control in enhancing a nation's status and prestige are well-known. But let us look at a different aspect of his thinking.

Sea Power & Economies

Mahan was equally emphatic about the impact of sea power on the economic prospects of a nation**.** Preaching that maritime commerce was the key to prosperity of a nation, and a powerful fleet was the best way to protect seaborne trade, Mahan added a caveat that surprised many. He said: "War has ceased to be the natural, or even normal, condition of nations, and military considerations are merely accessory and subordinate to the other great interests, economical and commercial, that they serve."

Insisting that the true path to national prosperity and greatness lay in safeguarding sources of economic strength, he went on to establish a relationship between a nation's economic prospects, its maritime trade and its navy.

Much of the oceanic spread, defined by Mahan as the 'global commons', offers all nations a source with unlimited potential for supporting the 'blue economy'; through yield of energy, mineral and organic wealth as well as generation of sustainable employment. Shipping is at the core of today's world economy, since it enables nations to participate in the global marketplace by undertaking international trade. Even information travels via high-speed data highways provided by sea-bed fibre-optic cables connecting all the continents.

Portrait of Admiral Alfred T Mahan

In theory, the ocean floor is the 'common heritage of mankind', but, as I just mentioned, in actual fact, ownership of seabed resources,contain an ever-present possibility of conflict. Similarly, while free-trade contributes to international prosperity and cooperation, historically it has always been the root of competition, rivalry and even war. Discussions of the 'Malacca dilemma' and the 'One Belt One Road' concepts is symptomatic of our insecurities.

As Indian Ocean neighbours, it is essential that we do not construe maritime security as a 'zero-sum game.' Assurance of security and prosperity, only for some nations, would becounter-productive, because it could foster anxiety amongst others and lead to tension and instability. Inclusivity is vital, and Indian Prime Minister Modi encapsulated this thought when he announced on a recent visit to Mauritius; "We seek a future for the Indian Ocean that ensures security and growth for all in the region." The phrase forms the acronym 'SAGAR', which is the Hindi word for 'ocean'. SAGAR has now become a foreign policy watchword in New Delhi.

Bangladesh Navy Offshore Patrol Vessel

Anti-piracy action in the Gulf of Aden

Future Outlook for IONS

There is a view that members of IONS have, so far, reached out for the 'low hanging fruit', addressing only common, non-traditional maritime security threats and challenges, but shying away from hard security issues. While this may be true, it is only appropriate that a young and diverse organisation like IONS proceeds with deliberation, because 'consolidation' and 'consensus' are the twin keys to its success at this stage.

Comparisons between IONS and the Western Pacific Naval Symposium (WPNS) are inevitable. But it needs to be borne in mind that the 27 year old WPNS had the powerful glue of the US alliance system to bind it together in its early years. IONS, by contrast, is a pioneering, project in a region, still trying to find its identity, and unaccustomed to such initiatives.

While the need for caution and circumspection is undeniable, there is, equally, a requirement to look ahead and conceptualise a future vision for this organisation that will shape its growth and trajectory. The inception of IONS, in 2008, was a step of historic significance, because it represented the first post-colonial endeavour by nations of the IOR periphery to create maritime linkages, directly with each other. While renewing ancient bonds, disrupted by colonial domination, IONS also sought to create new partnerships and thereby reinforce an IOR identity and cohesion.

What Can We Do?

As IONS attains maturity, we find that the scope and need for maritime cooperation in the IOR has become truly vast. Whether it is rampant piracy, maritime terrorism or marine disasters, the seas are rife with hazards. Natural calamities and the impact of climate change, too, present a severe threat to coastal and low-lying island-nations. A stark reality that has repeatedly emerged in crisis-response situations is the inadequacy of resources vis-a-vis demands of the situation.

'No nation can do everything by itself, but many nations can do something together'. This is a phrase worth remembering because most challenges, in the maritime domain demand a collective response. As the 2005 Hurricane *Katrina* in the USA and the 2011 tsunami in Japan demonstrated, even advanced nations can get overwhelmed by the sheer magnitude of such disasters and need external assistance.

In case of the 2004 Indian Ocean tsunami, even though regional navies rushed assistance to stricken neighbours within hours, we found that often our resources were inadequate. It was the arrival of the US Navy which saw deployment of massive relief efforts. However, we must remember that it took a full week for US Navy ships to cover long distances to the disaster-struck Indian Ocean locations.

Our dependence on the seas can be used as a binding force and a lever for collective endeavours to reduce vulnerabilities, and ensure the security of this vast commons. We should make strenuous efforts to identify areas of mutual convergence in order to promote multilateral cooperative endeavours which will foster better understanding through capacity-building and interoperability.

The search operations for Malaysian Airlines flight MH 370, on going since March 2014, provided a most convincing argument for concerted multilateral action. This display of cooperation, in which nations rose above political differences, should encourage a quest for capability-building and teamwork amongst IOR navies. Against this background, I draw attention of this gathering, to three areas of concern whose amelioration could suggest some ways ahead for IONS.

The Ways Ahead?

Firstly, we learn from experts how prone our part of the world is to natural disasters. We are also aware of the ever-present possibility of an aircraft or ship suffering a mishap. Two other types of contingencies that we need to keep in mind are a marine pollution incident and a submarine accident. Given the scale of effort and level of expertise required, most of our navies may not be able to cope with these emergencies on their own. But pooling of resources for a multi-national effort could save lives and limit damage. Instead of relying only on external assistance, regional navies need to equip themselves and be prepared for a swift response to such occurrences.

We hear concerns about the safety of some 100,000 merchantmen that annually transit the Indian Ocean, carrying cargo worth about a trillion dollars. Oil and gas-laden shipping, as it passes through focal areas, is vulnerable to interdiction or interference by non-state actors. Even as piracy has subsided off Somalia, it has appeared in the Gulf of Guinea and is slowly re-emerging in SE Asia. There is also worrisome evidence to suggest that pirate networks and militant groups like *al-Qaeda* and *al-Shabab* have formed a nexus to advance a militant agenda; with far more serious damage-potential.

The international anti-piracy response has been praiseworthy. But without intending any criticism I might say that it is sub-optimal for two reasons; firstly, much of the initiative, being extra-regional, came from a long way off and secondly, given the challenges of time and space the effort was deficient in platforms as well as coordination.

These scenarios give us cause to think about creation of a regional capability for collective response to maritime disasters, accidents and incidents. A decade ago, the US Navy had called for a Global Maritime Partnership' : perhaps we should think of an *'IOR Maritime Partnership'* to serve the common cause of safety and security at sea. While a standing force would be over-ambitious, a force 'in-being', capable

Indian Navy Il-38 Sea Dragon MR/ASW aircraft flies over Indian Navy guided missile destroyer

of mobilisation within 24-48 hours, could form a regional 'fire brigade' to rush to disaster struck areas or accident sites at short notice.

The importance of communication and information-sharing as the key to successful maritime cooperation is frequently. Thus, for any contemplated maritime partnership or 'force in being' to be effective, it must be supported by a system that will provide maritime domain awareness and the necessary information about the maritime traffic picture. Since no single nation or agency has the ability to obtain comprehensive MDA on its own, this brings us to a second tangible avenue for cooperation that IONS should resolutely pursue; the creation of a framework for an information sharing system between its members.

We are aware of the successful Information Fusion Centre in Singapore. Another model could be the 2013 tri-partite cooperative MDA agreement between India, Sri Lanka and the Maldives. The agreement, which envisages close cooperation in tracking and identification of merchant vessels, Search and Rescue and surveillance of Exclusive Economic Zones, could form the template for a similar accord within IONS. There would be security concerns about sharing MDA, but if we are all equally threatened by maritime terrorism, this is a price worth paying.

The last issue I want to broach relates to the need for reduction in pace and scope of the region's naval arms race. Arms races are motivated by a 'security dilemma' in which one state's pursuit of security decreases the real or perceived security of its adversary, producing an 'action-reaction cycle' of spiralling arms acquisitions. This is happening in the conventional as well as nuclear fields. A broad-based dialogue on maritime security issues would serve to alleviate misgivings and mistrust. My last recommendation is that IONS should consider constitution of a *Maritime Confidence Building Forum,* which could address the underlying causes of insecurity, discuss measures to limit maritime capabilities, and prevent an unbridled naval arms race.

Since the Indian Ocean is buzzing with naval activity, the possibility of a 'close-quarters' situation suddenly developing at sea or in the air above always exists. The *Maritime Confidence Building Forum* could also draw up an agreement on the lines of the US-Soviet 'INCSEA' or the more recent 'Code for Un-scheduled Encounters at Sea'(CUES), so that a small incident between naval units in the Indian Ocean does not snowball into a confrontation. It would be desirable to also involve extra-regional navies which operate in the IOR.

Unlimited Opportunities

In conclusion, I would say that the seas do not just make us all neighbours, they also provide unlimited opportunities for navies to work together in a common cause; certainly in good times, but even more so when neighbours need help. In the changing environment, navies must re-invent themselves as instruments of state policy, to bring nations closer together.

A collective system like IONS has to be based on common interests of the regional community, and cooperation for collective benefit. If it also works for conflict prevention so much the better. As the force of economics lifts the IOR to higher levels of growth, we must remember that our vital interests are inextricably linked to each other. No nation, big or small, can hope to prosper in isolation, leaving others behind. Inclusivity is, therefore, the vital key to our prosperity and security.

While no one believes that Utopia is around the corner, cooperation is certainly worth striving for. It is obvious that the maritime arena provides the most fertile ground to seek such an objective, and IONS is the right forum to convert our common challenges into opportunities for attaining peace and stability.

Adapted from an address delivered by the Admiral at the Indian Ocean Naval Symposium held in Dhaka in January 2016 (photograph above).

Vigilance Over the Seas

Indian Navy Dornier 228 taxis past an Indian Navy Tupolev Tu-142M (photo : Angad Singh)

For coastal defence and anti-piracy operations, the Indian Navy (IN) currently relies on its fleet of around twenty-four Dornier Do228 aircraft and Heron Unmanned Aerial Vehicle (UAV) to monitor India's 7,516-km long coastline, 1,197 islands and a two-million square kilometre exclusive economic zone. For long range maritime patrol, the Indian Navy have recently operationalised the Boeing P-8I which supplements the ageing Tupolev Tu-142Ms.

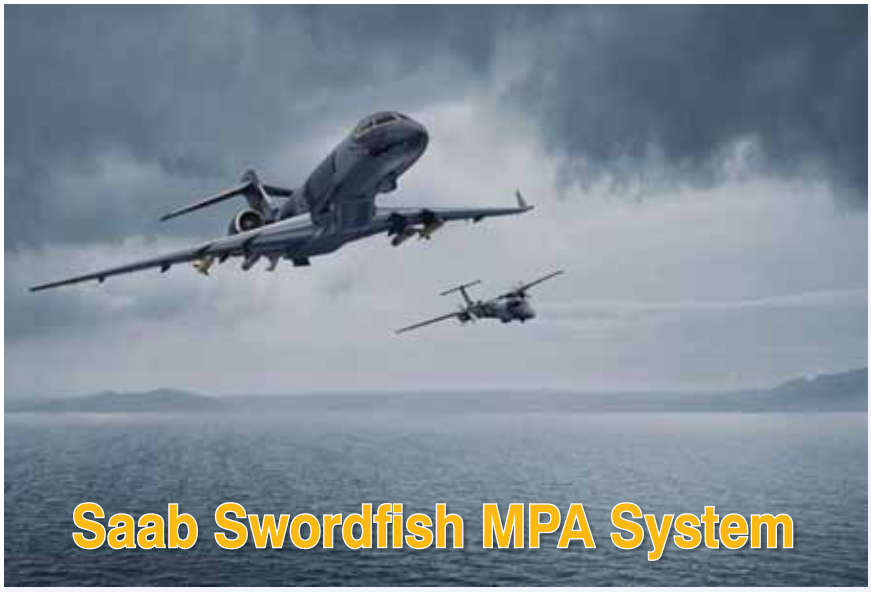
However, there are requirements for multi-engine Medium Range Maritime Reconnaissance (MRMR) aircraft capable of maritime patrol, anti-surface warfare, Electronic Intelligence (ELINT) and Search and Rescue (SAR) operations with the ability of patrolling for at least 4-hours extendable with Air-to-Air Refuelling (AAR), while 740-km from base in full mission configuration, with a minimum of two anti-ship missiles (AShM). The radar alignment should be capable of 360-degrees coverage that can detect and track ships, submarine periscopes and low flying aircraft/ missiles against sea clutter.

While Boeing has proposed a "simplified" variant of its P-8I Poseidon for the role, new aircraft under consideration include CN-235MP/MPA Maritime Patrol Aircraft with the two manufacturers, EADS CASA in Spain and Dirgantra Indonesia, proposing the aircraft with different mission systems. The Spanish-developed CN-235 MP Persuader is fitted with the Northrop Grumman APS-504 (V) 5 radar, while the Indonesian sourced CN-235 MPA is equipped with the Seaspray 4000 from BAE Systems, the AN/APS-134 from Raytheon or the Ocean Master 100 from Thales.

The CN-235 is powered by two General Electric CT7-9C3 turboprop engines each developing 1,305-kW, and wing-mounted in composite nacelles. If selected for IN service the CN-235 will certainly be furnished with IN specific mission avionics and weapons as standard practice.

Meanwhile the new Airbus Military C295, a stretched derivative of the CN-235, with its characteristic high-wing, rear-loader design is powered by two Pratt & Whitney Canada PW127G turboprop engines, each rated at 1,972-kW. The aircraft carries a 7,700 litre fuel load, giving a maximum range of 5,630-km.The aircraft can be equipped with an optional probe for probe and drogue refuelling, so the range can be extended by AAR. The maritime patrol variant can be fitted with EADS CASA FITS mission system.

FITS consists of four multi-function consoles and integrates data from sensors including search radar, Forward-Looking Infra-Red (FLIR), TV cameras or other sensors, with two Head-Up Displays (HUD) can also be fitted as an option. The aircraft is equipped with a dual Thales flight management system, controlled through two Multifunction Controller Display Units (MCDU), dual air data units type ADU 3000, dual Attitude Heading & Reference Systems (AHRS), two radar altimeters and an optional Honeywell ground proximity warning system. The colour weather radar, a Honeywell RDR-I400C, has search, beacon and vertical navigation ground mapping modes. Portuguese Air Force C295s are fitted with Northrop Grumman AN/APN-241 colour weather radar.



Saab Swordfish MPA System

Saab has unveiled its high-performance Swordfish mission system for maritime patrol aircraft which is available on two new platforms; Bombardier's Q400 turboprop and Global 6000 jet. Such flexibility of platforms, combined with Saab's mission system know-how and integration skills, means that the Swordfish system can fulfil the widest range of maritime C4ISR and combat roles and missions.

Saab's Swordfish maritime patrol aircraft (MPA) mission system delivers strategic multi-role capabilities, as it is adept at long-duration patrol or search-and-rescue missions, but can also handle the most complex anti-submarine and anti-surface unit warfare tasks, all during on the same mission. Swordfish also provides an effective overland ISR capability and can be easily introduced into a customer's existing operations and support infrastructure.

The Swordfish mission system combines proven, operational COTS sensors from several suppliers, with Saab's own specialist electronic warfare and C4I mission management systems. This advanced and tightly integrated sensor package is displayed on interchangeable work stations with an intelligent degree of automation and system support, meaning more can be achieved with fewer operators.

Saab has nearly 80 years of aircraft manufacturing and systems integration as its experience, with the Gripen multirole fighter and Erieye AEW&C as prime examples. Saab also has many decades of success in delivering large-scale, strategic airborne surveillance and C4I systems to customers around the world.

In Bombardier's Q400 and Global 6000 Saab has selected two aircraft with a firm production record and many hundreds in present service, the Q400 and Global 6000 being known for their high levels of reliability and performance. With these platforms, Saab's Swordfish mission suite gives operators multiple domain awareness; from littoral waters to the open ocean, and all places in between.

The company predicts a steady trend of fixed-wing maritime aircraft opportunities in line with the continued proliferation of submarines. This is particularly true across the Asia Pacific region where more than 100 submarines are projected in operational service by the year 2020.

However, Israel Aerospace Industries (IAI) have offered new generation ELI-3360 Maritime Patrol Aircraft (MPA), based on a modified Bombardier Global 5000 business-jet platform, as an attractive option to provide naval forces with Intelligence, Surveillance and Reconnaissance (ISR) mission capabilities and can also be deployed in broad area persistent theatre monitoring, Anti-Submarine Warfare (ASW), Anti-surface warfare (ASuW), and Communications, Command & Control (C3) applications. Designed by IAI's Elta Group to provide maritime domain situational awareness and maritime superiority, the new MPA provides the most sophisticated surveillance, reconnaissance and armament systems to be installed on a business-jet to date. As apparent, the platform based on business jet provides high endurance, speed, range and multi-mission versatility unmatched by large commercial transport aircraft or turboprops.

Designed to operate in coordination with shore based UAV platforms, the system incorporates the advanced Elta EL/M-2022 maritime surveillance, imaging and tracking radar (also operational on Indian Navy Dorniers), Electro-Optical (EO) and Infra-Red (IR) sensors, the ELL-8385 Electronic Support Measures/Electronic Intelligence (ESM/ELINT) system, and a comprehensive communications suite comprising radios, broadband Satellite Communications (SATCOM), HF, VHF, UHF radio communications and data-links as well as advanced Electronic Warfare (EW) gear, Automatic Identification System (AIS), Identification, Friend or Foe (IFF) and self-protection suite. Tactical and strategic ELINT data is collected and analysed by the ELL-8385 ESM / ELINT system, and can be applied for long-range, high-endurance ESM and ELINT operations.

The integrated Network-Centric Warfare (NCW) enabled multi-mission Command & Control (C&C) suite to control the flight planning, surveillance equipment, and armament includes multi-purpose operator workstations and a weapon and stores management system which controls the under-wing weapons that may include torpedoes and Anti-ship Missiles (AShM) for Anti-Submarine Warfare (ASW) and Anti Surface Warfare (ASuW) as well as dispensable Search & Rescue (SAR) stores. The new generation ELI-3360 joins IAI's series of Special Mission Aircraft (SMA), and is based on IAI's 30 years of experience in supplying advanced maritime domain sensors and integrated systems to leading customers worldwide. IAI's line of business-jet SMA includes the operationally proven Gulfstream G550 Conformal Airborne Early Warning (CAEW), and the G-V Signal Intelligence (SIGINT) Aircraft.

Sayan Majumdar

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WHEN RESULTS MATTER

'Submersible Destroyers' !

110 Years of Russia's Submarine Prowess

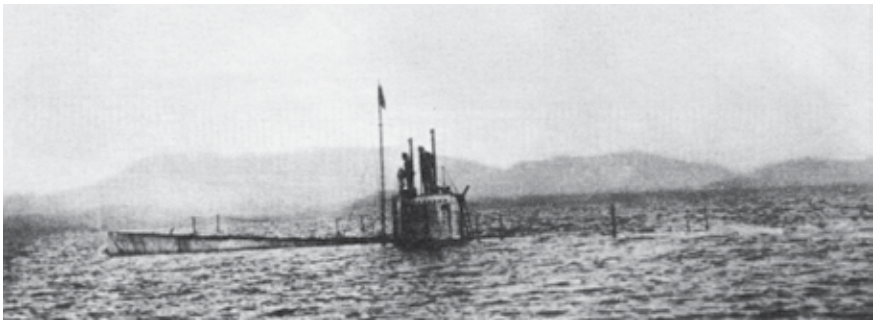
Painting of destroyer HMS Vittoria being sunk by Russian Bars-class submarine Pantera in 1918

Twenty 'submersible destroyers' became 'submarines' on 6 March 1906*, when Emperor Nicholas II applied his signature to an Order on classification of the Russian navy's warships. From that day forward, Russia's submarine force has been a properly recognised and indispensable part of the Armed Forces of the world's largest country, whose sea borders are washed by waters of three oceans.

Modern Russia is considered a superpower not least owing to the fact that her Navy's nuclear-powered, missile-carrying underwater cruisers can annihilate any country or military block in case of an all-out war.

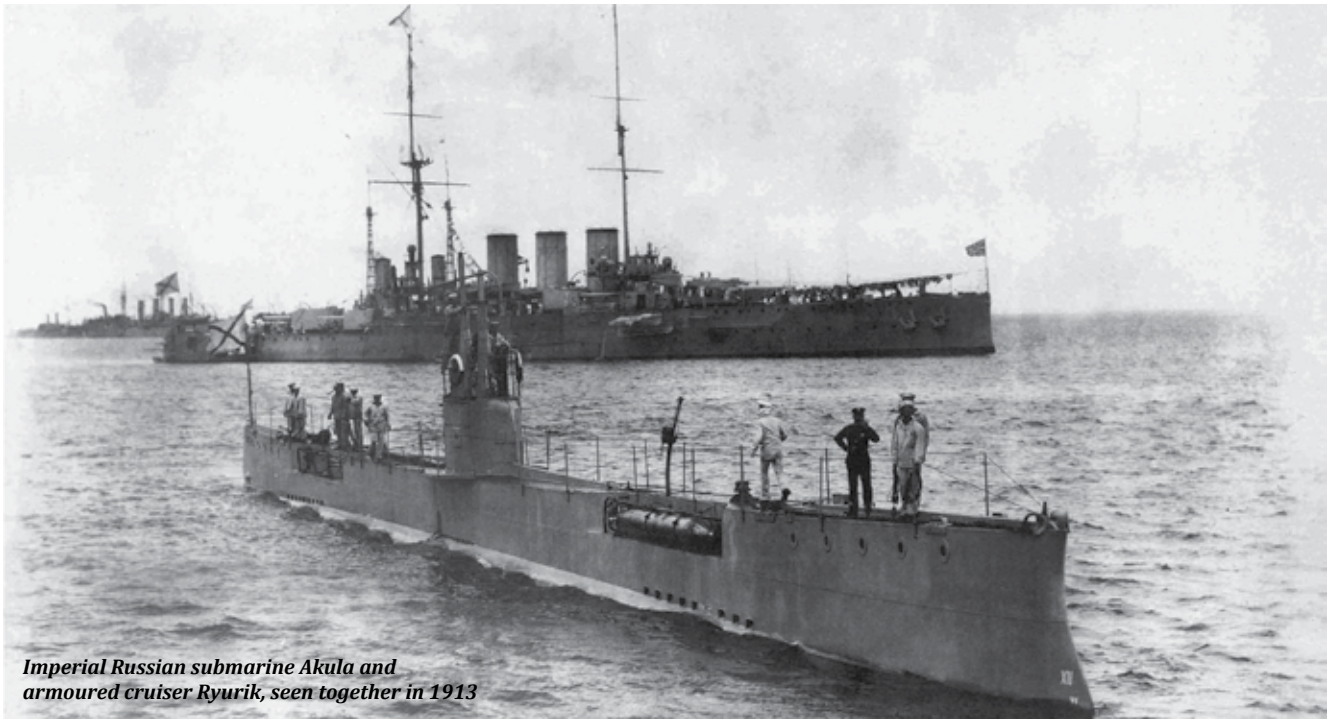
This capability has become available through a long journey of evolution. Today, it is hard to tell when exactly first submersible vessels were built in Russia and for centuries enthusiasts and inventors worked on dozens of designs that they thought should be good enough for military use. Perhaps the first of them who approached this business on a firm basis of then-contemporary science and technology was Carl Shilder. A military architect, fortress builder, and an Adjutant General, Shilder built a hand-cranked submarine in 1834. On 23 September 1840, this vessel successfully dived and spent three hours underwater before emerging again on the surface of a river running through Saint Petersburg. Today, this city is home to two major design houses specialising in submarines, the Rubin and Malachite Design Bureaux, as well as the Admiralty Shipyards, which manufactures *Kilo* class submarines and exports them worldwide (*see Vayu V/2015 and VI/2015*).

Looking from the might of today's Russian Navy, it is rather remarkable that Shilder's submarine was a missile-carrying ship! More than that, Shilder offered to fire at sea-going targets with these missiles from submerged submarines and succeeded in making this option available. Missiles running on powder were kept in long, sealed tubes attached externally to the hull,



The 'submersible destroyer' Kasatka underway in an undated photograph

* *The document was dated following the old-style Julian calendar, which corresponds to 19 March 1906 in the modern Gregorian calendar.*



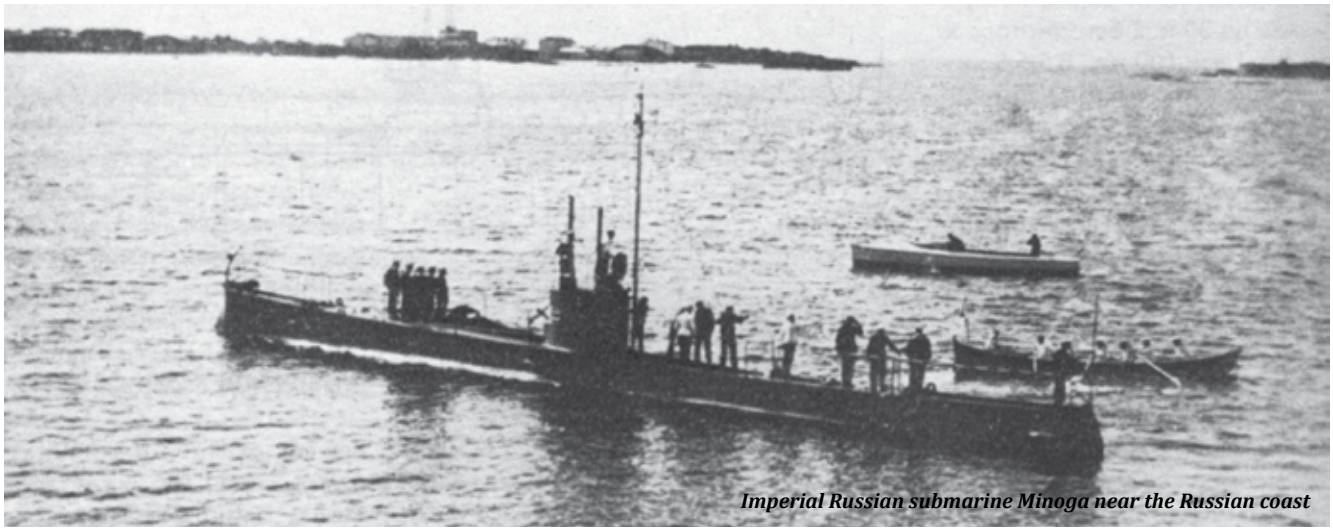
Imperial Russian submarine Akula and armoured cruiser Ryurik, seen together in 1913

and set at an angle to its main axis. Launch system was triggered electrically, making it possible to fire the missiles in the direction of an enemy vessel had it attempted to come close to a naval base from where submarines would operate.

The next step was made by Ivan Aleksandrovsky, with a 350-tonne submarine, which was able to stay submerged for hours, and move relatively fast underwater using pneumatic machines fed by compressed air from two hundred iron bottles.

Even though several countries had successfully tested their submersibles in the 19th century, Russia was the first to build them in series. Fifty man-powered submarines were constructed in 1884 to the design of Stepan Dzhevetsky (Stefan Drzewiecki). These submersibles were necessary to protect ports in the Baltic and, more importantly, the Black Sea at a time when Russian surface warships were heavily outnumbered by those of neighbouring countries and their allies. The miniature subs were meant to act in the manner of the American Confederate submarine *HL Hunley*, which attacked and sank the Union warship USS *Housatonic* during the American civil war in 1864. Their active service was short, yet it brought invaluable contribution to the Russian Navy: a group of naval officers mastered them and became inspired by submarines. Later, surviving hulls were modified through installation of electric motors, and from then onwards, it was electric power rather than men's muscles that propelled submarines. Drzewiecki was also first to propose an 'optical navigation pipe,' which later evolved into today's periscope.

Further development was also carried out. For instance, using surviving hull mechanisms, Russian Navy Lieutenant Yanovich built a 'motor boat of low visibility' with an internal combustion engine (ICE). This semi-submersible boat, called *Keta*, was employed in defence of the trait separating the island of Sakhalin from



Imperial Russian submarine Minoga near the Russian coast

the Asian mainland, and even mounted an attack on invading Japanese ships, but ran aground before coming close enough for torpedo launch.

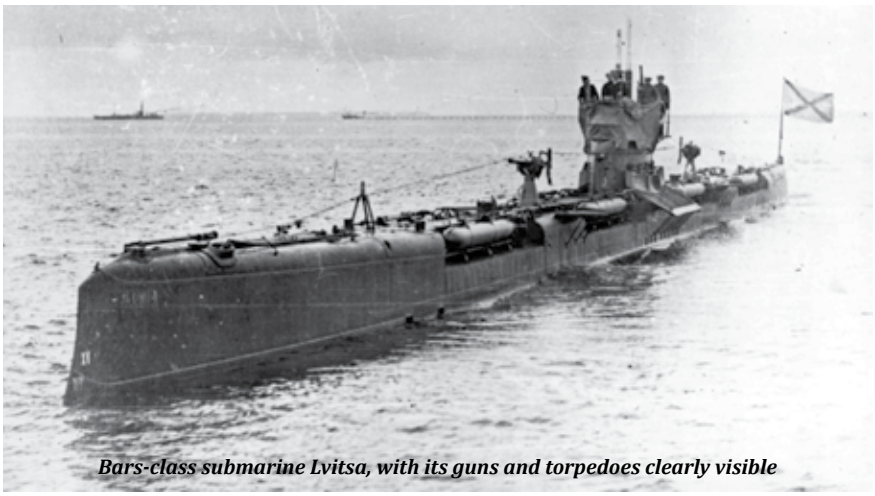
Destroyer #150

Russian naval history notched another milestone on 19 December 1900, with foundation of the Commission for Development of Submersible Vessels as an independent establishment under supervision of the Marine Department. The Commission had three members: Ivan Bubnov (as senior assistant to the chief shipwright), Ivan Goryunov (senior mechanical engineer) and Mikhail Beklemishev (Russian Navy officer). Later, it evolved into a full-fledged design house, and is now known as the Central Design Bureau for Marine Engineering 'Rubin,' the earliest Russian organisation specialising in design and development of submarines.

The electric motor, the internal combustion engine, the torpedo and the periscope had already been invented and tried on earlier submarine designs. So, the Commission's job was to put together all these and other inventions in an otherwise all-new project. Work on Destroyer #113 began in 1901. Later that year the drawings were approved and handed over to the Baltic Plant for materialisation into what became Destroyer #150 and, later, the submarine *Delfin*.

Trials in the Baltic were completed on 14 October 1903, and their successful conclusion prompted the Navy to order a series of six larger *Kasatka*-class vessels. Bubnov's *Delfin* and *Kasatka* provided Russia with a prominent place among other economically developed, seafaring nations as they transited from construction of experimental to series production, combat worthy submarines. In 1903, France had 34 submarines, England had 18, the United States operated nine, Sweden had seven and Italy two. The best foreign designs had much in common with Bubnov's, the most important shared attributes being internal combustion engines for propulsion while surfaced and to charge an accumulator battery, which powered electric motors to propel the submarine underwater.

comprising two officers and ten sailors – under the common umbrella of the Eighth Fleet Crew. "Forming a crew team is most important for the submarine, as well as any other warship. No crew – no submarine," wrote Admiral Eduard Schensnovich, a war veteran and a seasoned commander who played an important role as the head of the submarine force in the Baltic.



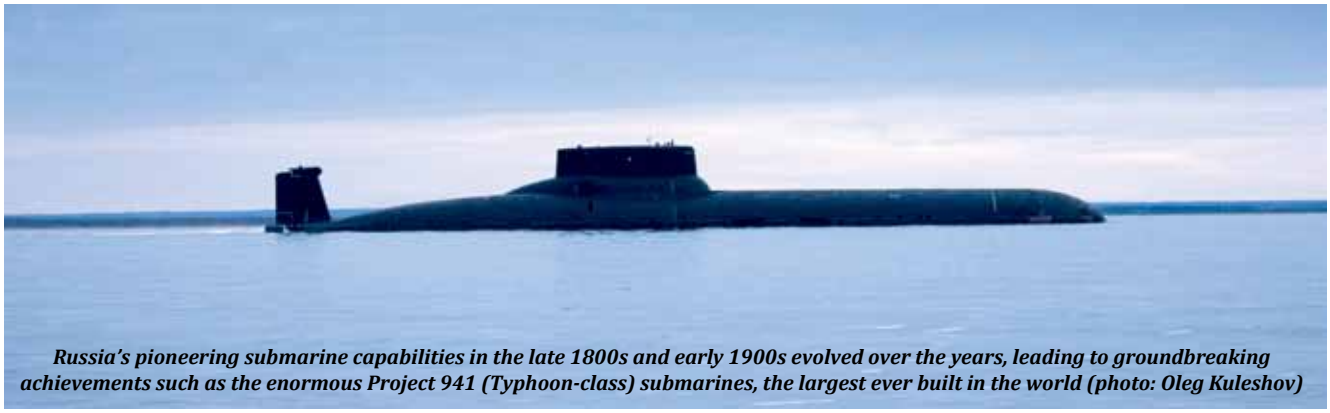
Bars-class submarine Lvitsa, with its guns and torpedoes clearly visible

Mikhail Beklemishev was the *Delfin*'s first commander and was a key contributor for the development, trials, modernisation and operational use of many submarines of the Imperial Russian Navy and later the Soviet Navy as well.

First encounter

The Russo-Japanese war broke out in January 1904. The Japanese enjoyed numerical superiority in battleships and armoured cruisers over the Russian Navy's First Pacific Squadron which made the Tsar's High Office look for emergency solutions to strengthen forces in the theatre. In April, the Navy began enlisting crew teams for 21 submarines – each crew

In August 1904, Russia launched a very special operation to transport submarines from the Baltic shores to the Pacific coast by rail. First to go was the *Forelle*. For almost half a year this 18-tonne, 15-metre vessel acquired from Germany was the only formally operational submarine in Vladivostok. In November, when special rail transporters were completed for carriage of much heavier loads, Russia began transportation of larger submarines: five of Bubnov's design (*Kasatka*, *Skat*, *Nalim*, *Sheremetiev* and *Delfin*) and one purchased from the United States (*Som*, ex-*Fulton*). This was the first case in history when a group of submarines was transported by rail from one continent



Russia's pioneering submarine capabilities in the late 1800s and early 1900s evolved over the years, leading to groundbreaking achievements such as the enormous Project 941 (Typhoon-class) submarines, the largest ever built in the world (photo: Oleg Kuleshov)

Russian Navy crew of Rostov-upon-Don, a Project 636.3 submarine, at her launching (photo: Vladimir Karnozov)

to another, over a distance of almost nine thousand kilometres!

In January 1905, seven submarines were in Vladivostok and formed an 'independent detachment of destroyers of Vladivostok port,' led by Alexander Plotto, Commander of *Kasatka*. This was the first complete submarine squadron to have ever been deployed in the Pacific. The detachment was given the combat task "to be on lookout for enemy ships, and carry out reconnaissance and protection of the coastline in the vicinity of Vladivostok naval fortress."

Russian submariners ventured into Pacific waters as they carried out sea trials and performed combat duties. Some 70 miles off Vladivostok on April 29, *Som* sighted two destroyers approaching. She dived and closed in at high speed. Having extended the periscope, the submarine's Commander, Vladimir Trubetskoi, watched the destroyers running away at full speed. This was the submarines' first and only encounter with Japanese warships during the entire conflict.

By the time the *Treaty of Portsmouth* was signed, Russia had increased the number of submarines in-theatre to thirteen (manned by 32 officers and 220 sailors). These included five by Bubnov designs, two by John Holland and five by another US inventor, Simon Lake. Except for *Forelle*, *Som* and *Osyetr* (ex-*Protector*), all submarines were assembled in Russia.

The Russo-Japanese war revealed that submarines of the time fitted poorly into the realities of naval warfare in the Pacific. But the very fact that Vladivostok was homeport for a complete detachment of submarines had a tangible effect on the Japanese, who chose not to conduct offensive operations in the area despite their superiority in capital ships.

War in Europe

After the Treaty of Portsmouth, Russia turned attention to the European theatre. Like other industrially developed nations, it strived to develop new sorts of naval weapons to rule at sea. This ensured the future of the submarine as a game-changer in naval warfare.

Russia chose to cultivate the national school of shipbuilding, while buying vessels of foreign make for comparative assessment. It acquired four submarines from Germany in 1904-1908, and one from Italy in 1917. Direct purchase of two submarines from the United States in 1904 was part of larger deals with their manufacturers: *Fulton* and *Protector* were specimens for production under license using imported parts and mechanisms. Domestic industry built nine submarines to Simon Lake's designs and twelve to John Holland's designs in 1904-1914.

When the European war broke out, Russia ordered five Holland 602Fs in kits and assembled them in 1915. Six more kits delivered under a follow-on order but their completion took place after WW I.

License production ensured localisation and transfer of technology (ToT). Import was important, but never primary source of warships for the Imperial Navy. Rather, it provided access to advanced technologies and stimulated the national industry. The Navy often supported gifted inventors when they came up with promising designs. Drzewiecki engineered the *Pochtovy* (in naval service 1908-1913). She featured a unified propulsion system (employing a combustion engine fed with compressed air) to propel the boat in both surfaced and submerged modes. This was an early attempt to produce Air Independent Propulsion (AIP).

Besides, the Navy provided funds for railways technician Mikhail Nalyetov to build the world's first submersible minelayer. In 1915-1916 the 533/722-tonne *Krab* with sixty bottom mines of special design on board, performed three missions in close vicinity of the Bosphorus strait, a very dangerous task that no other ship could manage.

The majority of Imperial Navy submarines were built to designs of Ivan Bubnov. Six *Kasatka* vessels (1904-1905) were followed by the *Minoga* (commissioned in 1908) and *Akula* (1911), the first diesel-electric submarines designed and built in Russia. Replacing engines running on petrol with diesels considerably reduced the risk of inner explosion caused by a mix of fuel vapour, gases from the batteries and oxygen from in the air. Having come through a long process of evolution, Russian diesel-electric submarines continue in production over a century later under orders of local and overseas customers.

Finest hour

Bubnov's career as naval architect reached its finest hour with the series of twenty-three *Bars*-class vessels commissioned between 1914 and 1918. These submarines proved their merit in WW I, with *Morzh*, *Tyulen* and *Nerpa* forming the first batch for the Black Sea fleet and successfully operating against Turkish shipping. They were responsible for sinking or capturing 13 steamers and 52 smaller vessels. The *Tyulen* contributed 8 and 33 respectively, her improved performance attributable in part to more powerful weaponry (one 76 mm and one 57 mm cannon).

By comparison, the best-performing submarines of foreign design, the *Narval*, *Kit* and *Kashalot* Holland 31A class boats built under license and commissioned between 1915 and 1916, claimed 7 steamers and 24 smaller vessels.

Together with British submarines operating out of Russian bases in 1914-1917, the Baltic Sea Fleet made far larger German forces substantially limit their activity in the basin. The most successful submarine, *Volk*, claimed four steamers, three of which fell victim to her torpedoes in May 1916. While Bubnov's submarines did not sink as much as German U-boats did in the Atlantic, this was due to the fact

Russia's newest nuclear-powered ballistic missile submarines are the Project 955 (Borei-class) boats currently under production (photo: Oleg Kuleshov)

that operations of the Russian Navy were largely confined to the Baltic and Black Seas, where enemy activities were much lower, and merchant shipping only a fraction of that in the Atlantic.

In all there were 32 submarines built to Bubnov designs: one *Delfin*, six *Kasatka*, one *Minoga*, one *Akula*, three *Morzh* and twenty *Bars* (the *Morzh* class is often considered to be part of the *Bars* classification). Four more were not completed and were scrapped after the October Revolution. The entire production run is sometimes referred to as "submarines of the Russian type" since they were members in an unbroken chain of evolving design. In the process, their displacement increased by a factor of six, length by a factor of three, and underwater and surfaced speed by a factor of two. The number of torpedo tubes went from two up to twelve, and artillery pieces appeared on board.

Technically, these submarines were 'sectionless' (no watertight bulkheads running across the pressure hull), a peculiar feature of all Bubnov designs till 1915. The pressure hull was made of nickel-alloy steel. Water tanks of the main (diving) ballast were set in the nose and in the rear outside the pressure hull.

These and other design features set Bubnov designs apart from then-contemporary submarines of foreign make. Yet one may read in certain western books that the *Delfin* was modelled after John Holland designs. While Bubnov did inspect the *Fulton* (Holland's model 7) during a trip to the USA in summer 1901, this happened *after* he had submitted his drawings to the Baltic Plant for materialisation in metal. Naturally, Bubnov met with Holland (and Lake) on a number of occasions to discuss licence production and other issues, and they certainly must have shared ideas and experience. At the same time, Russia exercised more caution than the US in demonstrating indigenous submarines, and did not export them until after WW II.

For the Navy early Bubnov submarines proved a good investment. *Delfin* stayed in

	Laid down	Commission	Displacement surfaced submerged, tons	Length *width, m	Max speed under water, knots	Max speed on surface, knots	Crew members	Electric motor, hp
Delfin	1901	1903	113/124-135	20*3.66	6	9	10	120
Kasatka	1904	1905	140/175	33.5*3.4	5.5	8.5	(25)	100
Minoga	1906	1910	123/152	32.6*2.8	5	10.5	15-18	70
Akula	1909	1911	370/468	56*3.73	6.3	10.6	22	300
Morzh	1911-1912	1914-1915	630/760	67*4.47	9.2	10.8	47	2*450
Bars	1913-1917	1914-1918	650/780	68*4.5	9-10	11.5 to 18	33	2*450
Project 636.3	2010	2014	2350/3950	74*9.9	20	11	52	1*5500, 1*190, 2*102

* **Note:** *The notably wide range of max surface speeds for the Bars type is due to the fact that many subs were outfitted with less powerful Russian or U.S. made diesels instead of German ones*
Disclaimer: *Project 636.3 is the most recent of Russian navy diesel-electric submarines. Her figures are provided for comparison.*

service from 1903 till August 1917, being written off because of "complete wear and tear." The *Kasatka* series went for scrap in the middle of 1920s. Holland designs were a good investment, too. *Som* (ex-*Fulton*) fell victim to a Swedish steamer, which rammed her in May 1916. Her sister ship, *Schuka*, forced a German steamer to run aground on the Swedish coast in November 1915 before being phased out of service with other surviving boats of the class in 1918. Lake designs did not have that sort of longevity. *Osyetr* (ex-*Protector*) served Russia for only nine years, having been withdrawn in summer 1913. All her sister ships were written off within a year. Four U-boats acquired from Krupp did not last long either. The Russian Navy learned early that a 'foreign label' is not always a testimony of a good product and that local products can be better. At the same time, all of the aforementioned early types were useful for training; hundreds of Russian officers and sailors got to learnt all about underwater warfare inside their hulls.

Lessons for the future

Having suffered serious defeats in a chain of naval battles with the Japanese in 1904-1905, the Russians managed to save their major "naval fortress" in the Pacific – Vladivostok – from being captured by the Japanese thanks to a mere presence of submarine detachment in that base. In the ten years that followed, Russia built a potent force of modern submarines that proved its merits during the Great War.

Regime changes in the course of February and October 1917 Revolutions brought about many perturbations. And yet the Soviet period of the Russian submarine history was not about "reinventing the wheel." Instead, submarine development went on as a logical continuation of what Ivan Bubnov and this team had already done. A few *Bars*-class submarines served with the Soviet Navy and some even survived WW II, thereby spending over thirty years on active duty. This set a good beginning for new generations of shipwrights in the country, who strive to be worthy of their predecessors!

The Imperial period of the Russian submarine history provides a good example of how persistent efforts can lead to positive results as far as advanced weapons systems for the Navy are concerned. Purchasing examples of foreign make, localising them, production under license and technology transfer, coupled with consistent development of the local industry, encouragement and support for gifted inventors and engineers – this policy worked in the last century. There is no reason it will not work today.

Vladimir 'Vovick' Karnozov

Vayu's next issue examines how the Soviet Navy's underwater component developed from largely a coastal defence into a true blue-water force. This transformation became possible through careful assessment of every submarine of foreign make that came into Russian service, and even more so because of rapid development of the nation's scientific and industrial capacities. Discoveries of the 'magic' qualities of the nucleus led to creation of nuclear-powered, nuclear-armed warships. The Soviet Navy became the world's largest in terms of N-submarines, first not only in numbers, but also in technical performance: the local industry built the world's fastest, deepest-diving nuclear submarines. Today's Russian Navy possesses a balanced inventory of nuclear and diesel-electric submarines, and is incorporating new technologies.

ICE, hp	Endurance, days	Torpedo launchers	Artillery	Comment
300 (petrol)	8	2	no	First submarine officially commissioned by the Russian navy
2*60 (petrol)	8	4	(1*47mm from 1914)	First series of Russian navy submarines to have been commissioned
2*120	8	2	(1*57mm from 1915)	First Russian designed and built diesel-electric submarine
3*300		8	(1*47mm from 1915)	Second Russian designed and built diesel-electric submarine
2*250	14	12	1*57mm, 1*47mm	A batch of three ships that preceded the mainstream Bars
2*250 or 2*450 or 2*1100 or 2*1320	14	12	1*57mm, 1*37mm	The largest series of submarines of the Imperial Russian navy
2*2040	45	6	no	Modern sub in service with the Russian navy

that had been ordered but never delivered. Only a handful of these submarines actually received diesels with power exceeding 1000hp.

India's Security Challenges

Air Chief Marshal Arup Raha, CAS Indian Air Force on the

Role of Aerospace Power*

Constant churning in geo-politics and geo-economics has thrown up new challenges in the global security scenario. The 9/11 terrorist strikes in the US mainland brought about greater international convergence on security issues and tackling of sub-conventional threats and challenges. New threats have reinforced the need for international cooperation to combat them. It has found expression as GWOT: the Global War on Terror. *The Arab Spring* and *Jasmine Revolution* have altered the character of regional politics in Northern Africa and West Asia, leading to regime changes in Egypt, Libya and Tunisia and fuelled instability in the region. The rise of the Islamic State (IS) and unrest in Syria and Iraq have created instability in the Middle East and caught the attention of the entire world. Economics, energy security, national interests as well as religious ideology are shaping views on geo-politics and national and international security. The rise of China, India and the Association of Southeast Asian Nations (ASEAN) has resulted in the shift of the economic centre of gravity and, hence, the strategic centre of gravity, to the Asia-Pacific region.

India and its Neighbourhood: India shares 15,100 km of mostly inhospitable land boundaries with six countries and its seventh neighbour, Sri Lanka, is separated by just 25 miles of a shallow water channel. This is a unique challenge for any country, as the dual task of physical security of the borders and maintaining harmonious relations with neighbours is a humongous one.

External Security Challenges: Today, the issues range from border disputes, the fallout of the uprisings in West Asia, the rise of the IS, instability in Afghanistan and Pakistan and the withdrawal of US troops from Afghanistan at a critical phase for the Afghan government. These are major concerns not only for India but the entire world. Additional challenges include ensuring continuous access to space and enhancing the cyber domain, as future wars are likely to be fought silently in these domains. We need to be prepared to deal with them proactively.

IAF Su-30MKIs in fire power demonstration

Internal Security Challenges: In an ever-changing security scenario, it is becoming increasingly difficult to separate the internal

threats to security from the external ones. The threats to India's internal security emanate from terrorism, insurgencies in the northeast and the Naxalite movement. In fact, in the recent past, Naxalism has emerged as the single biggest threat to India's internal security and has assumed serious and threatening proportions. Economic development in the north-eastern region has been slow. Thus, this region remains a weak area in maintaining border sanctity, as also very vulnerable to illegal immigrants and insurgents.

Composite Threat to Security: The security challenges faced by India are varied, complex and dynamic. Our most immediate and primary threat is that of terrorism. However, the constant conventional threat to our borders cannot be overlooked. Our national objectives should, therefore, be aimed to avoid conflict through deterrence. Hence, India will have to build capability across the entire spectrum of conflicts : sub-conventional, conventional to non-conventional. Our procurement plans must be in consonance with the aim to possess strategic reach that would serve the ends of military diplomacy and enable force projection within India's strategic area of influence.

Role of Military Power

In the current security environment, and with the growth of the nation as an economic power, its Human Resource (HR) development, science and technological base, with enhanced Comprehensive National Power (CNP), India will have to play its role in the international arena. We are destined to play a stellar role in ensuring peace and stability in the region, if not the world. Therefore, we have no option but to invest adequately in developing military power.

Composition of Military Power: The factors that influence military force structure planning are, firstly, the threat perception and its mitigation; secondly, national objectives and aspirations. These, in turn, govern the size and composition of the armed forces. For the army, it would determine the number of strike corps; in the case of the navy, the number of aircraft carriers and nuclear submarines; and for the air force, its offensive capability, strike power and other force enhancers.

National Objectives

- Our national policies are enshrined in the form of declarations in the Panchsheel, Non-Aligned Movement (NAM), United Nations (UN), etc.
- India has no territorial ambitions. However, we have hostile borders and border disputes. We have fought several wars on this account.
- Our broad objective is, therefore, to avoid conflicts and deter war. However, deterrence can be achieved through appropriate offensive capability.
- Aerospace power, with its unique attributes of speed, reach, footprint and precision, is the best national instrument for defence and deterrence.

Role of Aerospace Power

The IAF, along with the Indian Army and Navy, with their core competencies, including aerospace elements, are poised to contribute in stabilising the region. They provide for enhancing the nation's strategic presence. Aerospace power will be the first respondent in any contingency, peace or war. Aerospace power in the maritime domain would play an important role in dominating the seas and protection of island territories. While aircraft carriers and Maritime Reconnaissance (MR) assets of the Indian Navy (IN) are being augmented, the shore-based Maritime Air Operations (MAO) by the IAF would provide more teeth in offensive operations.

IAF Roles

The IAF has been performing roles in three categories to mitigate national security concerns. These include, i.e. classical roles, peacetime roles and roles in conventional conflict. As a multi-spectrum strategic force, the IAF performs these three classical roles which include:

IAF C-17 Globemaster III

IAF Mi-17 V5

- Firstly, *Power Projection :* Aircraft such as the Su-30, flight refuelling aircraft, airborne warning and control system, C-17, C-130, etc have enhanced our strategic reach and footprint. Certain capabilities have been aptly demonstrated during the humanitarian aid and disaster relief operations in Yemen and Nepal.
- Secondly, *Credible Deterrence :* A credible IAF with appropriate force levels and precision weapons has been one of the major contributory factors in deterring a major conflict since 1971.
- Thirdly, *Protection :* What often goes unnoticed is the 24x7 air defence

Il-78MKI mid-air refuelling pair of Su-30MKIs

Mirage 2000s of the IAF

provided by the IAF to protect the sovereignty of the nation's air space frontiers. With more than 6,000 civil and 1,500 military flights daily, radars keep churning, and fighter aircraft and helicopters are kept ready for armed action, if required. However, the biggest challenge shall remain the mitigation of unregulated sub-conventional aerial threats which include drones, gliders, microliter, etc. Review of Civil Aviation Requirements (CARS) and procurement of Close in Weapon Systems (CIWS) are underway to meet this evolving challenge.

Peacetime Roles

- *Air Maintenance :* Air maintenance in the northern as well as northeastern sectors is the lifeline of the ground forces securing our borders and the IAF lifts close to 35,000 tonnes annually by fixed and rotary wing aircraft.
- *Infrastructure* Creation : Assistance to the Border Roads Organisation (BRO), Indian Railways and other government agencies is being provided on a routine basis to create infrastructure in remote areas to enhance security.
- *Internal Security :* The needs of the Ministry of Home Affairs (MHA), Election Commission, etc. are being addressed, as and when the contingencies arise.
- *Op Triveni :* Logistics support to paramilitary forces engaged in controlling Left Wing Extremism (LWE) is another major peace-time task being performed by the IAF. Since 2009, the IAF has flown substantial number of sorties to airlift a large numbers of personnel and logistics supplies.

Conventional Conflict: Use Of Aerospace Power

Control of the Air : The primacy of gaining control of the air to wage war successfully along the entire spectrum shall always remain. Control of the air is a critical factor and the conduct of future wars will increasingly depend on the degree of air control. However, modern short and swift wars do not offer the luxury or the time to conduct a protracted counter-air campaign. This has given rise to the concept of dynamic air dominance and increased emphasis on achievement of favourable air situation to allow for the conduct of specific operations. Dynamic targeting is set to assume greater significance in the coming years. All air campaigns will be fought in parallel or simultaneously. The integrated Air Defence (AD) network, Integrated Air Command and Control System (IACCS), Akash Teer and Triguna will ensure efficient air space management, especially in the Tactical Battle Area (TBA).

Surveillance and Reconnaissance : The essence of air power is targeting, which in itself is entirely dependent on intelligence. The importance of the peace-time role of surveillance to build strategic databases cannot be overemphasised. While the sensors and means of data analysis and storage have undergone a change, digitisation has offered greater access to large amounts of databases in quicker timeframes. A mix of space-based assets, fighter aircraft, Remotely Piloted Aircraft (RPA) and even helicopters equipped with suitable sensors provide the IAF the necessary data acquisition capability. Tactical reconnaissance is another area where the IAF has made substantial progress with the induction of Electro-Optic/Infra-Red (EO/IR) pods and Synthetic Aperture Radar (SAR) pods for fighter aircraft.

Precision Targeting : The advent of Precision Guided Munitions (PGMs) has always been considered as a major turning point in the employment of air power. Modern short swift wars, with dynamic targets and minimum margin for collateral damage, will demand

Iconic image of IAF Mi-17 V5 and C-130J Super Hercules during the Uttarakhand relief operations

Pair of MiG-29s

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extensive use of PGMs both in support of ground forces as well as in independent operations in pursuit of strategic effects. *Air Transported Operations : Rapid Deployment of Troops and Equipment:* Air power will be used effectively for mobilisation through rapid deployment of troops and equipment, be it peace or war. Vertical envelopment at the crucial stages of the ground battle will ensure rapid progress of ground operations. Air maintenance of forward areas as well as ground forces and casualty evacuation are lifelines and crucial morale boosters during actual operations

Technology and Application of Aerospace Power

Aerospace power requires synergistic integration of air, space and information systems to achieve strategic military

Mirage 2000 over the high Himalayas

Super Hercules dropping para commandos

For illustrative purposes is shown this Network centric concept of the Royal Thai Air Force

Role of Aerospace Power in Future

The application of aerospace power would prove to be the decisive factor in winning the military campaigns, wherein the response has to be prompt and precise. Hence, one of the major challenges is to remain a contemporary aerospace power with credible response options. In the light of the expanding strategic footprint of a resurgent India, the IAF must possess complementary capabilities to operate effectively and decisively. With this aim in mind, the IAF's transformation plans aim at acquiring multispectrum strategic capability. The capability involves replacement of legacy systems, upgradation of existing systems and platforms and induction of state-of-the-art equipment.

Air Chief Marshal Arup Raha

**** Adapted from the Air Chief's address at the 12th Subroto Mukerjee Seminar***

The Inseparable Twins

Air Marshal Brijesh D Jayal urges

"A Robust Defence Industry and Modern Defence Management"

Self-reliance in pursuit of defence systems has been the cherished goal of Indian policy makers since independence. Towards this, progressive steps over decades have resulted in substantive infrastructure and human resource capital in the public sector. Today, India boasts of 9 defence PSUs, 39 Ordnance Factories and 48 Defence R&D labs and associated establishments. Notwithstanding this huge capital and human resource potential, the approach to manage this huge enterprise as a routine government department run by generalists, to keep the private sector divorced from the defence and aeronautics business and the reluctance to exporting military hardware have together resulted in India remaining the world's largest arms importer.

Along with this dubious distinction, the entire defence acquisition system is creaking, prone to repeated scandals and missteps and unable to cope with the modernisation needs of our armed forces, which face serious issues of obsolescence and upkeep. And if these were not matters of grave concern, we can add that our war fighting capability remains hostage to continued import of supplies from the Original Equipment Manufacturers (OEMs) and is hence uncertain. It was Lord Palmers ton who is credited with the view that in international dealings, there are no permanent friends or enemies, only permanent national interests. Having been denied legitimate spares support from foreign governments in the past, Indian defence planners must remain conscious of this frailty.

With such a litany of woes, even minor changes in the existing archaic system are received with great hope and expectations as is the case with the 'Make in India' mission closely followed by opening of the industrial defence sector to private enterprise alongside the promised, but yet undisclosed, new Defence Procurement Policy expected to be based on recommendations of the Dhirendra Singh Expert Panel.

Jaguar two-seater in final assembly at HAL, Bangalore

The euphoria that has followed is best reflected in some bold headlines. To name a few recent ones at random: *' Biggest Warship Project: Russia selects Anil Ambani's Pipavav to make Frigates for Indian Navy', 'Defence 'Make in India' on a roll: Boeing & Tata announce manufacturing partnership including drones', Mahindra Defence tied-up with Airbus Helicopters to form a Joint Venture, 'Boeing and Tata announce strategic aerospace partnership to Make in India', 'Mahindra Group and BAE Systems join hands again'.*

This writer, however, is in little mood to celebrate, not because the initiative of the government is unwelcome or the great enthusiasm and spirit being displayed by the private sector, who will need to put their own capital into these efforts, is not laudable, but because for a subject of such vital significance to a strategic industry and indeed national security, one must look deeper than grand declarations and exciting headlines.

In this "euphoric moment", it may be worthwhile drawing lessons from the USA of the early eighties when not only had the Vietnam war exposed weaknesses of inter-service rivalry, but each service had continued to adopt its own doctrine in isolation, resulting in fragmentation of operational effort. This then affected peacetime procurement activities, denying benefits of economies of scale and resulting scandals and outrage. In response, President Reagan ordered a Blue Ribbon Panel, commonly referred to as the *Packard Commission*, which was tasked with studying defence management policies and procedures that included amongst others, the budget process, the procurement system, legislative oversight, and defence organisational and operational management arrangements. Whilst the *Packard Commission* recommendations resulted in major changes to the system of defence acquisition, those relating to the Joint Chief of Staff System and Commands were then taken up by Senators Goldwater and Nichols. The resulting Goldwater Nichols Department of Defence Reorganisation Act 1986 made the most sweeping changes to the Department since it was established under the National Security Act 1947.

Eerily Similar

To those familiar with our present higher defence management and defence acquisition scene, the state of affairs then prevalent in the US seems eerily similar, if not infinitely worse. Not surprisingly, we are unable to keep up with modernisation, nor able to sustain our existing force levels and worse even our armament stocks stand depleted. In our context therefore, the above history has some valuable lessons.

Defence industries are defined as "strategic" because they are considered by the nation to be important from the point of view of both national security and the national economy. These industries attract interest from the private sector not only because of their strategic importance, but equally because they lead in the technology race, encompass diverse business enterprises from major system integrators to minor component manufacturers and enable the private sector to work closely with various arms of government including the military. Indeed it makes this segment a part of the larger nation- building enterprise.

Interestingly Dr Jacques Gansler, who had served as a senior consultant to the *Packard Commission* referred to earlier, is credited with the view that: "In order to understand the economic operation of the US defence industry, it is first absolutely essential to recognise that there is no free market at work in this area and that there likely cannot be one because of the dominant role played by the Federal Government. The combination of a single buyer, a few large firms in each segment of the industry, and a small number of extremely expensive weapons programmes constitute a unique structure for doing business".

HAL- designed and built Advanced Light Helicopter (ALH) landing on a Coast Guard OPV

The second series production LCA (SP-2) at HAL, Bangalore

This sums up the challenge to governments and their defence industries across the globe. How to keep this 'unique structure for doing business', finely balanced between government and private enterprise. No longer can the government, the armed forces and the defence industry, both public and private, think strictly in institutional and compartmentalised terms.

Clearly what we are witnessing here is not a traditional open market economy model, but one in which different agencies of the government, the armed forces, public and private sectors along with R&D each have an important contribution to make, and jointly. Through this partnership of an integrated perspective of defence and security requirements and missions, application of technologies and management approaches, should emerge options that will assist the armed forces in developing joint requirements and even joint operational doctrines.

In such an ideal scenario, whilst the armed forces devote their energy to the security of the country, it will be up to the defence industrial complex to meet their equipment needs indigenously and do so in an affordable manner. To achieve this they would need to exploit all the corporate strengths inherent within the vibrant private sector including foreign partnerships, exports for economies of scale and to financially support their R&D efforts.

'Grand Strategy'

With this background, it is worth attempting to highlight attitudes and areas that need to be decluttered and modernised within our higher defence management system, to enable the country to face contemporary security and economic challenges. Success will then result in our defence industry taking its rightful place alongside global defence majors of the world.

- In essence, the vision of bringing indigenous defence industry at par with international peers must be seen through the prism of a national mission and *grand strategy* and backed with suitable organisational and operational structures to ensure synergy and mission outcomes and accountability involving all stakeholders.

Dr Vikram Sarabhai

- The term 'grand strategy' implies synergy of diplomatic strategy, national security and military strategy and defence industrial strategy towards achieving our objective. Put simply these will respectively involve aspects of which nations and outside industries' can partnerships be explored; the types of national security challenges that may have to be faced by the armed forces and how the armed forces intend to face these in an integrated fashion and a comprehensive defence industrial strategy.
- The armed forces guard their respective turfs very zealously with no serious effort at integrated war–fighting or rationalising of roles and missions for a more robust, cost effective and affordable defence capability. This results in individual service shopping lists with little or no thought to a wider technology and affordable defence industrial vision or strategy. This self-defeating defence management approach is largely responsible for the poor state of both modernisation and indigenisation. Major overhaul of the higher defence management system is hence a pre requisite to formulating any future defence industrial strategy.
- The new defence management system must ensure that each service has a full-fledged Technology and Systems Command tasked with technology issues, requirements, evaluations, interface with the industry and such related subjects.
- Conceptually, we continue to view defence industry challenges purely in terms dictated by the Ministry of Defence when they should actually involve national effort and include many other organs of the state.
- We have for decades espoused the concept of self-reliance in defence production without really defining its content and strategy especially since the stakeholders in any such mission are many. No institutional mechanism has as yet been conceived to blend these important stake holders to work harmoniously, each bringing its strength to the national mission of becoming self reliant in the field of our military equipment needs.
- In 1970, Dr. Vikram Sarabhai had proposed to the Administrative Reforms Commission, an organisational model with a Ministry of Advanced Technologies comprising of separate

On the threshold of operational service : trio of HAL's Light Combat Helicopter (LCH)

Commissions for Atomic Energy, Space, Earth Sciences and Aeronautics. It speaks for his foresight that in all the fields, *except Aeronautics*, we have independent departments/ministry with their respective Commissions and consequently the nation is at par with the international community. Only aeronautics remains a technological orphan confined to the folds of the Ministry of Defence and totally import dependent ! With rapid advances in defence technologies, one can guess that had Dr Sarabhai been living today, he would also have added the Defence industry to his list. Clearly there are lessons to be learnt.

- A 'Defence Industrialisation Policy' must cover multiple policy issues ranging from offsets, optimum technology transfers/sharing, FDI and defence export regulations, amongst others. In addition the synergising of roles of Defence PSUs, Defence R&D, *Raksha Udyog Ratnas*, the major private players and MSMEs who will be co-opted to be part of this national defence industrial enterprise, also need institutionalising. Unless vehicles are evolved to ensure both active participation and smooth interface, we will continue to face innumerable bureaucratic roadblocks, not least because of the fear of the sword of CAG, CVC and CBI, which is enough to put fear in the strongest of bureaucratic and even corporate hearts!
- R&D costs, as those of modern weapon systems, are rising exponentially and consequently military budgets of even the richest countries are under severe stress. Militaries across the world are being compelled to look at "affordability" as one of their vital inputs to equipment planning. Military industries internationally, on the other hand, are continually having to adjust to these challenges in ways to ensure economies of scale and driving up exports through partnerships, if need be. In the Indian context 'so far' there appears no recognition of these sobering realities. Absence of the criteria of affordability as an input to equipment planning is a structural weakness in our defence planning and budgeting system that is partly responsible for the huge backlog in modernisation and attrition of force levels. The armed forces insist only on the "best" and, although no Finance or Defence Minister would admit to lack of budgetary support, there are any number of inexplicable obstacles that can come in the way.
- Defence Acquisition is now a highly specialised subject and is for professionals and not generalists to manage. The US Department of Defence runs a Defence Acquisition University whose mission is to "develop qualified acquisition, requirements and contingency professionals, who deliver and sustain effective and affordable war fighting capabilities". In our context, civilians involved and service men (though of professional arms) are not only generalists but also subject to routine rotational postings. Almost none are formally qualified as defence acquisition professionals.

To sum up. whilst India possesses all the pre-requisites for a sound defence industry, its contribution to the building of the nation's defence assets has not been in keeping with this potential. The primary reasons are an archaic higher defence management model, lack of doctrinal integration amongst the armed forces, lack of a national defence industrial vision backed by a strategy, absence of an integrated and mission oriented approach towards putting these industries at par internationally and the inability to institute a requisite organisational and structural framework along with supporting institutions to work towards this national goal.

Recent experience shows that notwithstanding many "task forces" and "committee recommendations", the country has not been able to gather the political courage to make any substantial changes to the burning issues of higher defence and industrial management. We have at best moved incrementally.

The Make in India mission can now be the catalyst to shed old prejudices and for the government to pick up the gauntlet of setting up a *Blue Ribbon Commission* to look afresh at 'higher defence and defence industrial management' as one composite challenge. Notably, the "Blue Ribbon" title signifies one that is independent, exclusive and consists of non-partisan experts.

India will then have taken the first critical step towards helping its defence industry achieve its huge potential alongside ensuring that the nation is equipped with an affordable and self-reliant war-fighting machine.

Tejas light combat aircraft LSP-7 carrying out aerial display at the Bahrain Air Show, 2016 (Lead photograph in this article shows the two LCA technology demonstrators in formation flight a decade earlier)

The world of UAVs

According to the new report, *'UAV Market by Class (Small, Tactical, Strategic, Special Purpose), Subsystem (Data Link, GCS, Software), Application (Military, Commercial, Homeland Security), funding (Procurements, RDT&E, O&M) & by Payload - Forecast & Analysis to 2020'*, the global UAV market was estimated to be $7 billion in 2015 and is expected to register a CAGR of 7.73%, to reach $10,573 million by 2020.

The major challenges faced by the UAV market are due to air traffic management, as also lack of regulatory policies and procedural issues.

North America accounts for almost 69% of the global UAV market. Asia-Pacific is expected to witness a strong growth, due to increase in investments in defence and commercial applications in emerging countries such as China and India. Technological advancements in UAVs along with, their success in combat situations, and the rising demand for non-defence applications is expected to drive the UAV market, in future. The technological efficiency of the UAVs which enables them to perform various applications in defense and commercial sectors is expected to contribute to the growth of the UAV market, globally.

Strict airspace regulations, lack of skilled and trained pilots, and defence budget cuts in the North American and European regions restrict the UAV market growth. The increasing demand for autonomy and better operational efficiency would drive growth of the UAV market. The market is segmented by class, by sub-systems, by payloads, by application, by region, and by country. The competitive analysis includes the market share of companies in the UAV market. The report includes analysis of impact of drivers and restraints country-wise, and region-wise to give a better insight into the UAV market. Technology and industry trends have also been highlighted, which would provide competitive market intelligence to utilise the business opportunities.

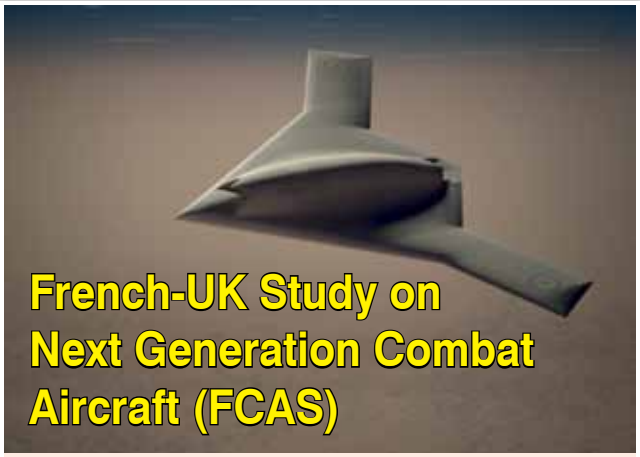
According to Strategic Defence Intelligence, UAVs are the next generation of aerial platforms being deployed by defence establishments around the world, demand for which has been fuelled by the successful deployment of these systems in combat operations in Iraq and Afghanistan. These unmanned platforms are used as force multipliers, performing ISR missions, target recognition, damage assessment and electronic warfare. Defence ministries around the world are investing in this capability to reduce troop casualties. Specifically, mini and VTOL UAVs are affordable and capable of performing ISR missions; demand for these cost-effective UAVs is on the rise in countries with low spending power.

The US comprises the largest market for UAVs in the world and is also the largest manufacturer of various unmanned systems globally. Over the years, the US

IAI Heron-1 operations in Afghanistan

Israel Aerospace Industries' (IAI) Heron-1 Unmanned Aerial System (UAS) recently marked its 70,000th flight hour in Afghanistan, after less than 7 years of operation in the country. This follows Heron's completion of 25,000 flight hours under German Air Force operations in Afghanistan. After successful use in Afghanistan by several Western NATO members, including Germany, France Canada and Australia, this milestone "demonstrates Heron's compatibility with challenging conditions in various areas around the world". In an announcement from the Australian Ministry of Defence, Senator David Johnston, the Australian Minister of Defence said: "The Heron is a proven capability– providing 'eyes in the sky' for our troops in the Middle East. The retention of the system following their withdrawal from Afghanistan will ensure that Australia remains at the forefront of this advancing technology."

Heron-1 is a Medium Altitude Long Endurance (MALE) UAS that provides crucial intelligence, surveillance, and reconnaissance information in real-time to commanders and frontline soldiers. It has significant capabilities, such as carrying a wide variety of sensors, which are able to provide real-time information over a wide area for an extended period.



French-UK Study on Next Generation Combat Aircraft (FCAS)

Dassault Aviation, BAE Systems and their industrial partners have been awarded a €150m/£120m contract by the French and UK governments for a two year co-operative Future Combat Air System (FCAS) Feasibility Phase study, formally signaling the start of work. This is the first step towards what could become a full demonstration programme that shapes the future of combat aerospace in Europe. Cooperation between France and the UK is seen as the optimum way to progress a UCAS (Unmanned Combat Air System) solution, whilst supporting both governments' intentions for closer defence ties. The joint study contract of €150m/£120m is to be supplemented with additional French and UK national funding to the combined value of €100m/£80m in the same period. The two-year study will build the foundations on which a long-term joint programme will be based by focusing on the development of concepts for an operational system, and maturation of key technologies that will be required for a future operational UCAS.

Elbit Hermes 900 HFE UAS to Switzerland

Elbit has been awarded contracts from the Swiss Federal Department of Defence, Civil Protection and Sport ("DDPS"), for the supply of Hermes 900 HFE (Heavy Fuel Engine) Unmanned Aircraft Systems (UAS) and an advanced ground segment for command, control and communications. The contract, to be performed over a four-year period, follows the DDPS June 2014 announcement about Elbit Systems selection as the preferred supplier for the UAS 15 new reconnaissance drone programme. The Hermes 900 HFE system, to be supplied to the Swiss Air Force, is an advanced adverse-weather unarmed reconnaissance UAS, offering improved operational capabilities.

has established itself as a global leader in developing advanced unmanned systems, and as a specialist in their subsequent graduation from Intelligence, Surveillance, and Reconnaissance (ISR) capabilities to combat warfare, as manifested in its decade long war against terrorism.

The necessity for continual and superior ISR capability by its armed forces has stimulated the US to invest substantially in unmanned air systems (UAS) and related technologies. Presently, the US DoD operates more than 7,000 UAVs, mainly in international locations such as Afghanistan, Pakistan and Yemen, as well as domestically along the US-Mexico border. A majority of these are small UAVs with a wing span of between three and four feet, which are used by ground units for real time geographical or structural surveillance. However, over 83% of the total UAV expenditure is on medium and large UAVs that are used in more strategic and tactical ISR and combat roles than their smaller counterparts.

Evidencing the trend, HALE and UCAV programmes are expected to dominate procurement expenditure during the forecast period, as the US military looks to induct more UAVs with enhanced endurance and weapon bearing capabilities.

NG's X-47B aboard USS *Theodore Roosevelt*

The US Navy's X-47B has completed final tests aboard USS *Theodore Roosevelt* (CVN 71) and returned to its home base at Naval Air Station Patuxent River after eight days at sea. While underway, the X-47B flew in the carrier pattern with manned aircraft for the first time and conducted a total of five catapult launches, four arrestments and nine touch-and-go landings, including a night time shipboard flight deck handling evaluation.

Testing began when the X-47B performed its initial cooperative launch and recovery cycle with an F/A-18. With its automatic wing-fold capability and new tailhook retract system, the X-47B met the programme's objective to demonstrate that carrier-based manned and unmanned aircraft could maintain a 90 second aircraft launch and recovery interval. The team evaluated the unmanned aircraft's performance during the first night time taxi and deck handling operations aboard a carrier. Since the shipboard environment presents different challenges at night, this test was an incremental step in developing the operational concept for more routine unmanned air system flight activity.

Elbit Systems introduces Skylark 3

Elbit Systems has developed the Skylark 3, a new autonomous mini-Unmanned Aircraft System (UAS), best suited for brigades and divisions in "beyond the next hill" reconnaissance, counterinsurgency and force protection missions, as well as for use in a range of civil applications, such as border and coastal security and anti-terror operations.

Leveraging the proven technology and operational experience of the Skylark family of mini-UAS, Skylark 3 offers a wide range of system enhancements, including a significantly larger range (more than 100 km), flight endurance (up to 6 hours) and payload capacity (up to 10 kg). Launched via a pneumatic launcher, mounted either on the ground or on a vehicle, Skylark 3 offers upgrades such as improved payloads with better target detection, classification and surveillance capabilities. These deliver superior Electro Optical/Infrared (EO/IR) video and photographic imaging in both day and night operations and in adverse field conditions. The aerial vehicle incorporates an electric motor which reduces sound signature and enables operating over long distances and at high altitudes, has a 4.8 m wingspan and a maximum takeoff weight of 45 kg, and a service ceiling of 15,000 ft.

In the USA, its Air Force, Army, Marines, the Navy and the Department of Homeland Security are the prime buyers of advanced UAVs, each having their own procurement objectives.

Global spending on unmanned aerial vehicle (UAV) programmes is expected to triple over the next decade in military, commercial, and consumer markets, according to analysts at Teal Group in a new market analysis. They estimate that UAV production will rise from current worldwide UAV production of $4 billion annually to about $14 billion, totaling $93 billion over the next ten years. Military UAV research spending would add another $30 billion over the same decade.

"The market for UAVs looks very strong, increasingly driven by new technologies such as the next generation of unmanned combat systems, and the development of new markets such as civil and consumer drones," says Philip Finnegan, Teal Group's director of corporate analysis and co-author of the study, titled *World Unmanned Aerial Vehicle Systems, Market Profile and Forecast 2015*. "Consumer UAVs are showing that they can do many of the easier commercial missions such as simple real estate photography," he adds.

Civil UAV growth is also continuing to grow, say Teal analysts. "Our coverage of the civil UAV market continues to grow with each annual report, mirroring the increase in the civil market itself," said Finnegan. "Our 2015 UAV study calculates the UAV market at 72 percent military, 23 percent consumer, 5 percent civil cumulative for the decade." Of the three areas, civil UAVs grow most rapidly over the forecast period as airspace around the world is opened, but it grows from a very low base.

"The Teal Group study predicts that the US will account for 64 percent of total military worldwide (Research, Development, Test, & Evaluation) RDT&E spending on UAV technology over the next decade, and about 38 percent of the military procurement," says Teal Group senior analyst Steve Zaloga, another co-author of the study. The larger, higher value systems procured by the US help drive the relative strength of the US market over the decade.

UAV payloads, such as electro-optic/infrared sensors (EO/IR), synthetic aperture radars (SARs), SIGINT and electronic warfare Systems, and C4I Systems, are forecast to double in value from $3.1 billion from Fiscal Year 2015 to $6.4 billion in Fiscal Year 2024, Teal analysts say. EO/IR

Sagem demonstrates Patroller Drone's 'see and avoid' System

Sagem (Safran) has completed a series of flight tests demonstrating the feasibility of a drone being integrated in a shared (manned/unmanned aircraft) airspace, in compliance with civil aviation regulations and air control procedures. The series of about 20 flights used the company's Patroller drone, and took place near Toulouse and carried out within the scope of Europe's SESAR programme. Sagem is teaming up with the French air navigation and safety agency DSNA *(Direction de la Sécurité de la Navigation Aérienne)*, the laboratory run by the national civil aviation school ENAC *(Ecole Nationale d'Aviation Civile)* and Rockwell Collins France through the ODREA project.

Sagem demonstrated a complete anti-collision function during these flights, one of the keys to integrating drones in a civilian airspace shared with manned aircraft.

The 'see and avoid' system developed by Sagem and integrated in the Patroller's control system, combines traffic detection sensors, including an infrared optronic (electro-optical) sensor, and an automatic risk collision estimation and avoidance flight path generation module. During the flight tests, this system was successfully operated using different conflict scenarios with a 'dummy' aircraft provided by ENAC, thus enabling Patroller to detect the risk of a collision and avoid it, without requiring an operator.

IAI's Heron UAS selected by Korea

The Defence Acquisition Programme Administration (DAPA) of the Republic of Korea has selected Israel Aerospace Industries' (IAI) Heron Unmanned Aerial System (UAS) for the corps-level UAV upgrade project. DAPA's official notification said: "We comprehensively evaluated price, capability, operational suitability, T&C and selected the equipment that has a higher score."

IAI and Korea to develop VTOL UAV

Hankuk Carbon, a Korean composite manufacturer, and Israel Aerospace Industries (IAI) have signed a MOA (Memorandum of Agreement) to develop, manufacture, and sell Vertical Take-Off and Landing (VTOL) Unmanned Air Vehicle (UAV). Both companies will co-develop and co-manufacture the next generation VTOL UAV. The Joint Venture will begin by developing up to 200~300kg MTOW. The next generation VTOL UAV will target 90% of domestic localisation and will be developed according to Korean needs. Furthermore, HC and IAI are considering adding ship borne take-off and landing capability to the FE-Panther, to be done by the end of 2018

In October 2015, Hankuk Carbon displayed the 67kg Hybrid VTOL UAV, FE-Panther for the first time. The UAV powered by lithium polymer batteries and a gasoline engine has an endurance of 8 hours flight time with 6kg of payload, which can fly to a maximum radius of 130km and maximum speed of 100km/h. In addition, the UAV has automatic VTOL capability and is easy to maintain.

IAI expands UAS Training Solutions

Israel Aerospace Industries (IAI) has acquired a full independent capability for UAS payload simulation by purchasing TView, a 3D image generator for simulation and C4I applications from Tiltan Systems Engineering, an Israeli company. The Agreement allows IAI to adapt the software, including the use of source code and other resources made available to IAI. TView is a powerful 3D image generator which enables real-time, photorealistic rendering of real world environments. TView generates 3D photorealistic, sensor-based visual scenes of real-world locations with greater realism than any other solution available on the market.

The UAS training field is expanding rapidly. IAI's various unmanned aerial systems include advanced mission trainers that allow complete and cost-effective operational training. Market forecasts indicate that synthetic (simulated) training will represent some 80% of the total training costs for UAS operators. One of the most challenging issues is to create a realistic simulation of the external environment and targets for the various payloads and sensors carried by a UAS, especially electro-optical sensors and SAR radar systems. To answer this important need, IAI has established a UAS training directorate which provides training solutions for a variety of unmanned aerial systems, from basic training within the control station to extended high fidelity simulation training.

IAI UAV control station

remains the default sensor for the majority of UAVs, but in recent years have seen inconsistent funding and considerable uncertainty, as legacy endurance UAV production has ended, they add.

New sensor markets will see significant increases as radio frequency (RF) systems replace EO/IR capabilities, and next-generation UAVs at all scales require much more sophisticated and expensive sensors. "Rapidly increasing capabilities for RF sensors will be funded, as potential conflicts shift from clear-skies Central Asia to the more restrictive geographies of Eastern Europe and the Pacific," stated Dr David Rockwell, author of the electronics portion of the new study. "And near future Unmanned Combat Aerial Vehicle (UCAV) and nano-UAV procurements will see much more expensive and capable sensors.

"UAVs will continue to provide the world's fastest-growing aerospace payload market, but not through continued growth of 'the usual suspects' from the past decade. Instead, new sensor programmes for current and future air vehicles will result in more unexpected growth spurts and losses," he continues. "We now forecast a number of speculative new programmes in the out-years, including estimates of classified programmes. Wise companies will plan today for growth tomorrow."

Saab UAV Systems for the Swedish Police

Saab has signed a contract with the Swedish Police to deliver three UAV (Unmanned Aerial Vehicle) systems in 2016. Each system comprises air vehicles equipped with day/night sensors and a ground station, plus spare parts, consumables, documentation, training and technical support. The contract will be in effect from 2016 to 2018.

The remote-controlled UAV system selected by the Swedish Police uses the proven Qube quadcopter air vehicle, provided by US company Aero Vironment Inc. The system will be tested in operations by the Swedish Police during 2016. The UAVs will be equipped with digital cameras for collection of information about specific geographical areas, as well as sensors and technology for image transfer.

Camcopter S-100 with 'Detect and Avoid' system

Schiebel and the Netherlands Aerospace Centre (NLR), the Netherlands Coastguard and the Royal Netherlands Air Force have conducted a series of successful flights with a newly developed airborne Detect and Avoid System at the airport of Den Helder. The AIRICA (ATM Innovative RPAS Integration for Coastguard Applications) project marks a major step forward in the process of safe integration of RPAS (Remotely Piloted Aircraft Systems) into all classes of airspace. During a special demonstration held at De Kooy Airfield in Den Helder, Schiebel provided the Camcopter S-100, onto which the NLR developed Air Scout Detect and Avoid System was installed. The Netherlands Coastguard provided a Dornier Do 228 as “intruder” and the Royal Netherlands Air Force contributed with an Alouette helicopter as “intruder”, and provided the Air Traffic Control services.

Elbit's Hermes UAS

The Hermes 900

Elbit Systems will soon deliver a unique area dominance system that enables simultaneous operation of two multisensor unmanned platforms, exploitation and analysis of all intelligence data received through two dedicated separate data links.

Elbit Systems wholly-owned subsidiary, Elbit Systems EW and SIGINT, Elisra Ltd. (Elisra) produces the SPS-65V5 system, supporting self-preservation and improving UAS survivability. It also contributes to UAS intelligence gathering capabilities through advanced sensors integrated in the system. The system relies on Elisra's extensive experience with the development of similar systems installed on various operational platforms (fighter aircraft, helicopters and transport aircraft) used by customers around the world.

The new maritime patrol configuration is designed for large area coverage and is capable of carrying advanced multiple sensor suites weighing up to 350 kg, including a maritime patrol radar, high resolution long range observaton system, electronic surveillance systems and Automatic Identification System (AIS).

The Hermes 900's aerodynamic efficiency enables frequent flight profile adjustments and mission execution at ranges up to 1,000 nautical miles using satellite communication.

The Hermes 900 is capable of an extended flight ceiling of over 30,000 ft. with a large internal payload bay that is suitable for carrying a large amount of payloads and is also capable of flying in harsh weather conditions. The UAS allows for autonomous liftoff and landing and to control two platforms, using two ground data terminals under Elbit Systems' Universal Ground Control Station (UGCS). The Hermes 900 utilises innovative avionic and electronic systems, such as electro-optical systems and laser pointers, ELINT sensors, COMINT, LOS communications and satellite communications.

MQ-4C Triton UAS completes operational assessment

The MQ-4C Triton unmanned aircraft system (UAS) built for the US Navy by Northrop Grumman has successfully completed Operational Assessment (OA). Pending final data analysis, the completion of this milestone signals the maturity of the system and paves the way for a positive 'Milestone C' decision, which will transition Triton into low rate initial production. As part of OA, an integrated test team made up of Navy personnel from Air Test and Evaluation Squadrons VX-1 and VX-20, Unmanned Patrol Squadron, VUP-19 and Northrop Grumman demonstrated the reliability of Triton over the course of approximately 60 flight hours. The team analysed sensor imagery and validated radar performance of Triton's sensors at different altitudes and ranges.

IAI Tamam's M-19HD multisensor electro-optical payload

The M-19HD payload on board IAI-made Heron UAV

Israel Aerospace Industries' innovative M-19HD payload has "successfully completed all airborne test-flights on manned and unmanned platforms." Local and international customers have reportedly shown interest in the novel electro-optical payload and advanced negotiations are underway.

The M-19HD is a true High-Definition, compact, multispectral, multi-sensor, single line-replacement unit (LRU) payload (simultaneously incorporating up to 7 sensors). The M-19HD enables continuous day/night surveillance under all weather conditions and provides outstanding acquisition ranges due to its powerful sensors, high stabilisation and unique image processing capabilities.

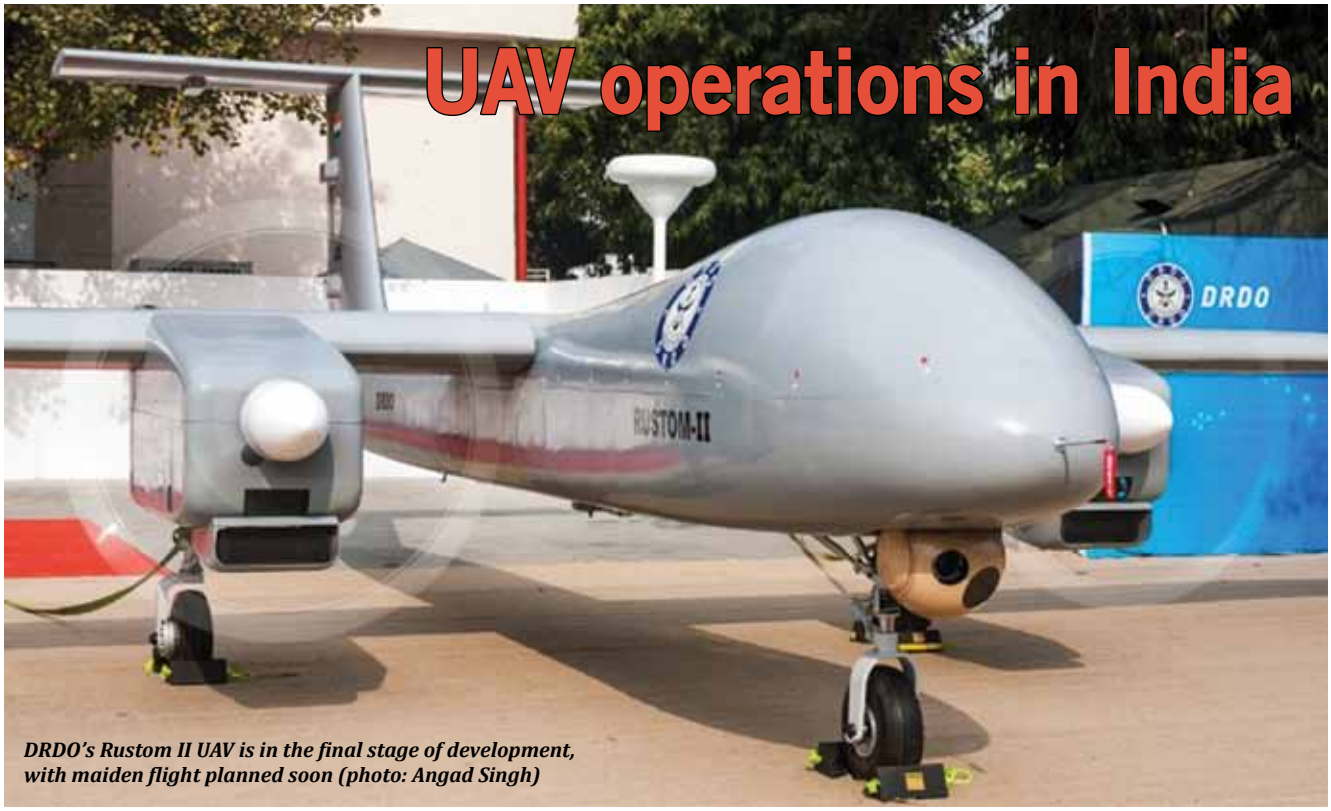
The M-19HD reduces the operator's workload and improves situational awareness by virtue of its multi-mode Automatic Video Tracker (AVT). It also provides accurate geo-location using its embedded IMU/GPS (Inertial Measurement Unit/ Global Positioning System).

The system is designed to be installed onboard advanced unmanned aerial platforms such as IAI's Heron-1 and Heron TP UAVs, as well as aerostats and manned platforms, able to perform strategic missions.

Spain to acquire Predator B

General Atomics Aeronautical Systems has announced Spain's selection of the Predator B/MQ-9 Reaper RPA system to support the nation's airborne surveillance and reconnaissance requirements. The Spanish Ministry of Defence has awarded GA-ASI the delivery of one Predator B RPA system for the Spanish Armed Forces to include four aircraft equipped with MTS-B Electro-optical/Infrared (EO/IR) sensors and GA-ASI's Block 20A Lynx Multi-mode Radar, two Block 30 Ground Control Stations (GCS), and Satellite Communications (SATCOM) and Line-of-Sight (LOS) data link capabilities by means of a Spanish-US Foreign Military Sales (FMS) agreement. The Predator B is a long-endurance, medium-high-altitude RPA that features an extensive payload capacity (850 lb/386 kg internally, 3,750 lb/1,700 kg externally), with a maximum altitude of 50,000 feet/15240 meters, and can stay aloft for up to 27 hours. Predator B is currently operational with the USAF, Royal Air Force, French Air Force and the Italian Air Force.

UAV operations in India



DRDO's Rustom II UAV is in the final stage of development, with maiden flight planned soon (photo: Angad Singh)

In India, its Army was the first to acquire Unmanned Aerial Vehicles (UAV) in form of Israel Aerospace Industries (IAI) Searcher Mark I, followed by the Searcher Mark II and finally the Heron. The Searcher Mark II is being successfully used in the mountainous region as also in the plains and semi deserts. The Indian Air Force was swift to build up similar inventory while the Indian Navy acquired the Searcher Mark II and Heron Medium Altitude Long Endurance (MALE) UAV for long range maritime surveillance missions, operating them from Kochi and Porbandar.

Prime UAV of the Indian fleet is the fourth generation GPS-enabled Heron / Machatz 1 MALE UAV, designed and manufactured by Israel Aerospace Industries (IAI) at its Malat division. It entered operational service with the Indian Air Force in high-altitude land surveillance near mountainous Chinese and Pakistani borders, and is in IN service in maritime patrol missions. The Heron proved to be capable of fully automated take-off and landing, even under adverse weather conditions, and flying at a height of 30,000 ft, the UAV has provided its operators with real-time information on enemy battlefields/activities by performing Information, Surveillance, Target Acquisition and Reconnaissance (ISTAR) roles over wide areas to national agencies, theatre commanders and lower echelons using multiple sensors and satellite communication (SATCOM) for extended-range capture and transfer of critical data. The UAV is also capable of providing reliable Battle Damage Assessment (BDA). IAI is to supply around 60 Heron MALE UAV to various branches of the Indian Armed Forces that now also includes the newer Heron TP/Eitan.

IAI Heron in flight

Powered by a single 85.79-kW Rotax 914 turbo aircraft engine manufactured by Austria's BRP-Rotax, a Heron UAV can climb at the rate of 150m a minute and fly at a maximum speed of 207 km/h to a range of 350 km (Satellite Communications enables this range to be extended to beyond 1,000-km) and has demonstrated 52 hours of continuous flight with modular space up to 250 kg for customer furnished equipment that may include Electro-Optical (EO) and Infra-Red (IR) sensors, thermal surveillance equipment and laser designator. While the EO sensor converts light rays into electronic signals for capturing images, real-time data and videos, the laser designator is applied for targeting the enemy on battlefield. Thermal surveillance equipment is used to capture high resolution images at night by penetrating through clouds, rain, smoke, fog and smog. Communications are established through direct Line-of-Sight (LoS) datalink, UAV airborne data relay for beyond LoS missions and ground-based data relay for

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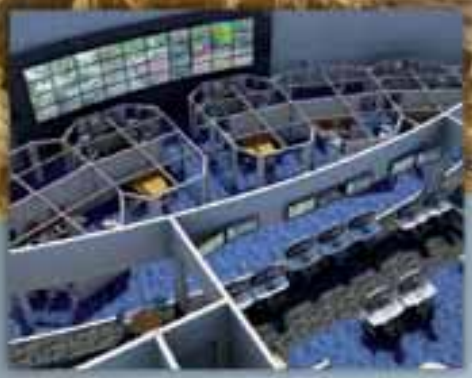

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WHEN RESULTS MATTER

Indian Air Force Heron UAV

communicating with the Ground Control Station (GCS). Additionally, Electronic Support Measures (ESM) helps the Heron in threat detection and examines the area to determine signals emitted from the surrounding radars.

For maritime tasks, the AIS gathers details of ships such as vessel type, vessel name and destination. The Elta Maritime Patrol Radar (MPR) identifies vessels from very long distances by applying silhouette target acquisition procedures. The MPR also provides Synthetic Aperture Radar (SAR) images and near coastline detects ground vehicles using its Ground Moving Target Indicator (GMTI) mode.

Heron can be controlled either manually from the GCS or operate in autonomous mode. As mentioned earlier, it is fully equipped with automatic launch and recovery (ALR) system which helps in automatic safe landing during communication failure with the GCS. The processing, retrieving and storing of the real-time data provided by Heron UAV is undertaken by the GCS to convert the sensor data such as live and stored images, imagery and spatial information, including EO, SAR, MTI maps, SIGINT and ESM, into actionable intelligence.

An enhanced variant, the Heron TP/ Heron 2/Eitan; developed under an Israel Ministry Of Defence (IMOD) programme can carry multiple payloads and perform multiple missions such as Communication Intelligence (COMINT), Signal Intelligence (SIGINT) and image intelligence (IMINT). These have entered service in Israeli Defence Forces (IDF) and cleared for export to India. Heron TP can fly at 45,000 ft with an endurance of approximately 36 hours. Apart from long range, long endurance Intelligence, Surveillance and Target Acquisition Reconnaissance (ISTAR) missions, Eitan is designed to execute a large variety of operational missions, including aerial refuelling and strategic missile defence. Eitan made its maiden flight on 15 July 2006 and this new MALE UAV will provide the Israeli Air Force with persistent, High altitude, Long Endurance (HALE) ISR capability well beyond the reach of enemy air defences, much beyond the Israeli borders. Heron TP is powered by a single 1,200-hp Pratt & Whitney Canada PT6A turbo-prop engine, powering a four blade propeller. The use of such powerful turbo-prop engine enables the aircraft to climb and operate at altitude above 40,000ft avoiding any airspace conflict with commercial aircraft traffic. Using on board fuel and power resources, Heron TP is able to sustain continuous missions for over 36 hours with full mission payload and is also equipped with de-icing systems protecting the aircraft when flying through icing conditions.

With maximum takeoff weight of 4,650 kg, Eitan can carry over 1,000kg of sensors in its forward section, main payload bay, and the two bulges located at the end of each tail boom, offering optimal separation for specific systems. Other stores can be mounted along the wing, in internal and external positions. Eitan could be fitted with wing hard-points for external stores. The aircraft is equipped with multiple data-links, supporting LoS and Beyond Line-of-Sight (BLoS) links via satellite communications. The giant drone maintains the twin tail boom principle offering stable and redundant design and large payload bay located around the aircraft centre of gravity, uninterrupted by the landing gear. This configuration allows for quick and simple payload reconfiguration on the flight line. While the indigenous Rustom is being developed as a UCAV, II according to media reports India has officially asked General Atomics and the United States Government on the possible sale of jet-powered Avenger (formerly Predator C) UCAV to India.

The IAF has also acquired the Harop loitering (6 hours) Anti-Radar Homing (ARH) UCAV, designed to explode itself on a high value pre-programmed target both on land and sea. Being capable of passive homing makes it an ideal candidate for Suppression of Enemy Air Defences (SEAD) missions.

Sayan Majumdar


Searcher II UAV in flight

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HAL's helicopter portfolio

The Rudra ALH

Prime Minister, Narendra Modi laid the foundation stone for HAL's new helicopter manufacturing facility at Biderehalla Kaval, Gubbi Taluk, Tumakuru, about 100 km from Bengaluru on 3 January 2016. "With this, the small village has come on the world-map as it would be manufacturing machines that would protect the country. It is no ordinary facility as the world's attention would be focused on it. I expect the indigenous helicopter under Make-in-India, to fly-out by 2018. It is a gift from Government of India to the people of Karnataka, Tumakuru in particular. Nearly 4000 families, direct or indirect will benefit from this largest ever investment of Rs 5,000 crores in Tumakuru", stated the Prime Minister. He hoped that HAL would produce 600 helicopters in a 15 year period and India's Defence Forces would be the greatest beneficiary of this. "I want companies such as HAL to help the country reduce dependency on overseas suppliers", he added.

Mr Modi congratulated HAL employees, past and present. "I believe that HAL has good manpower and technical knowhow to fulfill the future needs."

Speaking on the occasion, Defence Minister, Manohar Parrikar hoped that HAL would one day transform into a lead integrator and spearhead the development of aerospace eco-system in India. The Tumakuru facility would meet the country's massive requirements in the Defence sector, he added.

HAL CMD, T Suvarna Raju said HAL would continue to play a significant role in realising Prime Minister's missions like 'Make-in-India', 'Digital India' and 'Skill India' to achieve self-reliance in defence sector.

Full scale mockup of the light utility helicopter (LUH)

Light Utility Helicopter (LUH): The LUH is 3-ton class new generation helicopter being developed by HAL to meet the requirements of both military and civil operators. The helicopter with its glass cockpit will be deployed for reconnaissance and surveillance roles and as a light transport helicopter, capable of flying at 220 kmph, with a service ceiling of 6.5 km and a range of 350 km with 400 kg payload. The LUH is powered by a single TM/HAL Ardiden 1U/Shakti 1U turbo shaft engine with sufficient power margins to cater to demanding high altitude missions. Design


ALH Dhruv


LCH

and development of the LUH began in February 2009. The initial Ground Test Vehicle (GTV) run was completed on 6 December 2014 and IOC of the basic version is expected during 2016-17.

Advanced Light Helicopter (Dhruv): The Dhruv Advanced Light Helicopter (ALH) multi-role, new generation helicopter in the 5.5-ton weight class, has been designed and developed by HAL. With twin Ardiden 1H1 (Shakti) engine configuration, it has "superlative performance" throughout its flight envelope, with its high speed cruise for rapid deployment and to maximise the radius of operations. The basic helicopter is produced in skid version, but with options for a wheeled version.

The Dhruv is certified by both the Centre for Military Airworthiness & Certification (CEMILAC) and Directorate General of Civil Aviation (DGCA). The utility version of the Dhruv helicopter can be used for VIP travel, commuter, search and rescue, emergency medical service, underslung load, disaster relief and offshore operations.

The Dhruv has essentially been developed for the Indian Air Force and Indian Army, with more than 200 helicopters produced so far. The Armed version of the Dhruv, named Rudra, equipped with turreted gun, rockets, air-to-air missiles, EO pod, helmet pointing system and radar/laser/missile warning systems has received Initial Operational Clearance and is currently under production for the Indian Defence Forces.

Light Combat Helicopter (LCH): is a 5.5-ton class, combat helicopter designed and developed by HAL, and is powered by two Shakti engines, incorporating many technical features of the Advanced Light Helicopter. The LCH has a sleek and narrow fuselage, tri-cycle crashworthy landing gear, crashworthy and self sealing fuel tanks, armour protection, and low visibility features which makes the LCH "lethal, agile and survivable." The helicopter would have day/night targeting systems for the crew including the Helmet Pointed Sight and Electro-Optical Pod consisting of CCD camera/FLIR/Laser Range Finder (LRF)/Laser Designator (LD). The LCH is fitted with Self Protection Suite consisting of Radar/ Laser Missile warning systems and Counter Measures Dispensing System (CMDS).

The LCH prototype first flight was on 23 March 2010, followed by second and third prototype on 28 June 2011 and 12 November 2014. LCH TD4 had its maiden flight on 1 December 2015. The LCH has completed performance trials paving way for certification of basic configuration and a letter to this effect was handed over to HAL by CEMILAC in the presence of Defence Minister on 16 October 2015.

Cheetal : is the re-engined version of the proven Cheetah helicopter, earlier Artouste IIIB engine replaced with the modern TM333-2M2 engine from Turbomeca, giving the Cheetal improved payload at higher altitudes compared to the Cheetah along with improved range and endurance.

Cheetals are being produced for both the IAF and Army, first batch being inducted into IAF in 2009. Further orders for 20 Cheetals for the Indian Army and 10 for the Indian Air Force have been received. Three Cheetals have been delivered to Afghanistan recently.

Cheetal

"Aces up its Barrels" : the Barak-8

A robust area air defence Surface-to-Air Missile (SAM) system remains an invaluable asset of any 'blue water' navy and to obtain such a system, in February 2006 Israel and India signed a joint development agreement to create the new Barak-NG (now referred to as Barak-8) medium shipborne Surface-to-Air Missile (SAM). This is an evolution of the eight-cell vertically launched 10-km ranged Barak-1 system in service with both navies. Prime contractor for the programme is India's Defence Research & Development Organisation (DRDO), with Indian firms contributing the solid fuel smokeless dual-pulse rocket motors, associated safe and arm for rocket motor, and the pneumatic actuation system. Israel Aerospace Industries (IAI) missile & space group act as leading subcontractor with IAI

Elta Systems providing the multi-function phased array radar and Rafael Advanced Defence System producing the critical components (including the seeker) of interceptor missiles. For the Indian Navy (IN) the layered defence capability to be provided by long range Barak-8 along with other point defence SAM and Close-In Weapons System (CIWS) represents a key asset especially in relation to rampant proliferation of ballistic and cruise missiles in Asian continent. The layered SAM/CIWS network along with shipborne fighters from aircraft carriers will enable the IN to operate in high-threat areas outside land based air cover by establishing local air superiority. Bearing in mind that hostile submarines are likely to make an attack with sea-skimming anti-ship missiles, even Anti-Submarine Warfare (ASW) screening becomes analogous to air defence.

The 4.5-metre long 275-kg Barak-8 missile provides effective protection from all form of aerial threats, including manned, unmanned as well as Precision Guided Weapons (PGM) up to 60 to 70-km (probably a "very conservative" figure) and a ceiling of 16-km, thanks to a dual-pulse solid rocket motor. Fired from its Vertical Launch System the missile initially acquires

potential energy in the form of height, which can be traded for kinetic energy in form of speed to retain its manoeuvre capability even at the end of its flight. In addition while the first motor pulse propels the weapon through most of its trajectory, the second fires as the missile approach its target. This ensures that the missile is not just coasting in the final stages, but sprinting along with energy necessary to secure multiple chances against fast, manoeuvring targets taking evasive action or random weaving and preferably scoring a Hit-To-Kill (HTK).

More importantly the Active Radar Homing (ARH) seeker endows Barak-8 with extensive autonomy during the final stages of intercept. This is an excellent approach for dealing with saturation attacks even using passive ship radars, which can track many targets but its capacity to illuminate targets remain restricted, while the radars can operate intermittently to ensure their survivability against enemy Anti-Radar Missiles (ARM) besides remaining free to track other targets. Besides emerging as India's primary naval area air defence SAM, initially entering service in *Kolkata* class Guided missile Destroyers (DDGH), in Israel, the Barak-8 is slated to equip its next-generation *Sa'ar 5* and *Sa'ar 6* frigates/corvettes.

The combat suites of both vessel classes will be built around the Elta EL/M-2248 Multi-Function Surveillance, Tracking & Acquisition Radar (MF-STAR) conformal S-band digital solid-state Active Electronic Scanned Array (AESA) Radar System which Elta claims to be superior to the United States SPY-1 AEGIS radar. MF-STAR can deliver an accurate high quality arena situation picture (including real time distance, altitude, direction and velocity of targets) and weapons support and extract fast low Radar Cross Section (RCS) targets like stealthy cruise missiles, even in the toughest environmental (clutter and jamming) conditions by employing multi-beam and pulse Doppler techniques as-well-as robust Electronic Counter Counter Measures (ECCM) techniques. Besides acting as the ship's primary sensor in providing 3-D long-range air surveillance, at medium range MF-STAR automatically track and classify threat and simultaneously besides searching the horizon for potential missile threats. In parallel, it supports multiple engagements by offensive and defensive weapons. The agile radar operates in multiple simultaneous modes, offering short search frames and Track-While-Scan (TWS) revisit time. The system also offers a rapid tracking update rate and high accuracy for priority targets. The radar automatically establishes tracks of high flying targets at ranges beyond 250-km and at low flying targets, at ranges above of 25-km.

For weapons guidance, MF-STAR supports different operating modes of missile systems including mid-course guidance of ARH/SARH SAM and illumination enslavement for Semi-Active Radar Homing (SARH) SAM, thus making dedicated guidance radar systems redundant. Also incorporated is an automatic splash detection and measurement, to support naval gunnery in maritime security and CIWS role. As apparent the performance of Barak-8 surpasses operational profiles of other competitors and will be able to compete with Raytheon Standard SM-2 Block IIIA, MBDA Aster-15, or land-based Patriot. In fact Barak-8's ARH seeker would give it a performance advantage over the SM-2, and corresponds more closely to the SM-6.

Moreover Barak-8's potential uses in a point defence role against ballistic missiles remain implied in HTK performance and the land-based system's name. The missile launcher will comprise an eight-round module, three or more of which will make up a typical system. The missile is reputed to be able to decimate multiple targets both in high and low altitudes indicating a low minimum range and thus be able to function as both an area and point defence missile. And IAI still retain some aces up its sleeves, as besides developing 150-km ranged Barak-8ER, the company has hinted that its Barak-8 air defence missile may well be adapted for launch from airborne platforms possibly to decimate hostile ballistic missiles in their boost phase.

Sayan Majumdar

Sweden's focus on India

Sweden's Prime Minister Stefan Löfven led a large and high level delegation to Mumbai for the 'Make in India' Week, being received by Indian Prime Minister Narendra Modi on 13 February. As per the official joint statement issued thereafter by the Ministry of External Affairs, "Both Prime Ministers recognised how the respective strengths and character of the two countries and economies together underpin the great potential in the bilateral partnership. They noted that India's economic development and rise as a global power has created new opportunities to further deepen and extend this partnership to foster economic growth and inclusive development in both counties as well as to meet global challenges. The Prime Ministers agreed to scale up bilateral relations and committed to a close bilateral dialogue at all levels".

Prime Minister Löfven welcomed the 'Make in India' initiative. The joint statement continued with the "two Prime Ministers noting with satisfaction that Swedish companies had been Making in India for many decades and had created employment opportunities directly and indirectly for approximately 1.2 million people. They agreed that the 'Make in India' initiative had improved conditions for these companies to expand and deepen their investments. Prime Minister Löfven welcomed the Indian government's efforts to improve the ease of doing business. The leaders noted with satisfaction the favourable result of the recent Sweden Business Climate Survey, where 80% of Swedish companies in India shared their intent to invest further in the coming years". In a direct statement, Prime Minsiter Löfven stated "The world's eyes are now on India. They used to be on China earlier, but they are now on India".

An important aspect covered was cooperation on defence matters :"it was agreed that India and Sweden will enhance dialogue on defence in key areas. They welcomed progress in the Joint Working Group under the MoU on Defence including plans for India-Sweden defence seminars in India in spring 2016 focusing on aviation, maritime security as well as combat training and simulation in the army domain. The two prime ministers acknowledged the potential for successful collaboration and agreed that under the rubric of Make in India, cooperation possibilities between their respective defence industries could be identified and taken forward appropriately, including in the field of aviation".

In this context, the statement made by Defence Minister Manohar Parrikar is revealing. The minister stated that India is likely "to select at least one (new) fighter aircraft by the year end, that will be manufactured by the private sector for supply to the IAF under the 'Make in India' programme". He repeated that "it is the private sector which will be required to supply to the Air Force. We need fighters… there are proposals".

The Swedish delegation included Håkan Buskhe, CEO of Saab whose Gripen multi role combat aircraft has reportedly been subject of discussions with Indian companies over the past year,this aircraft type being one of the original contenders to meet the IAF's M-MRCA requirement. The new generation Gripen E has since been ordered in quantity by the Air Force's of Sweden and Brazil and represents a qualitative advance in performance and capability. It is significant that Marcus Wallenberg, head of the Investor Group that owns much of Sweden's industry, including Saab, was a prominent member of the Swedish delegation.

Meanwhile, Saab and the Kalyani Group have furthered their strategic alliance signed in 2014, now committing to form a joint venture company for manufacture of air defence systems which will comprise short range surface to air missile and very-short range air defence missile systems. In the first step, Saab have ordered missile parts from Kalyani Strategic Systems Ltd, a Kalyani Group subsidiary.

Airbus Group and its 'Make in India' programmes

C295

Airbus Group have a major presence at Defexpo 2016, highlight of the Group's participation being its 'Make in India' programme, which include the Indian Air Force's 'Avro replacement programme' where Airbus Group has proposed the production of its C295W in India together with Tata Advanced Systems as well as its partnership with Mahindra Defence to produce military helicopters.

At Defexpo are displayed scale models of the C295W as well as the military helicopters H125M Fennec, AS565MBe Panther and the EC725 (now marketed as the H225M). In addition, there are scale models of the Spexer border/coastal surveillance radar, a land based Electro Optical Targeting System (EOTS), Argos II and Goshwk II airborne observation systems, MUSS self-protection system against guided ammunition for battlefield vehicles and ALTAS-2QB hostile laser warners.

The selection process for the C295W medium transport aircraft is ongoing. This 'highly versatile aircraft is proven around the world as a tough, reliable and high-performance workhorse with outstanding lifecycle costs and excellent performance' on short or unpaved runways. To date, 144 C295s have been delivered out of 165 on order and it is in service in 20 countries.

The AS565 MBe Panther 'perfectly' answers the requirements of the Indian Navy's Naval Utility Helicopter (NUH) programme for around 100 units. It is an all-weather, multi-role light helicopter that can be operated from ship decks or offshore to cover a vast array of naval missions including maritime surveillance, search and rescue, casualty evacuation, vertical replenishment, offshore patrolling and counter-terrorism.


AS565 MB (photo: Marine Nationale)


Pierre de Bausset, President and Managing Director, Airbus Group India

The H125M Fennec is foreseen for the Indian Army's and Air Force's Reconnaissance and Surveillance Helicopter (RSH) need of around 400 units. The EC725 (now marketed as H225M) is under selection process for the Indian Coast Guard's 14 shore-based helicopter tender and is also perfectly suited for the Indian Navy's 120+ Naval Multi-Role Helicopter (NMRH) programme.

"We are at the forefront of the 'Make in India' initiative," stated Pierre de Bausset, President and Managing Director, Airbus Group India. "At Defexpo we are presenting our plans to produce defence platforms in India and basically, build an industrial eco-system supporting it in collaboration with local partners. This would involve creation of thousands of local jobs, skilling people, technology absorption, etc."

IAI: "Bright Future for Great Partnership"

IAI Heron in flight

"Israeli-Indian defence cooperation was seeded with an informal yet fruitful dialogue opened by Israel's MoD Director General Major General David Ivri in 1996. That was when IAI entered the Indian market, initially offering radars and satellites, before later introducing unmanned systems. These foundations of our cooperation remain strong and solid today, with cooperation programmes implemented in all areas of defence activities that are providing clear, unique operational advantages to all branches of the Indian military," stated Eli Elfassi, IAI Corporate Vice President for India Operations, in conversation with *Vayu* in the days before Defexpo 2016.

VAYU : With growing competition from east, west and within, can IAI maintain its position in the Indian market?

Eli Elfassi : With the decline in world defence markets, India shines as a strong, growing market that attracts all major world players. This is the playground that IAI has to play on. We are facing unprecedented, tough competition, but we are determined to succeed and to strengthen our position. We do it by being innovative and competitive, offer unique operational capabilities, and highly reliable systems; we also know to adapt, and tailor our offerings to the local business environment and customer requirements. By partnering and sharing essential know how, technology, manufacturing and support of our programmes, we leverage a strong business flow with repeat orders and new opportunities alike.

VAYU : What are your strongest attributes in this market?

Eli Elfassi : IAI is among few companies worldwide that can offer India a variety of strategic solutions in air, land, sea

and space that include space systems, homeland defence, cyber, special mission aircraft and more; this variety is one of our added values. Our advantage is in our position as a prime contractor or partner having multiple skills and versatility to provide and integrate diverse systems and capabilities. As the largest aerospace and defence company in Israel, and a strategic supplier for Israel's Defence Forces, IAI's talented employees master all the skills and expertise for the programmes we manage, an essential advantage that positions IAI to become a reliable, trusted partner in major programmes here in India.

IAI represents all aspects Indians attribute to Israel – superior technology, innovation, responsiveness, reliability and openness. IAI has proven these attributes in numerous programmes that have been inducted into service with the Indian Air Force, Navy, Army and other government branches.

VAYU : Do you find the industrial base in the India ready for 'Make in India'?

Eli Elfassi : Till now, most of the systems we supplied to India were made in Israel, with Indian participation. In the past 25 years, we developed close relations with the local industry and are teamed with more than a hundred subcontractors and partners even before the 'Make in India' policy. These subcontractors are supplying their goods both for Indian oriented projects as well as other destinations. Following years of cooperation, the quality and reliability we get here is second to none. We are proud of this partnership and are now gearing toward the new policy, further expanding our local partnerships in R&D, manufacturing and support.

Interviewed by Tamir Eshel

IAI's new Green Dragon loitering munition

Raytheon Standard Missile-6 successfully hits surface target

An SM-6 missile launches from the deck of USS John Paul Jones during a test in June 2014. Recent testing has shown SM-6, which was built for anti-air warfare, can also be used against ships at sea. (Photo: US Navy)

Raytheon's Standard Missile-6 (SM-6) successfully engaged a surface target, the decommissioned USS *Reuben James* (FFG 57), in a recent flight test. The test was a demonstration of the US Navy's concept of "distributed lethality," employing ships in dispersed formations to increase the offensive might of the surface force and enabling future options for the joint force commander. The USS *John Paul Jones* fired the SM-6 during the test; another Air Defence *Arleigh Burke*-class Destroyer was on station as the assist ship.

The mission validated that the legacy Anti-Surface Warfare (ASUW) capability of the Standard Missile-2 family of missiles and the MK7 Aegis Weapon System (AWS) has successfully carried over to SM-6 and the latest Aegis destroyer baseline 9. The investment in the Standard Missile family resulted in an affordable SM-6 effector that continues to perform beyond expectations.

Launched from the USS John Paul Jones, a Standard Missile-6 demonstrated its ability to intercept ballistic missiles in their final seconds of flight during live fire tests July between 28 July and 1 August 2015

In recent testing, SM-6 has shown expanded mission capability in three key areas: anti-air warfare, sea-based terminal and anti-surface warfare. the tri-mission capability of SM-6 continues to emphasise its value by providing additional capability beyond its original intended mission.

SM-6 delivers a proven, over-the-horizon, air defence capability based on the time-tested advantages of the Standard Missile's airframe and propulsion. The missile uses both active and semi-active guidance modes and advanced fuzing techniques and incorporates the advanced signal processing and guidance control capabilities of Raytheon's Advanced Medium-Range Air-to-Air Missile. The SM-6 delivers multi-mission capability for long-range fleet air defence and sea-based terminal defence.

SM-6 shatters engagement distance record

The Standard Missile-6 has successfully engaged five targets and shattered its previous maximum engagement range record, set in June 2014. This test series, supported by the Cooperative Engagement Capability, validated the tactical warfighting capability of SM-6, by demonstrating both maximum down range and a maximum cross range intercepts in over-the-horizon, engage-on-remote missions. The USS *John Paul Jones* (DDG 53), configured with AEGIS Baseline 9.C1, executed the series of four missions with five SM-6 missiles for Follow-on Operational Test and Evaluation, part of the final testing leading to a likely declaration of Full Operational Capability in 2017. The USS *Gridley* (DDG 101) was on station to perform as the AEGIS assist ship for the engage-on-remote missions. The tests also proved the ability of SM-6 to conduct complex, multiple target scenarios.

SM-6 is a key component of the US Navy's Naval Integrated Fire Control – Counter Air mission, providing US Navy sailors and their vessels extended range protection against fixed and rotary-wing aircraft, unmanned aerial vehicles, cruise and ballistic missiles.

The SM-6 deployed for the first time in 2013, and Raytheon has delivered more than 250 missiles.

Boeing's Apache and Chinook to enhance IAF's attack and heavy lift capabilities

In September 2015, 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.

In the days leading up to Defexpo 2016, Bradley Rounding of the Vertical Lift Global Sales & Marketing team at Boeing Defence, Space & Security revealed 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 Apache is the world's leading multi-role attack helicopter; 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.

Dennis Swanson, Vice President, Defence, Space & Security in India, 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.

AH-64E Apache attack helicopter

CH-47F Chinook heavy-lift helicopter

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 on

"Over the last 12 months, we have doubled our sourcing from India and are committed to continue that journey," said 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'.

Rafael: "Smart Tools for the Future Battlefield"

Vayu met with the new President and CEO of Rafael Advanced Defence Systems, Major General (retd) Yoav Har-Even, some days before Defexpo 2016.

VAYU : Thank you General Har-Even for this opportunity. Rafael is highly respected for its foresight and innovation. Can we have your view of the type of threats you and your company are preparing for?

Har-Even: Today's defence requirements are multi-dimensional; they span from underwater to above-water, land, and air combat, with all being interconnected, synchronised and coordinated. We believe that today's battlefield challenges dictate a new approach that requires forces to employ systems that are sophisticated, effective and precise on one hand, while on the other hand being economical and efficient, all while fitting budgetary constraints of defence spending. One of the major challenges nowadays and into the future is the threat of terrorist attacks against land and naval infrastructure and targets, requiring systems that can perform sensor-to-shooter battle management and give decision-makers quick, precise and reliable data and information to decide the course of target engagement. To achieve success in such scenarios, forces require a synergetic system that integrates sensors, such as Reccelite and Toplite; communication and networking, such as BNET; intelligence, such as the Imilite for data exploitation; and shooters: Spike, RCWS, and others. Together, these allow for real-time fast, accurate and efficient closure of the sensor-to-shooter cycle.

VAYU : Are all new systems hardware based? What about cyber?

Har-Even: As an answer to the ever-growing domain of cyber warfare and its strategic threat to critical infrastructure of governments and national bodies, Rafael has developed the Cyber Dome, a patent-based one-of-a-kind holistic suite of cyber defence solutions. We have introduced our capabilities in the cyber field to a number of Indian representatives both in India and in Israel. We are currently evaluating entering into partnerships with potential Indian companies with whom we have already had discussions. In 2015, Rafael was selected by the Israeli government to head Israel's Computer Emergency Response Team (CERT) programme. Rafael will serve as

the prime contractor of the programme, in cooperation with Israeli and global IT corporations.

VAYU : Is Rafael considering expanding its presence in India to win more contracts?

Har-Even: For us, India and of course the Indian industries are strategic and important partners and we are constantly striving to create additional partnerships and joint ventures with them to address offset needs. One of Rafael's strengths is our ability to conduct technology and knowledge transfer and produce systems at the buyer's facilities. Spike is an excellent example of this. This is also the reason we are displaying some of our systems in our partners' booths at Defexpo 2016, such as Bharat Forge, Reliance/Pipavav, Bharat Dynamics Limited, and Astra Microwave.

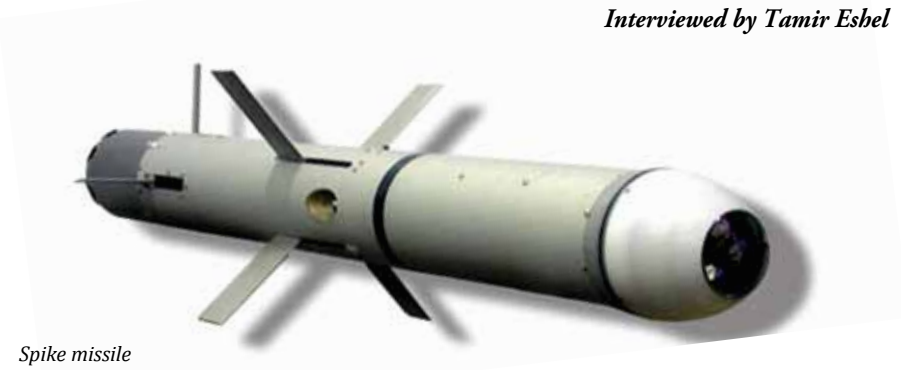
VAYU : Regarding this programme, what is the current status of Spike in India?

Har-Even: We are in the final stages of a process that at the end will allow us to produce Spike missiles in India for the benefit of all parties involved – business, economy and military. Rafael has completed all preparatory work with Bharat Forge for the creation of a joint venture company. The JV envisages work commencing as soon as the Indian government signs the Spike ATGM contract. Bharat Forge is being kept abreast of all developments on the negotiations, and is in parallel being provided with technical know-how appropriate to the status of the negotiations. The Indian MoD nominated Bharat Dynamics Limited (BDL) as the prime integrator for the missile, and accordingly Rafael is engaged in discussions with BDL as well. The JV will become a Tier 1 supplier to BDL and help in indigenous manufacturing of the system by supplying subsystems to BDL.

VAYU : Some of the systems you mentioned are missiles that use highly advanced seekers. Are you ready to assist India with the knowhow to master those technologies?

Har-Even: Missile seeker technology is present in many of Rafael's systems. Seeker technology is crucial for the system's performance and capabilities and it is often instrumental in providing the system competitive advantage over others. Rafael has developed both electro-optical as well as radar seekers, which can be found in many of our systems. We cannot relate to specific transfers of technology, but we can say that we always strive to cooperate with our international partners, in this case India, by transferring knowledge, expertise and technology, under the regulations of our [Israeli] MoD.

Interviewed by Tamir Eshel



Spike missile

Thales to showcase Flycatcher Mk2 and STARStreak at Defexpo

The Thales air defence fire control radar Flycatcher Mk2 which will be showcased at Defexpo is equipped with sophisticated 4D multi-beam radar, which combines high detection probability with low false alarm rate. It also has co-located surveillance and track radar, which makes it ideal to prevent errors in target hand-over and to minimise the number of radar locations required to protect the area. The Flycatcher Mk2 is capable of providing not only weapon control for air defence guns, but also target information for Man Portable Air Defence Systems (MANPADS).

Flycatcher Mk2 design has been particularly focused on minimising the detection and engagement time of targets appearing suddenly at short distances. The excellent reaction time is made possible by its unique technologies: multi-beam technology and combined antenna technology, which avoids complex and lengthy calculation to compensate misalignments of different antennas on traditional 2 antenna systems. The co-located and co-axial mounting of track and surveillance radar assures no errors in angular references and the smallest possible acquisition area for the track radar during target hand-over from surveillance to track.

Military commanders around the world are increasingly concerned about the serious threats being posed to their forces and civilians by low level FGAs, Unmanned Air Vehicles (UAVs) and Attack Helicopters. Thales' STARStreak has been designed to defeat these threats quickly and effectively and provide a vital capability in force protection.

STARStreak High Velocity Missile was designed to provide close air defence against conventional air threats such as fixed wing fighters and late unmasking helicopter targets. Thales has addressed the needs of military users around the world and introduced major improvements to provide increased range beyond 7 km, increased coverage and altitude and improved guidance precision against small targets.

The STARStreak

The STARStreak configuration remains based on the proven STARStreak principles of high velocity to defeat targets with short unmasking times. The three dart payload maximises levels of lethality and accurate line of sight; laser beam riding guidance enables engagement of the smallest signature targets, which are extremely difficult to defeat and lock onto by traditional fire and forget missiles.

The STARStreak missile is capable of being launched from lightweight land, sea and air platforms, from either automatic fire control systems such as the RAPID Ranger or the STARStreak Lightweight Multiple Launcher (LML).

STARStreak can therefore be deployed quickly into operations and is easy to integrate into a force structure.

STARStreak is a versatile missile and is most effective when dealing with targets with short exposure times. As soon as a target is detected the operator presses the trigger and launches the missile (there is no waiting for lock on). The rocket motor system accelerates the missile to greater than Mach 3 in a fraction of a second. The missile then releases the three laser guided hittiles towards the target. The laser beam riding guidance, which enables precision engagement of the smallest of targets, is immune to all known countermeasures. The hittiles in flight cannot be decoyed by even the latest flares or Electronic Countermeasures (ECM).

The STARStreak hittiles are designed to defeat both heavily armoured and light skinned aerial targets. On penetrating the targets the hittiles will inflict high levels of kinetic energy damage and each hittile also has a fragmenting warhead which detonates inside the target to maximise lethality. The strike is highly precise yet collateral damage is minimised.

Flycatcher Mk2

Brahmos: "the ultimate weapon of choice"

Even as India is acquiring new munitions and platforms, the weapon that has given the country's armed forces a major tactical advantage is the Brahmos supersonic cruise missile, which has a speed of Mach 2.8 with a range of 290 km, and has established itself as the 'ultimate weapon of choice' with its speed, precision and lethality. This advanced weapon system, jointly conceived, designed, developed and produced by India and Russia, has been tested in various configurations from land, sea and underwater platforms while its air-launched version is under development for flight trials.

At a time when India is renewing its efforts towards defence indigenisation by promoting the ambitious 'Make-In-India' programme, Brahmos has already has set a precedent with its state-of-the-art high-technology weapon involving several domestic defence industries and institutions. The Brahmos JV is regarded as the best example of technological synergy of strengths between India and Russia and has also led to the creation of a robust 'Missile Industrial Complex' in both the countries having an excellent networking of public and private-sector industries and laboratories.

The multi-role, multi-platform, multi-mission Brahmos has been inducted in the Indian Army, IAF and Indian Navy and is considered the long arm of the Indian Army's Regiment of Artillery. In fact, Indian Army is the only land force in the entire world to have a supersonic manoeuverable land-attack cruise missile regiment.

Several of the Navy's frontline warships have deployed the deadly Brahmos as the "prime strike weapon", while many more are set to install the weapon in the coming years. In its underwater configuration, the missile has also been tested successfully from a pontoon in 2013.

In its air-to-land attack mode, the missile is being integrated with the Su-30MKI of the Indian Air Force this year and once cleared, the Brahmos will dramatically augment the IAF's conventional offensive capabilities, making it the only air power in the world to have such an air-launched supersonic cruise missile system in its inventory.

Various public and private sector Indian defence firms have been actively involved in designing, developing and producing various components for this world-class missile system. The India-Russia JV programme has exemplified the very basis of a vibrant military partnership between the two strategic allies, and has also widened the scope for the establishment of a solid defence industrial base in India. The Brahmos programme has truly redefined the entire realm of defence partnership and defence indigenisation for India.

Courtesy : Brahmos

Mr. Sudhir K. Mishra, CEO & MD, Brahmos Aerospace

Smarter by far ! Thales and the Rafale

Since the beginning of military aviation over a century back, lethality of combat aircraft has been adjudged on the basis of their maximum speed, agility and firepower. In the 21st century, it is not just muscle that matters but also flexibility of role and intelligence.

Changing operational requirements mean that combat aircraft must be capable of performing a wide range of different tasks, from reconnaissance to air defence and precision strikes. They must also be capable of conducting several different missions in the same sortie.

The Rafale 'omnirole' fighter is designed to meet these needs. Advanced avionics hold the key: from nose to tail, the aircraft is equipped with an array of sophisticated electronics systems and equipment. Among other things, these allow the pilot to gather and share high-resolution imagery, target guided weapons with pinpoint accuracy and defend the aircraft from hostile actions. Thales also provides the electronics for some of the missiles equipped by the Rafale.

In tandem with this, the Rafale supports pilots with an unprecedented level of 'data fusion' combining information from all the different systems and sensors to build a comprehensive tactical picture to assist in decision making.

The Rafale's on-board electronics systems, equipment and sensors are supplied by Thales and account for about 25 per cent of the plane's value.

The following explains it all !

(1) Spectra electronic warfare suite

Spectra is the first line of defence for the Rafale aircraft, identifying, locating and jamming electromagnetic, infrared and laser threats. Multi-spectral sensors and smart data fusion offer high-sensitivity detection. Spectra's multiple threat capability, including missile approach warning and decoy dispenser, helps to ensure success in hostile environments.

(2) AREOS

Thales' Airborne REconnaissance Observation System –AREOS –provides rapid day/night imagery intelligence (IMINT) for reconnaissance and identification in any weather conditions. AREOS gathers high-definition imagery at long range and across a wide area, with information transmitted from air to ground via a high-capacity data link.

(3) Damocles and TALIOS

Thales' third-generation laser designation pod, Damocles, provides weapons guidance and a full suite of sensors for navigation and air-to-air target identification. It provides day/night recognition of targets at medium range, as well as long-distance reconnaissance capability. The pod's infrared sensor is designed to perform effectively in both warm and humid conditions. TALIOS –an updated version of Damocles –is an optronic multifunction pod that employs the latest generation of high-resolution sensors and high precision line-of-sight stabilisation, allowing for deep strikes with long-range missiles and bombs to air-to-air target identification and close air support. It includes Non-Traditional Information, Surveillance and Reconnaissance (NTISR) capabilities and the Permanent Vision system provides wide-angle vision and critical contextual information.

(4) Communication Navigation Identification suite

Secure state-of-the-art communication, navigation and identification capabilities covering every operational need, including ECCM (used to combat electronic countermeasures), IFF (identification friend or foe) and tactical data links.

(5) Advanced Man Machine Interface (MMI)

Thales' powerful visualisation tools provide instant situational awareness for the pilot and support well-informed tactical decisions. The MMI solution includes a combined head-up/head level display, lateral displays and a helmet-mounted sight display.

(6) AESA RBE2

The Active Electronically Scanned Array (AESA) RBE2 antenna is a multifunction radar system that provides coverage over long ranges. AESA RBE2 is automatic and highly versatile, sorting and ranking tracked targets, and allowing the pilot to track multiple targets while scanning. It is the first operational European active radar antenna, and provides air-to-air and air-to-surface capabilities.

(7) Front Sector Optronics (FSO)

Thales' FSO includes extensive IT capability with laser electro-optics for passive long-range target detection for air, sea and ground targets, designation and identification, all fully integrated into the aircraft. It allows the pilot to spot enemy aircraft without being detected and is immune to radar jamming because it operates in optical wavelengths.

(8) Modular Data Processing Unit

A powerful mission computer providing all-sensor data fusion and enabling multiple mission reconfigurations.

‘Omnirole’ combat aircraft

Smarter fighters

Thales will lead upgrades of the radar, electronic warfare, and identification and support systems used in French fighters under the terms of a contract to develop a new performance standard for the Rafale combat aircraft.

The F3R standard, launched in 2015, will play a vital part in ensuring aircraft are continuously improved to keep pace with changing operational requirements.

The upgrade will include deployment of Thales’ TALIOS next generation laser designation pod. This will provide enhanced imaging and engagement capabilities under day and night conditions. Both the Rafale and the Mirage 2000D can be equipped with the TALIOS pod. The programme will also see the integration of the European Meteor long-range air-to-air missile produced by MBDA. The equipment and solutions developed by Thales include RBE2 active and passive antennae, Spectra, IFF and maintenance support.

String of exports

The Rafale has enjoyed a string of major international successes in recent months, beginning with Egypt signing up to procure 24 Rafale omnirole combat aircraft in February 2015. And after many months of discussion, India has also signed a Letter of Intent to purchase 36 'ready-to-fly' Rafale for the Indian Air Force.

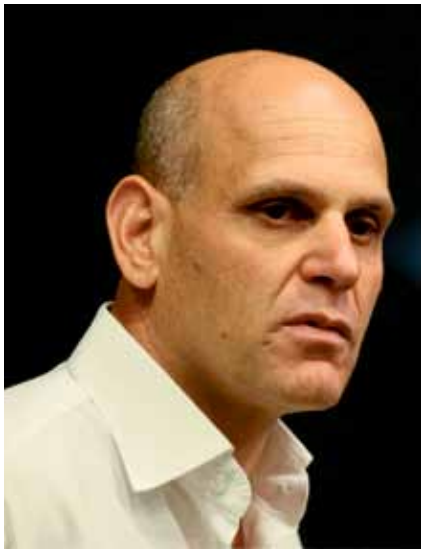
The latest contract comes from the Qatar Emiri Air Force, which will acquire the Rafale, with a total of 24 aircraft to be delivered under a contract between Qatar and Dassault Aviation. Thales is a member of the Rafale team with Dassault Aviation and Snecma (Safran).

The official signing ceremony was recently held in the Qatari capital Doha in presence of the Emir of Qatar, Sheikh Tamim bin Hamad Al Thani, President of the French Republic, François Hollande, Dassault Aviation Chairman and CEO, Eric Trappier and Thales Chairman and CEO, Patrice Caine.

Courtesy : Thales
Rafale illustrations: Matthew Cook

Elbit Systems: "A Global Company with Local Focus"

"The global defence market has transformed and I am happy to say that we have identified and prepared ourselves for this change, and adjusted our offerings to better cope with market trends," stated Elbit Systems President and CEO, Bezhalel 'Butzi' Machlis. New operational requirements demand holistic solutions that require suppliers to be more involved and creative in crafting technological and business solutions to match each opportunity. "Coping with growing asymmetric threats by elusive, irregular, terrorist activity, we see a growing demand for intelligence solutions adapted to low-intensity warfare, homeland security and urban warfare. Facing those challenges, Elbit Systems offers solutions harnessing innovative technologies and proven capabilities across the company's divisions, often positioning our solutions ahead of the competition," Machlis continued.



Elbit Systems President and CEO, Bezhalel 'Butzi' Machlis

"Our Asia-Pacific customers are seeking to deploy proven systems that employ the latest, most advanced technologies to sustain systems for many years to come. That's why we are displaying at the Defexpo an unprecedented variety of our offerings, from new unmanned systems for aerial and naval applications, avionics, weapon systems for aerial, land-based and naval platforms, comprehensive defence systems protecting civilian and military platforms, the latest command, control, communications, intelligence and cyber systems, along with electronic warfare, training and simulation solutions. Defexpo provides an important venue to showcase our capabilities in India. For example, we are presenting two highly versatile unmanned systems – the Hermes 900 Medium Altitude Long Endurance (MALE) UAS and the Seagull, an Unmanned Surface Vessel (USV) designed for anti-submarine and counter-mine warfare applications. Both are bound to generate much interest here."

Hermes 900 Medium Altitude Long Endurance (MALE) UAS

Elbit Systems is a world leader in the unmanned systems market, particularly in unmanned aerial systems (UAS). Its systems are the mainstay of the Israel Defence Forces (IDF) UAS fleet.

"Guided by our 'global-local' business philosophy that emphasise market-focused activity through domestic subsidiaries is successfully implemented in India, paving the way for more partnerships in pursuit of new business opportunities throughout the region. We expect these activities to expand to new areas, including cyber security, intelligence and unmanned systems," Machlis concluded.

The Superlative LIFT

Russia's Yak-130

The Yakovlev Yak-130 (NATO reporting name: *Mitten*) Lead-in Fighter Trainer (LIFT) was selected as winner of the trainer competition of the *Voyenno Vozdushnyye Sily* (VVS), or Russian Federation Air Force, in April 2002. Initially a joint programme between Yakovlev of Russia and Aermacchi of Italy the Yak/AEM-130D demonstrator first flew in 25 April 1996. However in 1999, the partnership was dissolved and the Yakovlev Yak-130 and Aermacchi M346 became separate programmes. Yakovlev projected the Yak-130 not only as an "outstanding LIFT" covering both basic and advanced jet training, but also as a useful combat aircraft when in mixed formation with multi-role fighters operating as per the Mixed Fighter Force Concept (MFFC). The potential export market was clearly a target and is actively marketed by Yakovlev, the Irkut Company and by Rosoboronexport.

Yak-130s on their own can be deployed as light yet formidable strike aircraft or as an advanced trainer for fourth or even fifth-generation fighters. The Yak-130 entered service in the Russian Federation Air Force at the military pilot training academy in Krasnodar in July 2009 and was subsequently showcased at the MAKS 2009 air show.

The Yak-130 represents a classical swept-wing and empennage monoplane design and light alloy construction with carbon-fibre control surfaces. Kevlar armour protection is fitted to critical areas like the engines, cockpit and avionics compartment. The moderately swept high-lift wing and the all-moving low-mounted tail plane allows the pilot to choose high angles of attack (controlled angle of attack of 42-degrees has been achieved). The Avionica Fly-By-Wire (FBW) Flight Control System (FCS) is used to adjust the stability and controllability characteristics and flight safety systems to simulate a number of aircraft such as the MiG-29, Sukhoi Su-27, and Sukhoi Su-30, by selecting the software model of the simulated aircraft's control system on the Yak-130 on-board computer, even during flight. For short airfield performance the aircraft is equipped with leading edge slats and three-position Fowler flaps acting as split flaps which move rearward and then downward on tracks to give a large increase in lift, high lift and drag for landing manoeuvres. The aircraft can be operated from unpaved runways and small, hastily prepared airstrips owing to the onboard auxiliary power unit and oxygen generation system thereby reducing dependency on ground support facilities and enhancing operational autonomy.

Weapons and payloads (upto a weight to 3,000-kg) can be accommodated in single centreline fuselage hardpoint, six underwing pylons and two wingtip points. Present weapon fits include the *Vikhr* laser-guided Anti-Tank Guided Weapon (ATGW), R-73 Close Combat Missile (CCM) and the Kh-25 ML Air-to-Surface Missile (ASM). The *Platan* IRST is installed under the fuselage for deployment of the KAB-500Kr guided bomb. The aircraft is fitted with 30-mm GSh-301 cannon or a podded GSh-23 cannon installed under the fuselage.

The aircraft has an impressive thrust-to-weight ratio of about 0.85. Production aircraft are fitted with two powerful high-economy AI-222-25 turbofan engines, each rated at 2,500-kg thrust and developed under a Russian and Ukrainian programme by Motor Sich, Zaporozhye Progress Design Bureau and the Moscow Salyut Motor Building Production Enterprise. The export variant of the Yak-130 can be fitted with the DV-2SM engine.

The Yak-130's internal fuel tanks, comprising two wing tanks and a centre fuselage tank, carry up to 1,750-kg of fuel. With two suspended fuel tanks (each 450-l) the maximum total fuel load is 2,650-kg. The aircraft is fitted with single point pressure or optional gravity refuelling and can be fitted with an Air-to-Air Refuelling (AAR) refuelling probe.

The Yak-130 is clearly destined to become one of the classic combat aircraft of this century.

Sayan Majumdar

Defence–Industrial developments from Israel

IAI reveals new UAV MOIC

Israel Aerospace Industries (IAI) has revealed a new UAV Mission Operational and Intelligence Centre (MOIC) (see model) which allows efficient command and control of advanced and challenging UAV missions. Instead of using separate platforms for each UAV, the MOIC uses numerous platforms and payloads in order to enable improved real-time operation of a fleet of UAVs.

MOIC's modular layout is based on mission operation cells including upper commander cell, exploitation centre, C2 cell, full trainer SATCOM facility, support facility, and data storage centre. The all-inclusive headquarter generates an efficient mission flow which includes planning, commanding, controlling and monitoring mission performance, interpreting offline and online payload data, archiving raw and processed information and reporting to high command. This mission flow provides a full operational picture of UAVs, and maximises the fleet throughput by allocating assets according to operational priorities, enhances coordination of UAV fleet and manned platforms, improves safety, protects ground assets and saves manpower and resources by centralising and automatising operations and maintenance.

As Joseph Weiss, IAI's President and CEO stated, "This unique solution addresses the needs of the advanced battlefield and adheres to customer requirements; it takes IAI's capabilities in the field of UAVs a substantial step forward. The MOIC system is another step forward in the development of IAI's UAV capabilities. As a pioneer and global leader in the UAV field, with dozens of customers worldwide and over 1.3 million flight hours, IAI is continuously striving to upgrade its systems and to generate creative, leading solutions that address the needs of its customers".

Elbit Systems introduces Seagull

Drawing on advanced know-how derived from generations of Unmanned Aircraft Systems (UAS) design, development and operation and its naval capabilities, Elbit Systems' newest offering in the unmanned platform field is the Seagull, an organic, modular, highly autonomous, multi-mission Unmanned Surface Vehicle (USV) system. Seagull is a 12-metre USV with replaceable mission modules, with two vessels capable of being operated and controlled in concert using a single Mission Control System (MCS), from manned ships or from shore.

The system provides unmanned end-to-end mine hunting operation, 'taking the man out of the mine field'. It provides mission planning, and on-line operations in known and unknown areas, including area survey, search, detection, classification, identification, neutralisation and verification. It is equipped to

search the entire water volume and operate underwater vehicles to identify and neutralise mines.

Seagull changes the dynamics of anti-submarine operations by creating a threat to submarines using a cost-effective and available asset, replacing and augmenting manned assets with minimal threat from submarines. It empowers a surface vessel or naval base commander with off-board, available and rapidly deployable Anti-Submarine Warfare (ASW) capabilities to protect critical sea areas and high-value assets from submarine as well as sea mine threats. The Seagull features a robust, highly-autonomous and safe sailing capability as well as modular mission payload suites, selected to match a variety of required missions including EW, surface force protection, hydrographical missions in addition to the core MCM and ASW missions. The sailing suite includes a patented Autonomous Navigation System (ANS), with obstacle avoidance, which considers the international regulations for preventing collisions at sea.

Network ready and with long endurance Seagull features inherent C4I capabilities for enhanced situation awareness and can remain at sea for over 96 hours.

Elbit command and control for artillery systems

Elbit has been awarded a contract for the supply of command and control systems and ATMOS long-range artillery systems, including self- propelled artillery battery, command stations, forward observation stations and target acquisition systems, as well as command and control systems, in an integrative solution to connect all systems, to an Asia-Pacific country. This contract is a follow-on contract for this customer and will be performed over a three-year period. The solution, mounted on various wheeled - platforms, enhances mission flexibility, reaction speed and survivability of both the crew and the system.

Meprolight selected to supply red dot sights

Meprolight, a manufacturer of electro-optical systems, thermal and night vision equipment, laser range finder systems, and self-illuminated sights for military, law enforcement and civil applications, has been selected by the Israel Defence Forces (IDF) as the sole supplier of the next generation of combat sights. "Delivery of thousands of MEPRO M5 Red Dot Sights will begin soon." According to Benny Kokia, Vice President, Sales and Marketing, "We are very proud that the IDF selected us as the sole suppliers of their next generation of combat sights, following an evaluation and testing process that resulted in a clear acknowledgement that the MEPRO M5 is the best sight in its category."

The MEPRO M5 Red-Dot Sight is an energy-efficient, compact sight that provides thousands of operating hours while utilising a single AA commercial battery. Featuring battle-proven LED technology and rugged MIL-STD design, the sight assures reliability under the harshest environmental conditions. With its large display window

and clearly-defined Red Dot, the MEPRO M5 ensures rapid target acquisition with both eyes open. Offering numerous reticle brightness intensities, the MEPRO M5 suits every tactical scenario.

Rafael Trophy APS on Oshkosh Defence M-ATV

Rafael Advanced Defence Systems Ltd, developer and manufacturer of Trophy APS, the world's only 'operational and combat-proven active protection system for armored vehicles', has revealed its lighter, Trophy LV (light vehicle) on an Oshkosh Defence M-ATV Base (SXB) 4X4 Mine-Resistant Ambush Protected (MRAP) vehicle. The Oshkosh M-ATV is an MRAP (Mine-Resistant Ambush Protected) vehicle and the Rafael Trophy LV solution enables greatest level of protection, hostile fire detection and greater lethality increasing operational capabilities and allowing troops to carry out missions with greater flexibility, maneuverability and confidence.

'Trophy is a family of situational awareness and active protection hard kill systems' that operate in three major stages: Threat detection and threat tracking, followed by hard kill countermeasure activation and threat neutralisation. The operational requirement to equip armoured vehicles with an APS is dictated by the growing proliferation of advanced anti-armour weapons. Trophy-LV has the proven capability to defeat advanced threats coupled with handling all safety considerations of an autonomous shooting system, an issue that has raised concerns among potential customers for many years.

Elbit's realistic Combat Training System for Special Operations

Elbit Systems will deliver live combat training system and equipment to the Special Operations Forces (SOF) of Poland. The Combat Training System (CTS) is an advanced, highly-realistic simulations-based trainer that has been specifically designed for marines and SOF, ranging from individual soldiers up to full-size units. CTS can be used to simulate a wide array of operational conditions and real-world elements, including those found in urban, rural and indoor environments. By combining cutting-edge simulation and live-fire training systems, CTS provides an ability to carry out 'train-as-you-fight' force-on-force exercises in realistic combat scenarios. It also allows trainees to hone their command and control battle management skills, as well as review, assess and improve their decision-making processes, both during and after exercises.

Controp's SHAPO selected for NATO

Controp Precision Technologies Ltd., a leader in EO/IR defence and homeland security solutions, said that the company had been chosen to supply 90 advanced SHAPO systems for a NATO army's patrol vehicles during the course of 2016. SHAPO is a unique ultra-lightweight gyro-stabilised EO/IR Day/Night Observation system especially designed for flexible EO payload deployment on multi-mission patrol vehicles. The high performance low weight system delivers the benefits of a built-in thermal imaging camera with a continuous zoom lens, advanced image enhancement, automatic target tracker, picture-in-picture and more, all offered in one compact integrated package.

"That SHAPO has been chosen by a leading NATO army is a validation of the system's superior performance," stated Johnny Carni, Controp's VP Marketing. "SHAPO won this highly competitive tender thanks to our in-house developed technologies that deliver outstanding operational capabilities relative to its low cost. The system maintains low SWaP (Size, Weight and Power) and superb gyro-stabilisation, which are crucial factors when dealing with patrol vehicles on rough terrain since the vehicles are typically overloaded with various sensors and other systems. These features make the SHAPO payload the most cost effective option when compared to other similar systems on the market".

SHAPO offers a wide range of communication interfaces to host platform (including RS-422 and optional ARINC 429 and MIL-STD-1553), its operating Control Unit has been specially ruggedised to survive the harshest environmental conditions, and its advanced ergonomics provide maximum comfort for extended use. "We are also in the final stages of evaluation of this system with remote control guns," Carni added, "and we hope to announce the signing of similar contracts in the near future."

Elbit in UK Military Flight Training Systems programme

Elbit has announced that Affinity Flying Services Limited (Affinity), its UK joint venture with Kellog, Brown and Root Limited (KBR), has been awarded a fixed price contract for the support of Ascent Flight Training (Services) Limited (Ascent), in the delivery of the UK Military Flight Training System (UKMFTS) programme for the UK Ministry of Defence (MOD). Elbit Systems and KBR, each holding a 50% share in Affinity, will evenly support and benefit from the programme. The UKMFTS programme is an innovative partnering agreement between UK Front Line Commands, the UK MOD, Ascent and other leading industry partners to deliver aircrew training for the 21st century. Revenue for Affinity associated with this programme is estimated to be approximately £500 million ($713 million) over an eighteen-year period.

Rafael: Protecting the Shoreline

Rafael has developed an integrated solution to provide shoreline protection against enemy threats, its main mission being to detect and identify the enemy far from the shoreline and to provide the engaging force with high valued intelligence and maximum accuracy of attack.

Command and Control of such missions is via a Command Post (CP) located in a sheltered and safe location, which is the originator, coordinator and the allocator of the mission and the mission players. The CP includes a multi-role C4ISR center to provide target and force location and Battlefield Situational Awareness, and serves as a UAV Remote Video Terminal. The centre carries out data distribution, communication between all forces, target following and intelligence collection.

For reliable intelligence collection, Rafael's approach comprises varied intelligence devices such as radar, electro optical sensors and UAVs, which collectively detect and identify the threats during day, night and poor visibility conditions.

Rafael's mature, combat-proven range of multi-spectral, multi-platform sensors deliver solutions for various operational scenario, enabling the detection, location and classification of hostile forces. These include Rafael's Litening attack and navigation pod, Reccelite reconnaissance pod, Toplite observation pod, and other advanced systems which enable high quality imagery of the relevant area.

Toplite

Reliable secure communication and networking is crucial to closing the loop. Rafael's broadband networking systems provide maximum connectivity for mobile and stationary platforms, advanced IP mobile adhoc network SDR such as Rafael's BNET for tactical operations, cost-effective wideband data link solutions, designed for use with reconnaissance pods, and real-time simultaneous video and data streaming from multi-sensors.

The final stage of engagement is carried out by a combination of static, maneuvering and aerial spike missiles, which as an electro-optic missile, with a dual seeker, enabling day and night capabilities, is effective against wide range of targets at ranges of a few hundred metres to 25 km. Spike has pinpoint accuracy with a low Circular Error Probability (CEP) regardless of the range.

Successful Arrow-3 BMD Engagement

The Israel Missile Defence Organisation (IMDO) of the Directorate of Defence Research and Development (DDR&D) and the US Missile Defence Agency (MDA) conducted a successful first engagement of a ballistic missile target with the Arrow-3 interceptor late 2015. This test was conducted from an Israeli test range and was led by the Israeli Air Force and Israeli Aerospace Industries (IAI). A target was launched and detected by radars, which transferred tracking information to the Battle Management Control (BMC) system. The BMC system analysed tracking data and planned the interception. After the interception solution was calculated, the Arrow-3 interceptor was successfully launched. The Arrow-3 interceptor performed its planned trajectory and engaged the low-debris target in the exoatmosphere according to plan. Preliminary analysis indicates that test objectives were successfully achieved.

The Arrow-3 interceptor is a central part of Israel's multi-layer defence array and will serve as the uppermost layer. The other layers of defence are: Iron Dome System (operational), David's Sling Weapon System (in its last phase before being deployed operationally), the Arrow-2 (operational) and Arrow 3 (under development). This successful test is a major milestone in the development of the Arrow Weapon System and provides confidence in future Israeli capabilities to defeat the developing threats. Additional Arrow-3 interceptor tests are planned in the future to demonstrate capability prior to becoming operational.

The primary contractor for the integration and development of the Arrow Weapon System is IAI MLM, jointly with IAI Elta. Boeing is partnered with MLM to develop and produce Arrow 3. Elbit, a subsidiary of Elisra, developed the BMC system. The target missile was developed by Rafael.

Full scale mockup of the Arrow 2 and 3 at the Paris Airshow 2013

Toplite and Spike on the Blackhawk

Rafael's SPIKE Family

Stand-off Precision for light and heavy attack helicopters

In the rapidly changing battlefield, the combat helicopter still holds a central and important role, being a valuable asset for the military commander, both for defence and offensive missions. The combat helicopter, also referred to as gunship, provides dynamic direct and accurate close air support for ground troops, destroying enemy armoured vehicle concentrations, while also being used as an armed scout.

In this scenario, Rafael Advanced Defence Systems Ltd. have been a leading supplier and integrator of a full armament upgrade package, named the SWS Package (Spike Weapon System), which includes both 4th generation stand-off precision guided electro-optical missiles in different weights and ranges up to 30km, EO devices (in different weights and capabilities), guided/unguided rocket interface, command & control interfaces for pilot situation awareness, HMDs (Helmet-Mounted Displays for cueing of Spike seeker and EOS to pilot head orientation) and even heliborne broadband digital data-link for continues communication between the different unit helicopters.

The Spike missile is an off-the-shelf 4th generation precision guided missile, which includes an electro-optical seeker and a bi-directional datalink, enabling ultra high accuracy and enhanced lethality, and has been in service for over two decades. The Spike family has been deployed by 24 armies, navies, air forces and special forces around the world, with thousands of Spike missiles fired both in training and combat.

Air Force, Army and Naval Aviation establishments are now appreciating that this type of upgrade can convert a dozen multirole helicopters into capable armed gunships, within the same budget that would otherwise procure only two new combat helicopters.

Rafael's experience in this field has been proven both as a subcontractor for helicopter OEMs such as AgustaWestland and Airbus Helicopters, also as prime integrator for a standalone armament package with simple interface and no

dramatic alterations to the helicopter. The relatively light weight of the Spike missiles and simple stand-alone integration capability of Rafael, enable the mounting of Spike missiles on multirole helicopters, thus enhancing helicopter capabilities. An interesting example is with the ARPIA 4 Project in Colombia, in which Rafael acted as a prime integrator to integrate Spike onto that air force's ARPIA 4 Helicopter (Blackhawk UH60). The suite included three types of Spike missiles (NLOS, ER and LR), advanced EOS (Toplite 3HD), stand-alone HMI, including moving-map application, helicopter collision warning application, a digital data link, as well as integration of the existing 70mm rockets and GAU19 gun to Rafael weapon suite.

The Spike Family includes the Spike SR (Short Range) a light shoulder launched 'Fire & Forget' disposable missile for 50-2000m weighing only 9.8 kg, Spike LR (Long Range) with a range of 5km and weight of 13kg, Spike ER (Extended Range) range of 8km and weight of 34 kg and finally, the Spike NLOS (Non Line Of Sight) with a range of 30 km and weight of 75 kg.

For combat helicopters, the main advantage of the Spike family is the ultra long stand-off range & non-line-of sight attack capability which increases aircraft survivability dramatically (in comparison to laser guided munitions which force the pilot to get very close to the target) and the passive EO seeker, unlike laser guided munitions which can be detected upon lasing the objective. The upgrade package includes generic Spike launchers that can carry all Spike Family missiles (LR, ER, NLOS) thus allowing tactical flexibility, reducing Integrations costs and enabling usage of existing customer Spike missile arsenal.

The Spike NLOS long range weapon enables engagement of targets up to 30 km in day, night and adverse weather, which is of vital importance considering the danger from MANPADS (Man-Portable Air Defence Systems) and other anti-aircraft weaponry. The missile includes various warhead configurations such as anti-tank, fragmentation or anti structural/anti-ship warheads, and is particularly effective in the Naval role. The Spike NLOS Missile has been integrated onto different combat helicopters such as the naval AW-159, the Blackhawk, the Apache Longbow and others.

The Spike ER (Extended Range) Missile Weapon System is a light multi-purpose missile system with a range of upto 8 km, its light weight (only 34 kg) enables mounting on almost any light helicopter (such as the Brazilian Esquillo/Fennec AS550 scout or the MD 530). The Spike ER includes an advanced electro-optical seeker with a robust target tracker with 'Fire & Forget' capability, allowing the combat helicopter to 'shoot and scoot' or engage multiple targets over a very short time.

The Spike LR (Long Range) missile is considered as vital factor with some 20 armies of the world. This light portable multi-purpose missile system engages targets within ranges of up to 5 km, weighs only 13kg and is used primarily in ground deployment either in infantry units or can be vehicle-mounted.

Zen Technologies Unified Combat Training Centre

Zen Technologies Limited, pioneers in simulation technology based training solutions, are displaying a large variety of capability rich training simulators and solutions at Defexpo 2016. The Company is showcasing, for the first time, 'Zen Unified Combat Training Centre' (UCTC) which encapsulates a composite, comprehensive and flexible training solution to fully meet Individual and Collective training requirements of combat units of the Indian Army.

The Zen Combat Training Centre (Zen CTC) is a flexible and customised training solution for Armed Forces, Central Armed Police Forces, Special Forces and State Police Forces. The facility comprises virtual, live and constructive simulators which fully addresses individual and collective training needs of combat units. Configuration of equipment at the centre will vary from force to force and from one unit to another. The UCTC can be customised and configured for specific needs of other combat units as well. For instance, a UCTC for an armoured regiment would comprise tank basic and crew gunnery.

Simulators, Tank and B-Vehicle Driving Simulators and Armour Combat Training Simulator (ACTS) for two-sided force-on-force tactical exercises: Besides these simulators, training systems such as small arms firing simulator, target systems and portable containerised tubular shooting range for live firing with personal weapons will also be required, as all combat arms need to be proficient in handling personal weapons. The Mechanised Infantry UCTC will have commonality of simulators with the Infantry unit and will in addition train on ICV Gunnery, ICV Driving and ACTS along with tank units. Similarly, Artillery will be provided with the forward observer simulator to train Fire Controllers in their duties. Small arms training systems and B-Vehicle Driving Simulator, will also form part of the Artillery UCTC inventory.

The UCTC is not only designed to train sub-units and units in conventional warfare but also for asymmetric warfare-Counter Insurgency (CI) and Counter Terrorism (CT). Add-ons such as shoot house/indoor live firing CQB Range are critical to train troops in room intervention drills.

Boeing envisages growth in defence services business

The services and support market is a significant growth area for Boeing in India and the company is working with the Indian Air Force and Indian Navy to provide training and support of Boeing platforms such as the P-8I maritime reconnaissance and anti-submarine warfare aircraft, C-17 Globemaster III airlifter and Boeing Business Jets.

The Indian Air Force's C-17 aircraft and the Indian Navy's P-8I aircraft have demonstrated an excellent record in supporting the missions they have been deployed for, and our customers have expressed satisfaction about the operational readiness of both aircraft. Both aircraft were at the forefront of rescue and humanitarian aid efforts in the natural disasters that affected Bihar, Jammu and Kashmir and Odisha states. The C-17 was deployed to evacuate people and deliver relief supplies. The P-8I has been used extensively in maritime reconnaissance missions by the Indian Navy, including performing aerial reconnaissance and gathering data for planning relief efforts during Cyclone Hudhud.

Dennis Swanson, Vice President, Boeing Defence, Space & Security in India explained that this has been possible due to the enhanced capabilities that Boeing's advanced military platforms provide and the focus on providing timely and affordable services and support. "In the future, Boeing will continue to ensure that we deliver on commitments to our Indian customers and partner with the Indian armed forces to achieve their modernisation and mission-readiness objectives," Swanson told *Vayu*. "We will continue to have discussions with our customers on their requirements and ramp up our support and training capabilities now and in the future.

Vinayak Rajagopal, director of Global Services & Support in India, explained that the high mission readiness of the C-17 fleet can be attributed to the Globemaster III Integrated Sustainment Programme (GISP) Performance-Based Logistics (PBL) contract. "The GISP "virtual fleet" arrangement ensures mission readiness by providing all C-17 customers access to an extensive support network for worldwide parts availability and economies of scale. The C-17 GISP is a system-level partnership, where the customer pays for readiness, rather than specific parts or services," said Rajagopal.

Indian Navy P-8I

Initial qualification training of Indian Air Force C-17 crews was conducted by the US Air Force at Joint Base Charleston in South Carolina. A total of 100 Indian Air Force airmen received instructions from the 373rd Training Squadron Detachment 5 on how to operate India's C-17 Globemaster IIIs. The training included classroom time as well as simulation training on the aircraft.

Boeing offers fully integrated training systems for C-17 aircrews (pilots and loadmasters) and maintenance engine run technicians. Boeing currently provides C-17 training for the United Arab Emirates, Qatar, and the United Kingdom, maintaining weapon system concurrency of all training devices and courseware, and all of the initial and recurring training.

Initial P-8I training for Indian Navy pilots, mission system operators and maintenance technicians that will operate and maintain P-8I aircraft was done at Boeing's facilities in Seattle. The programme included a combination of flight, classroom and lab training as well as real-world simulation experiences that can reduce total ownership costs. Boeing has trained more than 110 Indian Navy professionals, including five pilot crews, five mission crews and a number of flight signalers and observers.

Boeing anticipates other training opportunities for aircrew and maintenance courseware development for platforms such as the AH-64 Apache and CH-47 Chinook, opportunities which being pursued. Boeing been providing simulation based training solutions to the US Army and several other international customers operating the AH-64 Apache and CH-47 Chinook helicopters.

Courtesy : Boeing

IAF C-17 Globemaster III

Rockwell Collins TruNet networked communications

Various software defined radio options available within the TruNet family

Rockwell Collins' TruNet software defined network communications solution includes land-based, airborne and handheld radios, advanced networking waveforms, and a range of ancillaries and services to ensure secure connectivity between land and air elements in the battlespace. The system grants "true interoperability," giving ground and airborne forces the ability to network as never before with secure and real time sharing of critical image, voice and video communications. TruNet can be implemented from a few handheld radios to a complete land-air network (ground, handheld, and airborne radios), allowing the possibility of customising capability to meet specific mission needs, such as tactical, border patrol, search and rescue, natural disaster response, etc. The software-defined nature of the solution means that military programmers can easily port mission-unique, legacy, SCA-compliant waveforms across assets.

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.

Airbus DS explores expanded capabilities for C295

Polish Air Force C295M (photo: Angad Singh)

Airbus Defence and Space is moving ahead with development of an air-to-air refueling (AAR) capability for the C295 tactical airlifter. The programme will see the C295 outfitted with a single centreline hose-and-drogue refueling system mounted inside the cabin, giving it the ability to support both fixed wing aircraft as well as AAR-capable helicopters. Significant ground testing is already underway, and flight-testing is planned to commence this year. Airbus DS plans to begin with a 'dry contact' using another C295, before moving on to actual fuel transfer tests and then proving capability with a broader range of receiver aircraft. If testing proceeds as planned, the AAR capability could be offered to customers as early as 2017, according to Airbus.

Airbus is also set to proceed with 'XTOL' development (Extreme Takeoff and Landing) to further improve the C295's short-field performance. The improved capability has reportedly been specifically requested by a prospective customer, suggesting that there is market demand for even better field performance. Although work on this programme is still in the preliminary stage, Airbus plans to achieve the performance gains by leveraging experience gained from the A400M programme, specifically by conducting "aggressive optimisation of flap-utilisation in line with the approved operations for A400M."

Saab's RBS15 Missile Family – A Common Solution for India

Modern militaries are increasingly looking towards incorporating smart weapons and systems into their arsenals, leading to the adaptation of cruise missile technology to an increasing number of battle spaces. Agile, precise, maneuverable and smaller yet effective forces are the need of the hour for the asymmetric nature of today's military conflicts.

The RBS15 missile family, comprised of the RBS15 Mk3 and the RBS15F ER, has the potential to become the common missile for many attack purposes with its unique flexibility and ability to be launched from various platforms. The RBS15 Mk3 represents the latest generation of advanced surface-to-surface missile (SSM) systems. It is a true fire and forget multi-purpose anti-ship/land attack, sea skimming, cruise type missile. The missile possesses a high hit probability due to a flexible, pre-launch programmable, active radar seeker. The state-of-the-art design of the RBS15 Mk3 results in high availability, reliability and maintainability and long maintenance intervals, thus resulting in a very low cost of ownership during the system's specified lifetime of 30 years.

The RBS15F ER is the latest generation air-to-surface version in the RBS15 missile family. It can be launched from both fighter aircraft and reconnaissance aircraft. The RBS15 missile is designed to operate in the naval scenario, from blue water conditions to littoral warfare and in land attack missions. It can be launched from ship, land and airborne platforms making it suitable for a wide spectrum of threat scenarios. The long flight range and extremely flexible trajectory enables attacks from short distances to ranges well beyond the horizon. Attacks can also be mounted from different directions with pre-selected time of arrival for each missile as well as simultaneous arrival.

"Saab's RBS15 missile family has proven potential to meet the existing and future requirements of all branches within the Indian Armed Forces. Saab sees the RBS15Mk3 as an excellent complement to already existing Brahmos systems, in such a way that it will provide enhanced flexibility at a much lower life-cycle cost", says Jan Widerström, Chairman and Managing Director, Saab India Technologies.

Pair of EJ200s in afterburner powering a Eurofighter 2000 take-off (photo: Angad Singh)

Advanced Power :
Eurojet makes the case for AMCA

As development of the Advanced Medium Combat Aircraft programme progresses, selecting a suitable engine for the type becomes a more pressing concern. The AMCA programme, while still relatively early in its design and development phase, is believed by the Aeronautical Development Agency (ADA) to hold immense potential to replace a wide range of IAF aircraft, while simultaneously increasing the Air Force's capabilities as the aircraft will be a generation ahead of what the IAF currently fields, or is considering, for its requirements (*see Vayu V/2015 for a detailed report on the AMCA programme*).

Certainly, a decision on an aero engine must be taken well before the prototype stage, and while there have been recent pronouncements from various industry players pledging support to the programme and offering to co-develop existing engines in India, there is little clarity from either the Aeronautical Development Agency (ADA) or from the eventual user of the type, the Indian Air Force, on what the capability priorities are for the AMCA. It is important to establish a matrix of priorities during the development stage to avoid creating an impossible 'wish list' of demands that will inevitably cause problems down the road. An added benefit of this approach is that it allows an early forecast of available technologies and their maturity levels, significantly de-risking development, particularly if there is good communication between the user and developer.

The greatest technology risk, and arguably the Achilles' heel of the Indian aerospace industry at large, is that of turbine engines. It is clear therefore, that this aspect of the AMCA will require definition at the earliest, to avoid letting a single issue derail programme schedules and budgets, as was the case with the Light Combat Aircraft (LCA) and its Kaveri engine. From various public pronouncements by ADA, IAF and MoD officials, the AMCA will not be developed alongside a new engine, so clearly lessons have already been learned and applied. Whatever ADA's decision, it will be made in consultation with the Government (i.e. the MoD) and the user, and it will have to factor in the imperatives of good project management, the IAF's capability requirements and the Government's policy aims – no easy task! It is little surprise then, that there is little clarity on the AMCA's engine beyond that it will be a foreign solution. While ADA is casting its own net far and wide in search of a modern engine with reasonable growth potential, the Indian Government is separately engaging with the USA on a Jet Engine Technology Joint Working Group (JETWG). This is precisely the sort of 'crosstalk' that can delay design and development efforts, particularly when these efforts hinge on selection of a suitable powerplant!

Technology

In a comprehensive presentation during the 2015 Subroto Mukerjee Seminar organised by the Centre for Air Power Studies (CAPS) Eurojet's Wolfgang Sterr outlined key modern and futuristic technologies for combat jet engines. The talk covered the demanding requirements to be met by current and future engines, the challenges in design and engineering as well as a plethora of development paths ahead, not limited only to Eurojet, but looking at work taking place around the world.

Different missions in different flight operation regimes put differing demands on engines. High-altitude reconnaissance is carried out very differently from low-level strike and both are far removed from the rigours of air-to-air combat. In the past this was rarely an issue, as aircraft were typically tailored for a narrow set of requirements,

A RAF Eurofighter in flight with its two Eurojet EJ200 engines in reheat (photo: Angad Singh)

allowing them to perform in concert for maximum effect only where needed. However, the advent of the multirole fighter has placed great demands on aero engine designers. An airframe-engine combination now has to excel at low-level penetration, sustained air combat, all sorts of ISR flight profiles… and everything in between!

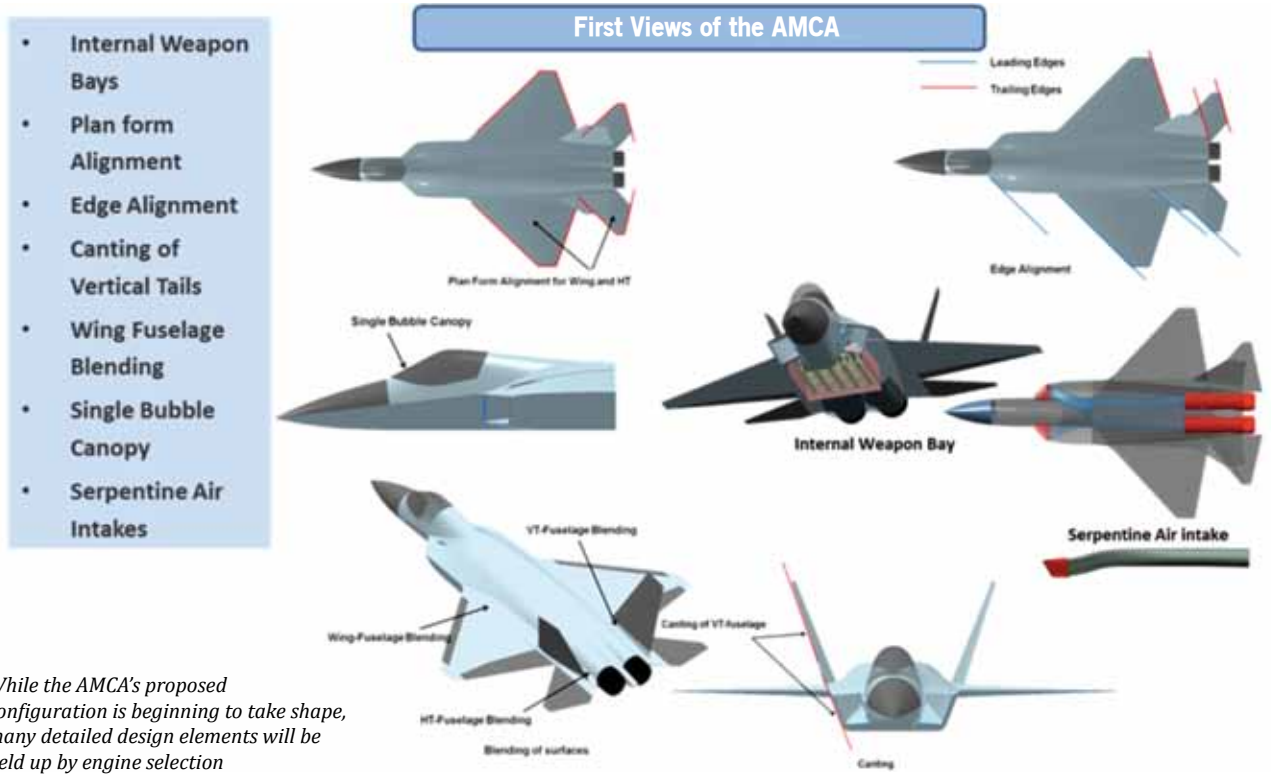
Future developments appear even more daunting as additional requirements are thrown into the mix. The fighters of tomorrow, particularly low-observable designs with fuel and munitions carried internally (including the AMCA) will necessitate engines with increased thrust-to-weight ratios, but also higher efficiency to offset the fundamental limitations in utilisation of internal volume. The aircraft can carry either more fuel or more weapons, both not both. The concept of life cycle costs has come into prominence in recent times and will doubtless have bearing on any future procurement decisions anywhere in the world. It is a simple adage that more complex parts have higher sustainment costs as a result of high part-count, labour intensive maintenance, or both. Therefore an engine must be relatively simple in design and manufacture to remain cost-effective in the long term.

Balancing these contradictory requirements with what is available glboally, either off the shelf, or after a short development cycle, is the job ahead of ADA and the IAF. For instance, the concept of supercruise – sustained supersonic flight without reheat – has come into vogue over the last decade or so. Yet Air Forces all over the world rarely use this capability, even if their aircraft are capable of supercruising. While supercruise is certainly more efficient than using afterburners to maintain a given supersonic speed, it is still many times worse than simply cruising in the high-subsonic range. In fact, many of the efficiency gains of supercruise can be matched and even exceeded by cruising at a higher altitude. European aero engine manufacturer Eurojet projects that Mach 1.4 flight at 50,000 ft in part reheat is actually more efficient than cruising at the same speed without afterburner at 36,000 ft. On the other hand, creating the ideal airframe-engine combination with a prime focus on supercruise results in significant penalties in subsonic flight regimes and loiter times. Sometimes the simplest solution to a problem may lie in operational changes, not technological! It seems clear then, that it is not a good idea to design an aircraft and engine combination with the express purpose of supercruise. It would be far better to focus on more mission-relevant capabilities such as internal volume, sensor/self-protection suite and so on. If the resultant aircraft can supercruise, then gains an additional capability with no negative impact to the overall programme. The same applies to tradeoffs in performance versus stealth, and vice versa.

Choices

The AMCA engine selection will have to be based on a current production engine, with an eye on size, weight and growth potential. Eurojet believes that the EJ200 offers the best combination of present-day performance in a compact package, with tremendous potential for further development to improve on every important aspect as noted above. Preliminary work is already underway on assessing a range of changes to the high- and low-pressure sections of the compressor and turbine stages, the afterburner section and the exhaust nozzle. Wolfgang Sterr's presentation last year indicated that specific fuel consumption, increased manoeuvrability, ownership costs and a 20-30% increase in thrust were realistic targets for further development of the EJ200. Indeed, many of these developments – such as thrust vectoring – are only awaiting formal requirements from existing or future customers, and can be delivered relatively quickly.

Angad Singh



While the AMCA's proposed configuration is beginning to take shape, many detailed design elements will be held up by engine selection

VAYU Interview with

Nathalie Smirnov

Senior Vice President, Services Division, DCNS

VAYU : How do you intend to support the Indian Navy's Project-75 (Scorpene) submarines? How is the support in India different from that in France?

Nathalie Smirnov : The Indian Navy is experienced in operating different classes of submarines, such as the *Kilo*-class and HDW Type 209. In the near future, they will operate *Scorpene*-class submarines built by MDL under Project-75 (P75). These modern submarines benefit from a very high level of integration and automation requiring integrated service support.

The French Navy has found it more cost effective and timely to subcontract all maintenance operations and support of its submarines to DCNS, through a 10-year service support contract guaranteeing an operational availability at sea every year.

Taking into account the IN's experience and existing infrastructure at its naval bases, DCNS is proposing to assist the Indian Navy to support the P75 submarines through an on-site team comprising Indian and French engineers, ensuring optimised operability and sea time.

VAYU : Do you think it would be more efficient in terms of cost and time to have two submarines lines, one DPSU and one private sector?

Nathalie Smirnov : In France, there is one submarine line, at DCNS. In India, it is up to the Indian Government to take this decision. We understand that the Aatre Committee will propose an effective arrangement for such strategic shipbuilding in the future.

VAYU : Could you share with our readers your experiences with Indian MSMEs during the on-going Scorpene project?

Nathalie Smirnov : One cannot deny the crucial role played by MSMEs in strengthening any defence ecosystem the world over. In India DCNS has been working with several MSMEs in the frame of indigenisation, such as SEC, HBL, FFL and others, to deliver indigenised equipment in all three categories highlighted by Indian Navy: Float, Move and Fight.

This provides a strong base for a sustainable industrial eco-system, which needs to be nurtured for long-term self-reliance so that support can be rendered to the Indian Navy for existing and future submarine programmes.

The level of quality achieved by Indian MSMEs involved in the P75 indigenisation programme has allowed DCNS to outsource to some of them certain equipment to be integrated in the French Navy's own submarines.

VAYU : How is your company contributing towards the on-going efforts of skilling Indian industry?

Nathalie Smirnov : 'Skill India' is the inherent notion behind creating DCNS India as a wholly-owned subsidiary of the DCNS Group. Today, DCNS India has trained engineers who are not only working on design modifications for MDL, but also at the shipyard alongside French experts to support activities on board. Through activities like Transfer of Technology (ToT) and technical assistance, the endeavour of holistic development of the entire industrial eco-system can be achieved.

We surely look forward to use these knowhow and skills sets to be retained and built upon for the maintenance activities of the P75 programme.

VAYU : Your comments on the key elements required to make India's defence manufacturing sector robust and self-reliant.

Nathalie Smirnov : As already mentioned above, driving factors for robust and self-reliant defence manufacturing would be:

- Sustainable and qualified industrial ecosystem with MSMEs requiring continuing workload to preserve expertise and trained staff.

- Cooperation where synergies can contribute to more cost effective and timely deliveries.

VAYU : What technologies and systems would you be showcasing at Defexpo 2016?

Nathalie Smirnov : DCNS is showcasing a wide range of expertise in naval systems at Defexpo 2016. The DCNS booth will showcase the Indian Navy's *Scorpene* submarine, the *Mistral*-class LHD, DCNS' Evolved Aircraft Carrier, the *Barracuda* SSN, MU90 torpedo, OTEC (Ocean Thermal Energy Conservation) project and DCNS' services solutions.

VAYU Interview with

Kjell Kringsjå, Senior Vice President Business Development, Nammo Group

***VAYU**: Nammo is one of the world's largest ammunition companies with a portfolio including not only small, medium and large calibre of ammunition, but also shoulder fired systems, rocket motors and demilitarisation services. What are Nammo's focus areas in India ?*

Kjell Kringsjå: Nammo's focus area will be on our core competencies and present this to the Indian market. We are well known as a high quality producer of both specialty and commodity ammunition. We believe that the Indian Armed Forces will appreciate the focus we have on products that really increase the capacity of the soldier and the systems. We also think that especially our high-end quality products in ammunition, shoulder fired systems and our demilitarisation expertise can be of interest for India.

***VAYU**: The Multi Purpose (MP) concept and Nammo's RF airburst technology has been offered to the Indian Army. While the feedback has been positive, can you please explain these two concepts?*

Kjell Kringsjå: The MP concept is in technical terms a pyrotechnical ignition train instead of traditional mechanical Safe & Arm device. This will after impact on the target result in a deflagration instead of a detonation compared with other ammunition. The operational effect (terminal ballistic) of the MP is that it is extremely effective due to the way it works; initially you get an effective penetration, then a delayed action and in the target you will see a tripled effect due to the fragmentation, blast and incendiary. On top of all this this is relatively inexpensive to manufacture and is very safe to handle both before and after being fired from a gun.

The airburst ammunition gives the troops the possibility to neutralise an enemy that is hiding behind obstacles to avoid direct fire. Nammo have developed a concept of airburst that incorporates radio frequency to programme ammunition. This is easy to integrate in both existing and new weapon platforms. It has a very reliable programming with a very high precision and is a very safe and reliable system with a very low dud rate.

Vayu: What are your thoughts on Prime Minister Narendra Modi's 'Make in India' initiative?

Kjell Kringsjå: I think that this is a very smart way of setting up production in your own country both to add value and improve logistic readiness. This will invite OEMs to find local partners and create possible Joint Ventures. In the end this will create added value to all partners and the end-user will have improved know how and logistic readiness. It will be a win-win situation for all parties involved.

The M72 shoulder launched munition is being showcased for the first time at Defexpo

***VAYU**: Are you open to partner with Indian defence companies to produce speciality ammunition, including Transfer of Technology (ToT)?*

Kjell Kringsjå: Yes absolutely. We think that it is possible to do both, but at the same time there will probably be some restrictions to components, technology or the volume of production that make it smarter to produce in locations where it already is in production. At the same time I think it will be an opportunity for Indian industry to find possibilities to export components to Nammo facilities. We have seen that the expertise, production cost and quality from Indian industry seems to be very good.

***VAYU**: Aside from your traditional customers from Europe and the US, which countries will take on particular significance for Nammo in the near future?*

Kjell Kringsjå: Nammo's main focus is as you mention The Nordic, European and North-American market. But we see the growth in the South-East Asian market coming and we are a very reliable and high-quality delivering OEM for products that a lot of countries find interesting.

***VAYU**: Do you feel the consolidation in the European defence industry will have an impact on India ?*

Kjell Kringsjå: I think that not only the European industry is changing – it is a worldwide trend. That will also open up for new constellations and ways of cooperating. At the same time it is important to remember that the defence industry is a protected market due to national security interest, so countries must make sure that they have available what they will need in an emergency situation.

I think that this is an opportunity for Indian industry to join into these consolidations. At the same time the Indian market is so large that in many ways it can stand for itself. But for the Indian customer I think it is very important to get advantages of the technology presented by other companies.

***VAYU**: DefExpo 2016 is a fantastic opportunity for Nammo to showcase its product portfolio. What products will you be showcasing during the event ?*

Kjell Kringsjå: It will be some of our core ammunition products. That includes our new family of modern Extended Range artillery ammunition for 155 mm, our 30 x 173 mm ammunition, 40 mm, 57 mm, 12.7 mm and not least our shoulder launched M72 product, both anti-structure and anti-armour variants.

Rolls-Royce in India

Armed with a legacy to power the present and future of Indian defence

Best known for delivering outstanding customer relationships and solutions, with its high performance power systems, Rolls-Royce's deep association with India started eight decades ago when Tata Aviation Services launched its first aircraft powered by Gypsy engines.

In 1933, Indian Air Force took to the skies powered by Bristol Jupiter engines. Rolls-Royce' collaboration with HAL started 60 years ago with licensed production of Orpheus engines that powered the Kiran aircraft and progressed to co-production of Adour family of engines. We have powered aircraft of Indian defence forces including transport, trainer and combat aircraft and helicopters. The Jaguar has flown with Rolls-Royce Adour Mk.811 since 1981 while Adour Mk.871 has been powering the new Hawk advanced jet trainer since 2008.

Today, Rolls-Royce is embedded in India as an investor, a high skills employer and as a supplier of power systems for use in the air, on land and at sea. It also oversees operations in Bangladesh, Nepal and Sri Lanka out of the regional headquarters in Delhi.

Powering the modernisation and indigenisation of Indian armed forces

With India embarking on a path of strong economic and infrastructure growth, we are trusted to deliver excellence with a broad gamut of products and services which address customer needs to achieve long-term sustainable growth. Over 750 Rolls-Royce engines power critical aircraft fleets, including: the Jaguar attack aircraft; the Hawk advanced jet trainer; the Sea Harrier fighter; the C-130 transport aircraft; the Embraer 145 VVIP aircraft and Airborne Early Warning and Control Aircraft; the Sea King Helicopter, and the HS748 'Avro' transport aircraft. Our portfolio in India spans proven products through to the latest new offerings with the IAF and IN considering new Rolls-Royce powered acquisitions in the coming years.

Article authored by Kishore Jayaraman
President, Rolls-Royce India and South Asia

Presently, we are working towards the indigenisation of the Indian defence industry by exploring strong partnerships with companies who share our goals. We are already leveraging the vast engineering talent pool and playing a leading role in the government's 'Make in India' initiative. In terms of design, development and supply chain capability, we have announced the recruitment of 500 people in Bengaluru by 2017. These people will undertake aerospace engineering for customers in the region as well as support for Rolls-Royce's regional supplier base. We have plans to hire around 100 engineers at our upcoming Engineering centre in Pune by this year. In addition, more than 1000 engineers, through our partnership with QuEST& TCS, work at Rolls-Royce managed engineering centres in Bengaluru. In terms of manufacturing, International Aerospace Manufacturing Pvt Ltd (IAMPL) is now at full production employing over 120 people for a wide range of engine programmes including the Trent XWB.

Our power systems division MTU established an Engineering and Research Centre (EARC) in Pune in 2011 to support new engine and component R&D activities as per requirement of the MTU Global Engineering Division. We are constantly expanding our service centre and support infrastructure with special tooling & trained manpower to overhaul all engine types; including the Series 8000 by 2017.

Defence Public Sector Undertaking (PSU) Garden Reach Shipbuilders and Engineers is a long term Licensee partner of MTU for the Series 4000 marine engines used in several Navy and Coast Guard Patrol Vessels. MTU is preparing to expand license cooperation to include other larger engines for Navy Frigates and power pack solutions for Army Light Infantry Vehicles.

Immense Potential

India's defence budget allocation is estimated to touch $620 billion by 2022 as per FICCI. We see a huge potential in India and we will definitely leverage our strategic partnerships for pursuing future growth. The initiative to introduce a new category called Indigenously Designed, Developed and Manufactured (IDDM) where it will be mandatory to source 40% of the content locally will give a huge impetus to the defence sector. As India gets ready to move on its growth path, we will continue to support the country with our powerful portfolio of products and services and the right combination of experience and advanced technologies.

Strengthening our relationship with India

Rolls-Royce, with a rich legacy of over 80 years has been a partner in India's defence modernisation and remains committed to India's efforts towards achieving self-reliance by acquiring superior technological skills and modern manufacturing and business processes. We will continue to support India thereby delivering 'better power for a changing world'.

MBDA offering advanced technology transfer to India

MBDA's stand at Defexpo 2016 will focus on a number of messages covering both the product as well as the industrial advantages that MBDA is offering to India. India's defence forces need the very best and most advanced equipment to meet the many operational challenges facing the country. MBDA's extensive product portfolio covering all three operational domains – air, sea and land is available to fulfil this need. Similarly, MBDA is striving to advance the government's widely publicised *Make in India* policy. MBDA has the know-how, the experience of international cooperation and the latest guided missile and guided missile system technology, which it is well prepared and eager to share with India. *Make in India* can benefit and make major leaps forward in progress by having access to the levels of advanced technology that MBDA has developed over many decades of research and development. Many people in the industry are making such a claim for India but often this technology is far below the necessary level to make a real difference to India's indigenous capability. MBDA on the other hand is prepared to go the distance and to offer technology at an advanced level. Moreover, it has the full backing of its domestic governments to do so.

Loïc Piedevache, MBDA Country Head for India

Mistral has proven itself a major success story with a 96% success rate in all firings. This highly versatile IR missile, already integrated with HAL's Rudra (ALH Mk.IV) using the MBDA ATAM launcher, can be deployed from a number of land and ship based launch systems. With a competition currently underway to meet India's Very Short Range Air Defence (VSHORAD) requirement, MBDA will be displaying the Mistral MANPADS (Man Portable Air Defence) system at Defexpo 2016. Easy to use, quick to set up, deploy, fire and reload, Mistral MANPADS was designed from the outset to be a highly portable tripod mounted system. Easily managed by two operators (one for the tripod and another for the missiles), the system has a distinct advantage over beam-riding systems in that its heat sensitive seeker allows the missile to be fully autonomous, a vital capability for dealing with close-in, manoeuvring threats. The system, which has already been part of several successful field evaluation trials for India, can also be mounted on vehicles.

Mistral MANPADS

The Short Range Surface-to-Air Missile (SRSAM) is an Indian DRDO project that MBDA is proud to be supporting, as it reinforces the partnership model the company is advancing within the country. Much has been written about this project, which stresses MBDA's commitment to India's *Make in India* policy. Offering the highest levels of technology transfer and a major boost to Indian defence industry, SRSAM is an ideal solution for the short-range air defence needs of India's Navy. Discussions are well advanced and as soon as a green light is given, this latest technology is ready to be developed by India in collaboration with MBDA.

Loïc Piedevache, MBDA Country Head for India points out, "The *Make in India* policy is an exciting opportunity for India. It is a policy that will provide India with the level of defence-industrial sovereignty that a country of such importance on the world stage should have. In this respect, MBDA is determined to work with its growing network of in-country partners to this end. However, it should be realised that we have been advancing a strategy of *Make in India* long before it became a publicly announced policy, a strategy that forms both the past and our future intended activities."

'Make-in-India' for M777 takes centre stage at Defexpo 2016

BAE Systems 81 mm mortar

BAE Systems' battle proven M777 Ultra Lightweight Howitzer (ULH), for which India and the United States are in discussions for a Foreign Military Sale to the Indian Army, will take centre stage at the company's stand at Defexpo 2016 in Goa. 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 includes 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 is 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,' will also be featured at the BAE Systems stand.

Recognising the ever-increasing importance of cyber in the defence mix, BAE Systems will also be showcasing 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), will also find 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 are 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.

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 are excited to participate again in Defexpo and underline our longstanding commitment to sharing technology and capability with Indian industry."

Courtesy: BAE Systems

MKU's multi-purpose armour solutions

The Indian firm is supplier to the German F125 future frigate programme

MKU will be supplying armour for the German Navy's future F125 (*Baden-Württemberg*-class) frigates, which are being built by two leading German shipyards, Thyssen-Krupp and Lürssen, at a cost of over €650 million each. A key design requirement of the F125 frigates is enhanced survivability – ensuring that the ships remain operational regardless of damage due to accidents or enemy action. MKU's participation in this flagship European shipbuilding programme highlights the firm's decades of experience in this domain, and their ability to provide flexible, effective protection solutions for a wide range of platforms. MKU, along with its wholly owned German subsidiary, MKU GmbH, has provided protection solutions for over 2,000 platforms globally, covering a wide range of naval vessels, land vehicles and aircraft. The firm provides comprehensive solutions and complete project management for land, air and naval platforms for protection against blast waves, splinters and bullets. MKU also provides maintenance and life cycle support for these solutions.

Naval platforms armoured by MKU include frigates, mega yachts, patrol boats, fast interceptor craft, rigid-hull inflatable boats, and hovercrafts, many of which are in operation with the Indian Navy and Coast Guard.

MKU owns patents on several specialised technologies that have been developed over years of in-house R&D. Engineers at MKU have developed '*Modulare Schutz Technik*,' a unique German-engineered patented system for armouring rotary wing aircraft, without having to make any structural changes in the platform. This, coupled with Polyshield V6, an ultra-light armour solution made using their latest 'Generation 6' armour technology, provides the ideal solution to add survivability to air platforms with minimal weight increase. Armour solutions using Gen 6 technology combine advanced materials with modern production techniques to reduce weight and thickness of armour panels by almost 40 per cent, translating into more useful payload and endurance for the aircraft without compromising its protection or performance.

Over the years these solutions have been used on a number of platforms such as the Mil Mi-17, Mi-8, Bo 105, Super Puma, and NH 90, among others, for several forces in South America and Europe. Ballistic solutions provided by MKU conform to environmental standards as per MIL 810 G and its facilities are AS 9100 certified.

A number of Indian vehicle and helicopter programmes are in the pipeline. These include the LAMV (Light Armoured Multipurpose Vehicle) and the mammoth Future Infantry Combat Vehicle (FICV). The engineers at MKU have leveraged their experience of working on platforms operated by European and Indian forces to develop the solutions required to meet the stringent demands of these programmes. Some of these solutions will be on display during the exhibition.

In addition to platform protection, MKU has provided body armour and helmets to more than 1.5 million soldiers worldwide. Over the past 30 years, the company has developed some 1,000 unique protection solutions for more than 100 types of threats. Its products and solutions are used by over 230 forces spread across 100 countries, including India. It is a registered NATO supplier since 1993 and also an accredited supplier to the Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw).

Floor armour on a Mi-17 helicopter

Bluebirds' last flight

Dutch Alouette IIIs retired after 51 years of service

15 December 2016 marked the end of an era. After 51 years of service with the Royal Netherlands Air Force (RNLAF) the final four Aerospatiale Alouette IIIs made their last operational flight day as part of 300 Squadron at Gilze-Rijen Air Base in southern part of The Netherlands. The Alouette III has been the longest serving type in the history of the RNLAF. Only four Alouettes (A-247, A-275, A-292 and A-301) remained operational with 300 Squadron as of 2004, and these were formally transferred to RLNAF Logistics Command during this event in December 2015.

The first batch of Alouette IIIs had arrived at Soesterberg Air Base in 1964 with the '*Groep lichte Vliegtuigen*' (GPLV/ Lightweight Unit), which was tasked with conducting operations in support of the Dutch Army. One of the unit's major missions was tactical observation at low level over the battlefield, as 'spotter' for armoured formations, for which the Alouette III was particularly suitable. In addition, the

Alouettes were used in a variety of other tasks: liaison, VIP transport, and medevac/SAR.

After the end of the Cold War the tasks of the RNLAF were rapidly changing and the Alouette III became obsolete. New types of helicopters came in service from the late 1990s to take over the tasks of the Alouette III. Brand new Eurocopter (now Airbus Helicopters) AS 532 Cougar and CH-47D Chinook helicopters took over most of the tasks from the Alouette III and MBB Bo 105 fleet. The SAR role had already been taken over many years earlier by Westland Lynx helicopters of the Royal Netherlands Navy. From an initial strength of 77 Alouettes, only 35 remained in service as of 1995, and by 1998 that number was further reduced to only nine operational with the RLNAF. Over the years three Alouette III units (298, 299 and 300 Squadrons) operated from Soesterberg, Deelen and Ypenburg, until only 300 Squadron remained, having transitioned to Gilze-Rijen Air Base.

During its operational service, the Alouette III was involved in a number of notable deployments, including Tunisia (1970), the Gulf War (Turkey/North Iraq, 1991), Former Yugoslavia (Zagreb and Ljubljana, 1991), Cambodia (1992-1993) and a second deployment to Former Yugoslavia with IFOR (1996).

From 2004 just four Alouette IIIs remained in service, mainly as a Royal flight and for VIP transport. These last four helicopters were upgraded in Switzerland by RUAG to extend their service life, and after the upgrade were painted in a distinctive royal blue that they wore until their phase out. The Alouettes were incorporated into the Defence Helicopter Command (DHC) at Gilze-Rijen, and some 10 pilots and 10 technicians, part of 300 Squadron, conducted operations with the type. In total the Alouette fleet flew nearly 400,000 hours since induction in 1964.

Text and photos: Carlo Kuit & Paul Kievit/ Bronco Aviation

(photo: courtesy event organisers)

Singapore Air Show 2016

The trade segment of Singapore Airshow 2016 concluded on a positive note with exhibitors and trade visitors giving the thumbs up to the wide range of emerging opportunities, dialogues and technologies that were the main themes of this year's event. Among the highlights were the nearly 60 companies comprising the French pavilion, the largest French presence ever at an airshow outside of France, which included prime contractors, equipment manufacturers, small to medium enterprises, and maintenance specialists; as well as the more than 140 exhibitors who represented the United States of America.

"This edition of the Singapore Airshow has been an excellent success for all the members of GIFAS, and more particularly for our SMEs. The status of Feature Country has clearly given a deeper dimension to the relationship between our two industries which we are looking forward to grow further," stated Mr Vincent Gorry, Director, European and International Affairs, GIFAS.

The Philippines also made event history by participating as a country pavilion for the first time at the Singapore Airshow and commemorated its debut by announcing deals with Airbus, Harris Corporation and Rolls-Royce.

A total of 50 deals were signed at the show 2016, representing an increase of 14% over 2014. These included 11 deals with a total value of US$12.7 billion, as well as 40 deals with undisclosed values announced by 20 companies. In line with changing business trends, and as the industry becomes more sophisticated and competitive, a growing proportion of the announcements and deals included undisclosed values. More deals were announced by LCCs and aircraft leasing companies compared to 2014. In addition, there were eight MOU signatures compared to four in 2014 as industry stakeholders looked to build future capabilities. Singapore Airshow 2016 saw close to 10% increase in trade visitors, as well as a nearly 5% increase in the number of VIP delegations. There was also an increase in the number of local companies exhibiting in the Singapore Pavilion, with 36 companies taking part this year, compared to 29 in 2014.

The wide array of opportunities at the Airshow spanned the commercial, defence, MRO, R&D and manufacturing sectors. These opportunities not only emerged within industry sectors, but also from Asian countries and markets that displayed significant potential and were key focal areas for exhibitors and visitors. GE Aviation announced new investments

The UAC pavilion

in new MRO facilities in Singapore, which includes establishing a new advanced technologies centre for R&D on repair applications, while Pratt & Whitney opened its first Singapore manufacturing facility a day before the event, the only facility outside of the US to manufacture components for the company›s latest engine, the PurePower engine. Among the growing spectrum of MRO opportunities was the agreement signed by Airbus and SIA Engineering Company (SIAEC) to form a joint venture based in Singapore. The joint venture company will provide airframe maintenance, cabin upgrade and modification services for Airbus A380, A350 and A330 aircraft to airlines in the Asia Pacific and beyond, and marks SIAEC's first collaboration with a major aircraft manufacturer for airframe maintenance.

Over the six day event from 16–21 February, Singapore Airshow 2016 welcomed over 130,000 trade and public day visitors. Trade attendance saw a 7% increase compared to 2014 with 30% from overseas. Singapore Airshow 2016 saw the participation of more than 1000 exhibiting companies from some 50 countries including 65 of the top 100 global aerospace companies.

Visitors to the Airshow were treated to flying display performances including those by the Republic of Singapore Air Force (RSAF)'s integrated aerial display team, comprising an F-15SG fighter jet and an AH-64D Apache attack helicopter. They performed 11 exciting manoeuvres, showcasing precision and coordination between two different aircraft types of different manoeuvrability and capabilities. Their routine included the Vertical Punch, a new manoeuvre that was performed for the first time. *The Black Eagles* from the Republic of Korea Air Force (ROKAF), known for their excellent stunts, were back to thrill the crowds with three additional manoeuvres added to their 2014 repertoire. Other flying displays included the French Air Force's Dassault Rafale, the US Air Force's C-17 Globemaster III, F-16C/D Fighting Falcon and B-52 Stratofortress, and the Sukhoi Su-30MKM from the Royal Malaysian Air Force.

The RSAF also showcased 11 military assets, including a Black Knight F-16C aircraft in its familiar red and white paint scheme incorporating the national symbols of the crescent moon and five stars, which was on display at the Singapore Airshow for the first time. Other key highlights of the static aircraft display included two USAF F-22 stealth fighters on display together for the first time at the event and the Airbus A400M which made its debut at the show. Visitors were able to see luxury business jets from Bombardier and Embraer, as well as Gulfstream's newest flagship, the G650ER, on display, while new helicopter models including the Airbus H145 and Bell 505 took part in the show for the first time. In addition, Finmeccanica showcased its Project Zero, a hybrid tilt-rotor technology demonstrator; the electric-powered aircraft that can take off and land like a helicopter but fly like an aircraft; while the Royal Australian Air Force's Alenia C-27J Spartan battlefield airlift aircraft, which is being deployed outside of Australia for the first time, also made an appearance at the Airshow.

The SPEAR at the MBDA stand

Boeing highlights partnership and product innovation

Boeing highlighted its innovative defence and commercial products and important regional partnerships at this year's Singapore Airshow. Boeing and the world's first all-787 airline, Singapore Airlines' low-cost, long-haul subsidiary Scoot, demonstrated the Boeing 787-9, which was on display during the show's first day. Scoot currently operates 10 787-8 and 787-9 airliners and plans to open new markets and routes with an additional 10 787s on order. Boeing defence products at the show include the Republic of Singapore Air Force (RSAF) F-15SG fighters, as well as

AH-64 Apache at the static area

CH-47 Chinook also at the static area

AH-64 Apache and CH-47 Chinook helicopters. A US Navy P-8A Poseidon, two F/A-18F Super Hornet aircraft and a US Marine Corps MV-22 Osprey were on static display. The Boeing exhibit at the show featured the company's family of commercial airplane models, including the 737 MAX, 747 Intercontinental, 777X, 787 Dreamliner, as well as a 737-800 Boeing Converted Freighter. On the defence side, the exhibit featured interactive displays, operator consoles for the P-8A Poseidon and Maritime Surveillance Aircraft, as well as models of the ScanEagle unmanned aerial system and other products. Boeing also had a F-15 Simulator in the RSAF exhibit area.

Bombardier C Series in Asia-Pacific debut

Bombardier's line-up included the all-new, recently certified CS100 airliner and two business aircraft - the Challenger 650 and the Global 6000 business jets. Additionally, Thailand-based airline Nok Air displayed an 86-seat Q400 aircraft. "Having our aircraft and teams on display at the renowned Singapore Airshow is a great way to debut the recently certified CS100 aircraft for our customers and stakeholders in the Asia-Pacific region. It's an exciting time as the Swiss-liveried CS100 aircraft embarks on its world tour over the next few weeks," said Fred Cromer, President, Bombardier Commercial Aircraft."

Bombardier's CS 100

Rockwell Collins at Changi

Flight2 avionics demonstration flight deck for C-130 platforms

Since the last Singapore Airshow, Rockwell Collins has significantly expanded its presence in the Asia-Pacific region through key acquisitions, the opening of new facilities, and the formation of new relationships and joint ventures. Highlighting its exhibit was Rockwell Collins' market-leading Flight2 avionics demonstration flight deck for C-130 platforms. The proven Flight2 avionics solution modernises C-130s to enhance situational awareness and safety for flight crews, and to meet current and future airspace requirements. The exhibit also featured Rockwell Collins PAVES Wireless high-performance onboard streaming and PAVES seat-centric in-flight entertainment (IFE) cabin solutions for airlines. PAVES Wireless can reach more than 500 personal devices at once with content ranging from movies and music to news and information, and PAVES seat-centric IFE is an easy-to-use, easy-to-maintain large-screen HD system for passenger seatbacks.

Northrop Grumman highlight Global Security Capabilities

Northrop Grumman highlighted its broad range of global security capabilities at the Singapore Airshow. The company's airborne surveillance and advanced situational awareness capabilities were showcased through visual displays of unmanned helicopters and high-altitude, long-endurance unmanned aircraft systems. Northrop Grumman's airborne fire control radars such as a model of the company's latest active electronically scanned array (AESA) fighter radar, the APG-83 Scalable Agile Beam Radar (SABR) were on hand at the show. SABR is a mature multifunction AESA radar that provides 5th generation radar capabilities to the F-16. The company showcased its C4ISR capabilities with space, air, land, sea and cyber examples.

Saab At Singapore

At the Singapore Airshow 2016 Saab demonstrated how its advanced technology and innovative thinking pushes the boundaries to break through the 'thought barrier!'

"From India to Australia Saab is known as a reliable partner and a source of strategic defence, security and aerospace technology. We stand proudly alongside all of our existing customers in the Asia-Pacific region, and we see great potential to do new business in many more places. The Saab product range speaks for itself; from the Gripen multi-role fighter to advanced submarines like the A26; from our complete radar portfolio on land, sea and air, to our superior ground combat systems; not forgetting our long expertise in command and control and network-powered defence. There is no other company that can match our range of proven, integrated solutions. We are the partner of choice for smart, sustainable progress," stated Dan Enstedt, President, Saab market area Asia Pacific.

Saab is enjoying a sustained period of expansion. There are few, if any, other defence, security and aerospace suppliers that can deliver the range of effective and efficient products found in the Saab portfolio. "Saab has been active in Singapore for the past 30 years, supplying the Republic of Singapore Armed Forces with advanced high-tech solutions like submarines, RBS 70 air defences, Giraffe radar systems and more. We are proud of what we have achieved here and we will support our Singaporean customer for another 30 years to come," said Anders Dahl, Vice President, Saab Singapore.

Royal Australian Air Force C-27J Spartan

Finmeccanica and 'One Company'

Finmeccanica participated with its newly integrated "One Company" organisation. There was particular interest in 'Project Zero', Finmeccanica's futuristic green-technology aircraft which made its Asian debut at the show. 'Project Zero' integrates future technologies in the fields of aeronautics, electronics and features electric propulsion with a low environmental impact. This year also marked the return of the C-27J, Finmeccanica Aircraft Division's tactical transport, which has been absent since the 2012 show.

Finmeccanica's expertise in vertical flight was also represented by existing successful aircraft such as the AgustaWestland AW101 and the intermediate models AW169 and AW139. Over 340 Finmeccanica helicopters have been ordered to date by defence, government and commercial operators in the region.

Singapore's Air Force is the first 'export' customer for Finmeccanica's M-346 trainer aircraft. The M-346 is the 'most advanced training aircraft' available for pilots who are preparing for future duty with current-generation defence aircraft. Owing to the M-346's flight performance and quality and its 'innovative technical characteristics', the aircraft provides a high level of safety combined with low acquisition and operation costs.

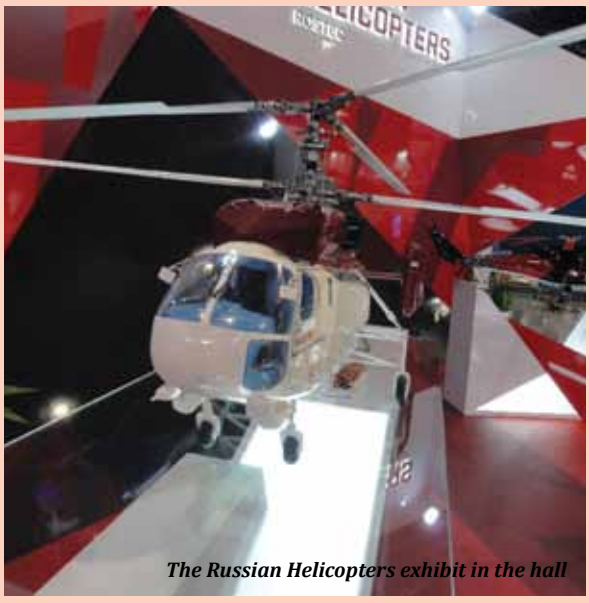
The C-27J Spartan, considered the benchmark medium-sized tactical airlifter, is also of great interest in the region, where the aircraft is in service with the Royal Australian Air Force and was displayed at the event.

Aviation PLC signs for 5 additional ATR 72-600s

ATR and the Singapore-based commercial aircraft lessor Avation PLC announced an agreement for the purchase of five new ATR 72-600 aircraft. At list prices the acquisition is valued at about US $130 million and brings to 35 the total number of ATR 72s ordered by Avation PLC since their first ATR purchase in 2011. As of today, Avation has already taken delivery of over 20 ATR 72s, mostly ATR 72-600s, which currently fly in the liveries of Virgin Australia, Flybe (for Scandinavian Airlines), UNI Air (Taiwan), Air India and Fiji Airways. Deliveries of the remaining ATR 72-600s on order extend out to 2018.

Russian Helicopters showcase newest products

Russian Helicopters showed its Mi-171A2 helicopter for the first time in Singapore. "The aircraft fleet in Southeast Asia is growing at a fast pace and strengthening of our competitive positions in that market is one of the key objectives of Russian Helicopters. More than 900 Russian-made civilian and military helicopters, which are currently in operation in that region, serve as a sound basis for the development of services. Russian Helicopters, which set the highest standards of performance, reliability and operating efficiency, will guarantee the future increase of the Russian presence in Asia", said the company's CEO Alexander Mikheev.



The Russian Helicopters exhibit in the hall

Thales AVANT IFE for SIA's A350 XWBs

Thales In-Flyt Experience will equip Singapore Airlines with its AVANT In-Flight Entertainment system and Ka-band connectivity solution on its future fleet of A350 XWB aircraft configured for medium-haul operations. Thales, with its AVANT Android based system offers a flexible architecture that responds to these needs. Through its innovative User Application portal, Thales will assist Singapore Airlines to constantly introduce the newest and most sought after apps present in the consumer market, to their passengers. The integration of Ka-band connectivity to the in-flight system, using the fastest airborne internet speeds will open up the world to the passenger. Delivery of the system will begin in 2018.

Thales SIA C2 systems for French Army and Navy

The French defence procurement agency (DGA) has selected Thales to upgrade the command functions of the French Army and Navy as part of the SIA information system transformation programme. Under this contract, designated SIA C2,1 Thales will replace the Army and Navy's legacy command information systems with a single harmonised system to meet the growing need for force interoperability. Today, interoperability within joint and coalition forces has become a key requirement. The chain of command is critically important and serves as the central nervous system for force operations. Over the next two years, SIA C2 will transform the command information systems of France's land and naval forces by combining them into a new-generation system. SIA C2 will facilitate information exchange at all levels by delivering a set of common tools for joint forces operations, while meeting all the specific requirements of land forces command. Legacy systems will continue to be maintained and supported until the SIA C2 system is rolled out across the two forces.

Sikorsky/Lockheed Martin's Seahawk fleet's 1m flight hours

The US Navy's fleet of MH-60R 'Romeo' and MH-60S 'Sierra' Seahawk aircraft has surpassed 1 million flight hours since their induction into the fleet in 2004. These helicopters deploy on frigates, destroyers, cruisers, aircraft carriers and other air-capable surface ships, the multi-mission helicopters capable of anti-submarine warfare, anti-surface warfare, search and rescue, vertical replenishment and medical evacuation. Behind the scenes, the US Navy's fleet of 464 Romeos and Sierras require maintenance and sustainment to achieve their target flight hours. For 11 years, the Maritime Helicopter Support Company (MHSCo) has kept Seahawk helicopters flying by providing the fleet with performance-based logistics (PBL) to sustain the systems longer. PBL helps to achieve effective, cost-efficient programmes by implementing an incentive model that fosters innovative and creative solutions to reduce costs and ensure operational readiness. Currently, MHSCo is managing spare and repaired parts for more than 1,710 aircraft and avionics components across more than 500 H-60 naval helicopters worldwide.

AVM AJS Walia, Regional Executive, India and South Asia for Sikorsky, at the Changi Exhibition Centre

Green Dragon

IAI unveils its loitering munitions family

Israel Aerospace Industries (IAI) unveiled at the Singapore Airshow the newest members in its Loitering Munitions (LM) family. IAI is the world's pioneer in developing and fielding various types of LMs: the most prominent so far being Harpy (an autonomous anti-radiation LM for SEAD/DEAD missions) and HAROP, an Electro-Optical/Infra-Red (EO/IR)-guided, man-in-the-loop LM, designed to locate, track and destroy high quality static and mobile targets. Both systems have been sold extensively worldwide. The new member in the extended family is the Harpy NG (New Generation), which is designed to counter the newer types of air defence radar threats that have evolved since the introduction into service of its former version. The totally revamped model introduces two major changes. First, improvement, as well as extension of the covered frequency band to much lower frequencies, to deal with all types of air defence radars, while still building on the extensive capabilities of the former generation Harpy.

Second, packaging the new Anti-Radiation (AR) Seeker in the more advanced airframe of its stablemate, the HAROP. This repackaging enables better flying characteristics including longer loiter time, extended range, higher altitude as well as commonality in maintenance and training.

An additional new member in IAI's family of LM's is the Green Dragon, a tactical, low-cost LM designed to provide small ground units and special operations units with significant situational awareness and firepower in a compact envelope. Green Dragon is a silent, all electric LM with up to two hours of loitering time, during which its operator can collect visual intelligence of surrounding areas up to a range of 40 km. This LM can locate, acquire and dive on operator designated targets with a warhead of nearly 3 kg and extremely high accuracy (better than 1 m CEP). The Green Dragon is launched from a sealed canister: as many as 12-16 units can be carried on a small vehicle and launched upon request. The operator has a small tablet-sized control panel and a tactical low-power datalink to the LM.

Loitering weapons on display at the IAI stand

The Spice 250

Rafael displays latest innovations

Rafael presented an array of innovative aerial capabilities, including the Spyder System with armoured and wheeled platforms. Among others, the Spyder-SR, a low-level surface-to-air missile system, was displayed in the static area. The system is designed to counter attacks by aircraft, helicopters, UAVs and precision guided munitions. The company also presented its Litening-5 (new generation of the airborne day/night navigation and targeting pod, provides precision strike capability to fighter aircraft), Reccelite XR (Real time multi-spectral reconnaissance system for stand-in and stand-off missions), Python-5 (Full sphere air-to-air IR missile and air defense missile), I-Derby (Beyond-Visual-Range, SDR Seeker, air-to-air and air defence missile), I-derby ER (active radar air-to-air missile, with ranges of up to 100 km), Spice Family (2000, 1000, 250) (air-to-ground gliding bombs, with range of up to 100 km), Lite Shield (electronic attack pod for close protection and escort Jamming), Iron Beam (High-Energy Laser (HEL)-Based system, design to intercept close-range rockets, mortars and UAVs) and the BNET SDR FAMILY (Broadband MANET IP Software-Defined Radio for ground and air applications).


The SpyDer system at the static display area

Elbit's new Skylark 3 family of mini-UAS

Elbit unveiled the Skylark 3 at Singapore. Designed for brigade-level and division-level units, the Skylark 3 delivers ground commanders organic intelligence, surveillance, and reconnaissance capabilities – both easily and affordably. To support interoperability, Skylark 3 uses the same advanced technologies and know-how found in other Elbit Systems' UAS. In addition, through a shared GCS, two Skylark 3 vehicles can be assigned to the same mission simultaneously, meaning a consistent target acquisition is maintained from two aspects. This also offers ground forces the ability to significantly extend the flight endurance of their mission by UAS hot-swap.

Elad Aharonson, General Manager of Elbit Systems ISTAR Division commented: "Skylark 3, the latest addition to our family of ultra-lightweight UAS, delivers brigade-level and division-level units, an ideal solution for carrying out complex ISTAR missions in a truly organic network-centric manner. Its easy launch, autonomous maneuverability and control, coupled with its cutting-edge payload technology, provide ground force commanders unrivaled situational awareness and enhanced force protection capabilities, ultimately allowing them to make faster, smarter and more cost-effective decisions."

Saab's GlobalEye redefines Airborne Surveillance Market

Saab has extended its airborne early warning and control portfolio, with the introduction of the GlobalEye multi-role airborne surveillance system. GlobalEye combines Saab's all-new Erieye ER (Extended Range) radar and mission system with the high-end Global 6000 jet aircraft from Bombardier. "With GlobalEye we expand and sharpen our offering, targeting customers looking to maximise their return on investment in extended AEW&C capabilities as a national asset to benefit their country," stated Micael Johansson, head of Saab's business area Electronic Defence Systems.

The multi-role GlobalEye automatically detects and tracks air and surface targets over a huge area. Ground surveillance of moving vehicles can be conducted through long-range, wide-area ground moving target indication (GMTI) radar modes. With the Erieye ER radar, detection and tracking ranges have been significantly increased compared to existing airborne radars, and against the smallest targets. The GlobalEye system can track very low-observable air and sea targets, including 'stealthy' aircraft, cruise missiles or submarine periscopes, even in heavy clutter and jamming environments. The GlobalEye integrates a comprehensive suite of sensors, including signals intelligence, and advanced self-protection equipment with a newly-developed command, control and communication system. Cost-effective system availability is assured through the combination of a small organisational footprint and Saab's in-service support.

A key aspect of the GlobalEye system is the Global 6000 ultra-long-range jet aircraft from Bombardier, which offers the latest avionics and combines ideal size for multi-role and extended AEW&C with outstanding performance. It is a high speed aircraft with impressive short field performance and low operating costs. Thanks to the Global 6000 platform GlobalEye mission endurance can extend up to 11 hours. The launch customer for GlobalEye is the United Arab Emirates, which ordered the system as the Swing Role Surveillance System (SRSS), in November 2015. (*see Vayu I/2016)*

Saab's GlobalEye


Textron Systems Shadow V2 UAV

Textron at Singapore air show

Almost two years after the merger of two famous brands in general aviation, Textron Aviation made its first appearance at the Singapore air show. The company had five aircraft on display, from its high-performance Cessna TTx piston single to its Citation CJ4 business jet. The merged company enjoys a dominant position in many sectors in Asia, said Chris Bogaars, vice president for international sales for Asia-Pacific. "The Citation fleet is the most successful in this region. One new aircraft being pitched at the Asian market that was not on the static display area is the Scorpion light attack/surveillance aircraft, although Textron is promising to take the first production version to the UK's Royal International Air Tattoo and Farnborough show in July. "The aircraft is very applicable to the maritime patrol environment in Asia-Pacific," says Russ Bartlett, president of Beechcraft Defense. "The magic of the Scorpion is that you can put a variety of sensors or equipment in its payload bay. You can do a lot of things very affordably." He said that the Scorpion has been "designed as an ISR [intelligence, surveillance and reconnaissance] aircraft first, and strike aircraft second" and is "positioned at a price point and cost per flight hour that just isn't catered for, significantly under single-engine fighter jets".

Textron Systems Sensor Fused Weapon on display


The new-generation A350 XWB performs another impressive flying display at the Singapore Airshow

Airbus' Asia-Pacific presence reinforced

"As the world's fastest-growing market for new civil aircraft, Asia-Pacific represents a key customer base for Airbus' product line of modern jetliners." There are more than 2,800 aircraft in service with 100-plus operators in the region, and Asia-Pacific customers account for approximately 31 per cent of all Airbus orders globally. Airbus' A350 XWB jetliner had a successful Singapore Airshow, showcasing its capabilities during flying presentations throughout the week and providing up-close views for event-goers while on static display. Approximately one-third of all A350 XWB orders received to date are from Asia-Pacific customers, with Philippine Airlines becoming the latest: announcing at the Singapore Airshow its intention to order six A350-900 versions, with another six purchase options.

Kiran Rao, Head of Strategy and Future Programmes for Airbus, accepted ATW's "Aviation Technology Achievement Award" for the A350 XWB

Airbus Defence and Space signs distribution agreement

Airbus Defence and Space signed an agreement with Singapore Technologies Electronics (Satcom & Sensor Systems) Pte Ltd ("ST Electronics"), as a channel partner for its satellite data and value-added products in Singapore. "We are very enthusiastic about this new cooperation considering ST Electronics' commercial strength on the Singapore market and its capacity to develop value-added services for the benefit of the end-users from this territory," said Bernhard Brenner, Head of Intelligence Business cluster at Airbus Defence and Space, "With this agreement, ST Electronics is now part of our global geo-intelligence services Channel Partner Network, the largest in the world with over 160 resellers."

With privileged access to a unique satellite fleet comprising the TerraSAR-X and TanDEM-X radar satellites and the high and very-high optical satellite constellation SPOT and Pléiades, Airbus Defence and Space offer daily coverage worldwide as well as weather-independent acquisitions, at a variety of resolutions. Based on this data, a substantial portfolio of geo-intelligence products and services as well as customised solutions is available to customers around the Globe.

The Airbus A400M at the static display

Rafales and Thunders in Doha

At the Doha Qatar Air Show in February 2016, announcement was made that down payment in support of the $ 6.9 billion contract for 24 Rafales, plus training, weaponry and maintenance support signed in May 2015, has taken place. There were speculations that the massive fall in global energy prices was the reason for delay, the country's total deficit in the new budget being estimated at QR 46.5 billion.

The Qatar Emiri Air Force has long been operating Dassault aircraft, including Mirage 2000-5s and Alpha Jets, apart from Mirage F1s previously. The Mirage 2000s were subject of some speculation a few years back when they were considered for acquisition by the Indian Air Force but this deal did not come about. The Dassault Rafales for the QEAF will be armed with a range of MBDA ordinance including the Hammer AASM, SCALP ALCMs and extra set AM39 AShMs. The QEAF already has the MICA-IR and EM and will also receive the Meteor BVRAAM, all of which will give the Service "formidable multirole capability."

Also participating at the Doha Air Show were pairs of PAC JF-17 Thunders and PAC Super Mushshaks. The high level Pakistan delegation was led by Prime Minister Nawaz Sharif accompanied by Air Chief Marshal Sohail Aman, CAS PAF, with presentations made to the Emir of Qatar Sheikh Tamim bin Hamad bin Khalifa Al-Thani and Prime Minister Sheikh Abdullah Bin Nasser Bin Khalifa Al-Thani. According to reports from Doha, the leadership of both countries discussed enhanced cooperation in various defence related fields.

More Su-30 MK2Vs for Vietnam

Another two Sukhoi Su-30MK2V multi-role fighters have been delivered to the Vietnam People's Air Force (VPAF) from the KnAAPO factory in Komsomolsk-on-Amur, arriving in Vietnam on board a Volga-Dnepr An-124-100M. A US $600million contract for 12 additional Su-30MK2Vs for the VPAF was signed in August 2013, the first two delivered to Da Nang Air Base in October 2014 and two in December 2014. The VPAF has taken delivery

of some 26 Su-30MK2Vs, the type equipping the 923rd Fighter-Bomber Regiment at Bai Thuong AB, 929th Fighter Regiment/2nd Squadron at Da Nang AB and the 935th Fighter-Bomber Regiment at Bien Hoa AB.

Second Royal Malaysian Air Force A400M delivered

Delivery of the second *Tentera Udara Di Raja Malaysia* (TUDM-Royal Malaysian Air Force) A400M military airlifter, took place on 23 December. The TUDM has four A400Ms on order, the first of which was handed over in Seville on 9 March 2015 and

which then departed on its delivery flight on 12 March. The third TUDM aircraft is completed at Seville, but is yet to be delivered.

Bangladesh inducts AW139s and Yak-130s

Induction ceremony for the Bangladesh Air Force's newly delivered AgustaWestland AW139 helicopters and Yakovlev Yak-130 combat trainer aircraft took place on 6 December 2015 at Bangabandhu Air Base at Dhaka-Kurmitola, the event marking formal entry into service of the BAF's first six (of 16) Yak-130s and two AW139s, to be operated by 1 Squadron in the SAR role. The six Yak-130s had arrived at Chittagong-Zahurul Haque Air Base on board a Volga-Dneper An-124-100 in September 2015 and after re-assembly joined 21 Squadron 'The Avengers' at the base. It has also been revealed that the BAF will take delivery of 16 Chinese Nanchang CJ-6/PT-6s, which would be based at Chittagong-Zahurul Haque Air Base.

Meanwhile, delivery of the last of five Mi-171Sh helicopters to the Bangladesh Air Force has been completed. Bangladesh ordered the Mi-171Sh helicopters under a contract signed with Rosoboron export in late 2013. The helicopters are equipped with additional fuel tanks to increase range and endurance, as well as an external sling for outsize cargo transportation.

Eight more F-16s for Pakistan

Ignoring the flurry of objections from US lawmakers and the Indian government, the Obama administration has moved ahead with its plan to sell eight more F-16 fighters to Pakistan. The administration has defended its decision on the grounds that "Pakistan has been using its fleet of F-16s effectively against terrorists and these have enhanced the PAF's precision-strike capabilities."

The F-16 Block 52s comprise six D models and two C models, powered by the F100-PW-229 engines, as also 14 Joint Helmet Mounted Cueing Systems (JHMCS). Included in the package are eight (8) AN/APG-68(V) 9 radars, and eight (8) ALQ-211(V)9 Advanced Integrated Defensive Electronic Warfare Suites (AIDEWS).

Three more CH-47Fs for Australia

The Australian government has a requirement for three more CH-47 Chinooks, which approval has been granted by the US State Department. The total estimated value is $180 million, and these will join seven already delivered to the Australian Army Aviation Corps. The last of the initial seven was delivered on 10 August 2015.

Pilatus PC-21 for Australia

Under the AUS $1.2 billion deal, Lockheed Martin Australia will deliver 49 Pilatus PC-21s to the Royal Australian Air Force (RAAF), along with seven flight simulators and support for an initial seven-year term. The Lockheed Martin-led Team 21 includes Pilatus, which will provide the PC-21s and through-life engineering and airworthiness support. Hawker Pacific will supply maintenance and fleet support. Lockheed Martin will provide overall project management and deliver a family of integrated ground-based training technologies. Basic Flying Training will be provided at RAAF Base East Sale, Victoria with 22 of the PC-21s, while Advanced Flying Training will continue from RAAF Base Pearce, Western Australia. The contract will also provide three PC-21s as replacement aircraft for 4 Squadron at RAAF Base Williamtown, New South Wales, for forward air control and four for the Aircraft Research and Development Unit (ARDU) at RAAF Base Edinburgh, South Australia.

Australia orders G550s for ISR Role

The Australian Government is acquiring two Gulfstream G550s which will be prepared by L-3 in their Greenville facility, with completion anticipated by 30 November 2017. Australian Government officials have confirmed that these will be used in electronic warfare and airborne intelligence, surveillance and reconnaissance roles.

Nigeria orders JF-17 Thunders

The Nigerian Air Force has ordered the Sino-Pak JF-17 Thunder fighter, which ends years of speculation that peaked in December 2014, when a Pakistani Ministry of Defence official stated that Nigeria was close to signing a contract for the acquisition of 25-40 aircraft. Nigeria has also ordered 10 PAC Super Mushshak basic trainers from the Pakistan Aeronautical Complex (PAC).

J-20 enters LRIP

Following maiden flight of the seventh J-20, China's fifth-generation fighter on 18 September 2015, CAC delivered two more aircraft within only two months, followed by the first low rate initial production (LRIP) aircraft. Several high-speed taxi tests were accomplished before the maiden flight took place on 18 January 2016. This aircraft will be ninth J-20 to fly. LRIP was reportedly started in 2015 and several more airframes are presently under construction.

Algeria's interest in Su-34s

Algeria is reportedly discussing the procurement of Su-34 strike aircraft from Russia. Late in 2015, Sergei Smirov, director of the Novosibirsk Aircraft Production Association (NAPO) plant that manufactures the type, stated that "Russia and Algeria had been in discussions over the Su-34 for the previous eight years and that an official application had been received." It is not confirmed how many aircraft will be acquired, but 12 have been mentioned. Meanwhile, Algeria has confirmed an order for 14 Su-30 fighters from Russia's Irkut to augment their 44 Su-30MKs in service.

P-8 Poseidons at Singapore

In an enhanced defence agreement between Singapore Defence Minister Dr Ng Eng Hen and his US counterpart Ash Carter, the island state will facilitate operation of US Navy P-8 Poseidons from Paya Lebar Air Base, the only such facility in Singapore open to foreign aircraft. The agreement is consistent with the 1990 memorandum of understanding and the 2005 strategic forces agreement signed between the two countries. The first involved P-8s assigned to Patrol Squadron 16 (VP-16) 'War Eagles' from a detachment at Kadena Air Base in Okinawa, Japan and took place in December 2015. P-8 operations from Paya Lebar will not be limited to the South China Sea and will be flown "wherever international law allows, including international air space above the South China Sea and other parts of the region."

Meanwhile, the US Naval Air Systems Command announced its work to integrate the APS-154 Advanced Airborne Sensor (AAS), aboard the P-8A Poseidon. Ongoing testing by Air Test and Evaluation Squadron 20 (VX-20) based at Naval Air Station Patuxent River, Maryland seeks to confirm the ability of the P-8A and AAS to operate safely and efficiently. The APS-154 radar is housed in a large externally mounted radome carried on underside of the aircraft's fuselage and is a follow-on to the Littoral Surveillance Radar System (LSRS) used by the US Navy P-3C Orion aircraft to detect moving and stationary targets at sea and on land. The system is classified as an integrated intelligence, surveillance, reconnaissance and targeting asset, with mast and periscope detection capability.

Eight more A330 MRTTs for FAF

The French Government has placed orders for a further eight Airbus Defence and Space A330 Multi-Role Tanker Transport (MRTT) aircraft , which constitutes the second tranche of the multi-year contract for 12 A330 MRTTs signed by the French Ministry of Defence. A firm order for the first of these was placed in June 2015 and the latest announcement brings the total firm order for the French Air Force to nine, the first French MRTT to be delivered in 2018, followed by the second in 2019. The remainder will follow at a rate of one or two per year. In French service, the type will be known as the *Phénix* (Phoenix) powered by Rolls-Royce Trent 700 engines and equipped with a combination of the Airbus Refuelling Boom System and underwing hose-and-drogue refueling pods.

29 additional MH-60Rs for US Navy

Sikorsky has contracted for a further 29 MH-60Rs for the US Navy, associated programme and logistics support also included in the contract, which has been financed with Fiscal Year 2016 'other procurement' funding. The award is a modification to the $8.5 billion contract signed on 10 July 2012, covering US Army and US Navy purchase of a baseline quantity of 653 UH-60M Black Hawk and MH-60R/S Seahawk helicopters through to December 2017. The deal also included options on a further 263 of these helicopters.

Support of Egyptian Mi-8T/Mi-17-Vs

Russian Helicopters will provide after-sales service and maintenance for the Egyptian Air Force's fleet of Russian-made helicopters, involving heavy maintenance support of the EAF's fleet of 41 Mil Mi-8Ts and three Mi-17-IVs. Russian Helicopters will authorise the Heluane plant as an official aircraft repair plant for the type. To support comprehensive work to the airframes, components gearboxes and rotor systems in helicopters operated by the EAF, Russian Helicopters will deliver specialised equipment to the facility, carry out commissioning work and transfer all the necessary documentation to Egypt. Egyptian specialists will be trained to work on Mi-8Ts, Mi-17-1Vs and Mi-17V-5s at Russian Helicopters' Novosibirsk Aircraft Repair Plant.

Zambian AF with L-15s

The first Zambian Air Force pilots and maintenance personnel have completed conversion to the Hongdu L-15 Falcon advanced jet trainer at Nanchang. The training took place on the first ZAF L-15s, which are expected to begin delivery in June. Although the ZAF was known to have signed a contract for acquisition of the L-15, details were never clear. It is now known the order is for six aircraft with a further six options. Unlike the first six, the second six will have a new afterburning engine currently in development.

More Iraqi Mi-28NEs

An additional two Mil Mi-28NE Night Hunter attack helicopters have been delivered to the Iraqi Army Aviation Corps. An initial batch of three Mi-28NEs was delivered to Iraq at the end of August 2014 and a second batch, which arrived on 1 February 2015, comprised only two helicopters and another four were delivered in August followed by two more in September.

An-178s for Saudi Air Force

Antonov and Saudi Arabia's Taqnia Aeronautics Company have signed an MoU for the delivery of 30 An-178 multi-purpose aircraft to the Royal Saudi Air Force (RSAF), an extension of co-operation between the two companies. Under the new agreement, the two companies will also jointly market the An-178 to other Middle Eastern countries and promote special purpose variants of the An-148. Major General Ali Mohammed Al-Ghamdi, President of Taqnia Aeronautics, stated that the An-178 had been selected because of "its advantageous characteristics, price and low operating costs compared to other types in its class."

Meanwhile, Lockheed Martin and Sikorsky have won contracts to provide ten MH-60R Seahawk helicopters for the Royal Saudi Naval Forces (RSNF). The MH-60R will be used by the RSNF to guard against maritime security threats and for secondary missions including vertical replenishment, search and rescue (SAR) and communications relay.

USS *Harry S Truman* in operations against Daesh

US Navy aircraft from the aircraft carrier USS *Harry S Truman* (CVN 75) flew their first missions in support of Operation 'Inherent Resolve' (OIR) on 29 December 2015. The *Truman* and embarked Carrier Air Wing 7 (CVW-7) have joined French carrier FS *Charles de Gaulle* (R 91) in combined combat operations against Daesh in Iraq and Syria from the Arabian Gulf. The *Truman* left its home port in Norfolk, Virginia in November and its arrival in the region marks the return of a US carrier to anti-Daesh operations after departure of the USS *Theodore Roosevelt* (CVN 71), which ended air strike operations against Daesh and left the Fifth Fleet area of responsibility.

C295W for Mali

Mali becomes the 23rd country to order the C295W transport and mission aircraft from Airbus Defence and Space. The single winglet-equipped model is now the standard version in transport configuration and has been ordered for the Mali Air Force, delivery due in the second half of this year. Head of Marketing and Sales, Jean-Pierre Talamoni stated, "The C295 is part of the

Airbus Defence and Space family of light and medium airlifters which also includes the earlier C212 and smaller CN235 platforms. Airbus Defence and Space now offers the C295W, featuring as standard winglets and higher engine power ratings, giving increased performance in all flight phases and lower fuel burn."

Embraer Phenom 100s for UKMFTS

The Embraer Phenom 100 business jet has been selected to provide multi-engine pilot training to armed forces aircrew in the United Kingdom. The contract with Affinity Flight Training Services will provide five aircraft to the UK Ministry of Defence's Military Flying Training System, (UKMFTS) programme. The Fixed Wing programme is intended to replace the elementary, multi-engine and basic flying training that is currently delivered on aging platforms with a new fully integrated solution that provides state-of-the-art training aircraft, ground based training devices and courseware all derived from the training design developed by Ascent Flight Training, the training service provider of the MFTS programme in UK. In 2014, Affinity was selected by Ascent Flight Training to provide and operate the aircraft selected for the MFTS programme.

T-6C for the UK Military Flying Training System

Beechcraft Defence Company, LLC, a subsidiary of Textron Aviation Inc will provide 10 Beechcraft T-6C Texan II military training aircraft to the UK Ministry of Defence's Military Flying Training System (UKMFTS) programme. A second contract has also been signed to include five years of engineering services, parts support, maintenance training and the placement of on-site Field Service Representatives who provide ongoing technical expertise to UKMFTS maintenance personnel. The T-6C trainers will replace Shorts Tucano T1 aircraft and join the fleet of Beechcraft King Air 350ER turboprops, which are already providing live and synthetic radar training for Royal Navy observers as part of the UKMFTS Rear Crew Training programme.

KF-X Full Scale Development

Development of South Korea's KF-X fifth generation fighter has been given the 'go ahead', with signature of contract between the Defence Aquisition Programme Administration (DAPA) and Korea Aerospace Industries (KAI). The development programme, expected to be worth around $7.4 billion, including production of six prototypes, will take a decade through to June 2026, leading to first deliveries to the Republic of Korea Air Force (ROKAF) in September 2026. The ROKAF is to acquire 120 of the type, with build of an initial 40 of the twin-engined fighters for the ROKAF by 2028, after which a further 80 are intended to be delivered to the service between 2029 and 2032. The KF-X is proposed to replace Korea's ageing fleets of Northrop F-5E/F Tiger IIs and McDonnell Douglas F-4E Phantom IIs.

Meanwhile, Indonesia is funding 20% of the development programme and plans to buy 80 aircraft for its Air Force. A provisional partnership deal between KAI and Indonesia was signed in November 2015, the agreement including delivery of one of the six development aircraft to the latter. This was formalised when a final agreement was signed on 7 January between KAI and Indonesia's PTDI at the Indonesian Defence Ministry in Jakarta. KAI is teamed with Lockheed Martin as its foreign technical assistance partner for KF-X and the Eurojet EJ200 reportedly has all attributes for meeting the KF-X performance goals.

First Japan-assembled F-35A

Major components (fuselage, wings and tail) of the first Lockheed Martin F-35 Lightning II have been put together at the Mitsubishi Heavy Industries (MHI) Final Assembly and Check-Out (FACO) facility in Nagoya, Japan. The aircraft (F-35A AX-5) will be rolled out of the factory for delivery to the Japan Air Self-Defence Force (JASDF) in 2017, while first four JASDF F-35As, AX-1 to AX-4, are being produced in the US and are currently in various stages of assembly at Fort Worth, Texas. The first, AX-1, is scheduled for delivery later this year. The remaining 38 JASDF F-35As, AX-5 to AX-42, will be assembled and delivered from Nagoya, which was also selected in 2014 as the regional F-35 overhaul facility.

Chinese Y-20 developments

The Chinese heavy lift aircraft, the Y-20, reached another milestone in early 2016 when AVIC/IXAC reported that all tasks concerning its development phase had been successfully accomplished. Following the first prototype in January 2013, the second airframe acted as static test aircraft and followed in December 2013. According to reports, an aircraft was finished in February 2014, but this is still unconfirmed and is likely to be another test aircraft. During that time, a pulse assembly line has been completed at XAC and is ready for production. The fifth Y-20 was reported as being ready for its maiden flight in July 2015, but was only recently spotted at Qionglai North. The type is currently undergoing operational evaluation with the PLAAF by its 4th Transport Division and is expected to enter service in 2017.

Sukhoi Superjet stretched

A stretched version of Sukhoi's Superjet 100 will receive certification in 2019, the firm's president Ilya Tarasenko confirming that conceptual design studies on the new variant, dubbed the SSJ100SV (Stretched Version) are due for completion by March 2016. This will feature an extended fuselage and a redesigned wing, and seat up to 125 passengers and also have an increased maximum take-off weight of around 55 tonnes. "The aircraft will compete directly against the Embraer E-Jet E2 and Bombardier C Series."

Russia's Advanced Lift Helicopter

Russian State Corporation Rostec has announced that contract for the Russian–Chinese Advanced Heavy Lift (AHL) helicopter programme would be signed in mid-2016. Under the agreement, Russian Helicopters will partner with China's Avicopter, part of the China Aviation Industry Corporation (AVIC), to develop the new helicopter. Rostec deputy CEO Dmitry Shugaev stated, "We can say that both sides have a desire to come together and finalise their contractual obligations as well as sign an intergovernmental agreement." Rostec's representative in China also stated that Russia and China were considering the possibility of equipping the Mil Mi-34 light helicopter with a Chinese powerplant and undertaking joint assembly in China.

First Israeli F-35A 'Adir'

Lockheed Martin has begun final assembly of the first F-35A Lightning II for Israel, which has given the type a Hebrew name, 'Adir' (Mighty One). The aircraft, designated as F-35A aircraft AS-1, officially began its final assembly process, where the four major components of the aircraft are joined together in an Electronic Mate and Assembly Station to form the aircraft's main structure. AS-1 is expected to roll out of the factory in June 2016 for delivery to the Israel Air Force later this year. Israel has contracted for 33 F-53A Adir aircraft through the US Government's Foreign Military Sales programme. Israel's contribution to the F-35 programme includes Israel Aerospace Industries F-35A wing production; Elbit Systems work on the Generation III helmet-mounted display system, which all F-35 pilots fleet-wide will wear; and Elbit Systems-Cyclone F-35 centre fuselage composite components production.

Finmeccanica begins final assembly of Polish Air Force M-346

Finmeccanica has started final assembly phase for the first two Aermacchi M-346s for the Polish Air Force, at a ceremony attended by General Commander of the Polish Armed Forces, Lieutenant General Miroslaw Rozanski, Brigadier General Tomasz Drewniak, Inspector for the Air Force, and Col. Paweł Smereka, Commander of the 41st Training Airbase. The delivery of the first two M-346 aircraft, built at Finmeccanica's Aircraft Division facility

in Venegono Superiore (Varese, Italy), is scheduled for the end of November 2016, in line with the programme's time frame. Signed in February 2014 with the Polish Ministry of Defence, the contract is to supply eight M-346 advanced jet trainer aircraft to replace the currently operational TS-11 Iskra.

A350-1000 in final assembly

Airbus has started final assembly of the first A350-1000, on schedule, at the A350 XWB Final Assembly Line (FAL) in Toulouse, France. This A350-1000, one of three flight test aircraft to be built, will be ready before the end of 2016 and deliveries will start in mid-2017. To ensure smooth integration of the A350-1000 into the FAL while A350-900 production is ramping-up, Airbus has added three additional final assembly stations. For maximum flexibility, all stations in the A350 XWB FAL can be used for both models.

While having a very high degree of commonality with the A350-900, the A350-1000, measuring nearly 74 metres from nose to tail, is the longest fuselage version of Airbus' all-new family of wide body jetliners. The A350-1000 will be powered by Rolls Royce Trent XWB-97 engines, the most powerful engine developed for an Airbus aircraft. The A350-1000 seats 366 passengers in a typical 3-class configuration and flies on routes of up to almost 8,000 nautical miles which represents a significant revenue-generating advantage for operators. Airbus has confirmed 181 A350-1000 orders from 10 customers.

Solar-powered Airbus Zephyr 8s for UK

The UK Ministry of Defence has contracted Airbus Defence and Space for the manufacture and operation of two solar-powered Zephyr 8 high-altitude pseudo-satellite (HAPS) craft. Flying at some 65,000 ft, the ultra-lightweight Zephyr 8 is uniquely capable of providing persistent surveillance over land or sea, and hosting communications links, over the same area for months at a time without landing. Although, the precise purpose for which the UK MoD will use its Zephyrs have not been disclosed, the craft flew slowly and above weather systems, loitering over a selected area under the close guidance of a ground controller to perform its mission. The latest generation Zephyr 8 has a wingspan of 25 metres, is 30% lighter and can carry 50% more batteries than its predecessor, the 22.5 metre wingspan Zephyr 7. The first Zephyr 8 is under construction at Airbus Defence and Space's Farnborough, UK facility and is due to fly in mid-2017.

ASRAAM missiles for F-35 integration

MBDA has commenced deliveries of a quantity of Advanced Short Range Air-to-Air Missiles (ASRAAM) for forthcoming integration of this infra-red air dominance missile with the RAF's F-35B. ASRAAM will be the first UK missile to arm the F-35 and its integration within the F-35 System Development and Demonstration (SDD) phase of the programme will give the Royal Air Force and the Royal Navy's F-35s a highly capable, passive, Within Visual Range air-to-air capability.

These test missiles will be used during 2016 for a series of flight trials and air-launched firings that are a key step towards the Initial Operating Capability of the aircraft by the UK. The trials will include environmental data gathering, safe separation from the aircraft, weapon integration with the F-35's on-board systems, and lastly, weapon firing trials involving the engagement of targets. These integration activities will take place at both the Naval Air Station Patuxent River and Edwards Air Force base in the USA.

ASRAAM is the Advanced Short Range Air-to-Air Missile in service with the RAF on the Tornado and Typhoon, the Royal Australian Air Force on the F/A-18 Hornet and on order for the Indian Air Force's Jaguars. The missile flies at over Mach 3 and its sleek, agile airframe, powerful motor, sophisticated seeker and software "are designed to defeat current and future countermeasures."

Lockheed Martin's T-50A for USAF APT

Lockheed Martin announced that it will offer the T-50A in the US Air Force's Advanced Pilot Training (APT) competition, also known as T-X.. The T-50A is developed jointly by Lockheed Martin and Korea Aerospace Industries (KAI) to replace the T-38

and train the next generation of pilots to fly 5th Generation aircraft. Lockheed Martin also announced that it has selected the company's Greenville Operations facility in South Carolina, as the preferred Final Assembly and Checkout (FACO) site for the T-50A. "The T-50A is production ready now. It is the only offering that meets all of the APT requirements and can deliver those capabilities on schedule," stated Rob Weiss, executive vice president and general manager, Lockheed Martin Advanced Development Programmes (Skunk Works).

Finmeccanica IFF systems for Swedish and Brazilian Saab Gripen NGs

Finmeccanica, through its Airborne and Space Systems Division, has signed contracts to provide Identification, Friend or Foe (IFF) systems for the Gripen Next Generation (Gripen NG) aircraft earmarked for the Air Forces of Sweden and Brazil. The

IFF systems will be used by Gripen pilots to identify other aircraft or vehicles as friendly (or potentially unfriendly) and to determine their bearing and range from the aircraft. Independent from the Gripen NG's radar and other sensors, the IFF system can look in a different direction, allowing the pilot to use the radar to queue-up targets for subsequent identification. Of particular note, the IFF system's separate antennas give it a wide, more-than 180 degree field of regard, providing operational benefits.

Each complete IFF system consists of a transponder and an interrogator. Also included is a crypto customised in accordance with customer requirements. The transponder, which is the company's Mode 5 M428 model, is the same being offered to the UK MoD to address NATO's requirement for a new standard of IFF across all platforms.

Finmeccanica and Saab collaborate on EW

Finmeccanica has signed an MoU with Saab to collaborate in EWOS (Electronic Warfare Operational Support) solutions. EWOS is the combination of mission support tools, people, specialised training and infrastructures that allows operators to get the most benefit out of their of electronic warfare systems. Selex ES are already strategic partner to Saab in a number of areas of defence and security. Notably all contracted Saab Gripen Next Generation (NG) fighters incorporate the Selex ES Raven ES05 AESA radar, Skyward-G IRST (Infrared Search & Track) passive sensor and IFF (Identification Friend-or-Foe) systems, with the Swedish company also being the first to offer Selex ES's new BriteCloud expendable active decoy as an electronic warfare option.

Turbomeca's Arrano engine on H160

Turbomeca's (Safran) Arrano engine powered the Airbus Helicopters H160's first flight at their Marignane plant. Since its first ground run in February 2014, more than ten test engines have been running at Bordes (France) to demonstrate performance, and major development and certification tests include a rigorous endurance evaluation campaign. The turbine's fuel consumption target has already been achieved: data indicates a 10 to 15% reduction compared with current models.

118 Airbus airliners for Iran

In major move, Iran has signed two agreements with Airbus covering new aircraft orders and a comprehensive civil aviation co-operation package. The agreements were signed at the Élysée Palace in Paris during Iranian President Hassan Rouhani's official visit to France on the invitation of French President François Hollande in end-January 2016. Iran Air has signed an agreement with Airbus for the acquisition of the full range of new Airbus airliners (73 widebodies and 45 single aisle), which includes pilot and maintenance training and support services to help the entry into service and efficient operations of these new aircraft. The agreement for 118 new aircraft signed by Farhad Parvaresh, Iran Air Chairman and CEO, includes 21 A320ceo family, 24 A320neo family, 27 A330ceo family, 18 A330neo (-900), 16 A350-1000 and 12 A380s.

"The skies have cleared for Iran's flying public and Airbus is proud to welcome Iran's commercial aviation back into the international civil aviation community. Today is a significant step in the overhaul and modernisation of Iran's commercial aviation sector and Airbus stands ready to play its role in supporting it," said Fabrice Brégier, Airbus President and CEO.

ATR 72-600s for Iran Air

ATR and Iran's national flag carrier Iran Air have signed in Teheran a deal for the purchase of 40 newest generation ATR 72-600s. The signature of the deal follows the commercial discussions held during the visit of the President of Iran, Hassan Rohani, and the Minister of Transportation of Iran, Abbas Ahmad Akhoundi.

Aeroflot consolidates

Aeroflot's reorganisation, driven in part by the recent failure of rival Transaero Airlines, will include merging Donavia and Orenair into Rossiya. The 'new Rossiya' will assume control of the three airlines' combined network of 90 destinations along with former Transaero routes transferred to Aeroflot in late 2015. The new-look carrier is also expected to inherit 24 widebody aircraft, which include five Boeing 777s, five 767s and 14 747-400s. The re-organisation, which will "save the Aeroflot Group billions of roubles in operating costs," is intended to create three distinct tiers: Aeroflot mainline will operate as the premium brand, Rossiya will serve the middle of the market segment and Pobeda for low-cost. Russian Far East offshoot Aurora will continue to operate separately.

A350 debut for TAM

TAM Airlines' first Airbus A350 XWB flew from Toulouse, France on 1 December. The aircraft passed the final production phase, which included ground and flight tests before being handed over to the Brazilian carrier later that month, the first of 27 examples the LATAM Airlines Group has on order. The carrier started operations with the new aircraft in January between Sao Paulo and Manaus and will be followed by international services from Sao Paulo to Miami, Madrid and Orlando.

Chinese airlines expand

China's largest budget carrier, Spring Airlines has signed a $6.3 billion deal for 60 Airbus A320neo Family aircraft. The purchase consists of 45 A320neo and 15A321neo jets and is meant to meet the massive demand for air travel from Chinese tourists. The new airliners are scheduled for delivery from 2019 through to 2023 and will increase Spring Airline's capacity by 158%.

Meanwhile, another Chinese airliner, Guizhou Airlines has taken delivery of the first of seven Embraer 190s on order with the Brazilian manufacturer. China Southern Airlines is planning to increase its stake in subsidiary Xiamen Airlines from 51% to 55% to help enhance the synergies between the two carriers.

'Make in Singapore': RR Trent 7000s

Rolls Royce plan to move production of its Trent 7000 engines, the exclusive powerplant for the Airbus A330neo, to its Seletar facility in Singapore, "because of the experience and expertise the Singaporean team has gained on building Trent 1000 engines for the Boeing 787 Dreamliner programme." The Seletar operation expects to ramp up its production of engines from the current 170+ to 250 a year by 2017. The Trent 7000 demonstrator engine has been run for the first time on a test-bed at Rolls-Royce's Derby facility and the first Trent 7000 powered A330neo is due to enter service next year.

Cebu Pacific ATR 72-600s

ATR has received EASA certification for its high-density variant of its ATR 72-600. Using the existing airframe, the new layout optimises the pitch as well as adjusting the forward cargo compartment, bringing the aircraft maximum capacity from 74 to 78 seats. The option will also be available as a retrofit. Cebu Pacific will be the first carrier to adopt the new configuration under a deal of 16 new aircraft, its first example entering service in August 2016.

A321neo with CFM LEAP-1s

The first A321neo equipped with CFM International LEAP-1A engines made its maiden flight on 9 February from Hamburg, Germany. The flight lasted five hours and 29 minutes during which tests were performed on the engine speed variation (low/high), systems behaviour and to validate the aircraft's flight envelope. The A321neo will join the NEO flight test fleet and perform a partial flight test programme to validate the impact on handling qualities, performance and systems. The first A321neo will be delivered at the end of 2016.

A380s for ANA Holdings

ANA Holdings has placed a firm order for three Airbus A380s, becoming the first Japanese airline to operate the mega airliner. ANA Group will take delivery of the aircraft from 2019 and has

selected Rolls-Royce Trent 900 engines to power its new A380 fleet. ANA Holdings' new order follows a recent order placed in 2014 and 2015 for 37 A320 Family single aisle aircraft.

A350XWB for China Airlines

Assembly of the main airframe sections of the first A350 XWB for China Airlines is progressing at Airbus' Final Assembly Line (FAL) in Toulouse, France, involving assembly of the wing-fuselage junction, installation of the tailplane and also the tailcone. China Airlines has 14 A350-900 twin engine widebodies on order. The aircraft will be deployed on the carrier's long-haul routes to Europe, Australia and the United States as well as on selected regional routes. China Airlines currently operates 24 A330s and six A340s on regional and long haul services.

Gulf Air orders 29 A320neo Family aircraft

As part of its fleet renewal strategy, Gulf Air has announced a firm order of 29 A320neo Family, which includes 17 A321neo and 12 A320neo of which 10 A320neo have been confirmed in 2012. The contract was signed at the Bahrain International Airshow between Maher Salman Al Musallam, CEO Gulf Air and Fabrice Brégier, Airbus President and Chief Executive Officer, in the presence of Kamal bin Ahmed Mohammed, Minister of Transportation and Telecommunications, Kingdom of Bahrain.

Comlux orders three Airbus ACJ320neo aircraft

Comlux Aviation Group has announced an order for three Airbus ACJ320neo aircraft, becoming the largest customer for Airbus' new corporate jet family. The order also consolidates Comlux's leadership in Airbus corporate jet deals, with more to its credit than any other client, with deliveries to begin at the end of 2018. Comlux has chosen CFM International LEAP-1A engines to power the aircraft. Cabin outfitting will be by Comlux America, in Indianapolis, the first independent authorised Airbus corporate jet service centre. Comlux has ordered corporate jet versions of all of the ACJ320 Family, and was the first to operate the Airbus ACJ318 and ACJ321.

First Airbus A320neo for Lufthansa

Lufthansa celebrated delivery of the world's first Airbus A320neo in the presence of Carsten Spohr, Chairman of the Board and CEO of the Lufthansa Group, Airbus President and CEO Fabrice Brégier and the President of Pratt & Whitney Robert Leduc at Hamburg-Finkenwerder. The first A320neo (D-AINA), has already flown scheduled service from January, the second 'neo' expected to complement the Lufthansa Airbus fleet shortly. Lufthansa Group's Airbus orders have reached a combined total of 582 aircraft including 386 A320 Family, of which 116 are NEOs (71A320neo and 45 A321neo). The full range of Airbus widebody aircraft have been or will be a part of Lufthansa's fleet from the innovative A300/A310 to the iconic A380 (14 in service), the versatile A330 to the modern and extra comfortable A350 XWB (25 firm orders).

Boeing 737 for Xiamen Airlines

Boeing have delivered the 8,888th 737 to come off the production line to Xiamen Airlines. The Next-Generation 737-800 features a special livery commemorating the aircraft's significance. Formed in 1984 as China's first joint venture between the Civil Aviation Administration of China and a municipal government, Xiamen Airlines is China's only all-Boeing carrier flying passengers in 1985 with two 737-200s serving three cities. With this delivery, Xiamen Airlines has now expanded its fleet size to 133 Boeing airliners, including 17 737-700s, 106 737-800s, 4 757-200s and 6 787-8s.

Bombardier introduces 90-seat Q400

Bombardier Commercial Aircraft has introduced the world's first commercial turboprop capable of carrying 90 passengers. "As part of Bombardier's ongoing commitment to the evolution of the Q400 aircraft programme, we are thrilled to offer customers increased capacity on regional routes with high passenger demand and the growth potential to increase profitability," stated Fred Cromer, President, Bombardier Commercial Aircraft. As a confirmation of Bombardier's focus on continuous improvement aimed at addressing traffic growth and customer bottom line, Bombardier is also pleased to announce a 2,000 lb-increase in payload and an escalation of the A-Check and C-Check intervals from 600/6,000 to 800/8,000 flight hours*, all available for entry-into-service as early as 2018.

RBS 70 Bolide Missiles for NSPA

Saab has received an order for RBS 70 Bolide missiles from NATO Support and Procurement Agency (NSPA) in December 2015. The Saab portfolio of short-range ground based air defence missile systems comprises the RBS 70 and the further enhanced RBS 70 NG. The order for RBS 70 Bolide missiles, placed by NATO Support and Procurement Agency (NSPA), is part of the long-term plan to enhance their air defence capabilities.

19 countries have so far procured more than 1,600 RBS 70 systems, including more than 17,000 missiles. The Bolide missile is the 4th generation all-target very short range air defence (VSHORAD) missile from Saab, developed to meet "the complete threat spectrum from fixed and rotary wing aircraft down to small targets such as cruise missiles and UAVs, with a range of more than 8 kilometres and with altitude coverage in excess of 5,000 metres." The RBS 70 is operationally proven and suitable in a wide range of climatic conditions. It is effective in clutter and jamming environment in different combat situations, as well as for event protection, and can also be launched from high mobility vehicles and ships.

F90 assault rifle for Australian Defence Forces

The Australian Department of Defence has signed an AUD 100 million contract with Thales to produce rifles, grenade launchers, spare parts and various ancillaries at Thales's facility in

Lithgow, NSW. The F90 is a light, versatile weapon "that meets the highest standards of performance and reliability," and in Australian Defence Force (ADF) service, the rifle will be known as the Enhanced F88 (EF88), marking a significant enhancement of the original Austeyr F88. Two versions will be delivered: a standard rifle with a 20" barrel, plus a carbine with a 16" barrel. Deliveries to the ADF will begin in the next few weeks and phased over six years.

Oshkosh JLTVs for US Army

The US Army Tank-automotive and Armaments Command (TACOM) Life Cycle Management Command (LCMC) has awarded Oshkosh Defense, LLC a $6.7 billion firm fixed price production contract to manufacture the Joint Light Tactical Vehicle (JLTV). The JLTV programme fills a critical capability gap for the US Army and Marine Corps by replacing a large portion of the legacy HMMWV fleet with a light tactical vehicle with "far superior protection and off-road mobility."

Harris contracted by US ANG and USN

Harris Corporation has received a $13 million order to supply the Air National Guard (ANG) with vehicular tactical and public safety radio systems that provide critical ground-to-air voice and data communications during wartime and domestic emergency responses, including natural disasters. Each system includes multiple Harris Falcon III AN/PRC-117G Multiband Networking Manpack Radios, the Harris AN/PRC-150 High-Frequency Manpack Radio, and Harris' Unity XG-100M Full-Spectrum Multiband Mobile Radio.

Harris Corporation has also received a contract from the US Naval Sea Systems Command (NAVSEA) to upgrade the Navy's primary long-range, three-dimensional defence radar, the contract including an initial $39 million order and three one-year options. Harris was awarded the contract under the Navy's Radar Obsolescence and Availability Recovery (ROAR) programme to upgrade AN/SPS-48E radars to the more advanced SPS-48G version, which uses a modern solid-state transmitter.

Raytheon's SM-6 tested

The US Navy has successfully executed four flight tests of Raytheon's surface-to-air Standard Missile-6 Block I (SM-6 Blk I) off the Hawaiian coast in January 2016. These tests, designated Alpha, Bravo, Delta and Golf, are part of the SM-6 Blk I Follow-on Operational Test and Evaluation (FOT&E) events planned to assess missile performance. The SM-6 provides an over-the-horizon engagement capability when launched from an Aegis warship and uses the latest in hardware and software missile technology to provide needed capabilities against evolving air threats. Flight test Alpha was the longest downrange, and flight test Bravo was the longest cross-range intercepts with an SM-6 to date. Along with flight tests Alpha and Bravo, flight test Delta successfully intercepted two targets with simultaneous engagements, and flight test Golf successfully intercepted a target with electronic counter-measures.

The SM-6 programme has completed development and achieved Initial Operational Capability in November 2013, being currently in the FOT&E phase, with a projected Full Operational Capability declaration date during the first quarter of fiscal year 2018.

Lockheed Martin delivers 200th F-35 EOTS

Lockheed Martin has delivered the 200th Electro-Optical Targeting System (EOTS) for the F-35 Lightning II. All 200 systems have been delivered on time or ahead of schedule for aircraft integration. Lockheed Martin is delivering F-35 EOTS under Low-Rate Initial Production contracts with a total of 367 systems ordered to date. Planned production quantities for the F-35 exceed 3,000 aircraft with deliveries through 2030. The F-35 EOTS is the world's first sensor to combine forward-looking infrared and infrared search and track functionality to provide F-35 pilots with precise air-to-air and air-to-ground targeting capability. EOTS allows aircrews to

identify areas of interest, perform reconnaissance and precisely deliver laser- and GPS-guided weapons while maintaining a stealthy profile.

Singapore Airlines 1st A350 XWB

Singapore Airlines has taken delivery of its first A350 XWB in Toulouse, France, becoming the fifth operator of the all-new widebody airliner. The A350 XWB will form the backbone of Singapore Airlines' future mid-size widebody fleet. Singapore Airlines' aircraft is configured in a premium three class layout with 253 seats, comprising 42 Business Class, 24 Premium Economy and 187 Economy. Altogether the airline has ordered 67 A350-900s which will be operated on long range flights, as well as on selected regional services. Seven of the aircraft will be delivered with an ultra-long range capability for flights of up to 19 hours, allowing the carrier to resume non-stop flights to the US. The A350 XWB will join an existing Airbus fleet at Singapore Airlines that currently comprises 19 A380s and 29 A330-300s, making the carrier an operator of the complete Airbus Widebody Family.

Second MC-21 composite wing panel delivered

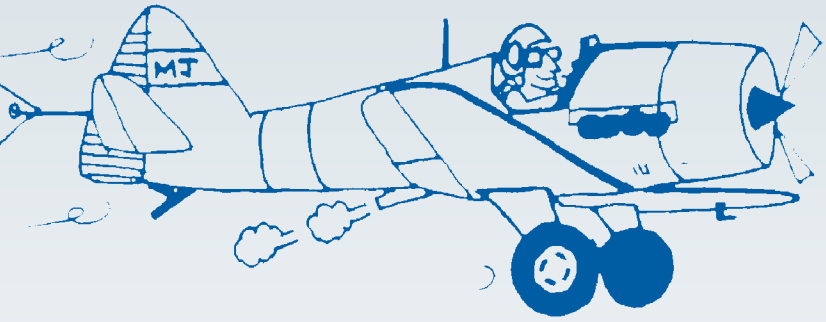
On 4 March, the second composite wing panel for MC-21 airliner manufactured by Aero Composite (a UAC subsidiary) was delivered to Irkut Corporation. Currently Irkutsk aviation plant is busy with connection of the first wing panel with the fuselage and installation of aircraft systems. Aero Composite performs assembly of the composite wing box for strength and static tests in TsAGI (Central Aerohydrodynamic Institute), as well as manufacturing of composite panels for MC-21 static tests.

The MC-21 cockpit on display at the Paris Airshow 2013

USAF Reveals B-21 Long Range Strike Bomber

US Air Force Secretary Deborah Lee James revealed the first rendering of the Long Range Strike Bomber, designated the B-21, at the Air Force Association's Air Warfare Symposium on 26 February 2016 and announced the Air Force would be taking suggestions from airmen to help decide the name of the bomber. While there are no existing prototypes of the aircraft, the artist rendering is based on the initial design concept. The designation B-21 recognises the LRS-B as the first bomber of the 21st century. The reveal came just weeks after both James and Air Force Chief of Staff Gen Mark A Welsh III delivered the fiscal year 2017 posture statement before the Senate Appropriations Committee, making it clear modernisation is a top priority for the Air Force.

James said, "The B-21 would allow the Air Force to operate in tomorrow's high end threat environment, and give the Air Force the flexibility and the capability to launch from the continental United States and deliver airstrikes on any location in the world." She also explained why the B-21 shares some resemblance to the B-2. "The B-21 has been designed from the beginning based on a set of requirements that allows the use of existing and mature technology," James concluded. The programme recently entered into the Engineering and Manufacturing Development phase and the Air Force plans to field the initial capability of the aircraft in mid-2020s.



For Pete's Sake

Early on New Year's Day we received the sad news of the passing away of 88 year-old Air Commodore PM Wilson, VrC on 28 December 2015 in the UK. Pete, as he was known to more than a generation of the Indian Air Force, received a spate of tributes from his long list of friends and admirers. Few are legends in their own time and this unassuming, straight forward officer, gentleman and pilot par excellence, was certainly one. A natural flier and strategic thinker in the employment of air power, Pete was also blessed with the rare gifts of both common and uncommon sense. Tall and fair, his hooded eyes seldom missed anything in the air or on the ground. His laconic speech was frequently laced with an understated sense of humour. Five years my senior, he was for me, instructor, guide, mentor and friend.

Our relationship dates back to 1951 when, as a flight cadet at the Basic Stage of pilot training on the Tiger Moth, Fg Offr Pete Wilson took me up for my very first sortie of low flying. This was an experience I still recall vividly 65 years later! He was a pioneer Canberra pilot, an aircraft he swore by. In 1968, on promotion to group captain, he came and took over the air base at Jamnagar where I had raised our air force's first Hunter Operational Training Unit, which I was in command of, as a Wing Commander. On one occasion, when a Canberra from his old squadron landed, he hijacked it, put me in the navigator's cockpit and flew low level over the Arabian Sea teaching me how to calculate drift! Thereafter I had the embarrassment of converting him on to the Hunter. I soon realised that within a few sorties he was handling the aircraft with greater skill than I, despite my extensive type experience! We both flew the Marut and Gnat for the first time. He flew the Hunter regularly and my flying instructors and I learned a great deal from this very experienced aviator who just loved flying. At my farewell party he finally admitted that the Canberra was the "second–best aircraft" he had ever flown!

Indian Air Force Hawker Hunter Mk. 56

Indian Air Force Canberra Mk. 66

Learning from Pete was not restricted only to the medium of the air. I recollect one occasion after the 1971 Indo Pak war when Pete was at the NDC and I had come to Delhi from Pathankot for my investiture. He called to congratulate me and asked me over for dinner as he was keen to learn about all the counter air sorties I had flown. While recounting my experience, I included some unflattering comments about the leadership of my air base. Pete listened patiently and responded thus: "when you work under effective seniors, observe them and learn what to do. If you work under ineffective ones, observe them and learn what not to do!" A typically cryptic example of 'Peters Principle' if you will. Pete's own professionalism as a pilot had been demonstrated in the 1965 Indo-Pak war, when he was awarded the VrC, and again as an air base commander in the 1971 war. In the mid-1970s he left the air force and migrated to the UK.

We continued to keep in touch. In 1980, while I was attending the RCDS in London, Pete was with Scotland Yard. We were both within walking distance of St. James' Park and met there frequently for an open air lunch on a park bench with sandwiches from the Wilson household and beer from the pub behind my college. We communicated more freely than when he was in uniform but I could sense that he had his heart in the world of military aviation he had left behind. Just a few weeks before he passed away I was in London and on the phone with him. Partly because of my own hearing disability, I could not clearly decipher his slurred speech. Mildred, his wife who was monitoring our conversation, interpreted his message thus: "tell him he is a good pilot and that I enjoy his articles." No *shishya* could possibly ask for more from his *guru*. So this one is for you Pete: RIP

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The reader is advised not to try and log on to the title website as it does not exist. In fact it never existed and is merely commemorative of a marital alliance that took place in No. 20 Squadron of the Indian Air Force long before advent of the internet. The wedding was solemnised soon after the 1971 Indo Pak war when the unit (of which I was in command) was based in Pathankot. The marriage is recalled because it generated an intriguing consequence which continues to remain a co-incidental possibility even today.

After distinguishing itself in the war, the squadron was in a relaxed build-up phase with a large number of personnel availing well earned leave. Among my officers was a tall young pilot from Kodagu automatically nicknamed 'Lofty'. He was a cheerful, active type whose spontaneous laughter was audible above the noise of a jet engine! He had earned himself a Vir Chakra gallantry award and came to see me with an application for some leave and permission to get married.

Lofty explained that his bride-to-be was from the north-east and, owing to distance, location and other commitments, families from neither side could be present. Since the marriage ceremony could not be held in the Officers Mess, he made a personal request for it to be conducted in my residence with the CO and his wife to kindly play the part of the bride's parents. We were happy and privileged to do so; a pandit was organised, all other arrangements made with the squadron officers forming the baraat. Just before the wedding day I was called urgently to HQ WAC in Delhi so my Flight Commander took over as 'father-of-the-bride'. I missed this unique marital union of a Coorgi lad from the deep south with a Khasi lass from the far east performed in the extremities of our western border!

I returned with the news that our Squadron had been tasked to operate a detachment of Hunter aircraft from Srinagar for the very first time. I carried out the trial flights for operations from a high altitude base. (In the course of these trials I experienced 'aquaplaning' for the first and only time - but that is another story). We moved six aircraft, technical tradesmen, pilots, support staff, ground equipment and families to Srinagar where many of us shared houseboats on the Jhelum river. Ali, the young son of our houseboat owner, was a helpful lad with a fund of tales to relate and entertain us. Our newly married couple was thus gifted with a honeymoon in Kashmir. On a squadron boat ride on the river, our new bride was showing one of her wedding gifts – a water proof watch – to the ladies when one of the children dropped it overboard to her consternation; we rallied around with appropriate support.

In 1985–86 while I was AOC J&K, at a social function I met a foreign tourist couple who happened to be staying in the very same houseboat we had occupied in 1972. They were full of praise for the service of Ali (now the owner) and fascinated with his many stories. He had told them that many years earlier, a trout (caught in the upper reaches of the Jhelum) when cut open, revealed a watch inside! I made no comment but my memory circuit stirred to life and I began to wonder…. Fishy story? Probably, but if the erstwhile bride (now a grandmother) reads this anecdote, she may like to e-mail Ali (muchh_ali420@gmail.com) and check if it was a ladies watch!

Air Vice Marshal Cecil Parker

25 Years Back

From Vayu Aerospace Review Issue II/1991

The Light Fighter retired

The end of March 1991 marked end of an era in so far as light fighters in service with the IAF are concerned. For 32 years, the IAF flew and fought with the Gnat, as also its Mk.II variant, the Ajeet, although the latter did not quite come to the IAF's post-71 requirements. What most observers little realise however, is that the present Light Combat Aircraft (LCA) programme had as its progenitor the Gnat itself. The Air Staff Requirement called for a 'Super Gnat' or Gnat Mk.III, having some supersonic performance with modern weapon-systems and avionics but still retaining the essential criteria of the light fighter : size, weight and cost. These critical qualities seem to have, alas, been lost as polemics took over and the LCA has also become victim of the faster - heavier - costlier syndrome.

Soviet engines overhaul at 3 BRD

Air Marshal IG Krishna, AOC-in-C, Maintenance Command, inaugurated the TV-2 and TV-3 overhaul building at the 3 Base Repair Depot (3 BRD) of Indian Air Force at Chandigarh. This facility will carry out repairs and overhaul the Soviet-origin powerplants of the Mi-8, Mi-17 and An-32 serving with the Indian Air Force. The Depot will also provide mid-life updating of the An-32 whose airframe life is 10,000 flying hours over which period, the powerplants are to be overhauled six times.

Continued support for LCA

Prime Minister Chandra Shekhar has given assurances for continued government backing of this Rs. 2,000 crore project at a recent meeting of the Aeronautical Development Agency. Following project definition completion and the start of full-scale engineering development Dr VS Arunachalam, SA to the Defence Ministry, said that first flight of the prototype LCA was planned for 1995, with production from 2000 (some five years later than originally planned). The LCA, he added, would carry four tonnes of tactical weapons, including beyond visual-range AAMs, laser-and radar-guided missiles and conventional bombs, and would carry the Soviet-designed 23mm GSh-23 twin-barelled cannon.

China's Defence Budget up 12%

China will spend 32.51 billion yuan (about $ 6.25 billion) on defence in 1991 representing a 12 per cent increase over the previous year according to Finance Minister Wang Bingqian's budget proposals which cited the need to "keep abreast of the complex and volatile international situation, to cope with unexpected possibilities and to protect national security and development" as reason for the 3.477 billion yuan rise over the estimates of last year.

Pakistan interest in A-5M

CATIC (China National Aero-Technology Import and Export Corporation) are reportedly negotiating for the possible Pakistan Air Force purchase of the uprated NAMC A-5M attack aircraft, following the recent completion of its development programme. Main feature of the A-5M is its AMX-type all-weather nav/attack system and digital avionics installation integrated through Alenia as prime contractor, although it also has improved WP6A turbojets, 12 external stores stations and other changes. The PAF is reportedly interest in buying up to 100 A-5Ms, with some Pakistani production participation, in addition to Alenia's 40 per cent work-share in the A-5M programme.

Apaches performed "to perfection"

Maj Gen Rudolph Ostovich III, Chief of US Army Aviation, is in full praise of AH-64 Apache attack helicopters flown in support of Operation *Desert Storm*. From their initial devastating attack on Iraqi early warning radar sites on 17 January to their history-making capture of prisoners of war and their unmatched ability to fly and fight in bad weather, Apaches performed "to perfection". The Apaches excelled in special missions and proved their flexibility in a variety of roles from deterrent to tank tiller to armed reconnaissance, scout and deep strike.

Gorkha Brigade adopts INS 'Khukri'

Lt Gen FN Bilimoria, GOC-in-C Central Command and President of the Gorkha Brigade, formally adopted the Indian Navy's missile corvette INS *Khukri* at a brief ceremony on board the ship at the Naval Dockyard Bombay on 8 March 1991. This event re-established the historical association between the Gorkhas and the INS *Khukri* which encourages exchange of visits between the men of the two establishments during peace and stand by each other in war.

Lockheed YF-22 is the ATF

After four years of intense competition Northrop Lockheed has been awarded a contract by the US Air Force to build the new advanced tactical fighter (ATF), designated YF-22. The aircraft would be developed as the F-22 and would be a replacement for the F-15 Eagle air superiority fighter.

The USAF would be ordering 600 such aircraft in the next decade. Analysts, however, said that the order would be reduced to 500 owing to increasing pressure to curtail defence expenditure. The deal is expected to save Lockheed thousands of jobs. Meanwhile, layoffs are in the offing at Northrop.

Third JAS 39 prototype flies

The third JAS 39 Gripen made its maiden flight on 25 March from the Saab airfield in Linköping. The flight test programme for the JAS 39 Gripen now comprises three prototypes and a modified Viggen, used partly for testing the Gripen's radar. So far, 64 flights have been made with the Gripen. Prototype 39-2 is currently being used for control system tests at supersonic speeds while 39-4 is being used to test the electronics system and the modified RM 12 engine.

Tale Spin

'Make in India'

A young automobile mechanic of Guwahati has spent much time, funds and effort to design and build a helicopter, named *Pawan Putra* by him. Designing this *jugaad* helicopter, built with metal sheets, car parts and two SUV engines, Chandra Siwakoti

Sharma, a school dropout, is awaiting clearance for the helicopter's first flight from the authorities but believes it will happen soon as this is inspired by Prime Minister Modi's ambitious call.

New Private–Public partnership in the offing ?!

Baaz Off !

Disappointing news for bird watchers on both sides of the Punjab, so savagely partitioned in 1947. One of the largest bird rearing farms is near Abbottabad in the erstwhile NWFP, where Northern Goshawk (*Accipiter Gentilis)* are bred and reverently desired by ornithologists on the other side of the Wagah border. India's Punjab has declared the Northern Goshawk, popularly known as *Baaz*, as the official State bird, having much significance in Sikh history. The bureaucrats think otherwise and have stalled the project – for the moment.

However, the *Baaz* of another kind fly high in Indian skies : the Indian Air Force named its MiG-29 air superiority fighter as the *Baaz* in the late 1980s and these continue to safeguard the skies.

Pachyderm on rampage

Folks of Siliguri, in the Dooars area of north Bengal, ran for their lives when an elephant which strayed from nearby jungles, went on a rampage for several hours, damaged over 40 houses, a shopping mall and many vehicles before it was tranquilised. The Air Force was then requested for a 12-wheeled trailer ('Queen Mary') to hoist the Jumbo with the help of cranes and then taken back to the Sukhna forest for release.

The Air Force is well acquainted with the fury of rampaging Pachyderm, having experienced several 'near misses' at its fighter bases, not only in Hashimara in the Dooars but also further away at Kalaikunda in western Bengal.

Making Nuisance !

It had to be on Air India again ! According to prosecutors in Birmingham, an unruly passenger on a Boeing 787 Dreamliner, when refused more alcohol, stood up in the aisle, pulled down his trousers and boxer

shorts then started to 'make nuisance'. He was quickly restrained by cabin crew with plastic handcuffs and seat belts for the rest of the flight, before being arrested on landing in the UK.

Additional signages in the cabin ?

The Sound of (eerie) Music

Only declassified recently by NASA, astronauts passing the dark side of the Moon had heard "eerie" and "outer spacey" music, remarking "Boy, that sure is weird music". While the sounds have not yet been shared with the public at large, this could well take *Top of the Pops* into a new orbit (pun intended). For the record (pun again), the original *Top of the Pops* was created by BBC producer Johnnie Stewart, inspired by the popular *Teen and Twenty Disc Club* which aired on Radio Luxembourg. The show saw many changes through the decades, in style, design, fashion and taste. The show was originally intended to run for only a few programmes but lasted over 42 years. So here we go again.

"Beam me up, Scotty" !

Afterburner

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