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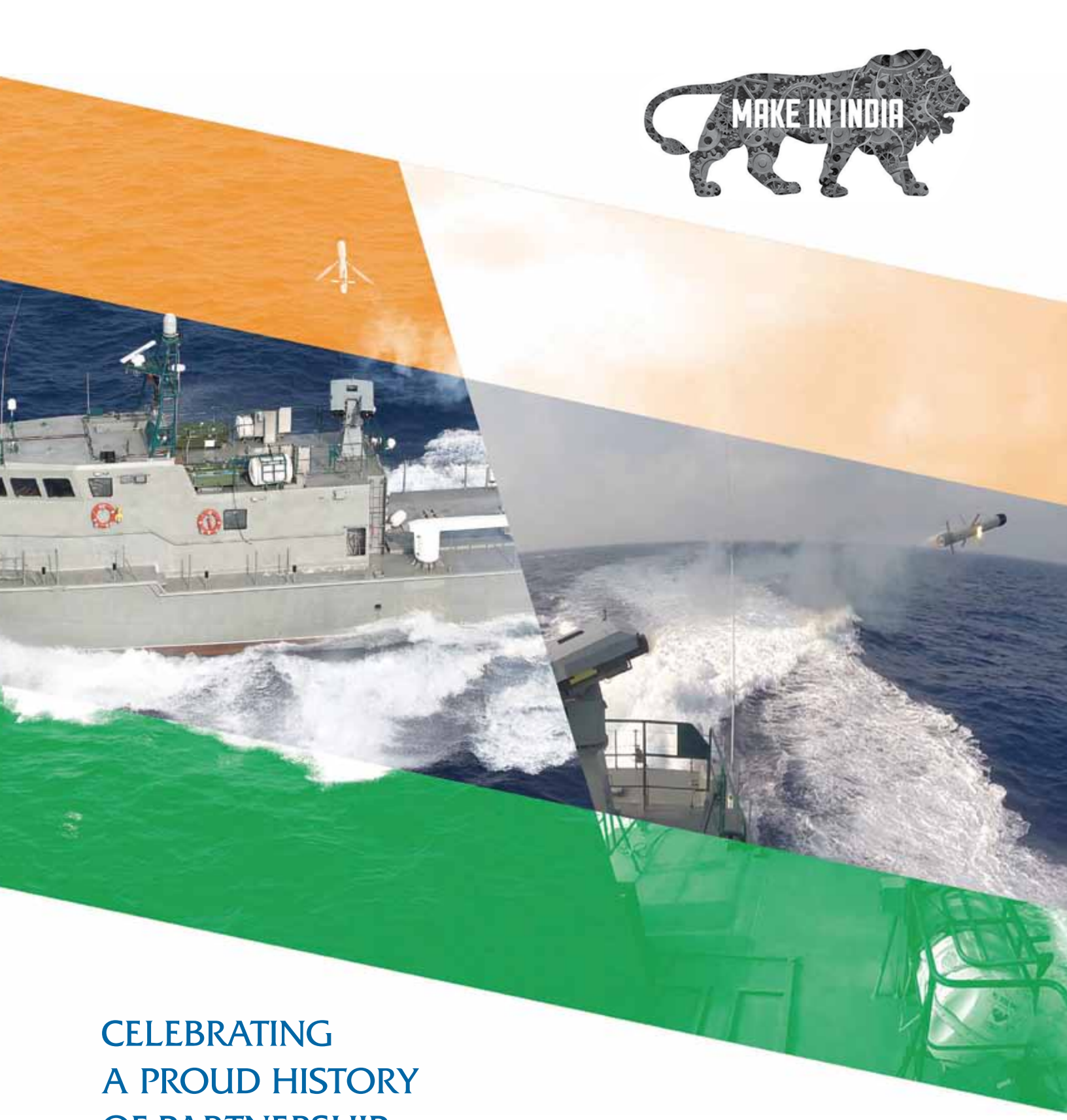

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Cover : INS Vikramaditya with fleet support vessel at Sea
(photo : Indian Navy)

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Printed at Aegean Offset Printers

Regular features :
Commentary, Opinion, Impact, Aviation & Defence in India, World Aviation & Defence News, Ancient Aviator Anecdotes, Vayu 25 Years Back, Tale Spin.

COMMENTARY

The Tillerson Turn

US President Donald Trump surprised India last August with a major departure from America's South Asia policy by asking Delhi to play a larger role in Afghanistan and demanding that Pakistan immediately shut down the terror sanctuaries on its soil. Then, in October, it was the turn of Secretary of State Rex Tillerson, who put India at the very heart of America's efforts to balance an increasingly assertive China. In a speech before his visit to the Subcontinent, Tillerson said America wants to be India's most "reliable partner" in an increasingly uncertain world. Looking beyond the bilateral, Tillerson affirmed that India and America "are two bookends of stability on either side of the globe" with shared political values and converging economic interests. As he lauded India's rise, Tillerson did not mince words about the challenges that Beijing poses to freedom of navigation, China's attempts to "subvert the sovereignty" of its neighbours, and its "predatory economic policies". Tillerson called for a more intensive regional collaboration between the US and Asian democracies — India, Japan and Australia — to ensure peace and promote prosperity in the Indo-Pacific.

New Delhi has been quick to welcome the Trump Administration's new approach to Pakistan and China — two factors that have long complicated India's relations with America. In facing up to India's concerns about Pakistan's use of terror as an instrument of foreign policy and China's quest for hegemony in the Indo-Pacific, Trump and Tillerson have certainly raised hopes for a closer regional alignment between Delhi and Washington. But there is no dearth of sceptics who caution India against premature celebration. The US foreign policy establishment that is appalled at the Trump Administration's incoherence and wild policy vacillations is barely saying two cheers to America's renewed enthusiasm for India. The traditionalists in the Indian strategic community have always questioned the potential for any basic shift away from US partnerships with Pakistan and China.

To be sure, Islamabad's critical role in stabilising Afghanistan and America's worries about Pakistan becoming a rogue nuclear state have tended to stop the US from dealing with the sources of terror there. America's extraordinary economic interdependence with China and Washington's need for Beijing's cooperation on a range of regional and global issues deter the US from an explicit balancing strategy. But India should resist the temptation for an endless debate on whether America can move away from China and Pakistan and be India's reliable partner. Delhi should focus, instead, on strengthening practical cooperation wherever possible with Trump's Washington. In the talks with Tillerson, Delhi must seek to stiffen America's resolve to confront the Pakistan Army's sponsorship of terror, encourage him to discard the residual bureaucratic hesitations in Washington about supporting India's rise and delineate the pathways for constructing a stable balance of power system in the Indo-Pacific.

From *The Indian Express*

Navy Blues

The commissioning of India's third and newest anti-submarine corvette, INS *Kiltan*, by Defence Minister Nirmala Sitharaman is good news. But it also underlines the ills that plague warship building in India. The *Kiltan* was commissioned five years later than originally scheduled and without anti-submarine capabilities that are fundamental to such a corvette. Three-and-a-half years after the National Democratic Alliance came to power promising to quickly make up the military's arms shortfalls, it is evident that, in warship building, like in the procurement of other weaponry, this government has performed no better than the United Progressive Alliance before it. In April, the navy's warships acquisition chief told defence industrialists in New Delhi that the navy would increase its strength from 140 vessels currently to 170-180 ships by 2027. This requires increasing warship numbers by three or four every year, as well as inducting four or five new vessels annually to replace warships that complete their service lives of 25-30 years. Against this requirement for seven to nine new warships every year, the navy is barely able to induct three or four. This lackadaisical production rate in domestic defence shipyards has forced the navy to look overseas at offers such as the Russian one to build four follow-on frigates of the *Talwar*-class.

A key reason for building delays is the navy's penchant for the latest, with admirals demanding that each warship incorporates newer and more sophisticated technology. This is a recipe for delay. In contrast, fast builders such as China finalise a particular design and then churn out a large number of those warships, benefiting from economies of scale, the certainty of supply orders and worker experience in building a particular "type". The People's Liberation Army (Navy) has already commissioned 25 Type 054A *Jiangkai* II-class frigates and is building three more. It has already inducted six Type 052D *Luyang* III-class destroyers and work is under way on at least eight more. In contrast, the Indian Navy builds barely three or four warships of one type before going back to the drawing board and reworking specifications. It built just three *Delhi*-class destroyers under Project 15 and then took years to rework the design into what it called a "follow-on" class – Project 15A – but which was actually a substantively different warship. Frigate orders have been similarly broken up. A different kind of disjointedness characterises the four-corvette Project 28 order. The ship now commissioned, INS *Kiltan*, has an all-composite superstructure in place of the steel superstructures on the first two Project 28 corvettes.

Besides design and planning confusion, warship building is also dogged by capacity limitations. All four public sector warship yards – Mazagon Dock (Mumbai); Garden Reach (Kolkata); Goa Shipyard (Goa) and Hindustan Shipyard (Visakhapatnam) – are located in metropolitan areas with little scope for expanding facilities. To add capacity, the defence ministry drafted the strategic partner policy to bring in private sector shipbuilders such as Larsen & Toubro and Reliance Defence Industries. But the poorly conceived policy faces opposition, not least from within the defence ministry itself. Consequently, projects earmarked for strategic partners languish, such as Project 75-I to build six new submarines, even as Mazagon Dock's submarine-building facilities lie increasingly idle. Without policy clarity within the ministry, the navy's strength and numbers are set to fall further.

From *Business Standard*

Defence and Aerospace

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Image courtesy: Elbit Systems

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COMMENTARY

Proof-test for OFB

The soldier would be relieved that the government is close to finalising a Rs 40,000-crore plan to procure long overdue small-arms – rifles, carbines and light machine-guns – for the generally unheralded footslogger. Much of the time the glare of publicity over combat aircraft, warships and missiles has blinded the common folk to a grim reality that was explained thus by a former Director-General of Infantry : "the Indian soldier is the world's best, but is worst equipped", and he estimated that casualties could be reduced by 50 per cent if the men had better weaponry. That observation must be seen in the context that apart from the localised action in Kargil the Army has not "gone to war" since 1971, so its equipment-deficit has to be gauged against what terrorists (state sponsored or otherwise) are now using. That the plans include acquiring 770,000 rifles speaks volumes for the "dud" that was the much-touted INSAS (Indian small-arms system) that entered service during the Kargil conflict, it has outlived its utility in just 25 years or thereabouts. As much of a "no-show" as the Arjun MBT and the Tejas LCA. The procurement plan actually translates into a grim test for the state-run Ordnance Factory Board. If it does not garner, on merit, a substantial share of the huge orders that will be placed it could spell doom for many of its 40-odd units, including the once-famous rifle factory at Ichapore.

Since foreign manufacturers are likely to be the OEM (original equipment manufacturers) but the "make in India" drive will also come into play, the OFB should make determined efforts to have its units selected as the indigenous partner in the joint-production exercise. It is true that in terms of physical infrastructure and experience the Ordnance factories have a head-start in small-arms production, but the foreign principal could have reservations over their work-culture and efficiency. Those manufacturers have global reputations to protect and might prefer to choose a private sector partner – restrictions on them have just been waived – to keep that reputation intact (the experience of aircraft producers Hawker-Siddeley, Dornier and MiG in licensed production of their transports and fighters, respectively, was not very encouraging). The OFB should not stand on false prestige and opt to play second-fiddle, profitably.

That would put 'make in India' in the defence sector into the correct framework. To do that, however, the OFBs units will need to abandon their *sarkari* mindset. It was all very well to laud them in an era when they had a monopoly in production as well as a captive market. Things have changed dramatically since the economy liberalised and major firms have now entered defence production. The OFB has to acquire a competitive, efficient outlook. Should it fail to carve its own niche in the upcoming procurement plans, it could face 'curtains'.

From *The Statesman*

Making arms in India

In yet another front-page news item, the country was informed about the government's supposedly unrelenting drive to make defence equipment in India. We may revel over the dedication of the Kalams and the Natarajans to their craft, but the hard reality is that India remains bracketed with Saudi Arabia as the world's leading importer of military hardware. Exhaustive reports by successive parliamentary committees have laid bare the cupboard of Indian R&D in military. Hence, the drive to somehow inveigle foreign defence manufacturers into setting up shop in India. The latest government initiative to promote domestic manufacturing of military hardware is to make the licences valid for lifetime and scrapping the system of renewal.

This latest tweaking of rules is not a good advertisement for the government's avowed intention of making the country a hub for defence manufacturing. A government with very little distractions that come from having a comfortable majority in the Lok Sabha should not be engaged in breaking down inter-ministerial silos in its third year in office. The same is the fate with making big ticket items like fighter planes, tanks and warships in the private sector. The musical chairs with the Defence Minister's office contributed to delays in choosing companies that will partner global defence giants to make their equipment in India. But for a couple of exceptions, the "chosen" Indian partner is a novice in the complex field of defence manufacturing and may not encourage the foreign partner to test the waters for fear of being scalded.

Inexplicably, the Modi government has dragged its feet on an overhaul of the existing public sector-heavy defence manufacturing industry. A company like Hindustan Aeronautics Limited should have been hived off into specialised units — helicopters, fighters, transports, drones etc — and privatised. A foreign partner would have felt more comfortable joining hands with companies that have domain knowledge about defence manufacturing. The only success on the horizon is for making Russian helicopters in India. For the real high-end items, the government's game plan of roping in friendly corporates with no past record of high-tech manufacturing will not yield quick results.

From *The Tribune*

The BrahMos test: a big boost

India's technological capabilities got a firm endorsement in the successful launch of the world's fastest supersonic cruise missile, gravity-dropped from a long-range Sukhoi fighter. The IAF becomes the world's first air force to launch a multi-platform, multi-mission, self-propelled attack missile of this kind, that can potentially reach Pakistani targets in the west and in Tibet in the east with 99.99 per cent accuracy. Variants can be designed to be deployed on Rafales and advanced medium combat jets too. Advanced versions of the missile are already on the drawing board, to double their reach and speed and to add a submarine launch capability. More significant, India's 'triad' of capabilities to launch the missiles from land, sea or air enhances its strategic deterrence prowess in a surcharged region.

Beyond the technical details of what was achieved and what is possible in the near future, what the BrahMos venture's success signifies is the durability of India-Russia ties. In the history of defence relationships, Russia has always been free and forthcoming, and has not denied India any state-of-the-art weapons technology unless specifically barred by international agreements. This relationship has been so stable over time that it irks the Chinese. The current vibrations may be different in a changing world order, but India shouldn't dilute its defence ties with Russia. There's no reason why India would be compelled to go the whole hog in favour of the United States and the West when Russia has been an all-weather friend. There is really no need to choose one or the other as India is in a good position. The supersonic missile only proves this.

From *The Asian Age*

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OPINION

Air Marshal Brijesh Jayal outlines the

Monumental challenges facing the new Defence Minister

Much has been spoken about the last cabinet reshuffle where, for the first time, a woman was chosen to head the ministry of defence. The debate has largely centred on the breaking of a gender glass ceiling and the incumbent's brief ministerial experience, rather than what the new person can do to a ministry that worships *status quo* and is stuck in a time warp.

Many of the problems ailing the ministry of defence are both historical and structural, and they remain so because of the desire of the civil and military bureaucracies not to disturb the *status quo*. One uses the term "military bureaucracy", with some hesitation, but sadly, over the years, the armed forces' headquarters have, to a degree, been influenced negatively by the work culture of the North and the South Blocks.

The new minister takes charge at a time when the Doklam standoff is behind us, the line of control continues to simmer, the army chief talks of his forces' readiness for a two- and-a-half-front war and the IAF chief of readiness for a two-front one, in spite of having earlier compared his depleted force to a seven-member cricket team.

In the face of numerous security challenges, the minister has set her priorities right by first reaching out extensively to our forces in the remotest areas to get a true feel of the 'sharp end' of her ministerial responsibilities. She will, no doubt, return impressed with the extremely tough task that our military personnel accomplish in their daily lives, their high morale and their sheer ability to cope with what they have rather than wait interminably for what they must have. Buoyed by the sobering experience of seeing the challenging part of her area of responsibility in the field and feeling proud to have been given the opportunity to head such a dynamic ministry, she will now expect to be informed about how this phenomenally complex operational machine is administered and managed from the ministry of defence, her home turf.

In briefings, she will learn that as per the transaction of business rules of the government, it is the defence secretary who is responsible for the defence of the country and not the defence minister. This may come as a surprise to her, but it will soon be clear that in matters of defence, the bureaucracy indeed has all the authority but little corresponding accountability. She will learn that higher defence organisation, a subject of much debate and innumerable studies, continues to remain wedded to a bygone era with security institutions resisting change.

She will also learn that it is the MoD that is responsible for all major decisions affecting the armed forces, including their war-fighting potential, with no uniformed personnel with domain knowledge within, thus casting the concept of specialisation to the winds. Further, the Kargil Review Committee recommendation of integrating the armed forces headquarters within the MoD, in line with modern democracies, was, by a sleight of bureaucratic hand, met by renaming service headquarters as 'Integrated HQ of MoD' whilst changing nothing other than their letter heads.

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When she visits the three Sena Bhawans for respective briefings, she will be conscious of the commitment she made on taking over, to provide the services with whatever they need. It is here that she will be faced with her next reality check when she learns that translated into practical terms, the combined service wish lists by far exceed what the defence budget can possibly afford and, as a logical first step, prioritisation of both individual service-wise and across the three services can be the only way to attempt progress.

Here she will be faced with another stark reality, that of the absence of a single-point military head to render her technical guidance and professional advice. She will learn that whilst the concept of a chief of defence staff has long been accepted in principle, it remains on paper, as it has been near impossible to get all the stakeholders on the same side.

The origin of many of these rivalries can be traced to the archaic higher defence management model, which, in essence, means that we have three different services, each planning, training and equipping individually to fulfil its operational responsibilities. Whilst the world over, a concept of integrated Theatre Commands has already taken shape, with China being the latest convert, we continue as before with individual service commands –totalling seventeen–neither co-located nor necessarily looking after a common geographical operational area with the lone exception of Andaman and Nicobar Command, which is "unified".

The outcome of this outdated higher command structure, whilst denying the operational benefits of integrated warfare, then results in the duplication of roles and missions with each service wanting to grab as large a domain of roles as possible. Such claims are based not on available scientific and engineering tools of joint warfare analysis, but age-old traditions and subjectivity. This results in duplication and ownership of various types of capital-intensive weapon systems and their equally expensive training, support and logistic infrastructure.

As the minister withdraws to the confines of her offices to absorb all that she has seen and heard over her travels and interactions, she will be reminded of the doyen of India's strategic affairs community, K Subrahmanyam, and his summation of the state of affairs where "politicians enjoy power without any responsibility, bureaucrats wield authority without any accountability and the military assumes responsibility without any direction."

Indian Defence Minister Nirmala Sitharaman with visiting French Defence Minister Florence Parly

She will by now be aware of the huge gulf that exists between those managing and administering national security and those actually executing it, and will rue that whilst internationally the concept of integrated warfare brought about by revolution in military affairs has been recognized with militaries transforming to adapt to these changes, the Indian military establishment appears content to remain frozen in time. The blame for this state of affairs cannot be apportioned to any one, but needs to be shared by every institution of our democracy that includes the armed forces, the MoD, the cabinet committee on security and, indeed, Parliament.

As she looks to the future, she will no doubt identify two parallel paths that need to be pursued with equal vigour to begin to set the MoD house in order. For the short-term, she would need to soften the various institutional turf wars within the ministry and attempt at meaningful prioritisation in keeping with budgetary constraints. This could at best be a holding operation in the short term to ensure the best for national security.

For the long term, armed with support of her institutional team, she may draw inspiration from some of the prime minister's national exhortations for out-of-the-box thinking towards transformation, and get Parliament approval to set up the equivalent of a *Blue Ribbon Commission* that would look afresh at where India wishes to place its armed forces and the roles and missions expected of them in keeping with the nation's aspirations. These recommendations would then need to be discussed, debated and finally legislated upon by Parliament. It is this one giant step that will earn her a place in the history of the MoD, not her gender or the length of her ministerial experience.

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IMPACT

Brig Gurmeet Kanwal on China's Xi Jinping who is

In Complete Control!

As had been widely anticipated, President Xi Jinping consolidated his position as the undisputed "core" leader of China at the 19th National Congress of the Communist Party of China held at Beijing in the third week of October 2017. Xi was also re-elected to all three posts that he has been holding for almost five years since the 18th National Congress: President of China, General Secretary of the Communist Party of China and the Chairman of the Central Military Commission (CMC).

In a move that placed him on the same pedestal as Mao Zedong and Deng Xiaoping, the National Congress unanimously passed an amendment to the party's constitution to include "Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era" in the party's constitution as one of its guiding principles.

Xi's 'Belt and Road Initiative', an ambitious infrastructure development programme designed to link China with its regional neighbours and beyond was also included in the party constitution. Xi ensured that only his protégés and those personally loyal to him were elected to the seven-member Standing Committee of the Politburo, China's most powerful governing council.

Report Card

Reading out his 'report card' at the marathon opening session of the National Congress, Xi presented China as an indispensable force in countering global economic sluggishness. He said that China had contributed significantly to dealing with international peacekeeping, regulating global economic governance, reshaping multilateral institutions, spurring global efforts to fight climate change, enhancing energy security and improving global health. Of course, he made no mention of the instability caused by Chinese military assertiveness in the East and South China Seas and by the blatant disregard of a rules-based international order.

As a princeling son of a revolutionary leader, Xi is the first civilian chairman of the CMC and presides over a 2.3 million-strong PLA, the world's largest armed forces. The 19th National Congress was utilised by Xi Jinping, who is also the Commander-in-Chief, to demonstrate his complete control over the People's Liberation Army (PLA). One of the key stratagems that facilitated his rise to the position of undisputed *numero uno* was his carefully choreographed plan to gain control over the PLA. Xi realised this goal through military reforms, the promotion of loyalists and the removal of Generals who did not easily toe the line. He launched a ruthless drive against corruption and had a large number of officers of the rank of Major General arrested. It has been reported that by March 2017, approximately 5,000 officers had been punished for graft; many other senior officers were forcibly retired.

Military Reforms and Strategic Outreach

Large-scale military reforms were initiated by Xi Jinping to make the PLA a more modern force "that can preserve China's territorial integrity and project power in China's area of strategic interest to extend China's strategic outreach through increased military presence overseas, especially in the Indo-Pacific region."

Sweeping reforms of the military to enhance combat readiness and operational efficiency included the cutting of troop levels by 300,000 personnel. Reforms have led to the disbandment of the four 'traditional' General Departments (General Staff, Political, Logistics and Equipment) and the establishment of 15 new departments all of which have been placed directly under the CMC. Under these 15 departments will be 84 restructured corps-level 'units'.

These units include the provincial military commands, military academies and universities that come directly under the Ministry of Defence. They also include the headquarters of the PLA Army, Navy, Air Force, Rocket Force (erstwhile Second Artillery) and the newly constituted Strategic Support Force. The seven existing Military Regions have been dismantled and five 'outward looking' joint theatre commands have been established. Five group armies (Corps-level formations) have also been disbanded, leaving 13 still standing.

The PLA Navy is getting the maximum attention in the military modernisation drive energised by Xi Jinping. It launched the first aircraft carrier in April 2017; in June it introduced Asia's most advanced guided missile destroyer; is developing cutting-edge propulsion technology; and is building large amphibious assault vessels.

Demanding the PLA's Loyalty

Officially, the PLA is the armed wing of the Communist Party and Xi Jinping has often reminded the PLA leadership of this fact. In April 2017, Xi Jinping demanded that all military units should be absolutely loyal to the Communist Party. In August 2017, Xi asserted, "You shall be unswervingly loyal to the absolute leadership that the party has over the army, heed the call of the party, follow the party."

At the 19th National Congress, Xi again asked the PLA to be absolutely loyal to the ruling Communist Party. He set two goals for the PLA: to become a modern fighting force by 2035 and to then graduate to the world's best military force by 2050 and, intensify its combat readiness by focusing on how to win wars. The message to India is clear: expect more transgressions of the Doklam variety.

With support of the Party and the PLA, President Xi Jinping plans to continue his pursuit of the "Chinese Dream" – an inspirational slogan coined by him to reflect the people's aspiration for a rejuvenation of the Chinese nation. However, the unfettered realisation of the Chinese Dream will be possible only in a peaceful and stable environment. However, in order to promote a regional security environment conducive to socio-economic development, China will have to tone down its military assertiveness and confrontational attitude and graduate to cooperation and respect for a rules-based international order.

US "considering" Indian request for armed UAVs

The United States is "considering" India's request for armed UAVs, according to a senior American official, "to help it strengthen the country's defence capabilities". Early this year, the IAF had reportedly requested the US Government for General Atomics Predator C Avenger aircraft, it being understood that IAF would need 80 to 100 such systems. This is in addition to the requirement for 22 unarmed Guardian UAVs, which would add the Indian Navy's surveillance capabilities in the strategic Indian Ocean region.

The Obama Administration had designated India as a major defence partner and the Trump Administration has accelerated the process of considering Indian requests. "The US Navy and the Indian Navy have been cooperating for many years on counter piracy efforts, on ensuring freedom of navigation in the Indian Ocean and the and Red Sea and the Persian Gulf," according to a US defence official.

Earlier, US Secretary of State Rex Tillerson had said that in keeping with India's status as a major defence partner and their mutual interest in expanding maritime cooperation, the Trump administration had offered a range of defence options for India's consideration, including the Guardian UAV."We value the role India can play in global security and stability and are prepared to ensure they have even greater capabilities," Mr. Tillerson said and added that "the proposals the US has put forward, including for Guardian UAVs, aircraft carrier technologies, the Future Vertical Lift programme, and F-18 and F-16 fighter aircraft, are all potential game changers for our commercial and defence cooperation."

Trump and Modi on Indo-US "strategic alliance"

Prime Minister Narendra Modi held wide-ranging talks with US President Donald Trump on the sidelines of the ASEAN summit in the Philippines on 13 November 2017 "beyond bilateral ties and

working jointly for the future of Asia".The meeting followed the day after officials of India, the US, Japan and Australia held talks to give shape to the much talked about 'quadrilateral alliance'to keep the strategically important Indo-Pacific region free, open and inclusive. "The cooperation between India and US can rise beyond bilateral cooperation and both countries can work for the future of Asia and the world...We are moving ahead together on many issues," the Indian Prime Minister said.The use of the term 'Indo-Pacific' by President Trump has led to speculation that it may have something to do with Washington preparing the ground for a revival of the so called Quadrilateral Strategic Alliance between US, Japan, Australia and India to counter China's expansion.

US Secretary of State visits India

The United States has pledged its commitment to deepening strategic ties with India as US Secretary of State Rex Tillerson met with Indian leaders, including Prime Minister Narendra Modi, in New Delhi during his visit on 25 October 2017 "which highlighted their strong emerging alliance".Combating terrorism and expanding India's role in helping Afghanistan's development were key issues discussed by Indian foreign minister Sushma Swaraj and Tillerson, who arrived in the New Delhi after stops in Kabul and Islamabad.

At a news conference after the talks, Tillerson extended an assurance that "in the fight against terrorism, the United States will continue to stand shoulder to shoulder with India. Terrorist safe havens will not be tolerated."

The Trump administration has unveiled a new South Asia strategy calling on India to play a larger role in Afghanistan's economic stabilization and on Pakistan to take more action against militant groups based in the country.Indian foreign minister Swaraj said President Donald Trump's new strategy for the region "can only be successful if Pakistan acts decisively against all terror groups without any discrimination." Tillerson expressed concern that extremist groups could threaten the security of Pakistan.

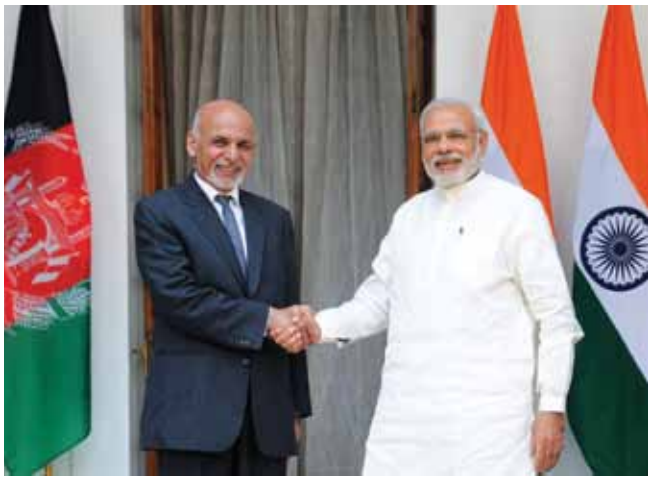
French Minister for Armed Forces visits India

Florence Parly, the French Minister for the Armed Forces visited India in late October and in meetings with her counterpart Nirmala Sitharaman discussed areas of mutual cooperation in the defence sector. This was followed by a meeting with the Prime Minister Narendra Modi, who said that he had "hoped to receive French President Emanuel Macron at his earliest convenience."Also discussed was Indo-French Cooperation in the Indo-Pacific and the Indian Ocean Region (IOR).

Florence Parly later visited Bombay and met with Vice Admiral Girish Luthra, the FOC-in-C , Western Naval Command. Aspects related to maritime security cooperation, bilateral exercises, ship visits, training, equipment, technology and professional exchanges were discussed. Interaction between the Indian Navy and the French Navy has, over the years, nurtured into a strong partnership based on mutual interests. Naval cooperation had progressed most encouragingly in recent years and the increasing scale of operational interaction "is indicative of a growing understanding between the two navies."

Afghanistan President's India visit

Talks between visiting Afghan President Ashraf Ghani and Prime Minister Narendra Modi on 24 October 2017 has included training of Afghan defence and security forces personnel with India having agreed to "extend further assistance depending upon the needs of the Afghan defence and police forces". The two leaders also agreed that "renunciation of violence and terror and closure



of cross border safe havens and sanctuaries were essential for any meaningful progress and lasting peace (in Afghanstan)", a clear but veiled reference once again to Pakistan's role in fomenting violence in the strife-torn country.

Run down in IAF combat aircraft strength and public concerns

Over the past decade, some ten squadrons of the Indian Air Force have been number plated owing to obsolescence of the aircraft in their inventory and this process will regrettably continue as some present aircraft types will be phased out over the next few years including the remaining squadrons of MiG-21s (save the 'bison') and MiG-27s. Although a squadron worth of HAL-built Su-30MKIs will be added annually to the IAF's order of battle over the next three years, and the two Rafale squadrons will join the IAF in 2019-2022, the IAF's official figure still gives the IAF only 32 squadrons by 2022. The media debate on suitability and availability of enough Tejas LCA Mk.I/IAs to equip six squadrons by 2027 is moot, but the IAF are understandably concerned and therefore want the Government to identify and order 114 'single-engine' fighters from abroad to make up the deficit, leading to some ill-informed debate in the press.

"IAF giving priority to single-engine fighters"

Air Chief Marshal B S Dhanoa, CAS has said that having a new fleet of single engine fighters was a "priority" for the IAF and the request for information (RFI) for this was to be issued "very soon". The selected fighter will be produced jointly by a foreign aircraft maker along with an Indian company under the recently launched strategic partnership model which aims to bring in high-end defence technology to India.In this context, Saab of Sweden and the Indian Adani group had announced their collaboration while US defence firm Lockheed Martin had earlier announced their teaming with the Tata Group. The IAF chief, however, said the Service has the requirement for more twin engine fighters as well, beyond the 36 Rafales ordered in 2016 and the continuing manufacture of Sukhoi Su-30 MKIs by HAL in India.

BrahMos launched from Su-30MKI

A modified Sukhoi Su-30MKI of the IAF air-launched a BrahMos ALCM supersonic cruise missile on 22 November 2017 against a sea-based target in the Bay of Bengal. The crew comprised Wg Cdr Prashant Nair and Wg Cdr KP Kiran Kumar, the missile first gravity dropped from the Su-30 before the two-stage engines were ignited propelling the BrahMos towards the designated target. The BrahMos Air Launched Cruise Missile (ALCM) at under 2.5 tonnes is the heaviest weapon deployed on the Su-30 aircraft, three of which have been modified by HAL at its Nasik facility. It is reported that some 40 Su-30MKIs will eventually be modified to carry the BrahMos missile, variants of which have been in service with the Indian Army and Navy since 2007 (*the image shows an inert Brahmos missile during a test drop*).

IAF Sukhoi Su-30MKIs to be upgraded

The Indian Air Force fleet of Su-30MKI fighter jets will undergo an upgrade and include more modern weaponry, an AESA radar and advanced avionics. The IAF operates around 240 of these fighters and another 32 are in the pipeline for delivery. "Hope the upgrade starts soon," said Air Marshall SB Deo, VCAS, at an event organised by HAL to mark 70 years of India-Russia diplomatic relations.The upgrade shall include long-range standoff missiles up to the range of 300 km and more powerful electronic jamming systems.Concerning the fifth generation fighter aircraft (FGFA), Chairman HAL stated that the multi-billion dollar co-development project with Russia "would be an opportunity as no country had ever offered such critical technology to India".

New Air Force Base in Gujarat

According to Defence Minister Nirmala Sitharaman, a new IAFfighter base is to be built at Deesa in Gujarat, located in Banaskantha district, adding to the existing air bases at Bhuj and Naliya in the Kutch area. This announcement comes soon after Air Chief BS Dhanoa declared that the IAF is prepared to fight a "short and swift war" at short notice and that the force has the capability of striking hard across the border "if the government decides". The need for stronger presence of forces near the borders has been felt in view of the increasing economic activities on the Gujarat coastline including petroleum refineries and new ports coming up. On the northern frontiers with China, the IAF is in the process of expanding advanced landing grounds in Arunachal Pradesh.

In defence of the Tejas

Countering increased criticism of capability of the Tejas Light Combat Aircraft, a government spokesman has commented, "The production of Tejas Mk-1A will begin in 2019. Most of the 43 improvements have already been made and the tender process to install an Advanced Electronically Scanned Array (AESA) radar and Self-Protection Jammer is underway. A refuelling probe would also be added to increase range".While the design cannot be changed and endurance improved as it is powered by the GE-404 engine, the enhancements will increase the capability of the aircraft, the spokesman added. Hindustan Aeronautics Limited was undertaking the enhancements and was in the process of setting up another assembly line to increase production rate from the present eight to 16 annually. The second line would be ready by 2019 when the Mk.1A goes into production.

AOC-in-C SAC flies Tejas

After Air Marshal RKS Bhadauria AOC-in-C Southern Air Command made a flight in the Tejas LCA from HAL Airport in Bangalore, on 14 November 2017. T. Suvarna Raju, CMD-HAL

thanked the AOC-in-C "for reposing the faith on this advanced and indigenous combat aircraft." As a more junior officer, Bhaduria was with the NFTC test-flying the LCA several years back. No. 45 Squadron 'Flying Daggers' was equipped with the LCA in July 2016 (*see Vayu V/2017*) and the Squadron is expected to move to its permanent location at Sulur, near Coimbatore, next year.

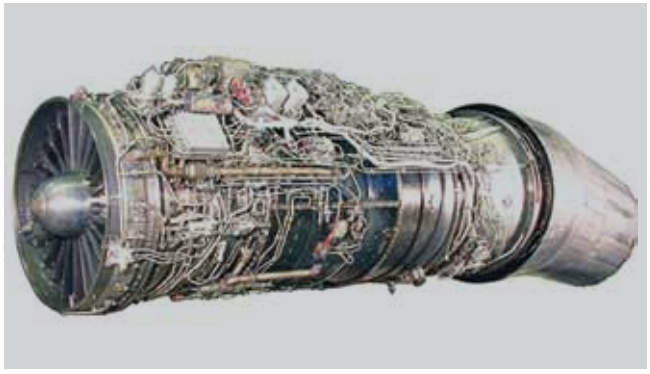
Thales offer active array radar for LCA Mk.1A

Thales has reported development of an active array radar to equip the proposed Tejas Mk1A multirole LCA. Thales is offering a lightweight, compact active array radar, the RBE2 radar also installed on the Rafale. The tests conducted during summer 2017 at the Cazaux air base in France on a test bench aircraft, focused on metrological analyses of the radar performance, which proved that "the radar is fully operational and perfectly corresponds to the specific requirements of HAL" for its combat and air superiority missions.

HAL to divest 10 % equity

The Government of India has approved the sale of a 10 percent stake in Hindustan Aeronautics Ltd. Accordingly HAL has initiated the process of Initial public offer (IPO) with the filing of the Draft Red Herrring Prospectus (DRHP) on 29 September 2017 with market regulator SEBI. "This is a major milestone towards listing of the defence PSU which is slated for partial disinvestment,"stated T Suvarna Raju, CMD HAL.

50th HAL-built AL31FP engine



On 24 October 2017, the 50th AL31FP engine, manufactured from raw materials by the Sukhoi Engine Division of HAL at Koraput was handed over to the IAF,marking the 70th year of India-Russia diplomatic relationship." The AL31FP engine powers Su-30 MKIs and is manufactured from raw material stage. All the components, including heavy forgings are manufactured at HAL", said T Suvarna Raju, CMD, HAL. He handed over documents related to the 50th Raw Material Phase Engine of Su-30MKI to Air Marshal SB Deo, VCAS.

HAL's engine division is ensconced in the valleys of Koraput region in Orissa. and was set up to manufacture turbojet engines for the MiG-21FL, followed by manufacturing, R25 series engines of MiG-21bis, R29B engines for MiG-27M aircraft and RD33 series engines for MiG-29s. The Division is currently engaged in the overhaul of R25, R29B and RD33 engines. In 2004, the Sukhoi Engine Division was established manufacturing and subsequently overhauling of AL31FP engines for Su-30MKIs. Till date the Division has manufactured nearly 1675 engines and overhauled 7730 engines, which includes the R11, R25, R29B, RD33 and AL31FP.

Indian Navy monitoring Chinese activities in IOR

The deployment of Chinese naval units in the Indian Ocean is being closely monitored by the Indian Navy, having identified more than a dozen Chinese warships in the Indian Ocean in summer 2017, including submarines, destroyers and intelligence-gathering vessels.Navy officials said anti-piracy patrols and freedom of navigation were the reasons cited by China for its rising presence in the region. Up to 15 Indian warships are to be deployed from as far as the Persian Gulf to the Strait of Malacca and northern Bay of Bengal to the southeast coast of Africa.In July, China began deploying troops to its first overseas naval base at Djibouti in the Horn of Africa, a significant leap forward in the expansion of its foreign military presence that has triggered concerns in India. The Djibouti base will boost Beijing's ability to sustain naval units in the Indian Ocean.The Indian Navy's deployments are part of an effort to meet any eventuality across the spectrum of operations including maritime terrorism, humanitarian assistance and disaster relief (HADR), human trafficking, piracy and narcotics trade.

Admiral Sunil Lanba, CNS has reportedly approved a new deployment pattern of Indian warships and patrol by aircraft along critical sea lanes of communications and "choke points". This was reportedly cleared at the naval commanders' conference on 24 October.(In the picture is seen INS *Trikand* off the coast of Madagascar's Antsiranana port)

Budget constrains Indian Navy's new warship requirements

Some thirty months after the Indian Navy signed a contract for new warships (the Rs 45,381 crore deal in 2015 with Mazagon Dock Ltd, Mumbai (MDL) and Garden Reach Shipbuilders & Engineers, Kolkata (GRSE) for seven stealth frigates under Project 17A),the Navy is finding it difficult to fund other warship procurements as it has "surrendered Rs 15,041 crore rupees during the last five years from its budgetary allocation for new warships." With contracts virtually finalised for 23 new warships, the navy is constrained by the lowest budgetary allocation since 2011-12 having this year only Rs 11,023 crore for fleet expansion, compared to Rs 13,617 crore in 2012-13; Rs 11,772 crore in 2013-14; Rs 12,576 crore in 2014-15, Rs 16,050 crore in 2015-16, and Rs 12,467 crore last year. However, most of this year's Rs 11,023 crore budget is pre-committed towards instalments on earlier contracts and on-going projects, including the construction of Project 75 Scorpene submarines, Project 15B destroyers, Project 17A frigates, Project 28 corvettes, the indigenous aircraft carrier, INS *Vikrant*, and others. "The government thought it fit to take back Rs 4,371 crore last year and Rs 5,285 crore the year before. The 23 contracts nearing finalisation are for building in Indian shipyards of five hydrographic survey vessels, two diving support vessels, and 16 anti-submarine warfare shallow water craft (ASWC)," as per a spokesman.

Naval requirement for 111 utility helicopters

On 30 October, the government accepted the necessity (AON) for procurement of 111 naval utility helicopters (NUH) worth Rs 21,738 crore for the Indian Navy, making this the first proposal under the strategic partnership model to get approval. Initially, 16 NUHs will be procured in a 'fly away' state from the selected foreign original equipment manufacturer (OEM) and the remaining 95 will be made by the strategic partner in India. The RFI states that the helicopters should perform multi-roles including search and rescue, medical evacuation, anti-piracy, disaster relief and surveillance. The RFI also seeks information on the kind of torpedoes compatible with NUH. Firms including Bell, Sikorsky and Airbus, are likely contenders for this project.

Indian Naval interest in E-MALS

According to reports, the governments of India and the US have made "some progress"on the launch system for the Indian Navy's next carrier (IAC II), specifically for the electric propelled latest electromagnetic aircraft launch system (E-MALS). An 11 member US team led by Rear Admiral Brian Antonio, Programme Executive Officer, aircraft carriers met his Indian counterpart Vice Admiral D M Deshpande, Controller Warship Production and Acquisition in Goa, wherein "the US was ready to power the E-MALS with integrated electric propulsion rather than nuclear power as the cost of latter alone is over $ 1 billion." This will involve installation of giant capacitors for storage and discharge of power. IAC-II will be powered by heavy fuels instead of nuclear reactors as the cost of the latter amounts to a massive Rs 2 lakh crore.

Navy requirement of active towed array sonar systems

The Defence Acquisitions Council has accepted AoN for the procurement of nine active towed array sonar systems (advanced) for the navy at an estimated cost of Rs 450 crore. AoN is the first step in procurement of an equipment as following this, the government would issue RFPs to selected firms for their technical and commercial bids. "The equipment will be fitted on modern naval vessels and will enhance their submarine detection capabilities," said an official.

INAS 310 relocated at Porbandar

Indian Naval Air Squadron (INAS) 310 'Cobras' has relocated to a new air base. The squadron, equipped with HAL-built Dornier 228 maritime reconnaissance aircraft, flew out of its previous base, Indian Naval Station Hansa, Goa-Dabolim, en masse on 29 September to its new home at INS *Sardar Patel*, Porbandar on the northern Gujarat coast. The squadron was first of the Indian Navy to operate the Dornier 228, since August 1991, and after some years was designated as an 'Information Warfare Squadron', with some of the aircraft equipped with electronic surveillance measures (ESM) and other advanced systems.

INS *Tarasa* commissioned

INS *Tarasa*, a water jet fast attack craft was commissioned into the Indian Navy by Vice Admiral Girish Luthra, FOC-in-C, Western Naval Command at the Naval Dockyard in Mumbai. INS *Tarasa* is the fourth and last of the follow-on water jet FACs built by the Garden Reach Shipbuilders and Engineers (GRSE), first two ships of the class INS *Tarmugli* and *Tihayu* being commissioned in 2016 and based at Visakhapatnam; while the third ship INS *Tillanchang* was commissioned earlier this year at Karwar on 9 March 2017.

L&T launches offshore patrol vessel for Indian Coast Guard

Larsen & Toubro launched the Lead Offshore Patrol Vessel (OPV) of a series of seven OPVs for the Indian Coast Guard on 27 October, which was designed in-house, from concept and is the first OPV class vessel for the Indian Coast Guard that has been built by a private sector yard "in a record time frame." The OPV named *Vikram* was launched by Jyoti Murthy in the presence of Additional Director General of Coast Guard, VSR Murthy.

L&T was entrusted by the Ministry of Defence to design and build seven OPVs for an order value of Rs. 1432 crores in March 2015. The order stipulated delivery of the first OPV within 36 months from signing of the contract i.e. by March-2018 and subsequent vessels at intervals of 6 months. However, with the construction of multiple OPVs progressing on or ahead of schedule, all are planned to be delivered ahead of the contracted delivery dates.

Tata Power SED Portable Diver Detection Sonar for Indian Navy

Tata Power Strategic Engineering Division will supply Portable Diver Detection Sonar (PDDS) for Indian Naval applications as a part of 'Make in India' initiative and has got a second contract under 'Buy and Make (India)'. Tata Power SED have partnered with DSIT Solutions Limited, Israel for the delivery of PDDS Systems under a Technology Transfer arrangement for DSIT's Pointshield PDDS. For Diver Detection Sonar's this is one of the largest order in the world market.PDDS will largely be manufactured in India at the Tata Power SED's Karnataka factories under ToT and support from DSIT Solutions Ltd.

XXXVI Coast Guard Commanders' Conference

Defence Minister Nirmala Sitharaman addressed the 36th Coast Guard Commanders Conference at Coast Guard Headquarters New Delhi on 27 September2017 and lauded the Coast Guard for all its operations which they carried out be it search & rescue, anti-smuggling operations or aid to civil administration. The conference was attended by senior officers of the Ministry of Defence and Indian Coast Guard (ICG) which included Director General Rajendra Singh, Additional Director Generals and Coast Guard Regional Commanders. She also appreciated efforts of the ICG in augmenting Maritime and Coastal security and suggested Coast Guard to focus on coastal development through *Sagarmala* programme and plan for operations not only in EEZ but beyond into the blue waters so that it stays relevant for next 20 years, particularly by developing digital capacity.

Chief of the Air Staff visits Vietnam

Air Chief Marshal Birender Singh Dhanoa, Chief of the Air Staff visited Vietnam from 30 October to 3 November 2017 and held bilateral meetings with senior commanders of the Vietnam People's Air Force and Air Defence (VPAF) "on security challenges in the current geopolitical scenario and explore ways to deepen the defence cooperation further". The main focus of his visit was on improving bilateral relations, promoting defence ties and evolving steps to further strengthen defence cooperation between the two Air Forces.The CAS also visited Headquarters of the Vietnam People's Air Force and Air Defence (VPAF) and a few operational air bases thereafter.

WAC Station Commanders' Conference

The Western Air Command, Station Commanders' Conference was held on 23 and 24 October 2017 at New Delhi where Air Chief Marshal BS Dhanoa, CAS emphasised the need to "enhance mission capability of all platforms and weapon systems and reiterated the need for development and upkeep of operational infrastructure and continuous orientation of human resource so as to absorb induction of new technologies for a smooth transition of the IAF into a potent aerospace power." The Chief re-emphasised the importance and pivotal role of Western Air Command in all future conflicts and in humanitarian assistance and Disaster Relief Missions and exhorted the commanders to revise their plans in consonance with lessons learnt during various exercises to bolster the mission capability of WAC.

President's Standard for 117 HU &223 Squadron

President of India Ram Nath Kovind presented the Standard and Colours to 117 Helicopter Unit and 223 Squadron of the Indian Air Force at Air Force Station Adampur on 17 November 2017. In the photograph are seen the President with CAS Air Chief Marshal BS Dhanoa while in the inset is one of the upgraded MiG-29s of 223 Squadron with some airmen on parade. (*Aerial photographs of 223 Squadron's earlier MiG-29s were published by The Society for Aerospace Studies in their book 'Touching the Sky' in 1992*).

Resurrection of No.18 Squadron, IAF

In face of continued depletion of the IAF's frontline combat squadrons, the dwindling number having been officially revealed during the Defence Minister's interaction with media in mid-November (down to 33 in 2017), is the announcement by Air Chief Marshal BS Dhanoa, CAS, that No.18 Squadron, which was number plated when flying MiG-27MLs some years back, will be resurrected with the Tejas LCA. This was announced during the ceremony to honour the late Flg Offr Nirmaljit Singh Sekhon, the only PVC awardee of the IAF, when flying Gnats in the Defence of Srinagar in December 1971 (*representative image is of Tejas LCA during cold weather-high altitude trials at Leh*).

Losing out on (IAF) History ?

Even as some new aircraft types are being inducted by the Indian Air Force, notably the Boeing C-17 Globemaster III and Lockheed Martin C-130J Super Hercules, the Service has ignored its own history and the 'right' of certain Squadrons to be resurrected after suffering from 'number plating' some years back. In particular, Nos.19 and 42 Squadrons, which had a distinguished record of service in war and peace, including during the 1962 China war and the IPKF years in Sri Lanka but had the ignominy of being ignored even as new squadrons were created for new aircraft types, namely Nos. 77 and 81…

As a side observation, and as this Issue goes to press, the platinum jubilees of Nos. 6, 7 and 8 Squadrons have been relatively low key, even though the Golden Jubilees of these highly acclaimed formations had been marked in major manner, also with comprehensive histories published which will be their proud record for posterity … till then.

Exercise *Indra* 2017

Exercise *Indra* 2017, the first ever Tri Services joint exercise between Indian and Russian Armed Forces was held in the Eastern Military District of Russia from 19 to 29 October 2017, conducted as a single service exercise alternately between the two countries nine times. 2017 marks a major milestone as this exercise has been upgraded to involve all the three services of the armed

forces. The Exercise was conducted at the 249th Combined Army Range Sergeevisky and in the Sea of Japan near Vladivostok. The Indian contingent comprised of 350 personnel from Army, 80 from Air Force, with two IL-76 aircraft and one Frigate and Corvette each from the Navy, while Russian Federation Armed Forces were represented by approximately 1000 troops of the 5th Army, Marines and ships of Pacific Fleet and aircraft from Eastern Military District.

Addressing the Indian Contingent Lt Gen Satish Dua reminded them of the importance of the exercise that provided "an opportunity to the armed forces of both countries to train in counter terrorism operations in a multinational scenario in a joint tri service environment." The scope of the exercise included professional interactions, establishment of joint command and control structures between the Indian and Russian forces and elimination of terrorist threat in a multinational environment under the UN mandate. "Exercise *Indra* 2017 will strengthen mutual confidence, inter-operability and enable sharing of best practices between both the armed forces."

New joint training warfare centre at Umroi

It has been reported that a hi-tech, new Joint Training Warfare Centre has been launched with a joint training exercise with the Bangladesh Army in Meghalaya at the Army's Umroi Cantonment. The centre has been set up for conducting joint exercises with foreign armies and has been envisaged by keeping in mind the conducive weather terrain offering optimal training environment developed on par with training centres of leading armies of the world.It comprises "best in class training facilities, including obstacle training course, jungle lane shooting range and world class infrastructure comprising fully computerised and network-enabled Computer Warfare Centre, besides top-bracket accommodation facilities." The project was located at Umroi keeping its proximity to Guwahati city and Umroi Airport, and was completed in record time of one year for hosting 'Exercise Milap', a multi-nation joint training exercise with the Bangladesh Army by *Red Horn* Division under the aegis of the *Gajraj* Corps of the Indian Army. It will also host exercises with Myanmar and Chinese troops in the later part of next year. The Army has other joint training centres in Belgaum, Varangte (Mizoram) and Bakloh.

Nirbhay cruise missile trials

The indigenous long range subsonic cruise missile 'Nirbhay', which can carry warheads of up to 300 kg, was tested from a test range at Chandipur along the Odisha coast on 6 November 2017, being the fifth experimental test of this missile system. The two-stage missile is 6 metre long, 0.52 metre wide with a wing span of 2.7 metre, can carry a warhead of 200 kg to 300 kg at a speed of 0.6 to 0.7 Mach with launch weight of about 1,500 kg. All initial critical operations of the missile were successful, a DRDO scientist said soon after the launch, the data being retrieved from tracking systems for detailed assessment.

Glide bomb tested

On 3 November the Indian Air Force flight-tested an indigenously developed Smart Anti-Airfield Weapon (SAAW) from the Integrated Test Range (ITR) in Chandipur on the country's east coast. Three tests of the precision-guided gliding munition were conducted under different release conditions in which the weapon, which was released from an IAF aircraft, reached its intended targets at a distance of more than 70 km with a high degree of accuracy. The weapon has been under development by DRDO in collaboration with the IAF.

BEL at Asian Defence & Security Exhibition

Bharat Electronics Ltd (BEL) participated at the Tri-Service Asian Defence & Security Exhibition, Conference and Networking Event 2017 held from 6-9 November 2017 at Bangkok in Thailand. The highlight of BEL's product display was the upgraded L70 Gun which has been designed, developed and manufactured by BEL for the Indian Army. The L70 gun upgrade is a fusion of the latest technologies in the areas of electrical servo drives, electro optical fire control system and video tracking.

Other BEL products/systems showcased included Land and Naval Radars, Communication Equipment, Night Vision Devices /Electro Optic equipment, Naval Fire Control Systems, Shipborne Systems including Naval EW Systems and Sonar Systems, Simulators and Air Defence Weapon System, besides the Coastal Surveillance System developed by BEL for the Indian Coast Guard.

Air India to buy 3 Boeing 777-300ERs

Air India is looking to raise loans worth US$535 million to finance acquisition of three Boeing aircraft, including two aircraft that will be used for transporting VVIPs. Out of three

aircraft, two are to be acquired in January 2018. However, the disinvestment-bound carrier has reduced the loan amount by around US$ 20 million in less than three weeks after floating a tender. The delivery of three B777-300 ERs is scheduled to be completed in February next year, with two expected to be bought in January. As per the purchase agreement with Boeing, Air India is to buy 15 B777-300 ER aircraft and it has already taken delivery of 12. At present, the national carrier has a fleet of 115 airliners.

SpiceJet orders more Q400s

SpiceJet will be launch customer for the 90-seat layout on the Bombardier Dash 8 Q400 turboprop after confirming its letter of intent to buy up to 50 such aircraft. This high-density seating offers 736mm pitch and is one of several cabin layout options on the aircraft. SpiceJet's order takes Q400 sales to 635 since the aircraft's launch back in 1999 and this is the largest single order received for the type.

SpiceJet's interest in amphibian aircraft

SpiceJet has been in dialogue with Japan's Setouchi Holdings to explore opportunities for 10-14 seater amphibious aircraft operations "to provide air connectivity to the remotest parts of the country." These however must be reliable, tough and resilient so that they can operate from water bodies, gravel and grass. Demo flights of the aircraft have reportedly been carried out in Nagpur and Guwahati. Japan's Setouchi Holdings Inc., a pioneer in the small aircraft aviation industry, is a part of the Tsuneishi Group of Hiroshima Prefecture. Setouchi Holding owns QUEST, the manufacturer of specialised amphibious and non-amphibious range of aircraft globally.

Photograph shows Chief Minister of Assam Sarbananda Sonowal, Ajay Singh CMD, SpiceJet, and Dr. Go Okazaki Executive Managing Director, Setouchi Holdings Inc during demo flight session of the Quest aircraft at Guwahati airliner

125th Boeing aircraft for Air India

Boeing and Air India celebrated delivery of the airline's 125th aircraft from Boeing, being the 27th 787-8 Dreamliner for the national carrier. "Boeing airplanes are, and always have been, the foundation of Air India's fleet, providing us with the very best in economics, fuel efficiency, flexibility and passenger comfort," said Rajiv Bansal, Chairman and Managing Director, Air India. "Taking delivery of our 125th Boeing airplane and 27th 787 Dreamliner marks an important day for Air India. The 787 has been integral to our expansion and competiveness, enabling us to open numerous new and nonstop routes and provide our customers with an unrivalled flying experience." Air India was an original member of the 787 Dreamliner launch group and took delivery of its first 787-8 in 2012. In all, the airline now operates 27 787-8 Dreamliners, along with 777-200LRs (Longer Range), 777-300ER (Extended Range), and 747-400s.

IndiGo begins regional services with ATRs

IndiGo will introduce ATR operations with flights between southern cities on its existing network of Hyderabad, Chennai, Bengaluru, Mangalore, Madurai and Nagpur and two new Tier-II cities of Tirupati and Rajahmundry. With an aim to enhance connectivity to these cities, the airline will deploy its ATR 72-600 aircraft in phased manner. The first ATR flight will commence from Hyderabad, starting 21 December 2017. IndiGo is also introducing

new ATR flights on its existing network which includes Chennai - Mangalore - Chennai, Hyderabad - Mangalore - Hyderabad and Hyderabad - Nagpur–Hyderabad.

Rolls-Royce TCS in digital partnership

Rolls-Royce and Tata Consultancy Services (TCS) have expanded their long-standing partnership so as to exploit future data innovation opportunities. "The partnership will help Rolls-Royce to accelerate its digital transformation, deliver further value to customers, improve existing services and create new areas of growth." As part of this agreement, TCS will provide digital platform capability, allowing data to be captured, shared and analysed across Rolls-Royce, so that new products and services can be developed at pace. "This will enable Rolls-Royce to use data to innovate within all of its businesses and collaborate more effectively with partners and customers."

100 new Indian airports in 15 years

So as to support increasing air connectivity, the government is planning to establish 100 new airports by investing Rs 4 lakh crore. Minister of State for Aviation Jayant Sinha said that the government is planning to complete the project in 15 years. As Sinha said, "Airport planning in the past was such that an airport is saturated by the time its development work is completed. We will need to add about 100 new airports, as aviation in India grows." The reports suggest that, out of 100, 70 airports will be 'green field' to facilitate regional air operations. Some 100 turboprop regional airliners have been ordered by IndiGo and SpiceJet adding to their existing fleets.

New SpiceJet flights under UDAN

SpiceJet launched its fourth daily flight under the UDAN (*Ude Desh ka Aam Naagrik*) scheme between Jaipur and Jaisalmer from 29 October 2017, being the first a to offer daily direct flight connectivity on this route. The same day marked launch of SpiceJet's new Jaipur-Varanasi flight, a sector that no other airline in the country operates. SpiceJet also recommenced operations on the Delhi – Jodhpur and Mumbai – Udaipur sectors and with the addition of Jaisalmer and Jodhpur, SpiceJet will be operating to 45 domestic destinations. The airline already connects Jaipur with Delhi, Ahmedabad, Chandigarh, Guwahati, Hyderabad, Jammu and Surat with direct flights and connects Goa and Mumbai via Ahmedabad and Surat respectively plus a host of other Indian cities on the domestic network. Internationally, SpiceJet connects Jaipur with a daily flight to Dubai and via connections to Muscat, Colombo and Bangkok.

Air India's sixth destination in the USA

Air India launched its sixth destination in the United States with three-times-a-week services to Los Angeles from New Delhi in November 2017. The new flight, AI-105/AI-106, will be operated with a Boeing 777-300 ER aircraft. Earlier, Air India flew non-stop services to New York, Newark, Chicago, San Francisco and Washington in the US. It also has a one-stop service to New York from Ahmedabad via London. Three of these services, New Delhi-San Francisco, New Delhi-Washington and Ahmedabad-New York via London have been launched in the past two years.

Direct flights to two more Afghan cities and Amritsar

Two more Afghan cities,Mazar-e-Sharif in Afghanistan's north, and Herat in the west will be connected by direct flights to Delhi, which is expected to further ease trade and commerce between the two countries.The inaugural direct flight took off from the Maulana Jalalludin Balkhi airport in Mazar-e-Sharif for Indira Gandhi International Airport on 2 October. Kam Air (a private airline of the Kamgar Group) will operate two flights a week from Mazar-e-Sharif, on Mondays and Wednesdays, and from Herat on Tuesdays and Fridays. In June, India and Afghanistan had launched a dedicated air freight corridor, which obviates the need for clearances by Pakistan. Currently, Air India and SpiceJet operate direct flights from Delhi to Kabul.

Meanwhile, Afghanistan's Ambassador to India Shaida Mohanmmad Abdali has said, "We plan to resume the air freight and passenger services link between Amritsar and Kabul by 31 December…to make Amritsar a major gateway for import and export between the two nations."

Mi-171A2 for Vectra Group

Russian Helicopters (part of State Corporation Rostec) concluded its first export contract for the Mi-171A2 with the Indian company Vectra Group during the Dubai Air Show, and the

contract includes an option for purchasing one more helicopter. CEO of Russian Helicopters Andrey Boginsky stated, "A wide range of potential customers from all over the world are keeping a close eye on the development of this project."

Saab-Adani JV: beyond the Gripen

The joint venture between Saab and the Adani Group will address a broad portfolio of programmes including UAVs and helicopters for the Indian armed forces, besides the key programme for supply of Gripen multi-role fighters for the Indian Air Force. Asish Rajvanshi, head of Adani Group's Defence and Aerospace division, said focus of the joint venture was on development of "foundational capabilities" to produce a wide-range of products in the aerospace sector for the domestic as well as export markets. On 1 September, Saab and the Adani Group formally announced their collaboration at a high level function in New Delhi, where Saab's Håkan Bushke and Gautam Adani were together.

Chairman and Managing Director of Saab Group's India operation Jan Widerstrom has re-iterated the JV was not only for the Gripen but there were other areas, including unmanned aerial vehicle (UAVs), military helicopters and various other aerospace components and equipment with a broad focus on developing a world-class ecosystem for the aerospace sector in India.

Dassault – Reliance Aerospace Manufacturing Facility

On 27 October 2017, Eric Trappier, Chairman of Dassault Aviation and Anil D. Ambani, Chairman of the Reliance Group laid the foundation stone for the Dassault Reliance Aerospace Limited manufacturing facility at Mihan, Nagpur in the presence of Ms. Florence Parly, Minister of Armed Forces of the French Republic, along with Nitin Gadkari, Union Minister for Road Transport and Highways of India and Devendra Fadnavis, Chief Minister of Maharashtra. The Dassault-Reliance manufacturing facility 'Dhirubhai Ambani Technology Park' is located in the Mihan SEZ adjoining Nagpur International Airport. Under this Joint Venture (51% Reliance Infrastructure and 49% Dassault Aviation) the facility will manufacture several components of the offset obligation connected to the purchase of 36 Rafale fighters from France, signed between the two Governments in September 2016. DRAL will manufacture components for the Legacy Falcon 2000 Series of business jets manufactured by Dassault Aviation and thus become part of its Global Supply Chain.

L&T, Godrej and HAL consortium on PSLVs

Larsen & Toubro, Godrej and Hindustan Aeronautics Ltd are to form a consortium, which is being put together by Indian Space Research Organisation (ISRO), to build Polar Satellite Launch Vehicles (PSLVs). The vehicles will launch small satellites and the first launch is being planned by 2020. A pact is to be signed by January 2018 for this initiative. India's space agency, which has designed the rocket, has been building and launching satellites, including probes for the moon and Mars missions indigenously, but has considerable work ahead to meet the country's requirement of building heavier rockets and reusable spacecraft that can carry bigger satellites and a capsule that will eventually put a man in space. Then there is a huge requirement for launch of smaller satellites, some as light as 1 kg, with a lifespan of two to three years. The PSLV, following its successful 104 satellite launch in February, has emerged as a preferred vehicle for small satellite launches globally.

DRDO & MKU agreement on ballistic protection technology

After having designed and developed bullet proof jackets as per GSQR 1438, DRDO has signed a ToT (Transfer of Technology) Agreement with MKU Ltd on 26 October 2017. Speaking on the occasion, MKU Chairman, Neeraj Gupta stated, "Our association with DRDO dates back to 2001, when we signed the first production agreement for body armour. The agreement was for the period 2001-2008 during which we manufactured and supplied BPJs to the Indian Paramilitary and Police forces through TBRL/ DRDO.We signed a TOT for Cool Vest with Defence Lab Jodhpur in 2016. Today we are receiving the TOT for Bullet Proof Jackets developed by DMSRDE/ DRDO. This is another step forward in this long relationship."

AXISCADES to acquire Mistral

AXISCADES, India's leading Product Engineering Solutions Company, is planning to acquire Mistral, a Bengaluru-based specialised embedded technology company. The acquisition to be completed in a phased manner will add significantly to AXISCADES' embedded practice and Make-in-India opportunities. Mistral was co-founded by Anees Ahmed and Rajeev Ramachandra in 1997 as a niche technology company and recorded INR 132 crore in revenue last year. Sudhakar Gande, Vice Chairman, AXISCADES said, "This acquisition of Mistral helps us to be a significant player in the Defence Offset and digital technologies. The synergy between AXISCADES and Mistral offers both the parties, impetus to create IP's, broadening service offerings leading to substantial business growth. This acquisition is EPS accretive."

Cooper MoU with GRSE for diesel engines

Cooper Corporation has entered into a Memorandum of Understanding (MoU) with Garden Reach Shipbuilders & Engineers Ltd. (GRSE) for joint development and manufacturing of small and medium diesel engines for marine applications. These will specifically be designed and developed for the Indian Navy and Indian Coast Guard, an indigenous alternative to multinational brands currently available in the market. In the photograph are Farrokh N. Cooper, Chairman and Managing Director, Cooper Corporation and Sarvjit Singh Dogra, Director Finance, GRSE.

Adani to enter airport business

The Adani Group are to enter the airport sector, and are planning an international airport at Mundra in Gujarat with integrated cargo and aerospace operations capable of handling large airliners. The Adani Group, through its subsidiary Mundra International Airport Private Ltd (MIAPL), will operate the airport to support corporate traffic in Mundra, which is fast developing into a business hub. With Ahmedabad being the only airport in Gujarat with international connectivity, the group believes there is potential for the airport to provide connectivity to the large expat Gujarati population.

There are also plans to develop the airport as a hub for cargo operations and maintenance. A separate cargo terminal will be developed to support the Mundra special economic zone (SEZ). Among the existing civil airports in Gujarat, Ahmedabd is already functioning above its capacity, while Vadodara is a defence airfield and has restrictions on development of infrastructure.

Airbus Helicopters HCare Smart contract with UTair

Airbus Helicopters has signed an HCare Smart contract with UTair India Private Limited whose three H125 helicopters will be covered by Airbus' HCare Smart programme for a period of five years. The contract covers both scheduled and un-scheduled events providing all necessary support to the operator to carry out its operations "safely, efficiently and cost-effectively."

Appointments

Vice Admiral Karambir Singh takes over as FOC-in-C Eastern Naval Command

Vice Admiral Karambir Singh took over as the Flag Officer Commanding-in-Chief, Eastern Naval Command (ENC) from Vice Admiral HCS Bisht at a ceremonial parade held at the Naval Base on 31 October 2017. Commissioned into the Indian Navy in July 1980, Vice Admiral Karambir Singhhas earned his wings as a helicopter pilot in 1982 and has extensively flown Chetak and Kamov helicopters. He is a graduate of Defence Services Staff College, Wellington; College of Naval Warfare, Mumbai and has served as Directing Staff in both these Institutions. In his career spanning over 37 years, the Admiral has commanded the Indian Coast Guard Ship *Chandbibi*, Missile Corvette INS *Vijaydurg* as well as two Guided Missile destroyers INS *Rana* and INS *Delhi*. He has also served as the Fleet Operations Officer of the Western Fleet. Ashore, the Admiral has served at Naval Headquarters as the Joint Director Naval Air Staff, and as Captain Air and Officer-in-Charge of the Naval Air Station at Mumbai. He has also served as member of the Aircrew Instrument Rating and Categorisation Board (AIRCATS).

On promotion to flag rank, the Admiral was appointed as Chief of Staff, ENC. His other important flag appointments include Chief of Staff of the Tri-Services Unified Command at Andaman & Nicobar Islands and as the Flag Officer Commanding Maharashtra and Gujarat Naval Area (FOMAG). In the rank of Vice Admiral, he has been the Director General Project *Seabird*, in-charge of infrastructure development of the Navy's modern base at Karwar. He was also assigned higher responsibilities at IHQ MoD(Navy) as Deputy Chief of the Naval Staff and Vice Chief of the Naval Staff, prior to his present appointment.

Admiral Ajit Kumar assumes charge as the Vice Chief of Naval Staff

Vice Admiral Ajit Kumar assumed charge as Vice Chief of the Naval Staff from Vice Admiral Karambir Singh at a formal ceremony held at South Block, New Delhi. Admiral Ajit Kumar is a specialist in Missiles & Gunnery, having had extensive operational tenures onboard frontline warships of the Indian Navy and has had the distinction of having commanded six seagoing platforms which include the guided missile corvette *Kulish* (commissioning), the guided missile frigate *Talwar*, the guided missile destroyers *Mumbai* and *Mysore*. His important shore/ staff assignments include Director Maritime Warfare Centre, Visakhapatnam, Commanding Officer of INS *Dronacharya,* Kochi, Chief Staff Officer (Operations) of the Western Naval Command, Mumbai. On promotion to Vice Admiral he was appointed as Commandant of the Indian Naval Academy, Ezhimala and thereafter has completed two joint service tenures as Principal Staff Officer at Headquarters Integrated Defence Staff, tenanting the billets of Deputy Chief of Integrated Defence Staff (Operations) and Deputy Chief of Integrated Defence Staff (Policy Planning & Force Development).

New Director (Finance) at BEL

Mr Koshy Alexander has taken charge as the new Director (Finance) of Bharat Electronics Ltd (BEL) on 25 September 2017 being GM (Finance) & Chief Financial Officer before his elevation. Having joined BEL-Bangalore in June 1986, he took over as GM (Internal Audit)/ BEL-Corporate Office on December 2012. He later served as GM (Finance)/ BEL-Corporate Office from June 2014 and later served as Finance Head of many of the BEL's Strategic Business Units of Military Radar, Naval Systems, Components etc., and was head of Finance of the BEL-Ghaziabad Unit.

Rear Admiral Sanjay Roye, new FOGNA

Rear Admiral Sanjay Roye has taken over as Flag Officer Commanding Gujarat, Daman and Diu Naval Area (FOGNA) from Rear Admiral Sandeep Beecha. The state of Gujarat, in view of its strategic location and vast coastline of 1600 kms, has a very significant role in the security and economic dynamics of India.

The Rear Admiral has served in the Submarine Arm of the IN, is a Navigation and Direction Specialist, has held a number of staff appointments onboard submarines and has commanded INS *Sindhurakshak, Sindhuraj*and *Chakra*. He was Project Director (Operations & Training) at Headquarters, Advance Technology Vessel Project at New Delhi.

Boeing launches HorizonX India Innovation Challenge

Boeing has launched the Boeing HorizonX India Innovation Challenge 1.0 "to energise aerospace innovation in India", in collaboration with T-Hub, India's fastest growing startup engine. The Boeing HorizonX India Innovation Challenge is aimed at attracting "the best Indian startups to propose disruptive solutions to tackle complex challenges in the areas of autonomous and unmanned systems, advanced manufacturing, industrial IOT and automation, analytics, artificial intelligence (AI) and machine learning (ML)". Entrepreneurs will be invited to present ideas on select themes that include drones and data application, factory productivity, supply chain, aircraft maintenance and services, passenger experience, defence, commercial and industrial uses. Pratyush Kumar, President, Boeing India said, "The Global Entrepreneurship Summit (GES) provides a perfect backdrop for us to unleash a wave of innovation, both within and outside of Boeing."

Rafale International and SMEs on 'Make in India'

On 24 November 2017, Dassault Aviation, Safran and Thales, which comprise Rafale International, were invited by the Centre Val de Loire Regional Council and Aerocentre at Tours to present their concept in creating an industrial aeronautical sector in India, as part of the 'Make in India' offsets programme in support of the Indian Air Force Rafale fighter contract which was signed in September 2016.

More than fifty French SMEs attended this Business-to-Business event, with the Rafale International partners presenting their approach on the Rafale Offset programme and outlined potential opportunities for French SMEs as also investment and productionisation in India. "Such an initiative will reinforce Franco-Indian cooperation and include SMEs in the Defence-Aeronautical sector, establishing an industrial ecosystem in India,for the benefit of both French and Indian companies", according to a spokesman.

The event provided clear opportunities and defined a roadmap for the French SMEs to assist them in joining the Dassault Aviation, Safran and Thales global supply chain, thus creating opportunities for new international markets.

Lucknow-Agra e-way as IAF runway

On 24 October 2017, the Indian Air Force carried out a highway landing exercise in Uttar Pradesh, validating a second stretch of roadway for potential use in wartime emergencies (the first was on the Yamuna Expressway between Delhi and Agra). A specially chosen stretch of highway between Agra and Lucknow, both home to IAF bases and within close range of a number of other Central Air Command stations, had the tarmac surface replaced with concrete, and runway markings (24/06) painted at either end of a 3-kilometre, 33-metre-wide strip.

The proceedings began with a C-130J inserting a team of IAF *'Garud'* special forces who 'secured' the strip before the fighters arrived. Fast jets included a trio of newly-upgraded Mirage 2000TIs from No.1 Squadron 'Tigers' and a pair of Mirage 2000Hs with a twin-seat Mirage 2000TH from No.7 Squadron 'Battleaxes', both based out of Gwalior (Maharajpur); two

Su-30MKIs from No.8 Squadron 'Eight Pursoot' and three from No.24 'Hawks' out of Bareilly, and finally three DARIN I Jaguars from No.27 Squadron 'Flaming Arrows' based in Gorakhpur. Given the limited infrastructure in place, the fighters did not actually land but the C-130J did. Each of the fast jets carried out a low missed approach on its first pass, before carrying out a touch-and-go on the second pass, which was considered enough to validate the highway airstrip for clear-weather VFR operations.

The exercise concluded with the C-130J arriving once again, this time to embark the *Garud* commandos and carry out a short take-off. The entire operation was planned and executed by Air Force Station Bakshi Ka Talab, a few kilometres north of the city of Lucknow, with Station Commander Gp Capt J Suares responsible for overall control and co-ordination.

IAF Chief voices concerns :

Single-engine fighter RFI "soon," but IAF at full strength only by 2032

Describing the IAF's requirement for a new single-engine fighter aircraft as "priority," Air Chief Marshal BS Dhanoa noted that the case was being processed under the Strategic Partnership model (Chapter VII of the Defence Procurement Procedure 2016). "The case is with MoD, RFI for single-engine fighters is likely to be issued very soon," he said on eve of Air Force Day.

The Air Chief also pointed out that twin-engine fighters typically cost significantly more than single-engine aircraft, saying, "Right now we are concentrating on the single-engine *[fighters]* so as to make up the numbers with lower cost." He did, however, stress that the IAF would continue to require twin-engine fighters in the future. "Is there a requirement for twin-engine *[fighters]* in the future? The answer to that is yes," he concluded.

Carrying forward the twin-engine theme, the Air Chief also made a few cryptic statements on the IAF's plans for fifth-generation combat aircraft. On the proposed Indo-Russian Fifth Generation Fighter Aircraft (FGFA) programme, the CAS acknowledged the slow pace of progress, saying "it has been on for the last ten years" before commenting that the issue is now with the MoD, which has classified inputs directly from the IAF as well as from the Air Marshal S Varthman committee set up to look specifically into the FGFA project. He did not specifically say whether the programme would proceed beyond the present preliminary design stage or not, implying that the decision would now be taken by the MoD.

Addressing growing concerns about the IAF's dwindling air combat strength, the Air Chief outlined plans for force accretion even as he admitted the IAF would not reach its sanctioned strength of 42 fighter squadrons before 2032 (the end of the 15th five-year plan). The IAF is set to take delivery of the last 36 Su-30MKIs of a total order of 272, 36 Rafales have been contracted for, and a total of 123 Tejas LCAs (20 Mk.I IOC-spec, 20 Mk.I FOC-spec and 83 Mk.IA) will be in service within the next 5-8 years. This, said Air Chief Dhanoa, would ensure that "the numbers will not go down below what we are right now," as these inductions would more or less offset the planned retirement of some 10-12 squadrons of MiG-21s and MiG-27s. "But they *[the squadron numbers]* will start going up only when the single-engine fighter comes in under the strategic partnership programme, and we will reach the number *[of sanctioned squadrons]* by the end of the 15th Plan period : 2032." While the Air Chief did state that the IAF needs 42 fighter squadrons "for full-spectrum operations in a two-front scenario," he also pointed out that mitigating strategies are in place for the current force structure.

On training and simulation, the Air Chief noted that the IAF today makes much greater use of simulators for technical and flying training than ever before. Depending on the fleet type, the kinds of missions being trained for and so on, the simulation to flying ratio can go as high as "about twenty per cent" said the Air Chief, which means that some IAF pilots could spend up to one hour in simulators for every 5 hours of actual flying. He noted that the Su-30MKI fleet still did not have simulators, indicating that force-wide exposure to simulation would increase as new technology was inducted.

The Air Chief also revealed that the first batch of three women fighter pilots commissioned in June last year (*see Vayu IV/2016*) have been assessed "at par" with their male counterparts, and that a second batch of female fighter pilots is currently undergoing Stage 2 training and will be commissioned in December this year. At a later press interaction on Air Force Day at Hindon AFS, ACM Dhanoa stated that the IAF planned to place these pioneering female fighter pilots in MiG-21 Bison units, subject to vacancies at those squadrons. The Air Chief emphasised that there was no bar to the induction of female fighter pilots, and that the IAF would "accept whoever volunteers" but without a dilution in standards. Female pilots would "have to make the cut," observed ACM Dhanoa.

The Air Chief summed up the future trajectory of the IAF, saying, "The Indian Air Force today stands at the threshold of acquiring multi-spectrum strategic capabilities, synonymous with India's growing regional stature and expanding national interests and is progressively nearing its goal of transforming into a true Network Centric Aerospace Force. The IAF is also focussing on indigenous acquisition of aircraft, radars, missiles and other aviation equipment in consonance with the 'Make in India' initiative."

IAF at 85: Air Force Day at AFS Hindan

The IAF's Surya Kiran team is now fully worked up as a nine-aircraft display, although the lack of smoke remains somewhat disappointing

Among the flypasts was the now common sight of a Boeing C-17 Globemaster III flanked by a pair of Su-30MKIs

A trio of locally based Lockheed Martin C-130J-30 Super Hercules transports made a formation flypast

The IAF Vintage Flight, presently limited to a Tiger Moth and a Harvard (pictured), displayed at Hindan and will shortly be joined by a restored Dakota

Dramatic pyrotechnics were the hallmark of the fighter displays, with DARIN II Jaguars, MiG-21 Bisons and Su-30MKIs (pictured) among the combat types dispensing flares over Hindan

'Critical Hollowness'

Brigadier Gurmeet Kanwal on India's Defence Preparedness

The contract for 145 BAE M777 ultra-light howitzers was the first Indian artillery order in over three decades

With attempts at infiltration being made virtually every night and frequent exchanges of small arms and artillery fire, the Line of Control (LoC) with Pakistan is more active than it has been in the last five years. The number of terrorist attacks in Kashmir has also risen sharply this summer. The stand-off with the People's Liberation Army (PLA) at Doklam has stretched to two months. The rhetoric being spewed out by the Chinese government-controlled media is getting shriller by the day. The China-Pakistan Economic Corridor (CPEC) now under construction will lead to further increase in their military collusion.

The net effect of India's deteriorating security environment will be that the country will be confronted with a two-front situation during future conflict. With the dogs of war barking in the distance, in July, the comptroller and auditor general (CAG) of India released a disquieting report about continuing ammunition shortages. There are large-scale deficiencies in other important military items of equipment as well. Addressing the inadequacies in the state of India's defence preparedness, termed as 'critical hollowness' by former army chief General VK Singh, merits the government's urgent attention.

Deficiencies in ammunition have an adverse impact on the ability to sustain military operations over the period of time that is necessary. According to the CAG, in March 2013, 50 per cent of the different categories of weapons (including tanks and artillery guns) had stocks for less than ten days of fighting. Since then, there has been some improvement, but for 40 per cent of its weapons, the army still holds stocks for less than ten days of conflict.

The Kargil conflict in 1999 lasted 50 days and we must acknowledge that any future border conflict may also be prolonged. During the Kargil conflict, 50,000 rounds of 155 mm artillery ammunition had to be imported from South Africa. The occurrence of such a critical situation during a time of crisis must be avoided through a prudent replenishment and stocking policy.

The army's sister services are no better off. While the Indian navy is far from acquiring the capabilities of a blue water navy, the People's Liberation Army navy is getting ready to sail into the Indian Ocean, and is acquiring bases and port facilities in fast-forward mode. Over the last five years, the Indian navy has had major accidents on board submarines INS *Sindhurakshak* and INS *Sindhuratna*. In another accident, submarine batteries that should have been replaced much earlier were still being

While the Indian Navy's Kilo-class submarines sail on, the country's undersea combat capabilities have seen no new inductions since the early-1990s

used due to inordinately long acquisition procedures. Meanwhile, the indigenous production of six *Scorpene* submarines has been delayed by almost five years.

From its peak at 39 squadrons over a decade ago, the fighting strength of the Indian air force has gone down to 32-33 squadrons, whereas 42-45 squadrons will actually be required to meet future threats and challenges. Obsolescent fighter aircraft like MiG-21s and MiG-27s and vintage helicopters are still in service. The holding of surface-to-air missile systems for air defence operations is grossly inadequate as indigenous research and development projects have been plagued by time and cost overruns. The fortification of forward air bases against terrorist attacks has not yet been completed, despite the attack on Pathankot Air Force Station in January 2016.

The continuation in service of obsolete and obsolescent weapons and equipment also affects the country's defence preparedness as fighter and bomber aircraft are extremely difficult to maintain towards the end of the life cycle. Modernisation of the armed forces has been stagnating due to the inadequacy of funds, the black-listing of several defence manufacturers and bureaucratic red tape that stymies the acquisition process. However, several pragmatic amendments were approved by Manohar Parrikar, then defence minister, in the new Defence Procurement Procedure to streamline procurement procedures and encourage participation of the private sector in defence manufacture.

Defence procurement projects worth over Rs 150,000 crore have been accorded 'acceptance of necessity', or approval in principle, by the NDA government, but it will take up to five years before deliveries of the weapons systems begin. And, like in the UPA regime, significantly large amounts of funds continue to be surrendered unspent from the capital budget.

In the army, artillery modernisation has been stagnating. There is an urgent need to acquire approximately 3,000 pieces of 155 mm/52-calibre guns to replace obsolescent towed and self-propelled guns and howitzers. So far a contract has been signed only for 145 pieces of M777 155 mm/39-calibre howitzers from the US. Another contract for 114 pieces of 155 mm/45-calibre Dhanush howitzers based on the Bofors design is expected to be signed with the Ordnance Factories Board shortly if the gun clears all trials. Air defence and army aviation units are also equipped with obsolete equipment that has substantially reduced their combat effectiveness and created vulnerabilities.

Modern wars are fought mostly during the hours of darkness, but a large number of the army's armoured fighting vehicles – tanks and infantry combat vehicles – are still 'night blind'. Only about 650 T-90S tanks of Russian origin have genuine night fighting capability. The infantry battalions need over 30,000 third generation night vision devices, new assault rifles – a soldier's basic weapon, carbines for close quarter battle, general purpose machine guns, light-weight anti-materiel rifles, mine protected vehicles, 390,000 ballistic helmets, and 180,000 lightweight bullet proof jackets.

The navy is in the process of commissioning an aircraft carrier at Kochi to replace the aircraft carrier INS *Viraat* and is building six *Scorpene* submarines at Mazagon Dock. It is also building 22 destroyers, frigates, corvettes, fast attack craft, landing ships and support ships. However, India's maritime security challenges are growing and the navy not only needs to modernise but also expand its footprint in the Indo-Pacific region along with the navies of India's strategic partners.

The modernisation plans of the air force are making progress, but at a snail's pace. The Medium Multi-Role Combat Aircraft (MMRCA) project to acquire 126 fighter aircraft to replace obsolete MiG-21s is scrapped, with the exception of the purchase of 36 Rafale fighters from France. Lockheed Martin (F-16) and Boeing (F-18) have jumped into the fray again with offers to produce their fighter aircraft locally with transfer of technology.

The IAF also requires several additional AWACS early warning aircraft, six mid-air refuelling tankers, 56 transporter planes, 20 advance jet trainers, 38 basic trainers, 48 medium-lift helicopters, reconnaissance and surveillance helicopters, surface-to-air missile systems and electronic warfare suites. All three Services need to upgrade their C4ISR capabilities to prepare for effects-based operations in a network-centric environment and to match ever increasing Chinese military capabilities.

The planned acquisitions are capital intensive and the present defence budget cannot support many of them. The defence budget has dipped to 1.56% of the country's projected GDP for 2017-18 – the lowest level since the disastrous 1962 war with China. It must be progressively raised to 3.0% of the GDP if India is to build the defence capabilities that it needs to meet future threats and challenges and discharge its growing responsibilities as a regional power in Southern Asia.

The government has recently sanctioned some funds and delegated financial powers to the three services to acquire the wherewithal necessary for combat readiness. However, unless the remaining deficiencies in weapons, ammunition and equipment are also made up quickly, the management of the defence budget improves by an order of magnitude and the defence procurement process is streamlined further, thoughts of critical hollowness in defence preparedness will continue to haunt India's defence planners.

The Time For Enforcing Jointness !

Defence Minister Nirmala Sitharaman with unique formation of tri-service personnel at the Andaman and Nicobar Command (ANC)

Are the Indian Armed Forces adequately joint to face the challenges of the 21st Century ? Logically one can ask, what has been done and more important, what is being done to ensure that the Indian Armed Forces 'become purple' (or Joint). Through this article one will try to analyse the best way forward to achieve jointness. But knowing our attachment to turfs, one premise may be fair to assume: that left to themselves the three Services will find it difficult to agree, as they haven't done so for decades. Therefore, it is time the Government took the bull by the horns and enforced Jointness in the armed forces. What gives us hope is the Prime Minister's track record of taking decisive action on critical issues, this being a long pending one.

The Present Status

At the apex level there is a Chairman Chiefs of Staff Committee (the longest-serving Chief tenants this post, in addition to being Chief of his own service). There is also the HQ Integrated Defence Staff (IDS) under an Army Commander equivalent officer, CISC, with 3-star level Principal Staff Officers heading various streams including the Defence Intelligence Agency (DIA). In addition, we have the tri services Andaman & Nicobar Command (ANC) at Port Blair and the Strategic Forces Command (SFC) tasked for just that. The three Army Commander level heads i.e. CISC, CINCAN and Commander, SFC are rotated periodically between the three services. There are also joint training institutions like the NDA, DSSC, CDM and NDC, with a joint capsule conducted for the three Higher Command/equivalent courses. There is some cross representation at various HQs, but this is vintage and not designed to meet the requirements of modern warfare. This is an antique system, with many loopholes and duplication, mitigating against unity of command, a key requirement of modern warfare.

In recent times two initiatives did focus on this issue, the Kargil Review Committee and more recently the Naresh Chandra Committee. Both, especially the latter were not comprehensive enough, but even the diluted versions have not been implemented, essentially because of lack of interest or enthusiasm amongst the political hierarchy as also the stakeholders. Thus, the time is opportune to review this issue comprehensively and more importantly, implement it.

Desired End State

In my view the best way forward is to adopt regressive planning. First decide the end state and then work backwards how to achieve that, in stages, if necessary. To achieve true jointness we need to have the end state based on Integrated Theatres under 4-star Commanders with all tri-service assets under one head. At the apex level should be a 5-star Chief of Defence Staff (CDS) with integrated staff to support him. The Integrated Theatres should report to the CDS and through him to the Defence Minister and CCS. The three Service Chiefs should continue to head their Services and be responsible for manning, equipping, individual training and other aspects. The HQ Integrated Staff

Exercise Indra 2017 was a unique tri-service bilateral training exercise with Russia in Vladivostok

and the MoD should also be integrated to an optimum level to avoid duplication and unnecessary interference. In addition, there should be jointness in all supporting streams and structures, such as logistics, medical services and so on. We may also consider a military cell suitably manned with the NSA, for coordination amongst all security and intelligence agencies and for fine tuning plans.

Four Integrated Theatres

- Western Theatre responsible for the Pakistan front from J&K to Kutch under an Army General.
- Northern/ Eastern Theatre responsible for the China, Nepal, Bhutan, Myanmar and Bangladesh borders under an Army General.
- Southern Theatre responsible for peninsular India and the island territories under a Navy Admiral.
- Central Theatre responsible for rest of India including Air Defence and Space under an IAF Air Chief Marshal.
- The functional Commands like SFC, Cyber and Special Forces should be directly under the CDS and dedicated to the Theatres based on the operational requirement. Out of Area Contingencies should also be under the CDS incorporating the capabilities available with the Central and Southern Theatres whose charter should include Out of Area Contingencies.

The above is the outline but much more detail will have to be coordinated, harmonised and the proposal detailed. Each Theatre will have appropriate tri service components and its integrated staff, but all reporting to the Theatre Commander. Locations of the Theatre HQs can be decided based on operational and functional requirements.

The Way Forward

To avoid earlier pitfalls, it is important that the complete road map and end state is approved by the CCS and if necessary, passed by Parliament to ensure this goes through. A suggested framework for the follow up is detailed below:

- Appoint a Permanent Chairman COSC (4-star) and charter him to work on the proposal and obtain CCS approval, thereafter move it for approval of Parliament within one year.
- In the second year, formalise and plans including redistribution of resources between the three Services.
- In the third year, appoint a 5-star CDS, which should be a rotating tri-service appointment, Whenever the CDS is from the Navy/Air Force, the VCDS should be from the Army.
- After appointment of the CDS, the Integrated Theatres need to be established over a two-year period, as this will take time to be ironed out.

China has recently initiated establishment of its own Integrated Theatres, where manifold inter-service problems are still being confronted.

The model presented above, in my opinion is the need of the future, keeping in view India's obligations and expectations. The grand strategic vision will need to be complemented by robust organisations and structures in the fields of diplomacy as well as security. The time is opportune for the armed forces to begin the process now. If the Services show reluctance, then it has to be enforced by the highest political authority and through an act of Parliament.

Lt Gen A K Singh
(courtesy CLAWS)

VAYU Interview with

Phil Shaw, Chief Executive, Lockheed Martin India

***VAYU**: The Indian Air Force continues to seek new fighters to build up much needed combat numbers. Lockheed had indicated a willingness to supply and locally manufacture F-16 Block 70s for this requirement in response to a letter circulated last year. This procurement, however, is yet to be formalised and no formal RFI, RFP or qualitative requirements (QRs) have been circulated. What flexibility does Lockheed have with the offer if, say, RFPs are issued under Chapter 7 (Strategic Partnerships) of the DPP 2016?*

LM: We are continuing to meet with the appropriate government authorities and we're currently in the wait-and-see mode in terms of government decision-making. We are encouraged by the dialogue at this stage. We are making our case and waiting for the government to decide how they choose to proceed.

***VAYU**: Could you provide an update on the status of the second lot of six C-130J Super Hercules for the Indian Air Force? Also, has the IAF/MoD approached Lockheed Martin about an attrition replacement for KC3803, which crashed last year?*

LM: We continue to deliver C-130Js to the Indian Air Force. Please contact the Indian Air Force with any specifics related to deliveries and acquisitions.

***VAYU**: Tata Advanced Systems Limited (TASL) is presently manufacturing empennages and centre wing box assemblies for the Super Hercules product line. What proportion of C-130Js produced in a year contain parts from Tata? Are you looking to source more aerostructures from Indian suppliers, across your various product families?*

LM: 100 percent of all C-130Js produced contain these TLMAL-made parts. We are indeed looking for additional opportunities to partner with Indian suppliers on other Lockheed Martin platforms.

***VAYU**: Could you comment on Lockheed Martin's plans to fulfil the Indian Navy's naval multirole helicopter (NMRH) requirement, particularly in regard to the Indian administration's focus on large-scale military projects needing to have an Indian production element? Would this impact your ability to offer the technologically advanced MH-60R, for instance?*

LM: Lockheed Martin remains very much engaged in pursuing and winning the Indian Navy's NMRH contract. We understand that a significant amount of the work would

Lockheed has proposed the F-16 Block 70 for the IAF's single-engine fighter requirements (photo: Lockheed Martin)

An IAF C-130J Super Hercules at Yelahanka AFS (photo: Angad Singh)

be performed in India by an Indian prime contractor and that any such agreement must meet the tech transfer requirements of India's Defence Procurement Procedure (DPP-2016).

VAYU: Does LM subsidiary Sikorsky have a suitable helicopter available to offer for the Navy's NUH requirement, should that requirement be firmed up around a multirole configuration including radar, sonar and guided/unguided weapons?

LM: Yes. Sikorsky is aware of the NUH programme and we will evaluate those requirements at the appropriate time.

VAYU: The F-35 programme seems to have turned a corner, with the USMC and USAF declaring IOC, and the Israeli Air Force taking delivery of their aircraft and operating them domestically. Full capability, however, is still some time away – could you give a brief update on the programme and the challenges that lie ahead?

LM: The F-35 programme is proceeding well. The F-35 fleet recently exceeded 100,000 flight hours while the F-35 Integrated Test Force teams are completing the remaining requirements in the programme's System Development and Demonstration (SDD) phase. The remaining development flight testing includes validating the final release of 3F software, F-35B ski jump testing, F-35B austere site operations, high-Mach Loads testing for both the F-35B and F-35C, and completion of the remaining weapons delivery accuracy tests.

VAYU: Lockheed made a relatively quiet and low profile entry into the Indian simulation market with FSTC, based in Gurgaon. Could you comment on further plans in this sector, and opportunities both civil and military?

LM: We are proud of our successful partnership with Flywings on the Flight Simulation Training Centre in Gurgaon. We are continuing to evaluate additional opportunities in India's simulation market.

An F-35B development aircraft carries out ski-jump testing with external stores, as required by the UK customer (photo: Arnel Parker)

‘Fully Capable and Always Ready’

VAYU Interview with

Admiral Sunil Lanba, Chief of the Naval Staff

VAYU: Observing the current defence preparedness scenario, analysts have pinpointed the existence of ‘critical hollowness’ as regards deficiencies in weapon systems, ammunition and equipment. Force structure and modernisation constantly come up against fiscal challenges, especially with a shrinking defence budget (in real, if not absolute terms) and increased pension burden. What steps are being taken to overcome this in the context of the Indian Navy?

CNS: The Indian Navy remains committed to translate its modernisation plans into action in a time-bound and effective manner. While doing so, we also remain prepared to respond to the present and emerging challenges in the maritime domain. The fiscal constraints in the modernisation process, if any, are addressed jointly with all concerned stakeholders. More emphasis is being laid on prioritisation, rationalisation and economy of expenditure. Greater value for money is being achieved by encouraging procurements from indigenous sources. Manpower requirements are also being rationalised through automation of platforms and outsourcing of non-core functions. The government has recently delegated certain financial powers to the Service Headquarters for procurement of critical ammunition and spares. These would help us in overcoming some of the existing shortages. Let me take this opportunity to assure your readers that the Indian Navy is fully capable of tackling all the existing and emerging challenges in the maritime domain.

VAYU: The Indian Navy currently operates only 13 old conventional submarines, 10 of which are older than 25 years, and with low availability rates reported for the fleet. What are the key goals for Project 75 (India) with regard to timely induction of new boats, and how will the programme be managed to minimise the delays and escalations that plagued the preceding Project 75 (Kalvari-class)?

CNS: As on date, the Indian Navy operates 14 conventional submarines including the first submarine of Project-75, *Kalvari*, which was delivered recently. Trials of the second submarine under this project, *Khanderi*, are also progressing well. We have imbibed correct lessons in the process and I am certain that the subsequent deliveries will materialise as per schedule. INS *Chakra*,

the nuclear powered submarine (SSN) inducted into the Navy in 2012 has added further teeth to the underwater warfare capability. The indigenously built nuclear powered ballistic missile submarine (SSBN) *Arihant* has put the Navy in a select league of nations capable of operating SSBNs. While we work upon these projects, the interim deficiencies are being made good through modernisation of older submarines by Medium Refit-cum-Life Certification to maintain the operational edge. You would be aware that Project 75(I) which will add six more submarines to our inventory is being pursued under the new guidelines for 'Strategic Partnership (SP) Model'. This model facilitates faster absorption of new technologies and creation of a robust domestic ecosystem for supporting the entire life cycle of the platform. We are optimistic about early conclusion of contract and timely execution of this project.

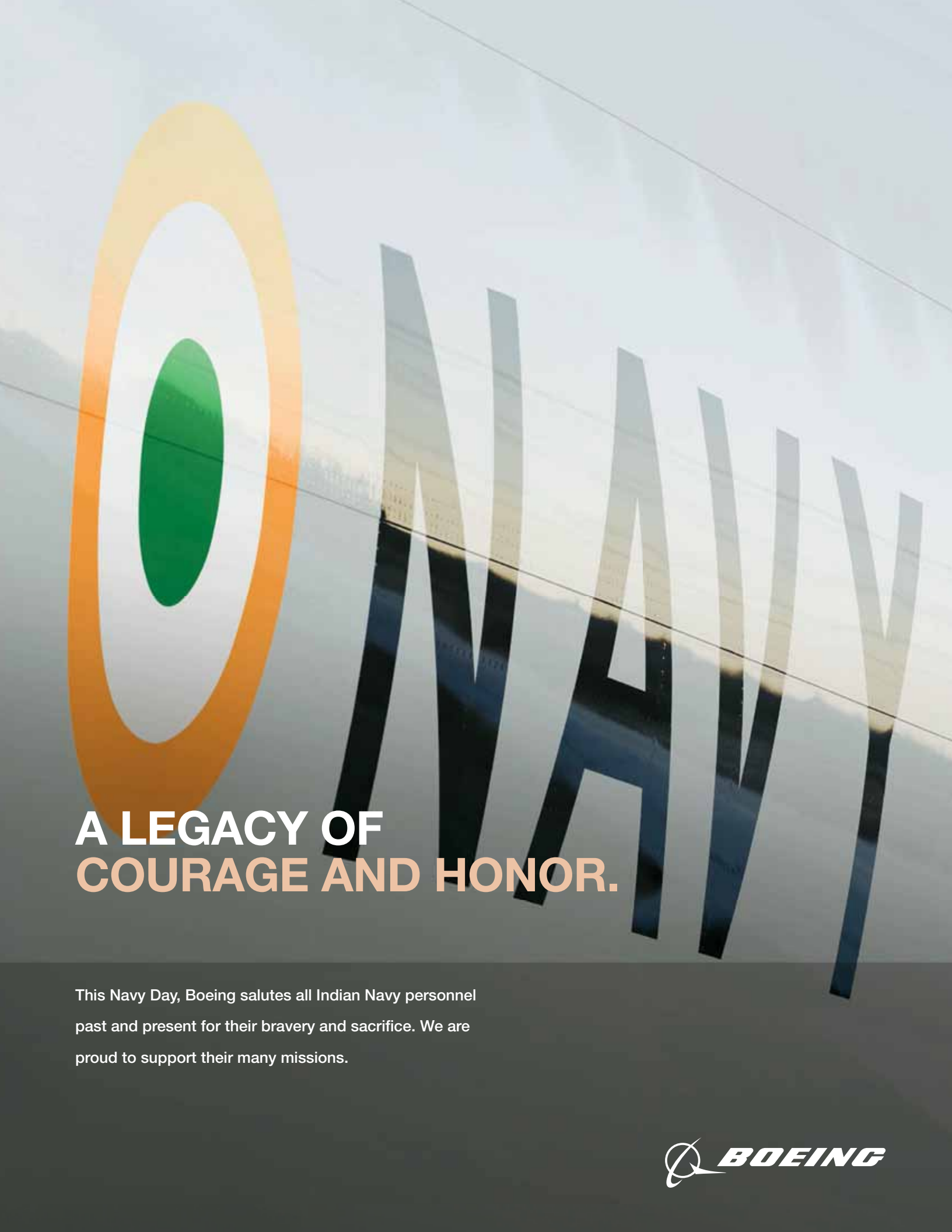
VAYU: China is reported to have built new military facilities on the disputed Spratly Islands in the South China Sea, and have commissioned their first overseas base in Djibouti on the African east coast, in addition to de facto bases in Pakistan (Gwadar) and Sri Lanka (Hambantota). With a clear drive towards expansion of Chinese influence in the IOR, what steps is the Navy taking with regard to securing island territories and countering Chinese naval influence in the region?

CNS: We are fully seized of the growing concerns regarding the presence of extra-regional maritime forces in the Indian Ocean region. As a professional military force, we lay a lot of stress on Maritime Domain Awareness (MDA) and constantly evaluate the maritime security environment in our areas of interest. Our deployment philosophy is also re-worked periodically to adequately address the current and evolving security threats. The Indian Navy operates a balanced force comprising aircraft carriers, destroyers, frigates, tankers, amphibious ships and a multitude of aviation and sub-surface combatants. Together, these platforms are capable of undertaking all mandated operations in the Indian Ocean Region and beyond. Our capabilities will continue to grow in consonance with our well thought out perspective plans. Let me also highlight that, over a period of time, we have developed very healthy, multi-layered and mutually beneficial maritime cooperation structures with most of our maritime neighbours. We have a shared vision of maritime security and all attempts are made to address these concerns together. As regards your specific query on security of our own islands, let me assure you that the force accretion and infrastructure development at both our island groups is very high on our agenda. Our Navy is fully capable and always ready to meet any challenges that may arise in the future.

VAYU: Although capital ships receive significant public attention, a large proportion of the Navy's smaller vessels – corvettes, missile boats and the like – are ageing or obsolescent. What is the Navy's priority for renewal of the surface vessel fleet in the near future?

CNS: As you rightly brought out, induction of smaller vessels may often miss the public eye. However, our modernisation programme includes induction of smaller vessels, which play an important role in enhancing the overall maritime security of the country. The first three Anti Submarine Warfare (ASW) corvettes under Project-28 have already been commissioned with the fourth one also likely to join the Navy in another two years. Construction of Naval Offshore Patrol Vessels (NOPVs) is well underway at M/s Reliance Naval and Engineering Limited (RNEL), Gujarat. The first three of these ships are expected to be delivered very soon. This year, we also inducted two Landing Craft Utility (LCU) MK IV ships built at M/s GRSE, Kolkata and more of these vessels will follow over the next two years. Induction of Water Jet Fast Attack Crafts (WJFACs), Fast Interceptor Crafts (FICs) and Intermediate Support Vessels (ISVs) has augmented our coastal

The Indian Navy has already commissioned three Project 28 ASW corvettes (lead ship INS Kamorta pictured)



A LEGACY OF COURAGE AND HONOR.

This Navy Day, Boeing salutes all Indian Navy personnel past and present for their bravery and sacrifice. We are proud to support their many missions.

BOEING

security significantly. Some of the other projects that are being pursued include Mine Counter Measure Vessels (MCMVs), Anti Submarine Warfare (ASW) Shallow Water Craft as well as Next Generation Missile Vessels (NGMVs). It is indeed a long list; but these smaller vessels are equally important for the Navy and adequate focus is being accorded to these projects.

VAYU : The Navy has issued RFIs for 234 much-needed rotorcraft, split into 111 utility helicopters and 123 multirole helicopters. What has the industry response been, and what is the Navy's desired timeline to begin inducting these rotorcraft types?

CNS: You must be aware that these two projects are being pursued under the newly introduced 'Strategic Partnership (SP)' model. The responses to both these RFIs have been very encouraging. Several OEMs have shown interest towards manufacturing these helicopters in India. We are hopeful that the induction of Naval Utility Helicopter (NUH), which is the basic ship borne utility helicopter, will fructify in another five to six years. However, the

The Airbus AS565 Panther (above) and Sikorsky Sea Hawk (below) are considered as leading contenders for the Indian Navy's NUH and NMRH requirements respectively

Naval Multi Role Helicopter (NMRH), as the name suggests, is a relatively larger helicopter with sophisticated weapons and sensors. Therefore, the induction of NMRH may take few years more than the NUH project.

VAYU: During Finance Minister (and then-Defence Minister) Arun Jaitley's visit to Japan in September this year, the acquisition of US-2 amphibious aircraft did not come up as prominently as it has in the past. Is this requirement being re-assessed by the Navy?

CNS: An amphibious aircraft does have added advantages with regard to greater operational flexibility in certain roles. These aircraft can enhance the mission efficiency in inter-Island operations, since it would not require a land based runway. Such aircraft can also undertake a variety of tasks including special operations, logistics and technical assistance to ships at sea, long range search and rescue, medical evacuation and Humanitarian Assistance and Disaster Relief (HADR) operations. You would perhaps recall that the aviation arm of the Indian Navy was initially established with induction of the amphibious aircraft 'Sealand.' It would be advantageous, on many counts, to reclaim that capability.

VAYU: There has been a flurry of press reports in recent months regarding Indian carrier aviation. The Navy received responses to its RFI for 57 Multi-Role Carrier Borne Fighters (MRCBF) but reports indicated issues with some fighters' ability to safely operate from current and planned aircraft carriers. Could you clarify the reasons for this fighter requirement as well as the carriers intended to host these aircraft?

CNS: There have been concerns regarding the ability of some of the contenders of the Multi Role Carrier Borne Fighters to operate from the existing carriers. This is mainly due to their wingspan in relation to the dimensions of the lift. The concerned manufacturers have been asked to work out methods to overcome these limitations. Several solutions have been offered by the OEMs, which are being examined in detail. We are primarily looking at these fighters for operations from our existing and under construction aircraft carriers.

New carrier fighters are planned for the IN (photo: Indian Navy)

Thank you Sir !
Pushpindar Singh, of Vayu, with the Navy Chief (photo: Indian Navy)

The Final

On Navy Day 2017, Admiral Arun Prakash writes on

Indian Navy flagship INS Vikramaditya sails alongside USS Nimitz and JS Izumo at the head of a tri-lateral naval formation in the Bay of Bengal (photo: US Navy/ MC3 Cole Schroeder)

As the nation contemplated the long drawn out Sino-Indian confrontation at Doklam, in neighbouring Bhutan, and China's strategic moves in the Indian Ocean region (IOR), a new consensus appeared to be emerging amongst analysts. Most seemed to be of the view that while the Indian army and IAF may be able to hold out against a PLA land-offensive, and even give the aggressor an occasional 'bloody nose' (so ardently sought by TV anchors), the final reckoning with China would be in the Indian Ocean.

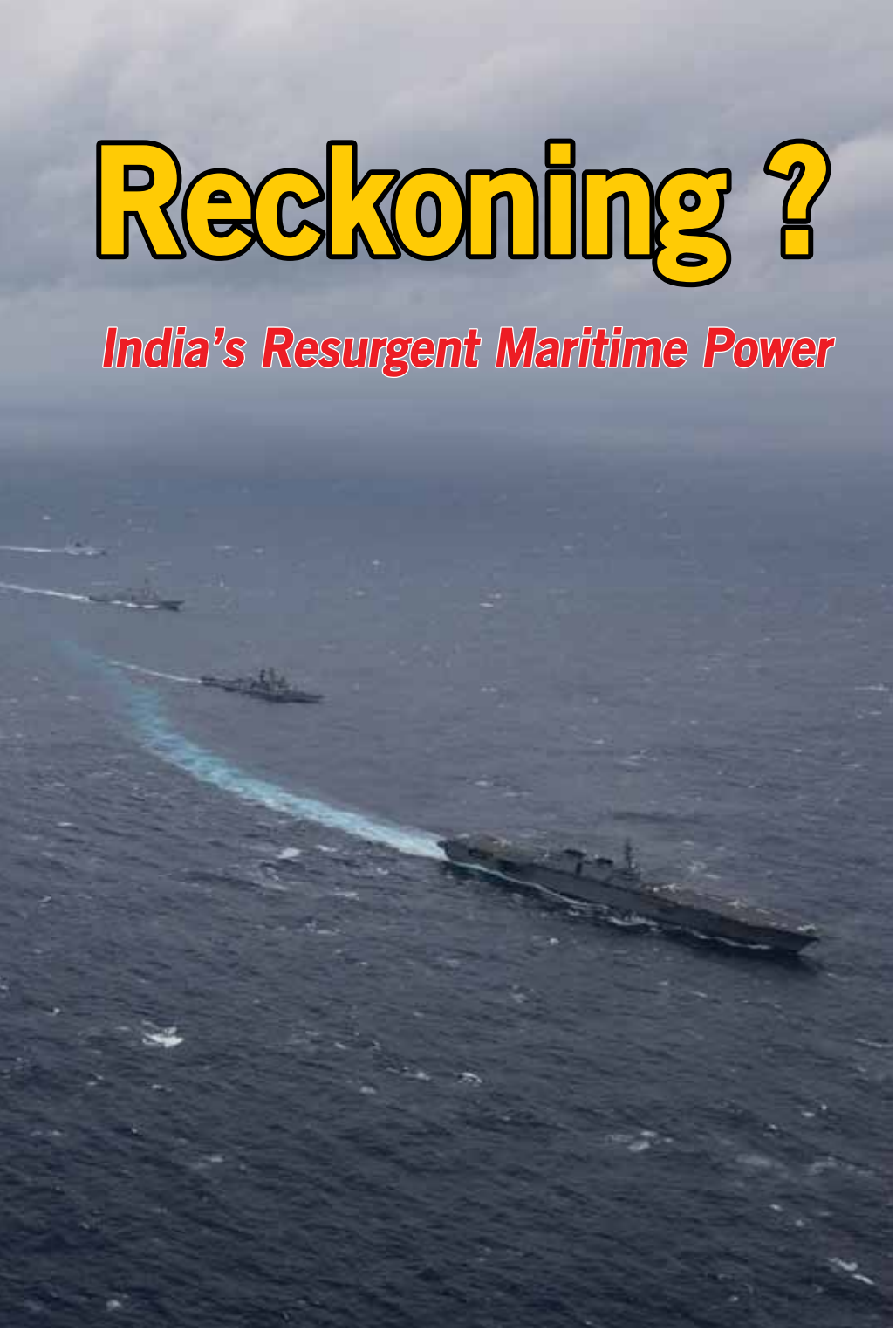
Why on Navy Day?

There is a general assumption that India possesses adequate 'maritime power' to deal with the PLA-Navy in home waters and opinion favours the opening of a 'maritime front' to capitalise on this putative advantage. One is not aware if this discourse is based on empirical data, war-gaming or mere speculation, but Navy Day 2017 seems to be a good juncture to take stock of India's 'maritime power', and apply our minds to future challenges.

Traditionally, Navy Day is celebrated annually, on 4 December, to mark free India's first naval victory in the 1971 War, and to remind our fellow-citizens of their forgotten maritime heritage. The Bangladesh War marked an important milestone in the navy's post-independence history. Still smarting from the ignominy of inaction in 1965, the navy's leadership ensured that it had an important role to play in the coming conflict. The Service was truly blooded as it saw the bold employment of the full range of maritime

Reckoning ?

India's Resurgent Maritime Power



capabilities; including missile-warfare, carrier operations, submarine and anti-submarine warfare, amphibious operations, shore-bombardment, special operations, and mine counter-measures.

On 4 December 1971 daring raids by missile-boats on Karachi harbour sank Pakistani warships, set ablaze fuel tanks, bottled up the enemy fleet and virtually shut down the port. This was a role that Soviet tacticians had never envisaged for these small 400-ton craft. In eastern waters, as we gathered wreckage of the ill-fated Pak submarine *Ghazi*, the aircraft carrier *Vikrant* and her escorts, blockaded East Pakistani ports, attacked airfields and interdicted shipping, thus tightening the noose around General Niazi and his murderous hordes, who eventually surrendered on 16 December 1971.

India's Maritime Tradition

While celebrating the successful storming of the Pakistani naval bastion, Navy Day is also an occasion, for the nation, to remind its citizens – especially the youth – of our glorious maritime heritage and of the forgotten seagoing exploits of ancient Indian mariners. Sardar KM Panikkar, Indian diplomat and historian debunks many Western myths in his 1945 monograph, when he proclaims, "Milleniums before Columbus sailed the Atlantic and Magellan crossed the Pacific, the Indian Ocean had become an active thoroughfare of commercial and cultural traffic."

Panikkar refers to the powerful navies maintained by the Andhra, Pallava, Pandya and Chola dynasties in our Eastern waters to offer convincing evidence that intrepid Indian seafarers sustained maritime trade and cultural links with SE Asia for centuries. However, maritime intercourse was not confined only to our eastern waters, and extensive trading and cultural links existed with Africa and the Middle East, whose signs are still in evidence.

In the 11th century AD, a hundred-year maritime conflict between the Sumatra-based Sri Vijaya and South Indian Chola dynasties weakened both Empires and heralded the end of Hindu sea power. So, when Vasco da Gama arrived off Calicut in 1498, there was no Indian ruler who could muster a naval force to oppose their small, armed caravels. A few decades later, the British East India Company made its appearance on Indian shores to be followed by the Dutch, Portuguese and French. Thus, Indians, despite being heirs to an ancient maritime tradition, were colonised, enslaved and exploited by foreign maritime powers, because of their 'sea blindness'.

In this dismal historical sequence, we must cherish the memory of a few naval heroes, who left a mark on the country's maritime stage. Amongst these are the resolute and visionary Samuthari Rajas (or Zamorins) of Calicut, who waged a 90-year long naval campaign against the Portuguese, led by Captains of the Kunjali Marakkar clan. A century later, the Maratha admiral, Kanhoji Angre's fleet of ghurabs and gallibats ceaselessly harried British, Dutch and Portuguese shipping, scoring many victories against their individual and collective forces.

While India's Mughal rulers were bereft of any maritime awareness, the British who succeeded them, deliberately kept their Indian subjects away from the sea, focusing instead of a large army to keep order at home, and in overseas possessions.

A Partial Maritime Awakening ?

Therein lay the roots of India's malaise of 'sea blindness' and the post-independence conviction that India was, inherently, a 'continental power'. As a consequence we find, well after independence, that the 'maritime sector' has suffered sustained neglect. Here, it is important for India's planners and decision-makers to comprehend that national 'maritime power' embraces a huge spectrum of the nation's technological, industrial, economic and military capabilities, and that a clear distinction must be drawn between 'maritime power' and 'naval power'.

The major components of maritime power include world-class ports and harbours, a modern shipbuilding industry, a substantive merchant marine, an effective coast guard, an ocean-going fishing fleet and the ability to harvest or extract economically important seabed resources. The last, but most important component of a nation's maritime power is a capable 'fighting navy', which underwrites the safety and security of all its maritime interests.

The past two decades have, fortunately, witnessed a 'maritime awakening' amongst India's land-oriented decision-makers. A series of developments, including the phenomenon of globalisation, the drama of rampant piracy, the traumatic 26/11 Mumbai terror attack, and the spectre of a growing Chinese Navy have all served to bring belated focus on the Indian Navy's role in maritime security. A brief look at China is warranted at this juncture.

China's 'Maritime Power'

China's pursuit of maritime power has been under-girded by the substantive growth of its seaborne-trade and energy supplies as well as overseas economic and security interests. In the security-related context, its long-standing claim on Taiwan and new-found territorial ambitions in the East and South China Seas have lent further impetus.

Ever since Xi Jinping designated the 'maritime domain' as an essential building block of his 'China Dream', the Communist Party has brought sharp focus on it, and overseen the systematic build-up of each element of 'national maritime power'. The following information is relevant and illuminating:

- China is the world leader in ship-building today.
- Its 5000-ship strong merchant marine ranks No.1 in the world.
- China owns the largest number of coast guard vessels in the world.
- China's ocean-going fishing fleet is the largest in the world.
- Chinese shipyards are rapidly adding to its fleet of modern destroyers, frigates, diesel submarines and logistic support vessels.
- Its force of home-built nuclear submarines has been operationally deployed.
- PLA Navy's first aircraft carrier is at sea, with more on the way.
- In a few years the PLA Navy (PLAN) will be second only to the US Navy in capability.

It is also noteworthy that China, for all its maritime prowess, has refrained from declaring itself a 'maritime power' yet, because of certain perceived deficiencies. It therefore behooves India, which has already donned the mantle of 'net security provider' in the Indian Ocean, to urgently conceive a national level strategy whose implementation will fill long-standing voids and create badly needed capacities in the maritime sector that will benefit our economy and reinforce maritime security.

Recent Naval Developments

The bright spot on India's maritime horizon is the attainment of a degree of self-reliance in warship building. The seeds of self-reliance were planted by a visionary naval leadership in the 1960s, by persuading the political leadership that the nation must embark on indigenous warship production. In the face of great skepticism, both at home and abroad, Mazagon Docks delivered the first *Leander* class frigate, INS *Nilgiri*, in 1972. In the half century

Construction of IAC-1 (to be named 'Vikrant' in service) is proceeding apace at Cochin Shipyard, with the vessel planned to be ready by the end of this decade

since, Indian shipyards have launched over a hundred warships; ranging from patrol boats to frigates and destroyers and from hydrographic vessels to nuclear submarines.

The pinnacle of this admirable endeavour was achieved in 2013, when Cochin Shipyard launched India's largest indigenously designed and built warship – an aircraft carrier – to be named INS *Vikrant*, in 2013. Building an aircraft carrier is, however, complex business and it could take anything up to 6-7 years before the ship goes to sea. In the meanwhile, plans for a second, bigger, carrier are on the design-boards in New Delhi.

The past few years have seen the IN realising many long-cherished objectives, in all three dimensions of maritime capability. The nuclear-powered ballistic missile submarine (SSBN) INS *Arihant*, a product of India's Advanced Technology Vessel (ATV) project, has become the 'third leg' of India's nuclear deterrent force, immensely reinforcing its credibility. The, 44,500 ton, former Soviet aircraft-carrier, re-named INS *Vikramaditya*, has been assimilated into IN fleet operations and participated in the tri-national exercise *Malabar*-2017, deploying its 4th generation MiG-29K fighters and Kamov-28 and Kamov-31 helicopters against US and Japanese naval units.

Another milestone was crossed in 2014 when the first of a series of stealth destroyers, INS *Kolkata* was commissioned in Mumbai; to be followed by sisters, *Kochi* and *Chennai*. What places this class of 7,500 ton warships on par with contemporary warships, worldwide, is the advanced multi-function radar, and a long-range surface-to-air missile; both being the fruits of a joint Indo-Israeli venture. The formidable, Indo-Russian, BrahMos supersonic surface-surface missile, that equips these ships, has no counter-measure, so far.

The January 2017 launch of the second of six *Scorpene* class submarines being built under licence, by Mazagon Docks saw a critical lacuna in our navy's capability well on the way to redressal. A further four boats of the same design are to follow; by which time it is hoped that a second line of submarines (equipped with 'air-independent propulsion'), designated 'Project 75-I' will be ready to go into production.

With PLA Navy submarines, - both diesel and nuclear – now undertaking patrols in the Indian Ocean, the IN was in urgent need of upgrading its anti-submarine warfare (ASW) capabilities. The induction of the Boeing P-8I maritime-patrol and ASW (MR-ASW) aircraft will provide a major boost in this area.

Amongst its varied peacetime roles, the IN accords primacy to maritime diplomacy, exercised through its 'Foreign Cooperation' programme. By undertaking bilateral exercises with the world's major navies, and by extending a hand of friendship to Indian Ocean neighbours through security, material, training and humanitarian assistance, it has not only established its own credibility, but also reinforced our diplomatic outreach.

In the above context, the 2016 *International Fleet Review* which saw the participation of 60 navies, was a major landmark for India's maritime diplomacy and helped promote mutual friendship and understanding between the participating navies. Another notable and more recent initiative was the first biennial *Goa Maritime Conclave*, held in November 2017, in which Chiefs of ten IOR navies participated.

But, some Lacunae

Having recalled our maritime past and undertaken a survey of the present, it is necessary to take note of three major lacunae that may pose hindrances to India's future growth as a maritime power; especially, in the face of China's resolute advance in this field.

The current absence of an intellectual underpinning to India's maritime power constitutes a worrisome void. The political establishment has, so far, neither spelt out 'national aims and objectives', nor focused on 'national maritime interests'. The IN has bridged this gap by evolving a Maritime Doctrine and Strategy as well as a force-planning document. Even as India creates a world-class 'fighting' navy, we lack most of

The MiG-29K has transformed carrier aviation in India, but the IN already appears to be looking beyond the type for its third carrier, the under-development IAC-2 (photo: Angad Singh)

The IN's antiquated helicopter force is becoming a major concern (photo: Angad Singh)

the other constituents (pointed out earlier) of 'national maritime power'. It is, therefore, essential that India, like other maritime nations, draws up a national level 'Strategy for Maritime Security', which will bring focus on the missing ingredients. Without them, India cannot aspire to become a maritime nation; much less catch up with China.

The second area of concern, and one that affects combat-effectiveness, relates to the navy's material shortcomings, arising from acute import-dependence. India's vast indigenous defence-technological and industrial base has, so far, failed to make the navy self-sufficient in terms of guns, missiles, electronics, propulsion machinery and many other vital systems that go into warships and aircraft. While the nation eagerly awaits implementation of the 'Make in India' project, our reliance on imported hardware constitutes a serious vulnerability.

The last and most critical shortcoming in our national security matrix is the dysfunctional process of importing ordnance and hardware. The complex and sluggish bureaucratic processes within the MoD, can take anything from 5-10 years to induct a critically needed weapon-system. A grave manifestation of this lacuna is the fact that, today, every major IN warship, is handicapped (and vulnerable) as far as anti-submarine and anti-ship capability is concerned, because it lacks an integral helicopter. Obsolete shipborne naval helicopters have been awaiting replacement for over a decade. Urgent reformation of the acquisition and procurement processes will immeasurably boost our navy's capabilities.

So, as far back as 1945, Sardar KM Panikkar had spelt out a vision of India's naval power re-claiming the Indian Ocean as its area of influence. Today, Panikkar would have been pleased to see that his dream has been substantially realised by the steadfast endeavours of a naval leadership, inspired by his prophetic writings. Given the trans-national reach and versatility of maritime power, not only is the IN going to find greater salience in India's national security matrix, but will also play a vital role in sustaining India's economic prosperity.

All eyes seem to be on the Indian Navy – a modern and capable three-dimensional force – rated by other navies as professionally up to NATO standards and eagerly sought by them as a partner for maintaining 'good order at sea' in the IOR. India's 'maritime awakening' and the level of maritime consciousness amongst India's politico-bureaucratic elite, however, remains inchoate. If the IN is, indeed going to play the role of a 'game changer' in the national security matrix, Navy Day 2017 should be an occasion for introspection.

As an important postscript, mention needs to be made of six young India women – all naval officers – who are almost half-way through their voyage of circum-navigation of the globe in a small sailing boat the Tarini. Skippered by Lt Cdr Vartika Joshi, *Tarini* follows in the wake of *Mhadei* which carried Captain Dilip Donde and Cdr Abhilash Tomy on their solo voyages around the world in 2010 and 2013 respectively.

The Indian Navy is doing its best to revive India's hoary maritime tradition. The nation needs to follow.

An all-women crew is currently attempting to circumnavigate the globe on the sailboat INSV Tarini (photo: Indian Navy)

Adani Defence & Aerospace

India takes pride being one of the world's fastest growing economies and on course to be the world's third largest economy by 2030. India needs to have a similar vision to become self-reliant in defence and security, and to equip its armed forces with "the best in the world" by 2030. Today, India not only spends billions of dollars in importing weapons, but also relatively does not get the latest technology.

In continuation of Adani's vision of nation building, the Adani Group is keen to play an instrumental role in helping transform India into a destination for world class high-tech defence manufacturing, aligned to PM Modi's 'Make in India' initiative which underpins Adani's strategy to enable a greater degree of self-reliance for India in defence and security, stronger trade balance, making India an export hub for defence equipment and technologies, substantial skill building and job creation in industrial manufacturing and finally develop indigenous base for Research, Innovation and Technology

The Adani Group, with US $12bn revenues, $2.5bn operating margins and $20bn of assets is one of the most experienced in mega projects execution, engineering, system integration, and hi-tech manufacturing.

There are four pillars to Adani's Defence & Aerospace roadmap :

- Focus on platforms and technologies of critical importance to assert India's military competence and help meet the security challenges
- Collaborate with credible and committed global partners willing to team-up for the long term, and willing to transfer state-of-the-art technology and skills to India
- Focus on capabilities critical for true indigenisation including design, system integration, maintenance & upgrade in India
- Help to develop and grow dynamic MSMEs, critical for rapid scale-up and sustainable ecosystem in India

Adani has announced collaboration with Saab for the Gripen, Elbit Systems for UAVs and Solvay to explore aerospace grade carbon fibre in India. Adani and Saab are actively working on setting up the R&D centre for Gripen technologies in India, and to manufacture composites for civil aerospace in country. Adani and Elbit are setting up carbon composites aerostructures manufacturing of the Hermes 900 for export to Israel.

Adani has setup technology scouting centres in Tel Aviv, San Francisco, New York and London to ensure it is able to bring 'best of technologies' and partners to India. The Group is setting up a defence and aerospace cluster in Mundra, Gujarat where it has a private air strip which is functional, hangar and plug-and-play infrastructure with excellent connectivity to port, railway and highways. The social ecosystem in Mundra supports more than 5000 families employed across Ports, Power, Agri, Solar manufacturing operations.

Hermes 900

Admiral Arun Prakash on

COOPERATION IN THE INDIAN OCEAN REGION

Defence Minister Nirmala Sitharaman (centre) with Admiral Sunil Lanba on her left at the Naval War College, Goa, during the first Goa Maritime Conclave

RE-VISITING NAVAL FORCE STRUCTURES*

The countries represented at the Goa Maritime Conclave range from city-states and island-nations to archipelagos and sub-continents. We may follow diverse methods of governance and even differ in political beliefs, but the waters of the great ocean that wash our shores form a powerful glue that binds us together. For centuries, the Indian Ocean, called *Bahr al Hind* by the Arabs, has carried religions, cultures, languages, traditions, and people, across thousands of miles; creating relationships that transcend nationality.

Historically, India, because of its central geographic location, has been privileged to play a catalytic role in this process of synthesis and churning. Even as our nations prosper on the rising tide of economics, our destinies remain inter-twined and it is important for us to stay engaged on security issues of mutual interest. It is, therefore, apt that the first Session of this Conclave should focus on 'naval force structures' in the context of an evolving maritime scenario.

While examining a navy's force paradigm, one has to consider the strategic environment as well as national interests, and the strategy that has been crafted to safeguard them. However, before embarking on a discussion of these factors, let me indulge in a brief historical 'flashback.'

Historical Flashback

The discovery of sea routes across the Indian Ocean in the late 15th century, by the Portuguese, made it, for the next five hundred years, virtually a European monopoly, where trading nations, paying scant heed to Asian civilisations, cultures and races, engaged in a relentless quest for spice and specie.

As we look back, let us note that while colonialism may have become extinct, realpolitik continues to flourish, and there are hegemonic states, whose thirst for territory and resources as well as ambition for dominance can lead to intimidation of smaller nations; from whom they seek deference. We became victims of colonialism because we lacked the vision and will to unite against interlopers who came by sea. Nations of the Indian Ocean Region (IOR) need to make common cause in the interests of security and ensure that we do not allow neo-colonialism to repeat history.

Another regrettable fall-out of our colonial past is relegation of the IOR to a strategic backwater. In the post-colonial era, blame for the IOR not acquiring its own identity must be accepted by all of us, who live on its shores. Not only has the level of intra-regional political interaction and trade remained low, but we have invariably gone beyond the IOR to seek partners.

Let us also note that the MEA has remained a passive bystander in the ongoing debate about the suitability of terms like 'Indo-Pacific' and 'Indo-Asia-Pacific' to replace 'Asia-Pacific'. Since this discourse is rooted in conflicting external geo-political interests, we need to tread with caution and ensure that the coherence of the IOR is not impacted adversely.

Having taken note of the past; let me highlight some salient aspects of our current geo-strategic environment.

The Geo-Strategic Environment

The juxtaposition of three nuclear-armed neighbours; i.e. India, China and Pakistan, has created some unique deterrence-related issues in the maritime domain. At the strategic level, we must reconcile ourselves to the presence, in our waters, of nuclear-powered ballistic-missile submarines which represent the seaborne leg of respective deterrents. With the unilateral introduction of tactical nuclear weapons, into the equation, by Pakistan, we may also have to countenance their appearance at sea.

In the conventional domain, too, there is instability in the IOR; due to historical animosities, territorial disputes, or plain

mistrust amongst neighbours. China, although not an Indian Ocean nation, has to be accorded recognition because of its close alliance with Pakistan, as well as strategic aspirations, that have translated into naval presence and bases in this region.

Faced with economic constraints and developmental needs, many IOR nations also fear the prospect of political or military domination. Some have, therefore, resorted to, arms acquisition programmes, in the hope that a military build-up might provide insurance against hegemony. This has led to an unstated naval arms race in the IOR, and we are going to see more diesel-submarines, missile-armed warships, fighters and patrol aircraft in our seas and skies; with the attendant risks of mutual interference.

Non-traditional Threats

These were 'traditional security threats', arising from typical issues of international relations that are dealt with, by states or governments. At the level of navies, especially in a regional gathering such as this, it would be more appropriate to address, 'non-traditional security threats'; described as, 'challenges to the security and well-being of peoples and states, arising, primarily, from non-military sources'. Such sources may include international terrorism, piracy, environmental security, illegal migration, health pandemics, resource shortages and cyber attacks.

Since the end of the Cold War and especially since 9/11, concerns about non-traditional security threats have been growing steadily, and they are, in fact, assuming as much significance, in the national security calculus, as war and armed conflict.

At this point, let me draw attention to recent our experience in four areas, from which we can draw lessons regarding force structures to meet NTS challenges.

Safety of Shipping

Some 100,000 merchantmen transit the Indian Ocean, carrying cargo worth a few trillion dollars annually. All shipping, especially oil and gas-laden, as it passes through focal areas, is vulnerable to interdiction or interference by non-state actors. Safety of international shipping, in the IOR, has, therefore, been one of the prime issues of common concern, in the maritime domain.

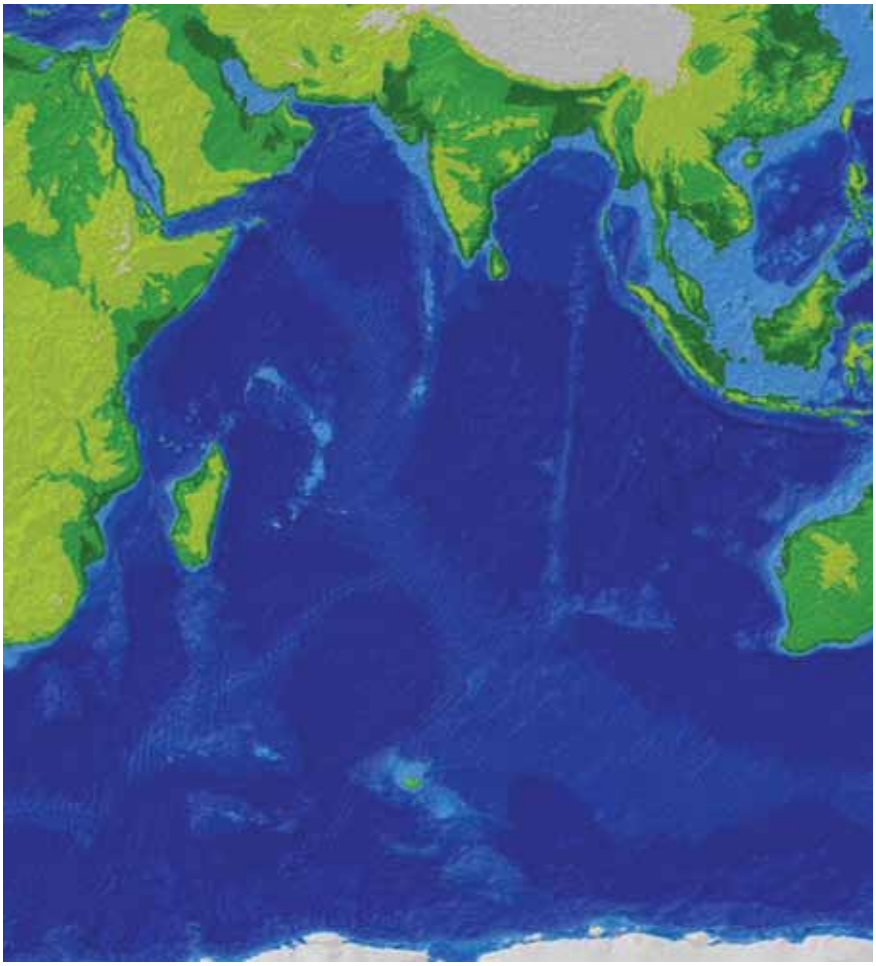
We saw piracy in the IOR starting with sporadic incidents in 2004, and then rapidly spiralling to assume major dimensions; disrupting international shipping traffic and sending insurance rates zooming. It took the maritime forces of two dozen individual navies as well as coalitions, a decade, to bring this menace under control. Being a cyclical phenomenon whose ebb and flow is dependent on a number of complex factors, it is not surprising that piracy has re-appeared after a three-year lull.

The sustained international anti-piracy response saw a rare show of unity amongst nations, but remained sub-optimally effective, for two reasons. Firstly, the initiative, being largely extra-regional, had political, legal and technical constraints; and secondly, given the huge ocean areas to be covered, the effort was deficient in platforms as well as coordination.

Regional navies will need to work together and play a more prominent role; choosing from a number of economic, military and political options to craft a broad-based strategy to pre-empt or prevent a resurgence of large-scale piracy.

Humanitarian Assistance and Disaster Relief (HADR)

The December 2004 Great Asian tsunami saw the Indian Navy deploying 38 ships, 21 helicopters, 8 aircraft and about 6000 personnel, within hours of receiving appeals for help from neighbouring countries. While our sailors did their best, the arrival of the US Navy, one week later, with its massive resources, clearly showed up our inadequacies. Where we had sent destroyers and frigates with inflatable boats, they brought amphibious ships with landing craft and heavy-lift helicopters. The 2004 tsunami was to have one fortunate outcome. Soon after the event, NHQ took up, with MoD, the acquisition of a 35-year old landing platform dock (LPD) USS Trenton, offered to us at a very cheap price. The bureaucracy, having – expectedly - thrown out the proposal, I took up the matter with the, then RM, Pranab Mukherjee. As soon as I mentioned that the ship could carry 900 armed troops or 1500 refugees, the



The Indian Ocean Region is a sizeable maritime area and opportunity for regional naval co-operation

Minister responded, 'Why one? Buy two of them.' The 9000 ton Trenton arrived within months and remains in service as INS Jalashwa, where we had carried crates of bottled water, they landed RO plants; and where we had sent medical teams, they sent hospital ships.

The tsunami killed over a quarter-million people and was a harsh reminder that the Indian Ocean is not merely a geographic term but an eco-system connected by humans as well as natural forces. It also demonstrated the value of multi-national collaboration in rescue, relief and rehabilitation of victims. Climate change, too, is looming and has begun to affect islands and low-lying nations. Rising sea levels will lead to mass migration, social upheavals and regional crises. Under such circumstances, neighbours have a duty to render assistance in every possible way; and navies must lead.

The growing importance of HADR challenges requires that all regional navies, big or small, participate in the common endeavour to make the IOR as self-sufficient as possible in responding to these challenges.

Aviation and Submarine SAR

The disappearance of Malaysian Airlines flight MH-370 in March 2014, in uncertain circumstances, brought focus on a critical area which demands maritime cooperation. The Search and Rescue (SAR) operation mounted, over vast ocean areas, was a task that Malaysia, by itself, could never have coped with, but setting aside political differences, many nations came together in this humanitarian cause.

In a related context, with a growing number of submarine operating navies in the region, the ready availability of a submarine-rescue facility has become imperative. Currently, only the Singapore Navy operates a deep submergence rescue vessel (DSRV), in our region. The IN has been lucky that it has managed to operate submarines, for nearly 50 years, with ad-hoc rescue measures. India's first two DSRVs are due to arrive by next year.

Clearly, increasing aviation activity over the sea and submarine operations underwater make a compelling case for regional navies to pool aviation SAR and submarine-rescue facilities in a common cause.

Maritime Domain Awareness

For maritime cooperation, in any sphere, 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 is another arena where IOR neighbours could pursue cooperation by creating a framework for information sharing with each other.

Singapore's Information Fusion Centre as well as the 2013 tripartite cooperative MDA agreement between India, Sri Lanka and the Maldives could form the template for other similar accords across IOR.

Against this backdrop of threats, challenges and opportunities, let me turn to India's force planning options. As I had mentioned earlier, the force-paradigm is rooted in maritime strategy and I will start by referring to it.

India's Maritime Strategy

The Indian Navy contributes to the nation's deterrence strategy in the conventional and nuclear domains by offering assured maritime capability, combat-ready forces and situational awareness; and by conveying clear signals of intent through 'presence' in areas of interest. Having addressed deterrence, India's Maritime Strategy seeks to actively reach out to IOR neighbourhood for cooperative endeavours. By ensuring 'good order at sea' and reducing common threats, India hopes to also, don the mantle of a provider of 'net security' for regional friends and neighbours.

India's Maritime Strategy describes its overarching objective as; 'safeguarding national maritime interests at all times''. At the same time, it also seeks to provide reassurance to IOR neighbours by focusing on:

- The safety and security of IOR trade and energy routes.
- Maintaining freedom of navigation and strengthening UNCLOS for universal benefit.
- Enhancing cooperation between navies to counter common threats at sea.

The strategy spells out a number of sub-strategies; each based on a discrete 'maritime security objective'. Of these, two are of interest in the present context. The strategy for 'Shaping a Favourable Maritime Environment', envisages a set of actions to preserve peace, promote stability and maintain security; thus contributing significantly to provision of 'net security' in the IOR. It encompasses activities like EEZ patrols, anti-piracy operations, HADR, non-combatant evacuation operations, maritime interdiction operations, UN peace support operations and search & rescue missions.

The strategy for 'Force Development' looks at about a dozen thrust areas and capabilities required to meet the navy's future roles. It envisages a force-architecture for Power Projection and for exercising Sea Control, through a balanced surface and submarine fleet, supported by integral and shore based naval aviation.

Three aircraft-carriers are envisaged as forming the core of battle-groups, to be accompanied by requisite number of surface combatants and logistic support ships. The multi-mission combatants will be capable of waging anti-ship, anti-

Piracy in the western IOR remains a global concern

submarine and anti-air warfare. They will be complemented by amphibious and mine counter-measure forces. By end of the next decade, these capabilities should translate into a sizeable force of about 170 modern ships, submarines and auxiliary vessels and about 400 aircraft, supported by MDA and network-centric warfare capabilities.

Force Planning Options

India's force-planners are compelled to tread a thin line; balancing future threats with present ones; strategic deterrence with conventional deterrence; and capabilities to counter traditional threats with those required for non-traditional threats. Fiscal constraints imposed by needs of national development will sooner than later, force our planners to make some hard choices.

Of these, the most critical one relates, perhaps, to our aircraft-carrier building programme. The affordability and continuing operational utility of aircraft-carriers is often questioned, especially in light of China's anti-carrier strategy. At the same time, the PLA Navy's own ambitious carrier building programme poses a potential challenge. The conundrum which we need to resolve is this: can the commanding presence, deterrent potential and concentrated firepower of an aircraft-carrier be substituted by a paradigm of 'distributed lethality', that is spreading firepower amongst destroyers, frigates and attack-submarines?

Navies also need to diversify. While concentrating on their 'Military' role, they must include, in their repertoire, a range of capabilities required for the 'Diplomatic', 'Constabulary' and 'Benign' roles. Whereas aircraft-carriers, landing platforms and amphibious ships lend themselves readily to multi-tasking, other combatants may need modifications at the design stage to enable compatibility for non-military roles. Funding a hospital ship, by the IN, would be money well-spent in terms of its huge utility as well as goodwill potential.

'Distributed lethality' could be an answer to the steep costs of aircraft carrier strike capability

Another choice that navies will need to make is that between independent operations and inter-operability and cooperation with other navies. Here, we may note that the broader compulsions of globalisation and universal concern for security of the global commons are eroding the old concepts of naval dominance within the nation-state paradigm. We may need to review the relevance of Admiral Mahan's teachings and perhaps, lean towards Julian Corbett's more subtle approach to seapower.

Historically, Indian Ocean nations have faced threats from insurgencies, mercenary invasions, attempted coups as well as natural calamities. Since many regional navies are. Now, growing in strength and capabilities, it is time for us to consider the creation of an 'Indian Ocean Maritime Partnership'; perhaps under the aegis of IONS. Such a multi-national partnership, first envisaged by former US Navy Chief Adm. Mullen, could be mobilised at short notice to spread the burden of meeting tasks related to 'good order at sea' and address many other maritime areas of common concern.

As conclusion, we can state that even as the dynamic of growing economies promises a bright future for countries of our region, there are a host of traditional and non-traditional security threats at sea which could disrupt progress and inflict human suffering as well as economic damage. It is our belief that maritime security cannot be seen as a 'zero-sum game.' Assurance of security and prosperity, only for some nations, would foster anxiety amongst others, and lead to tension and instability.

Inclusivity is vital, and India's Prime Minister Narendra Modi encapsulated this thought when he announced on a 2015 visit to Mauritius; "We seek a future for the Indian Ocean that ensures Security and Growth for All in the Region." These words have given birth to the acronym 'SAGAR', which has become the leitmotif for India's regional maritime diplomacy.

Bearing the PM's message in mind, as well as another piece of old wisdom which says; 'No nation can do everything by itself, but many nations can do much together', our force-planners must build navies that are inter-operable and will complement each other to enable collective responses.

**Adapted from a speech delivered by the writer at the first Goa Maritime Conclave on 31 October-1 November 2017 at the Naval War College, Goa.*

Dan Gillian, Boeing Vice President, F/A-18 and EA-18 programmes, on the

Super Hornet and the Indian Navy's quest for a carrier borne fighter

As the Indian Navy continues its ongoing progress towards becoming a blue-water navy, it will need a carrier borne fighter fleet that is not only mobile but also easy to maintain with low operational costs. The future naval carrier borne fighter will also need to be compatible with current and upcoming aircraft carriers of the Indian Navy.

Attributes of a Future Carrier Air Wing

The importance of carrier aviation cannot be understated – in particular for a country like India with a large coastline covering more than half its borders. The Indian Air Force is focused on protecting the north and east, but with coastlines covering much of India's south, and west, the need for a strong carrier air wing is obvions.

Mobility is key for both the current and future fighters, which is likely to grow only more complex in this region.

The carrier air wing of today and tomorrow has become a mobile network that houses aircraft that can serve as extended nodes on an integrated network. The future fight is about who is best networked to gather and share the intelligence to carry out the most effective mission quickly, efficiently, and effectively.

The future carrier air wing will need to do it all: find–target–track–engage–and assess in a kinetic and non-kinetic manner.

As such, when I think about next generation carrier aircraft that operate off US or Indian Navy carriers, I think about two key attributes: "networked and survivable."

The next generation of aircraft, will need to connect into a network, plugging into an information stream shared across its fleet. This means integrated and varied sensors, large computers, big data networks, and advanced displays to help aircrew manage all of the available Information.

Survivability is often confused with stealth, but stealth is just one element. Next generation aircraft will need to balance stealth with lethality. Future fights will require increased magazine depth and sophisticated air-to-air sensors to deal with advanced

threats. Survivability means that future fighters need to have increased range to push the threat further away.

Another aspect of survivability is reliability, especially in a shipboard environment. Carrier aircraft need to be tough, easy to launch, easy to land, and easy to maintain. This is increasingly important at a time when deployments are longer and farther away than ever before. Ease of maintenance will only become more important as sensors and systems continue to grow in sophistication and complexity.

With multi-role capabilities, advanced technologies with room to grow and low acquisition and sustainment costs, the Boeing F/A-18 Super Hornet is most suitable for India. With designed-in stealth, an AESA radar and many other advanced technologies that are required for mission requirements of the naval aviator, the F/A-18 Super Hornet is the most advanced aircraft of its kind in operation today and will provide operational benefits to the existing and future force structure of the Indian armed forces.

Evolution of the Super Hornet

Boeing's Super Hornet offers the best of those attributes: it is combat proven, but defined to meet the US Navy's flight plan so that it continues to evolve to outpace future threats. The Super Hornet will remain on US Navy carrier decks well into the 2040s – being three-fourths of the Navy's strike fighter capacity into the 2030s and no less than half the carriers striking force into the 2040s.

On 23 May 2017, the President of the United States sent his 2018 fiscal year budget to Congress, and included in that budget was a requirement for 80 Super Hornets over the next 5 years to address its strike fighter shortfall. Also in that budget request was funding for Block 3 capabilities to ensure the air wing has the capabilities needed to win in the 2020s and beyond.

The next generation of Super Hornet aircraft comes into the US Navy and potentially international customers to fulfil its role as the next-gen airplane in a complementary way with the F-35. Those two aircraft are going to work together on the carrier decks for the US Navy, well into the 2040s.

That gives Boeing great opportunity to continue the programme, which is evolutionary capability development from a risk perspective of low risk change that delivers revolutionary performance. We are excited to be building airplanes at a current production rate based on the US Navy demand and some other international customers, which takes us into the 2020s. Boeing's current production rate is two per month but have built and can build up to four aircraft per month.

Introduced in 2007, the F/A-18 Super Hornet Block II is the world's preeminent carrier capable aircraft. The F/A-18 Super Hornet was designed for carrier operations and is the world's preeminent carrier capable aircraft, is combat proven, supersonic, an all weather multirole fighter with a defined US Navy flight plan to outpace threats into the 2040s.

The Super Hornet's benefits of being a twin-engine aircraft help provide the warfighter a margin of safety that does not

An F/A-18E ready to launch from a US Navy Nimitz-class carrier (photo: US Navy)

exist in a single-engine platform. A single-engine aircraft can be lost owing to engine malfunctions or loss of thrust while a twin-engine platform can lose an engine and still safely return to base–or carrier.

The Super Hornet has a buddy refueling capability that can extend time on station, range, and endurance. Additionally, the Super Hornet can provide sustained air support through its Active Electronically Scanned Array (AESA) radar targeting data and reliable data links.

The Super Hornet is compatible with the Indian Navy's aircraft carriers. Extensive simulation has shown that the Super Hornet is capable of conducting STOBAR operations with a meaningful weapons and fuel load.

Ease of maintenance

The F/A-18 Super Hornet not only has a low acquisition cost, but costs less per flight hour to operate than any other tactical aircraft in the US inventory. Part of its affordability is because the Super Hornet is designed to need far less maintenance; which translates into high mission availability. Ease of maintenance (supportability) results in lower maintenance man-hours per flight hour.

Importantly the Super Hornet does not require any scheduled depot-level maintenance and the engine does not require any scheduled maintenance between overhauls.

In any case, Boeing's active production line and robust supply chain allow the company to offer the most affordable platform. Having low cost of operation, low maintenance requirements and twin-engine based survivability, allows the Super Hornet to operate in harsh environments.

The F/A-18 (Block III)

The Super Hornet is a platform that is continuously evolving to outpace future threats. Virtually every two years, Boeing and its industry partners along with the US Navy have been delivering new capabilities


Advanced Super Hornet demonstrator seen flying with conformal tanks (photo: Boeing)

F/A-18E Super Hornets being marshalled on a US Navy carrier flight deck (photo: US Navy)

The RAAF's Super Hornets: a case for the IAF?

The Royal Australian Air Force operates 24 Super Hornets and 12 Growlers, being one of seven air forces operating the type. The F/A-18 Super Hornet brings the latest generation of technologies to the warfighter. The AESA radar in particular is an expediential leap in technology needed for current and future missions. The Advanced Targeting Forward Looking Infrared system, Joint Helmet Mounted Cueing System, Multifunctional Information Distribution System, advanced high capacity computer system, and state-of-the-art cockpit provides the warfighter with intuitive situational awareness and capability now and far into the future.

The Super Hornet is highly capable across the full mission spectrum and is a true multi-role aircraft, able to perform virtually every mission in the tactical spectrum, including air superiority, day/night strike with precision guided weapons, fighter escort, close air support, suppression of enemy air defences, maritime strike, reconnaissance, forward air control and tanker missions.

to the fighter. Critical mission systems such as the radar, mission computers and sensors continue to evolve.

Boeing has also developed the Block III Super Hornet to complement existing and future air wing capabilities. Block III is also known as the Advanced Super Hornet. The Advanced F/A-18E/F Super Hornet's multi-mission capabilities include increased battle-space situational awareness, counter stealth targeting, greater range and increased acceleration, improved survivability with reduced signature.

The Block III Super Hornet will be operational at the same time as will the F-35. In the 2020s, three Super Hornet squadrons and one F-35 squadron may form the airwing of US carrier fleets.

These advanced capabilities can both be built into new aircraft and incorporated into existing aircraft, allowing maximum ability to field these capabilities rapidly. Block III Super Hornet is built from the same airframe as Block II, providing low risk development and maintaining the lowest operating costs of any US tactical fighter. While Boeing demonstrated advanced Super Hornet capabilities in flight in 2013, the package of upgrades has evolved to complement the F-35, EA-18G and E-2D which will be operating together in the air wing well into the 2040s.

Key Features

Key features of Block III Super Hornet include enhanced network capability, longer range with low-drag, stealthy conformal fuel tanks, long-range detection with Infrared Search&Track, an Advanced Cockpit System, improved signature with low observable next generation radar cross section for increased survivability and 9,000+ hour life for reduced life cycle costs.

A significant design feature is the addition of Conformal Fuel Tanks. Mounted on shoulder of the Block III, conformal fuel tanks extend the range of the super Hornet by 100 nautical miles, a significantly longer range than the Block II. Conformal Fuel Tanks also free space occupied by a centreline drop-tank, thus giving an additional hard-point to carry air-to-air or air-to-ground weapons.

Modern next-generation aircraft collect a large amount of data through their sensors. The Super Hornet Block III comes equipped with Distributing Targeting Processor Network (DTP-N) and Tactical Targeting Network Technology (TTNT). These are basically a computer and a big data platform that work together to aid in even more efficient movement and management of data within assets.

The Advanced Cockpit System simplifies the interpretation and projection of a large quantity of information for the aircrew – both in the front and rear cockpit – making it easy to manage an information network.

The F/A-18 Block III's sensors along with the APG-79 AESA Radar coupled to DTP-N and TTNT systems plots information for aircrew to view and manage information more efficiently.

Boeing has made a few signature improvements to reduce the Radar Cross Section (RCS) of the Block III to make it even stealthier.

F/A-18 Super Hornet, 'Make in India'

Boeing has had a presence in India for more than seven decades. Boeing's proposed 'Make in India' plans for the Super Hornet is not about moving a production line but rather building an entirely new and state-of-the-art production facility that can be utilised for other programmes such as India's Advanced Medium Combat Aircraft (AMCA) programme.

Boeing is prepared to bring its global scale and supply chain, its best-in-industry precision manufacturing processes, as well as the company's unrivaled experience designing and optimising aerospace production facilities to bear in both expanding India's aerospace ecosystem and helping realise the Make in India vision. This addresses the infrastructure, personnel training, and operational tools and techniques required to produce a next to gen fighter aircraft in India.

Boeing will work closely with India industry to ensure they have the very latest technologies, applying lessons learned from the current Super Hornet production line. The programme means that airframe and subsystem manufacture by Indian industry will be done in a deliberate way, an opportunity for technology insertion and growth of India's aerospace industry.

Boeing will partner with Indian industry to develop the right capabilities as efficiently and cost effectively as possible to integrate these suppliers into the global supply chain. Boeing and its current industry partners have had robust discussions with suppliers in India about building Super Hornets. Currently over 60,000 people from 800 suppliers across 44 states are part of the supply chain supporting the Super Hornet, which includes suppliers who manufacture parts for the Super Hornet in India.

With advanced technologies and multi-role capabilities, the Super Hornet is surely suited to meet needs of the Indian Navy- and Indian Air Force – now and in the future.

Presentation at the FICCI Seminar

"Life on an Ocean's Wave"

The Royal Navy's new Carrier

Vayu's UK correspondent Richard Gardner reports on the Royal Navy's impending resurgence as a fixed-wing carrier operating force

The UK Royal Navy's new aircraft carrier, HMS *Queen Elizabeth*, made a spectacular entrance to Portsmouth harbour on 16 August 2017, which is now her new home base. On this occasion, which marks a major step in the RN's ambitious plan for the regeneration of strike carrier capability, the UK Prime Minister, Theresa May and Admiral Sir Philip Jones, First Sea Lord and Chief of Naval Staff, underlined the intention to use the new carriers "to open a new era in global maritime power projection."

Admiral Jones said, "These ships and our continued investment in a strong Royal Navy send an unmistakable message to friend and foe alike–the UK has both the intent and means to protect our interests, shoulder our responsibilities and advance our ambitions in an uncertain world.

Then Secretary of State for Defence, Sir Michael Fallon said, "As we look to life beyond the European Union, a global Britain won't be stepping back; we'll be stepping up to defend our shores and fight for the global good."

The August edition of the RN's *Navy News* carried a comment piece entitled, "Eastward, look, the land is bright". It highlighted the UK Foreign Secretary's recent remarks that Britain is back East of the Suez and is concerned with military expansionist activities by China from Djibouti to the South China Sea and recognises that the Asia Pacific region contains two of the world's three largest economies and if the UK wishes to forge new partnerships beyond Europe then this is where it must be. The new aircraft carriers will be at the centre of a Carrier Strike Group including escort surface ships, a submarine and supply ships, and will be expected to deploy on a global basis. New RN base facilities in Bahrain and Oman will act as springboards for more frequent deployments beyond the Gulf and the regeneration of a more globally focused fleet will help to develop closer UK links with allies in the region. The *Navy News* commentary suggests the Royal Navy will continue to maintain operations beyond the Gulf in the Indian Ocean, where for many years it has been part of the international effort to protect commercial shipping from pirate attacks. The availability, in the next decade, of a new Carrier Strike Group will represent a big increase in RN capability for long-range deployment which will have the support resources to provide a mobile forward air presence,

The carrier's four-acre flight deck is seen to good effect in this overhead photo

equipped with fifth generation jets, to work alongside allies and also to be there for providing aid and assistance if required following natural disasters. In this relief role the *Queen Elizabeth*-class will be able to embark over 40 helicopters, including Merlins, Chinooks and Wildcats. In a Strike Carrier role the normal air complement will be between 24 and 36 F-35B combat jets, with 9 ASW Merlin Mk 2 helicopters, 5 Merlin Crowsnest AEW/ISR radar and communications helicopters and a mix of Merlin Mk 4 and Wildcat helicopters for transport, logistics support and general duties.

The 65,000 ton super carrier has started its ship trials in the North Sea, paving the way for acceptance into service later this year to be followed by the embarkation of a rotary wing squadron and the first fixed wing deck trials and aircraft operations the next year. This is a major step towards the regeneration of UK carrier strike capability, following the retirement of the *Invincible*-class light aircraft carriers and their Harrier combat jets. The two new *QE*-class ships are the largest ever warships to be built for the Royal Navy and are destined to provide a significant overseas force projection capability, with a planned 50 year service life. The Royal Navy is anxious to deploy these new carriers with a balanced air group to Asia Pacific waters in due course to demonstrate a wider global defence commitment and to underline its continuing support for regional allies, as was shown earlier this year with the detachment of RAF Typhoons to Malaysia, Japan and South Korea.

HMS *Queen Elizabeth* sailed from her shipyard at Rosyth, Scotland, for the first time in June, for Scapa Flow, to work up sea trials, concentrating on ship systems. All aspects of the ship's performance are being evaluated and tested, including speed tests and manoeuvrability, along with the ability of the on-board services and facilities to support an embarked ship's crew and air component strength of up to 1,700 personnel. Such aspects as catering and stores provision will also be put to the test. The ship design includes the most advanced internal automated provisions and weapons storage and delivery systems ever to put to sea, featuring much innovation transferred from the automotive manufacturing and logistics sectors. It is claimed that this will allow very quick operational re-supply of aircraft to maximise sortie rates. After the initial handling and support trials, ship mission systems will be fully tested and some helicopter deck trials have already started. Early next year all aspects of rotary wing flying trials off the ship will commence leading up to fixed-wing flying trials.

In 2010 it was announced that an alternative flight deck and equipment design, featuring conventional arrestor wires, angled deck and EMALS catapults, would be fitted to the second of the two carriers, HMS *Prince of Wales*, but after a re-appraisal of the operational benefits of conventional versus STOVL combat aircraft operations, it was concluded that higher rates of sortie generation could be achieved, with much lower training and support costs, if both new carriers were built to the original design with embarked F-35Bs, a ski-jump ramp for take-off and a straight through runway, flanked by generous preparation and parking areas. While HMS *Queen Elizabeth* is now at sea, HMS *Prince of Wales* is nearing structural completion at Rosyth and fitting-out is underway. Both carriers are built to an identical STOVL optimised layout but such is the flexibility offered by the four-acre flight deck design there is plenty of room for a revised deck if requirements change in the future.

The first British unit to fly the F-35B will be No. 17 Squadron based in the USA to expand experience of operating the type ahead of the build-up in RAF and Royal Navy pilot training alongside the US Marine Corps, who also operate the B model. In 2018, HMS *Queen Elizabeth* will deploy to the East Coast of the USA to carry out deck handling and operating trials with both UK and USMC embarked F-35Bs. An Initial Operating Capability with the UK STOVL fighters is due next year and in the meantime the home base in England at RAF Marham will have been extensively rebuilt to accommodate what will be a joint training and operating base for F-35Bs. The joint operational conversion unit will be No. 207 Squadron, which has the heritage of being an early naval squadron and later becoming an RAF unit. The first operational F-35B Squadron will be given the famous RAF identity of No. 617, the famous 'Dam-Busters', and the second will be No. 809 Naval Air Squadron, which previously flew Buccaneers off HMS *Ark Royal*, and later, during the Falklands War, Sea Harriers off HMS *Hermes* and HMS *Invincible*. These units will be jointly crewed and interchangeable so that squadrons will fly from the carriers and land bases as needed.

The new carriers were built to take up to 60 aircraft and have large deck-edge lifts and spacious hangar space below deck. The lifts can carry a Chinook or two F-35Bs at a time, allowing rapid transfer movement between hangar and deck. The role of vertical lift support for the Royal Marines in the Royal Navy's amphibious assault force is currently provided by the helicopter carrier HMS *Ocean*, but the future of this ship is under discussion and that task may be absorbed into the role of the second *QE*-class aircraft carrier. It is intended that the IOC for the carrier strike combination will come into effect in 2020.

The UK has committed to purchasing an eventual total of 138 F-35Bs, but this is

likely to be a lengthy programme to spread out costs. There has been much speculation that the USMC will take up the UK offer of co-deploying its F-35Bs aboard the RN carriers alongside RAF/RN F-35Bs. There will certainly be enough room to take them, and the size of the flight decks will allow for rather more operational sortie generation compared to the restricted decks on the USMC's own assault helicopter carriers. It is known that the USMC is enthusiastic at the prospect of these joint possibilities, which will be fully tested at sea next year off the US coast. In anticipation of future UK/US joint aircraft carrier operations more than 60 RN and Royal Marines personnel were involved in August as a part of a giant NATO maritime exercise off the coast of Scotland. They were embedded within the US *Nimitz*-class super-carrier USS *George HW Bush* and worked alongside their US counterparts to hone their carrier strike skills ahead of the arrival of HMS *Queen Elizabeth* in service. The war games were part of *Exercise Saxon Warrior*, and saw the Commander of the UK Carrier Strike Group, Commodore Andrew Betton, and his team direct fighters, firepower and personnel across the task group for ten days of realistic training. 15 ships, 100 aircraft and over 10,000 personnel took part. This has seen the UK team working with US counterparts to fight off a series of simulated threats from enemy forces, using all the air, surface and sub-surface assets of the entire task group. These threats were specifically designed to test the UK personnel's reactions for coordinating a response and were coordinated from the RN Clyde Naval Base.

The Royal Navy has been planning the re-generation of a large-scale carrier strike capability for many years, and although the versatile VSTOL Sea Harrier provided a very cost-effective stop gap, the loss of heavyweight naval air power provided in the last era of large RN aircraft carriers, equipped with Buccaneer nuclear bombers and Mach 2 F-4 Phantoms, has been badly missed. The new RN carriers, the most modern anywhere, will soon be able to restore UK global air power projection on a scale more appropriate to today's dangerous world, and that must be good news for allies near and far.

(Photos: A selection of images of HMS Queen Elizabeth on sea trials in the North Sea, Crown Copyright Royal Navy 2017. Pictures at Portsmouth by the author.)

HMS Queen Elizabeth entering Portsmouth harbour with five Merlin helicopters on deck

Second QE-class carrier : HMS 'Prince of Wales'

HMS *Prince of Wales*, second of the Royal Navy's two future flagships being built by the Aircraft Carrier Alliance, was officially named so during a ceremony in Rosyth at Scotland, on 8 September 2017.

The ship's new sponsor, Her Royal Highness The Duchess of Rothesay, followed Royal Navy tradition by triggering a bottle of 10-year old whisky from the Laphroaig distillery in the Isle of Islay, smashing it against the ship's hull. The ship will be the eighth in the Royal Navy to bear the name HMS *Prince of Wales*, honouring Britain's history as a seafaring nation from the Sixth Rate gun ship in 1693 to the *King George V* Class Battleship that fought in World War II.

This significant milestone comes just three weeks after the first aircraft carrier HMS *Queen Elizabeth* made first entry into homeport of Portsmouth as part of her maiden sea trials programme.

"HMS *Prince of Wales* is a prestigious name for what I'm sure will be a most prestigious ship. Today is yet another landmark in an incredibly busy year for the Royal Navy and shipbuilding. HMS *Queen Elizabeth* has undergone her sea trials and arrived into Portsmouth, I have cut the steel on the new Type 26 frigates and we announced our ambitious new National Shipbuilding Strategy this week," said Defence Secretary Sir Michael Fallon on the occasion. "Together these magnificent carriers will act as our statement to the world. By having two we will ensure the UK will be one of the few nations able to maintain a continuous carrier strike presence on the high seas to project our power across the world."

Admiral Sir Philip Jones, First Sea Lord and Chief of Naval Staff, said: "The name HMS *Prince of Wales* represents many centuries of loyal service to Crown and Country, and its return to the Royal Navy is a moment of great strategic significance for the United Kingdom. To build one carrier is a symbol of national ambition– but to build two is a sign of real commitment to our own security and to our international responsibilities. With two *Queen Elizabeth*-class carriers in Royal Navy service, one will be available for operations at all times. When paired with the F-35B Joint Strike Fighter, they will provide our nation with a continuous Carrier Strike capability – a powerful conventional deterrent in a dangerous and uncertain world. I congratulate all those who have worked so hard over many years to make the Royal Navy's carrier-led renaissance a reality."

Sir Simon Lister, Managing Director of the Aircraft Carrier Alliance, which built the QE-class carrieos said: "Today's naming ceremony is a significant moment in the life of the programme and for each and every person involved in the design and construction of HMS *Prince Of Wales*, one of the largest engineering projects in the UK today. The nation has come together to build this magnificent ship which will in turn protect our interests around the globe. HMS *Prince of Wales*, along with her sister ship, HMS *Queen Elizabeth*, reflects the very best of British design and engineering capability and has created a once in a lifetime opportunity for highly skilled employees to be involved in an iconic programme."

With a crew of 679, HMS *Prince of Wales* is expected to carry out sea trials in 2019 before entering Royal Navy service. There are also currently 150 Royal Navy and RAF personnel continuing F-35 aircraft training in the United States. By the end of 2017 it is planned that the UK will have 14 of these next gen fighters, with initial flight trials from the deck of HMS *Queen Elizabeth* planned for 2018.

The Royal Navy's Flagship goes to Sea

"This is a historic moment for the UK as our new aircraft carrier takes to sea for the very first time. This floating fortress is by far the most powerful ship ever built in Britain (and) that will enable us to tackle multiple and changing threats across the globe," said UK Defence Secretary Sir Michael Fallon as HMS *Queen Elizabeth* left the Scotland coast for the first time. "HMS *Queen Elizabeth* is an enduring example of British imagination, ingenuity, invention that will help keep us safe for decades to come. She is built by the best, crewed by the best and will deliver for Britain. "For the next fifty years she will deploy around the world, demonstrating British power and our commitment to confronting the emerging challenges from a dangerous world. The whole country can be proud of this national achievement. "

Three years after she was officially named by Her Majesty The Queen, the Royal Navy's future flagship spent an initial period of around six weeks at sea to test the fundamentals of the ship. The sea trials monitored speed, manoeuvrability, power and propulsion as well as undertaking weapons trials and additional tests on her levels of readiness.

Following the trials, HMS *Queen Elizabeth* transited to her home port of Portsmouth to be handed over to the Royal Navy later in the year.

Admiral Sir Philip Jones First Sea Lord and Chief of Naval Staff said: "This is a hugely significant moment for the Royal Navy, for all our Armed Forces and for our island nation. Once in service HMS *Queen Elizabeth* will be the largest aircraft carrier in the world outside the United States, and the first designed from the outset to operate a fifth generation aircraft."

"Already this ship represents the best of the UK's industrial and engineering expertise, and once in service she will symbolise our military power and authority in the world for decades to come. There is still much work to do between now and then, but be in no doubt: a new era of British maritime power is about to begin."

HMS *Queen Elizabeth* is the largest and most powerful warship ever constructed for the Royal Navy. The ship will operate with a crew of approximately 700, increasing to the full complement of 1,600 when aircraft are in operation. The Ship's Company moved on board earlier and working alongside industry colleagues, they have been familiarising themselves with the new ship and the high tech systems on board as well as undergoing training.

"The *QE*-Class programme demonstrates our pride and commitment to deliver these highly capable aircraft carriers to the Royal Navy," said Jon Pearson, Ship Delivery Director, HMS *Queen Elizabeth*. "The departure of HMS *Queen Elizabeth* marks an exciting stage in the programme and is the first real opportunity to put the carrier's outstanding capability to the test, demonstrating the best of British engineering and manufacturing."

HMS *Queen Elizabeth*'s sister ship, HMS *Prince of Wales* is structurally complete and currently in the outfitting phase of her programme. The Class will be the centrepiece of Britain's future maritime capability. Each aircraft carrier, embarking the F-35B Lightning aircraft, will form an integral part of the UK's carrier strike capability. "The vessels will transform the UK's ability to project power around the world, whether independently or working closely with our allies, on operations ranging from high intensity warfighting to providing humanitarian aid and disaster relief."

The *Queen Elizabeth* class: key facts and figures

The aircraft carriers HMS *Queen Elizabeth* and HMS *Prince Of Wales* are being delivered by the Aircraft Carrier Alliance, a unique partnering relationship between BAE Systems, Thales UK, Babcock and the UK MoD. A national endeavour, at its peak the programme directly employed 10,000 people across six build yards. While manufacturing and commissioning is now solely focused at Rosyth, the skilled and diverse workforce is sourced from across the country.

Each carrier weighs 65,000 tonnes

Each carrier is 280 metres in length

Top speed is upwards of 25 knots

The carriers will have a crew complement of c.700, increasing to c.1,600 when a full complement of 36 F-35B aircraft and four Crowsnest helicopters are embarked

The flight deck is 70 metres wide and 280 metres long: enough space for three football pitches

Each carrier stocks 45 days' worth of food in its stores

Each carrier is made up of 17 million parts

There are 364,000 metres of pipes inside each of the ships

51 million hours have been spent designing and building the Class

The QE-Class aircraft carriers are the first Royal Navy vessels to have piped oxygen within the medical complex

Key efficiencies include:

★ Highly mechanised weapons handling system: At the push of a button pallets of munitions can be moved from the magazines deep in the weapons preparation area to the flight deck where they can be loaded onto aircraft

★ Storage: The location and design of the storage facilities enable 20 people just half a day to replenish the ship's stores

★ Visual surveillance system: 220 cameras allow monitoring of engine and machinery spaces, external catwalk, aircraft hangars, ship entrances and access to classified areas

★ Galley: Technologically advanced equipment and layout of the galley makes maintenance and service more efficient. The entire crew can be served meals in 90 minutes or 45 minutes when at action stations

Pair of USN Boeing F/A-18 Super Hornets over the HMS Queen Elizabeth

Bullish on India!

MBDA's Future Plans

Indian defence procurement might be slow, the business environment a maze, and military requirements in near-constant flux, but from CEO Antoine Bouvier down, MBDA's top leadership remains positive on India as a market and an opportunity for international co-operation.
Vayu's Angad Singh reports from MBDA's facilities in France and the UK.

European missile manufacturer MBDA is backed by three major aerospace and defence shareholders : BAE Systems (37.5%), Airbus (37.5%) and Finmeccanica (25%). The company was created in 2001 after the merger of the leading missile manufacturers of France, Italy and the UK, with an aim to achieve "critical mass" so as to challenge the primacy of the American munitions industry at the time. CEO Antoine Bouvier, speaking to *Vayu* at the Company's offices outside Paris in September, believes this has been achieved with a roughly 25% global market share today, equivalent to the major US firms.

MBDA continue to pursue growth, and has identified exports as a key driver, with a target of greater than fifty per cent of total sales to export customers. The Company has historical links in the Gulf countries of the Middle East, but India has emerged as a key market in recent years, particularly as a destination for "long-term industrial co-operation," according to Bouvier. He highlighted the decade-old Kelkar Committee report as an articulation of India's sovereign defence industrial aims, but noted that progress has been limited. However, Bouvier stressed that the broad Indian aim for a robust, sovereign defence industry dovetails with MBDA's own history, given its genesis as an organisation intended to be Europe's answer to the then global 'heavyweights' in the missile market.

India's defence industrial aims also fit with MBDA's future growth plans, as exemplified by the joint venture announced with L&T in February 2017 (*see Vayu II/2017*). Bouvier is confident that there will be a close alignment with India in terms of strategic objectives, stating that it is clear that India is a "long term partner in terms of security … *[and]* defence."

Bouvier also noted that MBDA has the support of its European stakeholder Governments (France, the UK, Germany, Italy and Spain) for technology transfer to India and support to indigenous manufacturing under various DPP provisions. "MBDA's history is one of co-operation, consolidation and development of an autonomous missile industry among multiple European nations", said the Company's CEO, and with MBDA's presence in India being the firm's largest outside of Europe, Bouvier believes that what MBDA proposes with India is a continuation of this "legacy of cooperation in Europe."

[Lead picture is of the Saab Gripen, first fighter type operational with MBDA's Meteor]

L&T Joint Venture

The 51-49 JV with L&T addresses both MBDA's objectives, and what Company executives feel are India's objectives (DPP, *Make in India* and so on). For the present, the JV is intended to exclusively tackle a limited set of Indian requirements – new generation ATGMs (with a development of the MBDA MMP), an Exocet MM40 Block 3 based mobile coastal battery, and high speed low flying aerial targets – with more programmes available to be added to the JV's plate as necessary. Company officials noted that the JV is intended to reply to *all* current and future RFPs, whatever they may be. The target is to be compliant with the DPP's *Indian Designed, Developed and Manufactured* (IDDM) provisions, with 60% Indian content for a non-Indian design (or less if there is greater Indian share in Intellectual Property Rights holding). The L&T MBDA Missile Systems executive board has already been constituted, and the company is "working and underway." Teams from both companies are already working together, and an office is set to be established shortly.

An MMP firing team (photo: MBDA)

While MBDA plans to focus its future efforts in India through the joint venture, the Company has no objection to working with other public or private sector players as sub-contractors. The scope of the JV is certainly ambitious enough that this could be a distinct possibility. For instance, the joint venture will "hot assemble" missiles with warheads and rocket motors, and the partners are hoping for an agreement with the MoD for a live firing test range. While present focus is on Indian requirements, missile exports are already formally accounted for in the JV agreement. The volume of work envisaged for the JV could certainly allow for third

Upgraded IAF Mirage seen taxiing with five MICA missiles, three on wingroot stations, two on outboard wing stations (photo: Angad Singh)

party vendors to establish themselves in the supply chain.

As always, however, all plans are hostage to Indian procurement timelines. With so many false starts over the years, it may be quite a while before co-developed or 'Made in India' missiles are seen streaking toward their targets.

The Programmes

Notwithstanding the situation with the glacial pace of acquisitions noted above, MBDA is targeting a large number of requirements in the Indian market. Jean-Luc Hollette, Director of Technical and Military Operations (TMO), Jean-Paul Faye, TMO Vice President of Product Solutions, Frank Morgan, TMO Head of UK Airborne at MBDA, Russ Martin, Military Advisor at MBDA, and Philip Gazard, who handles naval systems at TMO, detailed for *Vayu* some of MBDA's on-going and future programmes in the Indian market.

MBDA is fond of pointing out that its weapons have been produced and used by India for decades, through its progenitor companies. The Nord SS.11 and MILAN family of ATGMs have been licence produced in India (over 40,000 of the latter), while a range of air-to-air, air-to-surface, and surface-to-surface munitions were, and are, in service with the Army, Navy, and Air Force. In recent years, MBDA has had particular success in the air-to-air arena, with ASRAAM on IAF Jaguars, MICA on the Mirage 2000s, Mistral on the Rudra and LCH, and most the weapons package for the IAF's 36 Rafale fighters, including the long-range Meteor BVRAAM and SCALP air-launched cruise missile, both of which will enter Indian service for the first time.

MBDA's offset obligations for these orders stand at a total of about 1 billion Euro, and MICA parts are already under production in India. For the moment, these parts will go on missiles destined for the Indian Air Force, but depending on global sales volumes for the missiles, Indian offset partners may see their parts being shipped off, even to third parties.

Air Launched

Of MBDA's air-launched portfolio MICA and ASRAAM are already in service, Meteor and SCALP are on order, Mistral is platform-qualified but yet to be ordered in volume, while the much more recent Brimstone (and derivative SPEAR) are being proposed for current and future IAF platforms.

The all-aspect MICA is typically used on French fighters (in-service with the IAF's Mirage 2000 fleet and planned for IAF Rafales), and has a uniquely flexible guidance concept, able to employ either imaging infrared (IIR) or active radar seekers. The missile has seen over 350 test and operation firings and is operational on a wide range of platforms with 15 customers worldwide. But for the seeker heads, the missiles are identical, and can be rail- or eject-launched, making them suitable for a number of aircraft and carriage stations. The high fidelity seeker on the IR variant can even be used as a 'look up' optical sensor for aircraft that lack built-in IR search and track (IRST) capability, and this has been validated by operators of the Rafale and Mirage 2000. As with most modern western missiles, the MICA is delivered as a 'sealed round' requiring nearly zero maintenance for 15 years – the radar-seeker variant usually undergoes a seeker function test every five years to allow for preventive maintenance as necessary, but the IR variant can be stored

Pair of ASRAAMs seen fitted on a RAF Eurofighter Typhoon in flight (photo: UK MoD/Geoff Lee)

Inert ASRAAMs mounted on an ex-RAF Jaguar during trials (photo: MBDA)

maintenance free for the full 15-year period. Overall missile life can be extended beyond 15 years if necessary, based on condition.

ASRAAM, on the other hand, was designed for a UK MoD requirement for a long-range (near-BVR), exceptionally fast, IR-guided missile to complement the radar-guided AIM-120 AMRAAM. This led to a thrust-vectoring, large diameter (166mm versus 112mm of the Sidewinder), IIR-guided missile that entered service in 1998. ASRAAM has seen over 100 in-service firings, and is currently integrated with the Tornado, Typhoon, F-35B, F/A-18 (legacy) Hornet and SEPECAT Jaguar, where it can be used both under-wing as well as on the type's distinctive over-wing launchers. Frank Morgan, TMO Head of UK Airborne at MBDA, noted that the ASRAAM's design drivers resulted in a unique low-drag missile with extremely long range and low radar cross section owing to the lack of control surfaces barring a set of small cruciform fins at the very rear of the airframe.

MBDA is now working to expand the ASRAAM onto the Hawk and Tejas LCA, which already uses the Russian R-73 and is in the process of integrating the Israeli Python CCM. Company officials stated that they opened talks with the IAF regarding additional platforms almost immediately after securing the Jaguar order, and with ASRAAM already in the IAF's inventory, MBDA believes there is a strong case for the MoD to pursue integration of the missile with other types such as the LCA and Hawk, the latter being pitched as a relatively low-cost, low-risk integration effort, because the Mk.132 Hawk is already wired for missiles (MBDA Magic) on its wingtip LAU-7 launchers, which are compatible with ASRAAM. Some integration work will be required, but the exercise will be far simpler than integrating an all-new missile.

Meanwhile, it was suggested that Python integration with the LCA has run into some issues, described as "flutter" but noted in ADA's annual report as a vibration issue at high-subsonic/transonic speed. Sources at HAL, however, confirmed in October that Python integration work would continue and that they were not aware of any plans at that time to integrate a third CCM type. Notwithstanding the flutter or vibration issues, MBDA believes the ASRAAM to superior to the Python owing to its low-drag four-fin configuration (versus the Python's 18 fins), higher range, and significantly lighter weight (the Python is 15-20kg heavier). MBDA has already shared a great deal of technical documentation for their LCA offer, although whether this will be taken up remains to be seen.

Dual Mode Brimstone being loaded onto a triple rack under a RAF Tornado strike fighter (photo: UK MoD)

Parallel to ASRAMM, MBDA also believes there is the case for the IAF to adopt the Brimstone surface-strike missile. Brimstone entered service with the RAF as a radar-guided autonomous anti-tank weapon in 2005. The missile was further developed into the modern day Dual Mode Brimstone (DMB) in response to an urgent operational requirement from the UK MoD for use in Afghanistan and Iraq. The seeker and software were modified to enable 'man in the loop' engagements to account for the restrictive rules of engagement in theatre, and the first DMBs were operational on the Tornado strike fighter in December 2008, some 18 months after the MoD contracted for the modification. Since then, the missile has seen extensive use in operations over Afghanistan and the Middle East, with further improvements including the ability to engage high-speed manoeuvring ground targets moving as fast as 110km/h, accurately strike small manoeuvring maritime targets such as speedboats, and finally successful test firing from the Boeing AH-64 Apache.

Each missile weighs 50kg, while three missiles together with their specially configured triple-rack weigh a total of

A render of a Hawk Mk.132 armed with ASRAAM on the wingtips and two Brimstone triple racks

240kg, essentially the same as a standard 500-lb bomb, but with far greater range, accuracy and targeting flexibility. The warhead is a tandem shaped charge with blast effect, meaning the DMB is as effective in the anti-armour role as the original first-generation Brimstone, but able to operate using three different guidance modes: dual mode using radar and laser guidance, with laser as primary and radar for terminal lock on and autonomous homing; laser-only, particularly useful for low- or no-RCS targets on land and sea; and finally the original radar-only mode for autonomous engagement of land and sea targets. DMB range is estimated at around 20km, although the actual figure is not public.

Speaking to *Vayu*, MBDA officials stressed that Brimstone is the only missile of its kind able to be employed from fast jets, with other similar weapons such as Hellfire limited to helicopters and slow-moving UAVs. Brimstone integration work with Apache is well underway, and significant work has been done to integrate the missile with the UK's future Protector UAV fleet (GA-ASI Predator-B), which will see the missile remain Britain's principal high-precision, low-collateral strike option for the foreseeable future. MBDA hopes to leverage the missile's relative ease of integration for the IAF, again suggesting that the BAE Hawk could be an early candidate to employ DMB, although the Jaguar – as the IAF's principal strike asset – was also mentioned as a logical choice. Talks are already underway with the IAF, HAL and BAE Systems, and "there is nothing physically about the weapon that should prevent it being integrated across the cross section of Indian platforms," said a company official, since the missile communicates on the ubiquitous MIL-STD-1553B data bus, used by almost all Indian combat aircraft.

The flip side of this proposal is that there is no formal IAF requirement for a Brimstone-type weapon, and even if there were, there are no other missiles in this class, which could lead to the dreaded 'single vendor' situation that derails so many Indian military procurement programmes. MBDA remains hopeful that the Brimstone's "force multiplier" capabilities, particularly when integrated with a non-frontline asset like the Hawk, could make an attractive case.

Meanwhile, negotiations for an order of Mistral Air-To-Air Missiles (ATAM) to

The Future: SPEAR with the Gripen E

Concept rendering of a Gripen armed with Meteor, ASRAAM, SPEAR and Brimstone

MBDA's SPEAR is an extended range derivative of the DMB under contract for development. It is the only missile that meets UK MoD's Selective Precision Effects At Range (SPEAR) Capability 3 requirements, and because it is developed and made exclusively in the UK, is a product that will have "complete freedom of action and delivery" in terms of employment and exports.

SPEAR is designed from the outset for the UK's F-35, which means it is optimised for internal carriage. Each missile weighs 100kg and boasts an incredible range of over 100km. A triple rack with three missiles would weigh just under 400 kg, and would enable precision strike on multiple fixed, mobile, and re-locatable targets, with low collateral damage, at very long ranges. The missile is network enabled, but MBDA notes it is "not net dependent," featuring a number of additions to the base Dual Mode Brimstone, including a new multi-mode seeker that incorporates radar imaging, GPS, a multi-effect warhead, Link-16-based datalink, a wing kit and a Pratt&Whitney TJ-150-3 turbojet engine. The missile's relatively small size results in greater "magazine capacity" for the carrying aircraft, with the F-35 able to carry eight internally, while the Typhoon (the primary 4th-generation platform for the missile) will receive the same triple-rack as the Brimstone currently integrate under the type's Phase 3 Enhancement (P3E). SPEAR will be programmable in-flight, allowing for exceptional flexibility regarding fuzing options for a wide variety of targets.

SPEAR's UK assessment phase is complete with the Eurofighter Typhoon platform, and industrial development of the weapon system is planned to be complete by 2020, with service entry in the following years, after user testing.

Since the Brimstone and SPEAR can be integrated with nearly any combat platform with the 1553B or 1760 data bus, MBDA had an interesting proposal ready regarding the IAF's future fighter plans, should the Saab Gripen E be selected as the new 'single engine fighter.' Company officials showed off an 'all-MBDA' multirole loadout for the Gripen E, with two ASRAAMs on the wingtips, three Meteor BVRAAMs underbelly, and twelve SPEAR missiles (four racks of three). The air-to-surface weapons could also include a mix of six Brimstone and six SPEAR, or a maximum of six DMB, carried on the outer wing stations. The latter configuration is a limitation owing to the fact that Brimstone has a rocket motor that ignites 'on the rail,' which could lead to the missile's exhaust gases being ingested by the fighter's engine. Since SPEAR is jettisoned, not fired off the pylon, there are no such issues with a 12-missile SPEAR load. MBDA also noted the Taurus long-range cruise missile, which is a Saab-MBDA product, is integrated with the Gripen, with the Gripen E able to carry two.

equip the HAL ALH Mk.IV (also called Weapons System Integrated, ALH-WSI or Rudra) are on-going, and MBDA is hopeful of a production contract soon. The missile is the only air-to-air missile fully qualified with the Rudra, and an earlier contract for launchers has already been executed with HAL. The contract for the missiles themselves needs to be signed by the MoD, and this is being negotiated separately.

Mistral twin-missile launchers seen on the outboard weapon stations of this Indian Army Rudra helicopter (photo: Angad Singh)

The HAL Light Combat Helicopter (LCH), derived from the ALH, will also carry the Mistral ATAM, and qualification is underway. MBDA expects a live firing test by December 2017 at the Chandipur test range, but the actual timelines are under the control of HAL and the customers. The LCH will likely end up carrying four Mistral per wing, double the two-per-wing configuration of the Rudra.

Other air-launched weapons, such as the SCALP cruise missile and Meteor BVRAAM are being supplied as part of the Rafale weapons package, although MBDA is certain that additional orders, including perhaps some for new platforms, are likely to come up in the near future.

Surface-launched

On the surface-launched side of the business, MBDA has had more limited success, the large licence-production run of the MILAN ATGM notwithstanding. The Company is pursuing a mobile coastal defence battery opportunity with the Exocet MM40 Block 3 anti-ship missile, which is in service with 11 navies around the world (40 operators use other variants of the Exocet). Each coastal defence battery would comprise one mobile sensor unit, one mobile command post, and a multitude of truck-mounted firing units, with four missiles per truck. The MM40 Block 3 is a sea-skimming 200-km-range missile with 3D waypoint navigation, time on target capability for multiple missiles, and terminal agility for point-defence penetration. The coastal defence implementation can integrate customer specified sensors and communications, and is pitched not just as a defensive weapon system, but as a node in a larger maritime command, control and surveillance network. However, Indian interest in the system appears to have waned since the RFI went out some six years ago, with the Navy seemingly electing to focus on more pressing priorities.

MBDA's other surface-to-surface offering for India, and one that has seen considerable attention from the Company, is the new-generation MMP anti-tank missile (*Missile Moyenne Portée,* or medium range missile). MMP was selected by French MoD in 2011 to replace MILAN, Javelin and the Euromissile HOT in the French service. Rafael's Spike LR, Javelin and MMP were evaluated, with MMP coming out ahead.

A contract for the man-portable infantry variant was awarded in 2013, calling for 450 launchers and 3,400 missiles. The first of these is under delivery to the French military. The contract for vehicle integration and qualification was awarded in 2014, with the primary platform being France's Jaguar Armoured Fighting Vehicles. That work is on-going and validation will be carried out in the 2018-2019 timeframe, with deliveries from 2020 onward.

Cutaway model of the MMP at MBDA's Selles-Saint-Denis production site, showing tandem warheads, mid-body motor, as well as seeker and guidance hardware (photo: Angad Singh)

A VL-MICA launch from land (photo: DGA)

MMP has a range greater than four kilometres, and apart from its principal anti-tank mode, can be used to conduct direct fire support. The missile features a tandem warhead and dual mode seeker (uncooled imaging infrared and TV), and is controlled by a fibre-optic datalink to the firing post. MMP has two firing modes, a lock-on before launch (LOBL) 'fire and forget' mode for line of sight or 'shoot and scoot' engagements, as well as a non-line of sight lock-on after launch (LOAL) mode. Both modes allow for 'man in loop' control and in-flight re-targeting to either abort a shot or engage a higher priority target. The firing post's targeting sight doubles as the display for missile control post-launch. *Vayu* was given an opportunity to try an MMP simulator (an actual production-representative command post setup, but with virtual imagery displayed in the targeting sight) and despite no prior experience or instruction, was able to successfully complete LOBL and LOAL engagements, including in-flight re-targeting.

For India, the MBDA-L&T JV will initially propose the MMP 'as is' with warhead and smokeless propellant ToT as required by the RFI, for integration with the Future Infantry Combat Vehicle (FICV) and as part of the BMP upgrade programme. However, Company officials noted that there is "no reason why additional ToT cannot be offered," and detailed plans for further development of the missile system to be carried out by the JV. MMP fulfils the French MoD's range requirements, but the missile was designed from the outset to require minimum modifications to extend its range. Should the missile be selected for Indian requirements, MBDA expects future range extension work to be carried out and validated by the MBDA-L&T JV in India itself.

In the surface-to-air arena, MBDA has had made little headway in the past five-odd years, with a number of programmes cancelled before making it to the contract stage, and quite a few stuck in the sort of limbo that has unfortunately come to typify Indian defence procurement. For the Navy's ostensibly urgent short-range surface to air requirement (SRSAM) the European missile house is offering both its VL-MICA as well as Sea Ceptor systems. The compressed timelines have necessitated offers of existing products instead of a proposal to continue and complete development of the MBDA-DRDO Maitri SRSAM, which has been hanging fire for some years now. The Maitri proposal was based around a larger airframe overall, with DRDO handling propulsion

Sea Ceptor launch from HMS Argyll (photo: MBDA)

and MBDA offering ToT for the seeker, but the time required to resume the programme and complete development of the new system appears to be incompatible with the Navy's stated urgency.

VL-MICA (Vertical Launch MICA) is simply the radar-guided variant of the air-to-air MICA missile adapted for vertical launch. The system has eight customers worldwide and has been in operation since 2013. It is a lightweight modular system with a range of about 20km and the ability to integrate with a range of radar and combat management systems. MBDA is working with the specifications of the BEL Revathi (3D CAR) radar supplied by the Navy, and based on simulations projects a single-shot kill probability (SSKP) of 90% for the combination. VL-MICA can also operate with a fire control system independent of the ship's CMS, as well as accept targeting information from simpler 2D radars or even electro-optical sights. Deck penetration is two decks for the compact vertical launch cells, with ships as small as 1,500-2,000 tonnes able to accept a meaningful number of missiles. On larger capital ships, as many as 32 VLS cells can be installed. MBDA officials say there is no theoretical upper limit on the VLS installations, but no customer has ever requested more than 32.

The VL-MICA's British counterpart, developed for the UK MoD, is the Sea Ceptor, based around the CAMM (Common Anti-air Modular Missile) interceptor. CAMM is based on the ASRAAM airframe, and has an identical diameter. Unlike VL-MICA, it can be quad-packed into the US Mk41 vertical launch system, Lockheed Martin's Extensible Launch System (ExLS), as well as the French SYLVER VLS, and is soft-launched by a piston sitting atop a gas generator. Each missile is 3.2 metres long and weighs 100 kg, and the ASRAAM's IIR seeker is replaced by a solid-state active radar (but with microwave generator and phase shifters separate, unlike an AESA). Mid-course guidance is inertial, with terminal radar homing and a two-way data link to communicate with the host CMS. According to MBDA, CAMM does not actually need a 'weapons quality' guidance track, and can be cued even by a surveillance radar to the general target area (rules of engagement permitting), before the on-board seeker takes over to lock and engage.

The missile is designed to engage a wide range of targets, including glide bombs, UAVs, anti-ship missiles, helicopters, fighters, and even small boats or fast attach craft. It can fit on most naval vessels in the 1,000-tonne class and larger, and the long 25-km range makes it a near local area defence weapon, although its primary role remains a short-range SAM for close protection. CAMM also has a short minimum engagement range of less than 1 km, and the Sea Ceptor system can conduct multiple simultaneous engagements, with up to 48 targets engaged in simulations so far.

The missile is designed to remain in its launch canister through its 20-year life, with preventive maintenance scheduled for the energetics every 10 or so years. The built in test functionality means the missiles do not need to be removed from their sealed canisters for functional testing.

Sea Ceptor has been successfully integrated with four Royal Navy Type 23 frigates so far, and HMS *Argyll* has successfully qualified the system with a series of test firings in the summer of 2017. The system will be fitted to all Type 23s in service by 2021, as well as the planned Type 26 frigates currently on order. In addition, Sea Ceptor has been contracted for by the Navies of New Zealand (for two *ANZAC* frigates), Chile (for three Type 23s), and Brazil (*Tamandaré*-class corvettes). The Type 23 refit marks the first time the Royal Navy has elected to retrofit an all-new SAM system across a fleet, this decision being enabled by the CAMM's low footprint and the system's low overall cost. The Brazilian order was seen as an endorsement of the system as the Brazilian Navy selected the Sea Ceptor system *before* freezing the design of the *Tamandaré* class.

The final surface-to-air offering has seen arguably the most protracted acquisition saga in recent memory – the Indian Army's VSHORAD (Very SHOrt Range Air Defence) tender. MBDA's offer is the Mistral, a 6-km range fire and forget man-portable missile system with a speed of Mach 2.5 and a 3-kg warhead that combine to grant it a 96% kill probability in testing with global customers. The system, in its various guises, is in service with 42 operators across 30 countries, and is used across a wide range of operating conditions, from deserts to mountains to maritime.

With Saab's RBS 70 and the Russian Igla-S as the other contenders, the VSHORAD procurement process has dragged on for over seven years. The RFP calls for 5,185 missiles and 800 launchers, and has seen multiple rounds of customer trials, the last of which was carried out in April 2017. It is understood that the Army has drafted the final report on the trials process, which has gone to MoD for further action and approval. MBDA claims to meet all technical requirements of the RFP, and representatives in Paris could only say that they hope the programme sees some movement soon.

A Mistral unit in Kourou, French Guiana (photo: MBDA)

"Programmable Ammunition"

Keeping soldiers safe from drones

Although originally designed for counter-defilade, the accuracy of Nammo's programmable ammunition allows it to act as an effective anti-drone system as well

Winter of 2017 : coalition forces, aid groups and reporters in Iraq are harassed by commercial drones used by ISIS to spread fear. Lacking effective countermeasures against what was potentially flying IEDs, they are forced to flee from the simple and cheap commercial drones, causing widespread disruption. Now, in part thanks to a new technology from Nammo, that threat may become a thing of the past.

Known as 'programmable ammunition', this new technology makes it possible for any large gun to fire shells that can be programmed to explode with pinpoint accuracy, either before, above or inside a target. Adaptable to several weapon platforms, including 40 mm grenade launchers, 30 mm guns, 120 mm tank ammunition and M-72 rockets, this makes this technology ideal for dealing with a number of different threats, including drones. With the first versions already combat proven and in production, the technology offers three distinct benefits : low collateral damage, flexibility and ease of installation, together delivering a significant and reliable advantage to its users.

One of the challenges faced by modern warfighters is the danger of collateral damage when operating near civilian infrastructure. This makes it difficult to fire regular ammunition at small aerial targets such as drones, because if they miss, the bullet or shell will just continue and eventually hit something else, potentially causing significant and unintended damage. This threat is virtually eliminated with Nammo's programmable ammunition, as it will explode where intended, independent of whether it has hit its target or not. In the case of smaller ammunition types, such as 40 mm grenades, these are designed to maximise their effect within a specific range from the point of detonation, with more limited effects beyond that. This means that as long as they are set to detonate sufficiently high above the ground, the fragments created by the detonation will fall harmlessly to the ground.

The 40 mm version of Nammo's programmable ammunition has already been proven in combat

Additionally, given the accuracy of this ammunition, it has a good chance of either detonating or disabling any explosives or weapons that the drone may be carrying when they hit, further reducing the danger to infrastructure or personnel below.

Another constant challenge for warfighters is the question of space and weight, which limits the amount of weapons and supplies that personnel and vehicles can carry. The benefit of Nammo's programmable ammunition is that rather than being a dedicated anti-drone system, that has to be carried in addition to other weapons, it is instead an upgrade to an existing weapon system, allowing it to be effective against a wide range of threats.

In fact, the technology was originally not developed with drones in mind. It's primary purpose is as a 'counter defilade' system, able to defeat enemy forces hiding in trenches or behind cover by exploding just above or beside them. Alternatively, in the case of larger calibres, it can be set to penetrate a certain distance inside a target, such as a dirt wall, before detonating. The ability to take down drones is therefore mainly a demonstration of the flexibility of the technology, rather than a key design requirement.

A final challenge is the question of cost and complexity. Use of Nammo's programmable ammunition does not require any physical changes to the gun itself, nor its ammunition handling system, which means that instead of expensive modifications and upgrades, the system can be easily added to any existing platform.

The system architecture is quite basic : in addition to the ammunition, it consists of a programming unit and an antenna that is mounted on either the weapon or the vehicle. The distance to the target is entered into the programming unit either manually or based on input from an automated range finder. Then, in contrast to competing systems, instead of programming the ammunition before it is fired, or inside the barrel, it receives its instructions just as the shell leaves the gun, which eliminates the need for upgrades to the barrel.

Anti-drone operations are extremely complex, and place high demands on rules of engagement, sensors, and targeting procedures. Nammo's ammunition does not alone resolve this issue, but it offers ground forces something they so far have been lacking, which is a cost effective weapon that could be used even in urban areas.

Courtesy: NAMMO

Dazzle over the Desert

DUBAI AIRSHOW 2017

As the doors closed on another record-breaking Dubai Airshow from 12 to 15 November 2017, exhibitors were rushing to close deals and re-book for the next edition of the biennial event to be held in 2019. Trade visitors to the event were up around 20% on the 2015 event, with some 79,380 people entering the purpose-built hall at DWC, Dubai during its five-day run.

At the end of the show's final day, the order book stood at almost US$113.8 billion with Michele van Akelijen, Managing Director of organisers, Tarsus F&E LLC Middle East, stating, "The figures speak for themselves – it has been another successful year. Dubai is geographically at the centre of the global aviation world and Dubai Airshow is where the sector comes to do business. We have seen incredible, unmatched deals, innovations and ideas. Our variety of conferences – the Space Pavilion and Conference, the UAV Summit, the Cargo Zone conference and Pavilion, Airport Solutions Dubai Conference and Pavilion and the Gulf Aviation Training Event – underline our commitment to making the Airshow a centre of global thought leadership. We aim to help generate the creative knowledge-sharing environment the industry needs in order to thrive."

The Airshow was marked by 'game-changing' deals from start to finish. Airbus revealed its largest single announcement ever – a US$49.5 billion deal with Indigo Partners to purchase 430 aircraft in its A320neo family. With the Airbus order, Indigo Partners, a US-based private equity fund, has doubled its existing order of 427 A320 family aircraft. The fund owns four ultra low-cost airlines, Wizz Air, Frontier Airlines, JetSMART and Volaris. Golden Falcon Aviation, the exclusive aircraft provider of Kuwaiti carrier Wataniya airways signed a deal to lease 25 Airbus A320neo Family aircraft, while Air Arabia, the Middle East low cost carrier, agreed to lease six Airbus A321neo's. AerCap and Egypt Air negotiated a deal with Airbus during the Dubai Airshow to lease 15 Airbus A320neos.

Boeing won large commitments across its twin-and single-aisle commercial airplane families, debuting key capabilities including the CST-100 Starliner docking and KC-46 re-fueling simulators and announced services agreements at the 2017 Dubai Airshow. "This has been a very successful show for Boeing. Our regional customers have maintained their trust in our products

and technology, and our partnerships in the Middle East region continue to grow," said Bernard Dunn, President, Boeing Middle East, North Africa and Turkey. "We signed agreements with key airline partners including Emirates, flydubai, Azerbaijan Airlines, ALAFCO and Ethiopian Airlines. In addition, Egypt Air became a new customer for the 787. The Airshow was a great opportunity to introduce our newest business unit, Boeing Global Services, to the Middle East market and reiterate the region's importance to Boeing."

The static display at the Dubai Airshow featured over 160 commercial, business and military aircraft. New for this year was the Sukhoi Superjet 100 and the Japanese Air Force Kawasaki C2, in addition to first time exhibitor Calidus displaying not one but two aircraft: the B-250 Bader and the TX-C. Military might on display included the Su-35, Dassault Rafale, Gripen, the Taqnia/Antonov An-132, the IOMAX S2R-T660 Archangel and a PAF JF-17 Thunder. In addition, helicopters were well represented with a Turkish Aerospace Industries T129 attack helicopter, the Motor Sich Mi-2 and Mi-8 MSB-T.

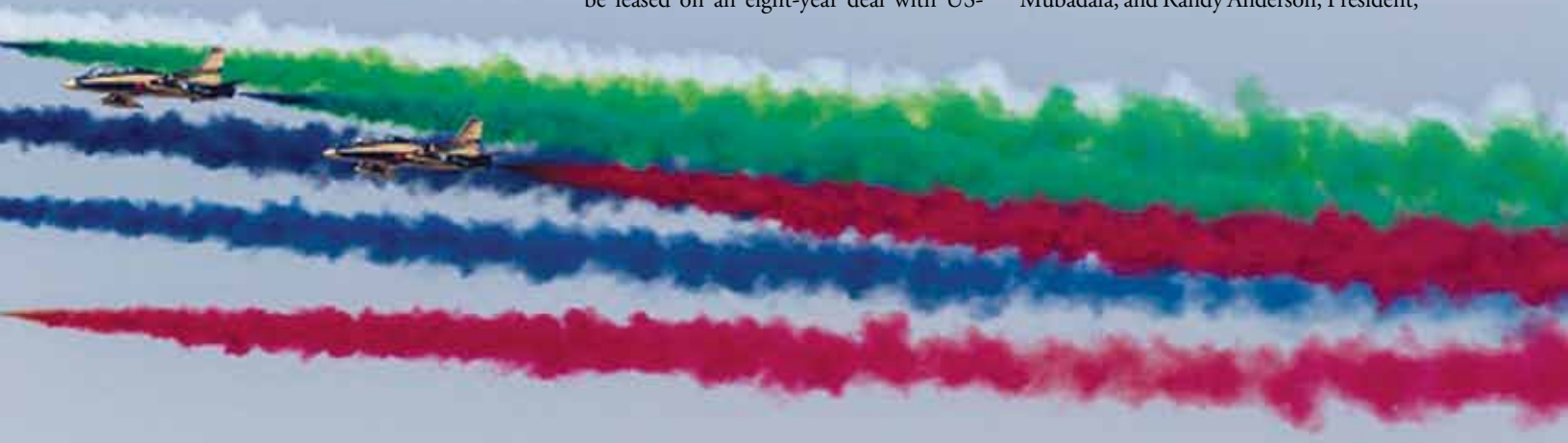
The Dubai Airshow 2017 opened its doors at DWC, Dubai Airshow Site on 12 November to a record number of exhibitors, aircraft on display, visitors – and an array of ground-breaking deals. Sheikh Mohammed bin Rashid Al Maktoum, Vice-President and Prime Minister of the UAE and Ruler of Dubai, opened the 15th Dubai Airshow before taking a walking tour around the 645,000 square metre site, pausing to speak with several exhibitors. He was accompanied by Sheikh Mohammed bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the UAE Armed Forces; and Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai. His Highness then joined officials from Emirates airline and Boeing to witness the signing of a US$15.1 billion commitment to purchase 40 Boeing 787-10 Dreamliners. Emirates is already the world's largest Boeing 777 operator and the airline will be first to receive the new 777X in 2020.

On the second day, Air Arabia unveiled plans to expand into new markets, as it signed a lease on six new Airbus A321neo's in a deal valued in excess of US$2.79 billion at current list prices. The new aircraft will be leased on an eight-year deal with US-based Air Lease Corporation (ALC). They will be added to the Sharjah-based airline's existing fleet of 50 aircraft, based out of five regional hubs in the UAE's Ras Al Khaimah and Sharjah as well as Morocco, Egypt and Jordan. Their eight-hour flying range will give the airline capacity to expand into new markets including South East Asia, Eastern Europe and the wider African continent.

The UAE Ministry of Defence unveiled further plans worth more than US$891.5 million with eight individual companies, securing a range of logistical, technical support, aircraft hiring and telecommunications services. The list of deals included a US$120 million purchase of P-3 bombs from Tawazun Dynamics LL, to be employed with Mirage 2000-9 and Black Hawk aircraft.

Elsewhere, Boeing and Kuwait's Aviation Lease and Finance Company (ALAFCO) finalised an order for 20 additional 737 MAX 8s, doubling their order to 40 aircraft in a deal valued at US$2.2 billion at current list prices. Meanwhile, Kuwait's Directorate General of Civil Aviation (DGCA) and General Civil Aviation Authority (GCAA) endorsed a memorandum of understanding aimed at sharing experience and expertise to further develop cooperation on boosting performance. It was signed in the presence of GCAA Chairman Saif Al-Suwaidi and DGCA President Sheikh Salman Sabah Salem Al-Hmoud Al-Sabah.

Abu Dhabi-based investment company, Mubadala, signed a Memorandum of Understanding with Honeywell International to bring a suite of maintenance, repair and operations products to the Middle East. The MoU was signed by Badr Al Olama, Director of Aerospace at Mubadala, and Randy Anderson, President, Aerospace, Europe, Middle East, Africa and India at Honeywell.



Business aviation, a market which is growing in the Middle East, is always heavily represented at the Dubai Airshow and this year was no exception with around 50 business aircraft on the static park, including a Gulfstream G650ER and Bombardier Global 6000; while Emirates Airline displayed its all business class ACJ319.

Also on display were the Airbus A350 and Boeing 787-10 Dreamliner, with both Emirates Airlines and Etihad Airways exhibiting their flagship A380s and Flydubai showing its Boeing 737 MAX 8.

The penultimate day of the Dubai Airshow saw two enormous aircraft purchase orders for both Airbus and Boeing, in one of the most exciting days in recent aviation business history. Airbus revealed its largest single announcement ever that morning – a US$49.5 billion deal with Indigo Partners to purchase 430 aircraft in its A320neo family, described as Airbus' largest ever single announcement. Meanwhile Boeing firmed a US$27 billion deal with carrier

flydubai for 225 aircraft in its 737 MAX family, the largest-ever single-aisle jet order – by number of airplanes and total value – from a Middle East carrier.

The mammoth deal puts Indigo Partners among the biggest customers by order number for Airbus single-aisle aircraft. John Leahy, COO, Customer, Airbus Commercial Aircraft, described the deal as 'remarkable' and said: "It's gratifying that [this order] comes from a group of airline professionals who know our products as well as the folks at Indigo Partners do. We are proud to augment [Indigo Partner's] airline fleets in Latin America, North America and Europe with the single-aisle aircraft that offers the lowest operating costs, longest range and most spacious cabin. " Increasing demand for air travel will push jetliner sales to more than 34,000 worldwide in the next 20 years, according to Airbus's 2017 global market forecast. Almost three-quarters of that will be single-aisle models according to Airbus.

UAE orders five Airbus C295s

The United Arab Emirates Air Force & Air Defence has ordered five Airbus C295 medium transport aircraft. The agreement takes the C295 orderbook past 200, underlining the type's market leadership in its class. The aircraft will serve with the UAE Air Force replacing the existing CN235s still in operation. Deliveries will begin in the fourth quarter of 2018. Orders for the C295 in the Middle East and North Africa (MENA) region now total 51.

UAE to upgrade Mirage 2000-9s

"The UAE Armed Forces have announced their intention to sign a contract with Dassault and Thales to upgrade their Mirage 2000-9 aircraft," stated HE Major General Staff Pilot Ishaq Saleh Al-Balushi, Head of the Executive Directorate of Industries and Development of Defence Capabilities. "This modernisation comes within the framework of the directives of the wise leadership of the country to support and promote the comprehensive development of our Armed Forces in various branches and in line with the requirements of our Armed Forces."

Saab and its Gripen at Dubai Airshow

Saab displayed a wide range of advanced systems, focused on control and dominance from – and of the air. This was demonstrated with displays and exhibits from across airborne surveillance, ground based air surveillance and the air traffic management sector. Products from each of these groups were presented such as the GlobalEye airborne swing role surveillance system, the Giraffe 4A ground based radar and the Digital Tower for airports. "The Dubai Airshow is a highlight for Saab and the United Arab Emirates is a key country for us and our plans for the region. GlobalEye symoblises both the strong relationship between us and the UAE, and Saab's approach to developing capabilities that high-end customers demand. We are looking forward to meeting and discussing business with our many clients who travel to be here from around the world," said Hans Rosén, head of market area Middle East & Africa.

The Gripen took to the skies daily. "The Gripen is renowned for its outstanding aerobatic display that we all enjoy, but much of the fighter's true capability is really appreciated when sitting in the cockpit. The Gripen pilot is at a distinct combat advantage thanks to the aircraft's network centric design combined with its sensor fusion, which is seamlessly presented via its smart digital cockpit. Once you factor in that Gripen has the swing role ability to conduct air-to-air, air-to-surface and reconnaissance missions with the latest weapons, such as the Meteor Beyond Visual Range Air to Air Missile, you can appreciate that the Gripen pilot has an unrivalled edge over his competition," stated Jonas Hjelm, Senior Vice President and head of Business Area Aeronautics. Two Gripen C fighters were at the Dubai airshow with one aircraft on static display and the other taking part in the daily flying display, flown by one of Saab's Gripen pilots.

Highlights at the Dubai Airshow

Airbus success : 510 aircraft orders and commitments

The Airbus portfolio at Dubai

The Airbus product line of commercial jetliners, military airlifters and helicopters literally reached new heights at the show with transactions and business announcements for 510 aircraft. Validating the company's slogan: 'We make it fly,' these orders and commitments involved 500 aircraft from Airbus' single-aisle A320neo Family and two widebody A330neo jetliners (worth a combined total of $58.3 billion at list prices), along with five of the company's multi-role C295 transports and three 'H generation' H160 rotorcraft. Leading the activity was the historic Memorandum of Understanding for 430 A320neo Family jetliners negotiated by private equity firm Indigo Partners for operation by four ultra-low-cost airlines in its portfolio. This represents Airbus' largest single commercial jetliner announcement by aircraft numbers, while setting a company record in terms of its $49.5 billion value at list prices. All four of these carriers, located on three continents, are current A320 Family operators and will significantly increase their Airbus single-aisle fleets with aircraft from the new agreement. These are Frontier Airlines of the US, JetSMART of Chile, Mexico's Volaris, and Wizz Air of Hungary (although many have confused this Indigo with India's airline).

In the military airlifter sector, Airbus announced an order for five C295s for the United Arab Emirates Air Force & Air Defence. Deliveries of these medium transport aircraft to begin in the fourth quarter of 2018. The UAE contract takes Airbus' C295 order book now past the 200-aircraft milestone.

Airbus displays comprehensive range of weapons for armed C295

Airbus Defence and Space showcased its new C295 Armed ISR (Intelligence Surveillance & Reconnaissance) version at the Dubai Airshow. A C295 was on the static display flanked by a wide range of weapons which have been selected to be integrated onto this versatile platform. The company has signed a series of agreements with air-to-surface weapon suppliers paving the way for flight-trials to qualify their products to equip the C295. Since the previously announced memorandum of understanding with Roketsan of Turkey, similar arrangements have been reached with Expal, Escribano and Equipaer of Spain, as well as Rheinmetall of Germany, and the US suppliers Nobles Worldwide and US Ordnance.

Aircraft have already been delivered to an "unidentified customer" including two 12.7mm light machine guns and mounts, supplied by Nobles Worldwide and US Ordnance, to be mounted in the paratroop sidedoors. The next weapon to undergo airborne carriage trials is planned to be Roketsan›s L-UMTAS anti-tank missile. Roketsan is also providing the Cirit laser-guided missile and Teber-82 laser bomb-guidance kit. Rheinmetall's BK 27 autocannon provides a heavier door-mounted option, targeted by Escribano's Door Gun System.. Expal displayed its CAT-70 (2.75 inch) rockets and Mk 82 warhead, and Equipaer had its CAT 70 Multiple Rocket Launcher in the exhibition.

Bombardier at Dubai

Bombardier Commercial Aircraft celebrated the CS300 'exceptional' first year in service by showcasing airBaltic's newest aircraft at the airshow. "We are very proud to bring a CSeries in airBaltic's livery at this year's Dubai Airshow, and to celebrate alongside airBaltic the recent launch of the new route between Riga and Abu Dhabi with a CS300 aircraft," said Fred Cromer, President, Bombardier Commercial Aircraft. "We are thrilled to see our CS300 aircraft exceeding performance targets and opening up new opportunities for our operators." Bombardier also lands with a forecast of growth for airlines in the Middle East region over the next 20 years.

Bombardier Commercial Aircraft also announced that it had signed a letter of intent (LOI) for up to 24 CS300 aircraft with EgyptAir Holding Company, of Cairo. This included 12 CS300 aircraft with purchase rights for an additional 12 aircraft. Based on the list price of the CS300 airliner, a firm-order contract would be valued at approximately US $1.1 billion. Should EgyptAir also exercise the 12 purchase rights for CS300 aircraft, the contract value would increase to nearly US $2.2 billion.

Raytheon showcased at Dubai

Raytheon featured some of its latest technologies and innovations as it acknowledged 30 years of partnership with the United Arab Emirates. "The Dubai Airshow allows us to connect with customers and industry partners to create new opportunities for collaboration," stated John Harris, vice president, Business Development and CEO, Raytheon International Inc. "We look forward to building on our 30-year relationship with the Emiratis as we explore the art of the possible to be a partner of choice."

At the airshow, Raytheon featured a number of its solutions and capabilities that span integrated air and missile defence, cyber security, land- and sea-based defence systems and air launched weapons. The company also highlighted its air traffic management support and services, including in the UAE, and the global need for greater cyber security across aviation transportation. In addition, it introduced a new Joint Precision Approach and Landing System that uses GPS to guide fast jets, helicopters and drones to safe landings.

Dassault Aviation at DWC

Dassault Aviation presented its Rafale omni-role fighter and the Falcon business jets. The static display highlighted a Rafale C (single-seater), a Falcon 8X and a Falcon 900LX while the flying display included a French Air Force Rafale C. For 40 years, Dassault Aviation has been a partner of the United Arab Emirates, whose air forces have acquired the Mirage 5, Mirage 2000 and the Mirage 2000-9, "the most advanced version of the delta-wing multi-role combat aircraft." The French detachment deployed on the Al Dhafra airbase in the Emirates is equipped with the Rafale.

Many Falcons are operated in the Emirates and in the Gulf States and a service station, spare parts centre and sales office are also available to our customers in Dubai.

Rolls-Royce's engine power on display

Rolls-Royce put its key engine technology on display at the show and celebrating the first flights of three aircraft over the last 12 months. The Boeing 787-10, on display for the first time at the show is powered by the Trent 1000 TEN engine and also at the show was an Airbus A350-900, powered by the Trent XWB. "The Dubai Airshow comes at the end of a significant period for us where we've worked closely with both Airbus and Boeing to achieve three first flights," stated Eric Schulz, Rolls-Royce, President, Civil Aerospace. The A350-1000 is exclusively powered by the Trent XWB-97 engine, while the A330neo, which flew for the first time recently is powered by the latest Trent engine, the Trent 7000.

PAL Aerospace showcase ISR platform

Canadian aerospace firm PAL Aerospace showcased its 'On Demand Intelligence, Surveillance and Reconnaissance (ISR) Special Mission Platform' named *Force Multiplier*, which is a Bombardier Dash-8 Q300 modified, owned, operated and maintained by PAL Aerospace and fitted with a Thales Searchmaster radar that can identify and classify targets at ranges out to 200nm and an Amascos mission system mainly dedicated for ASW, ASuW and high-end ISR missions. The aircraft is fitted with CarteNav's AIMS Mission System software and Surveillance Information portal. The aircraft has also been modified to accommodate a satellite communications system (SATCOM), Electro-Optic/Infra-Red (EO/IR) sensors with long-range day/night visual camera, drop hatch that can be opened in-flight to allow deployment of stores such as life rafts, smoke markers.

Lockheed Martin "seeks" customer for Fury UAS

Lockheed Martin displayed a model of its Fury long-endurance, survivable unmanned aerial system (UAS) at the event in what is its maiden appearance. The company has been seeking customers in the region, for the lightweight, multi-mission UAS that can fly 12-hour sorties while operating 100 pounds of ISR payload. Company officials stated, "Lockheed Martin manufacturing facilities already have the necessary infrastructure is in place to rapidly deliver Fury UASs to meet the requirement of potential domestic and international customers." The Fury UAS's have been regularly flying long-range endurance test missions and the platform is being pitched as an "anytime, anywhere tactical Group 3 aircraft."

The BrahMos at Dubai

BrahMos Aerospace, an Indo-Russian joint venture, showcased the Brahmos Mach 3 cruise missile at the show. This is interesting in the wake of India and Russia agreeing "in principle" for export BrahMos to several friendly countries. Changes have been made in India's official defence export policy and negotiations are at an advanced stage to export the missile to several potential customers. Potential clients include the United Arab Emirates, Vietnam, South Africa and Chile, according to a BrahMos official. "So far, we couldn't export the missiles because the Indian Army has been buying many missiles and, hence, priority was given to our country's defence requirement," the official stated, while adding "now we can fulfil any volume of export orders because Brahmos is in serial production."

New variants of BrahMos with Extended Range (ER) was successfully test fired in March 2017 from the Integrated Test Range (ITR) off the Odisha coast. The land-attack variant of the missile, launched from a Mobile Autonomous Launcher (MAL) deployed in full configuration, has once again 'proved its mettle' to precisely hit an enemy target at a much higher range than the current range of 290-km, with a supersonic speed of 2.8 Mach. This technology upgrade comes after India's full membership to the Missile Technology Control Regime (MTCR), which has removed the caps on the range of BrahMos. A new variant of the Brahmos, that is now on the drawing board stage is the design of a perspective small-size option of the missile (BrahMos Next-Generation) earlier known as BrahMos-M. BrahMos NG will weight approximately 1.4 tonne and have a range of 120-250 km.

Leonardo's M-346FA at Dubai

Leonardo's M-346FA (Fighter Attack) made its debut at the Dubai Airshow. The M-346FA, for which several international air force's have already expressed their interest, represents a further evolution – after the AJT (Advanced Jet Trainer) for the advanced training of military pilots and the multi-role M-346FT (Fighter Trainer) – of a family concept designed to create a common baseline, able to rapidly answer to the different requirements. "Thanks to the integration of the Grifo multi-mode fire control radar, designed and manufactured by Leonardo and already chosen by several customers in the world, the M-346FA offers advanced operational capabilities."

With seven pylons for external loads, the M-346FA is able to operate very effectively as multi-role tactical aircraft, capable of air-to-surface, air-to-air and tactical reconnaissance missions.

Pakistan seeks additional orders for Super Mushshak

Pakistan Aeronautical Complex (PAC) at Kamra ,manufacturers of the Super Mushshak, seek additional orders for the primary trainer aircraft. According to a senior company official, PAC is looking at the possibility of additional orders from Qatar and Saudi Arabia. "Qatar in particular is very pleased with a new air conditioning system developed by PAC, that has proven effective and reliable," the official said. PAC offers the Super Mushshak to export customers with the option of glass cockpits (Garmin 950 or Dynon Skyview) or analogue cockpit. The Garmin version comprises of two 10.4" flat-panel high resolution LCDs, while the Dynon Skyview Classic cockpit consists of two 10" flat panel multi-functional displays.

The Super Mushshak is operated by the air forces/ armies of Azerbaijan, Nigeria, Pakistan, Qatar, Oman, Saudi Arabia and Turkey and an estimated 111 examples are in operational service.

JASDF Kawasaki C-2 makes international debut

Japan showcased its newest transport aircraft, the Kawasaki C-2 which was at the static display. "The C-2 is a transportation aircraft developed by the MOD/SDF and made in Japan. In consideration of its performance and loading capacity, this aircraft is attracting interest from military authorities of various countries," a senior Japanese official stated at the official event to mark the C-2's presence at the show. The Japan Air Self-Defence Force (JASDF) currently has three operational C-2 aircraft, which are based at Miho Air Base in Japan and is to receive a fourth example by the end of 2017. The JASDF has ordered a total of 11 C-2s, with a final requirement for 30 aircraft projected.

New contract for MBDA's Small Diameter Bomb

MBDA has been awarded a new contract award from Boeing to produce up to 21,000 Diamond Back Wing Assemblies for the Small Diameter Bomb (SDB-1), which follows a US Air Force award to Boeing for additional SDB-1 production. MBDA's Diamond Back Wing Assembly (a key component of Boeing's Small Diameter Bomb) features a patented tandem wing design that improves SDB's manoeuverability and extends its range to over 60 nautical miles, increasing pilot safety and expanding operational reach. SDB-1 is an advanced precision-guided glide bomb that provides aircraft with the ability to carry a higher number of weapons and accurately strike multiple targets in a single combat sortie.

MBDA and Safran in partnership for Australia

MBDA and Safran Electronics & Defence announced their global strategic partnership which will play a key role in response to the Commonwealth of Australia's Defence Industry Policy Statement to support the development of Australian sovereign industrial and strategic capability. The MMP is the only 5th generation multi-purpose guided missile system, currently ordered by a major NATO member and was developed by MBDA for dismounted applications and for integration onto armoured fighting vehicles. MMP has been ordered by France for its infantry and combat reconnaissance vehicles (Scorpion programme). It will be fitted onto the French army's new Jaguar combat vehicles along with Safran Electronics & Defense's PASEO advanced sighting systems. Qualification of MMP was completed in July 2017, and deliveries have now started. PASEO sighting system, with its advanced capabilities and already integrated to fire the MMP missile, has additionally been ordered by France and integrated on to the Scorpion programme's Jaguar combat reconnaissance vehicles.

Russian Helicopters at Dubai

Russian Helicopters took part at the Dubai Airshow with the management holding a number of meetings with the traditional operators of the Russian-made helicopters and potential customers. Negotiations with foreign partners for supply of civil helicopters kept the company busy and special topics for discussion on after-sales service and maintenance systems were carried out. "Dubai Airshow brings together leading world companies in aircraft-building industry and the Russian Helicopters holding company is certainly one of them. In the context of this show, we scheduled intense business programmes, we met not only with our Middle Eastern partners but also with our partners from Europe, Asia and Latin America as well", stated Andrey Boginskiy, Director General of Russian Helicopters.

An-132D makes Dubai show debut

The Saudi Arabia-backed An-132D multipurpose turboprop transport was first rolled out by Antonov in December 2016. As a major upgrade and modernisation of the An-32, the An-132D is powered by Pratt & Whitney Canada PW150A engines, Honeywell avionics and other improvements. Series production of the An-132D will transition to Riyadh and this is likely to guarantee substantial interest in the region for the transport which can carry 8tonnes of cargo at altitudes up to 28,000ft. Antonov expects to be able to better gauge demand within the region for the new type.

Russian Defence portfolio showcased by Rosoboronexport

Rosoboronexport displayed the latest Russian-made air force and air defence equipment at the Dubai Airshow. The Russian exhibition pavilion at the show was huge (700 square metres) and featured participation from Rostec and Rosoboronexport as well as eight leading Russian manufacturers of weapons and military equipment. "The Middle East arms market is essential to us. The countries of the region traditionally equip their armies with the most advanced types of weapons and military equipment. It's no secret that they pay great attention to Russian air defence equipment, including the S-400 Triumf systems, which worked flawlessly in Syria," stated Rosoboronexport's Head of Delegation Sergei Kornev, Deputy CEO - Director of Air Force Equipment Export Department. "We also see interest in the latest combat aircraft, for example, the Su-35 multipurpose super-manoeuvrable fighter which is participating for the first time in the Dubai air show with its flight demo programme," he added.

"Rosoboronexport considers its participation in Dubai Airshow 2017 as an extremely important marketing task. In recent years, the exhibition has turned into one of the key events of its kind. Along with such venues as MAKS (Russia), Paris Air Show (France), Farnborough International (United Kingdom) and Airshow China (China), it is among the top five largest aerospace shows in the world," Kornev further said.

UAC's Su-35C makes Middle East premiere

Russia's United Aircraft Corporation (UAC) brought the Su-35C fighter aircraft to Dubai for its show premiere. The *RusskiyeVityazi* (Russian Knights) aerobatics team were at the show with their new Su-30SM fighters which were delivered starting late 2016, replacing their Su-27 and Su-27UB fighters. The crew took off from the Kubinka air base to reach Dubai with two stopovers, along with an Il-76 heavy transport which carried aviation engineering service specialists and engineering equipment.

UAC's military product portfolio, comprising the Su-35C, Su-34, Su-30SM and MiG family fighters are being extensively promoted in the region and now feature many improvements incorporated as a result of combat operations in Syria. UAC also brought a Sukhoi Superjet 100 aircraft with a VIP interior to the show, in addition to having a Be-200ES multipurpose amphibian and Il-76 heavy transport aircraft on static display. The Sukhoi Superjet 100 in VIP configuration has already been delivered to eight customers till date and the VIP variant of the aircraft features a number of enhancements such as installation of additional fuel tanks and other system improvements, which have seen an increase in range to 7,000 km.

Calidus launches the B-250

Calidus, a recently incorporated Abu Dhabi-based advanced technology company unveiled the B-250, its new light attack aircraft with multirole capabilities at the Dubai Airshow. Designed to address modern warfare requirements in terms of performance as well as operating costs, the Calidus B-250 has generated "significant interest among regional and international air forces," and its characteristics make it a formidable contender as a CAS, ISR/Armed Reconnaissance and trainer platform, with an extensive multirole weapons capability.

Thales' Searchmaster multi-role surveillance radar

In the maritime space, ultra-quiet submarines pose a continuing threat, whilst the use of small fast-attack craft and jet skis by pirates and other illegal operators is an increasingly serious concern. As a result, focus now needs to include not only blue-water combat but also operations in coastal and littoral zones. This development calls for improved maritime surveillance capabilities to identify and track intelligent, rapid and agile targets in all sea conditions, including rough seas, poor visibility, day and night, and navigational areas.

Searching moving or fixed objects of interest in large land areas or along extensive borders calls for airborne surveillance systems with increasingly high level of performance and the ability to detect the smallest objects at long range. Even in the air there is an increasing need for surveillance against illegal traffic using small aircraft.

As forces evolve, they need a versatile aircraft to adapt their missions to the continuously changing demand, creating an operational requirement for a radar solution combining maritime surveillance, ground surveillance and air surveillance capabilities. Thales has developed the Searchmaster high performance multi-role radar to meet this requirement onboard a broad range of aircraft types. This multi-role surveillance radar meets the requirements of five general mission types: anti-surface warfare, anti-submarine warfare, maritime surveillance, ground surveillance and mapping, and air surveillance missions. It incorporates fully qualified and combat proven technologies such as the RBE2 AESA (Active Electronic Scanning Antenna) nose mounted radar operational on the Rafale combat aircraft. By capitalising on Thales's expertise in AESA technology for combat aircraft, Searchmaster also benefits from the associated ITAR-free supply chain. The solution is based on an ultra-compact, robust and agile antenna which offers high mission reliability as well as lower weight, size and power consumption.

The radar also offers a number of additional advantages: extended range, 360° field of vision, simultaneous short-range and long-range coverage, 'outstanding' detection performance even in harsh climatic conditions, greater discretion, very high resolution and the ability to cover huge areas in imaging mode while simultaneously tracking multiple targets.

This high-performance radar meets the requirements of airborne surface, ground and air surveillance missions. Thanks to its compact, lightweight design (under 80kg, air-cooled), the radar is simple to integrate on a host platform and integrate with a system. It is suitable for small and heavier MALE UAVs, medium-tonnage and heavy-lift mission helicopters, large, medium and small mission aircraft (turboprop or jet) and aerostats. "The intrinsic reliability linked to the use of AESA technology together with new innovative concepts in integrated maintenance at least halve the cost for possession of the radar and improves operational availability. All the new capabilities incorporated into a product of its class makes this radar a highly competitive solution especially with respect to more constrained budgets", state company officials.

Safran's JIM Compact infrared binoculars selected

The JIM Compact multifunction infrared binoculars made by Safran Electronics & Defence has been selected by seven NATO countries. In particular, these latest-generation binoculars are recognised as the best solution for special forces, since they meet the full range of ISTAR missions: Intelligence, Surveillance, Target Acquisition & Reconnaissance). JIM Compact features very light weight (less than 2 kilos, including the battery), long range and advanced battlefield connectivity, to meet users' most demanding requirements, especially size, weight and power (SWaP), as well as run-time. Because of its intuitive ergonomic design, low-light sensor, cooled infrared and daytime sensors already used on the original JIM LR long-range binoculars, and pointer and laser designator displays, JIM Compact delivers the "best performance/weight ratio on the market". Nearly 10,000 of these are already in service or on order in some 40 countries.

Foundations of Emirates Airline

Over the past 30 years His Highness Sheikh Ahmed Bin Saeed Al Maktoum has been at the forefront of Dubai's remarkable economic development spearheading the successful expansion of aviation and, more recently, formulating economic, investment and fiscal policies and strategies in support of the emirate's overarching vision.

Sheikh Ahmed embarked on his career in the aviation industry in 1985 when he was appointed President of the Dubai Department of Civil Aviation (DCA) – the governing body that oversaw the activities of Dubai International and Dubai Duty Free, among others. In the same year Emirates Airline – Dubai's international carrier was launched with Sheikh Ahmed as its Chairman. He is now the Chairman and Chief Executive of Emirates Airline and Group, which includes dnata – a leading global provider of aviation and travel services, and other aviation related entities.

Under Sheikh Ahmed's leadership, the DCA underwent an organisational restructuring in April 2007 resulting in the creation of the Dubai Civil Aviation Authority (DCAA) as the local regulatory body, and Dubai Airports as the owner and operator of Dubai's airports – Dubai International and Dubai World Central. Following the restructuring, Sheikh Ahmed became the President of DCAA and Chairman of Dubai Airports.

The fact that Dubai is now firmly established as the region's most desirable leisure destination is due in no small measure to the efforts of Sheikh Ahmed. Under his leadership, Dubai International has developed from humble beginnings into the world's fourth busiest airport for international passenger and cargo traffic with a network of over 220 destinations served by more than 150 airlines. Emirates has grown from being a regional airline with just two leased aircraft and three destinations, to an acclaimed international airline with a fleet of more than 250 aircraft and over 150 destinations across six continents. Emirates is today the world's fastest growing intercontinental carrier. With the launch of fly dubai, its own budget carrier, Dubai added another first to its long list in June 2009. With Sheikh Ahmed to guide the fledgling carrier as its Chairman another success story is already in the making. Within two years of its launch flydubai has emerged as the second largest contributor to traffic at Dubai International, and flies to more than 45 destinations.

The opening of Dubai World Central (DWC), Dubai's airport of the future on 27 June, 2010 was another historical moment for Dubai as the first major step towards establishing Dubai as the world's most preferred aviation and logistics hub. The launch of DWC follows the spectacular opening of Dubai International's Terminal 3 on 14 October, 2008 – widely acknowledged in the industry as the most successful launch of a terminal of its size. Sheikh Ahmed holds a number of government positions and plays an increasingly pivotal role in leading the emirate's finance and energy sectors; and despite his numerous business activities, he is Patron to many charitable organisations. He has also received numerous recognitions and accolades from various Governments and multi-nationals. The various Government, Semi-Government positions; patronages and accolades are also listed below.

His Highness Sheikh Ahmed has a Bachelor's Degree from the University of Denver, Colorado, USA. He is well known internationally for his contribution to the development of aviation in the region. The Royal Aeronautical Society, one of the industry's oldest and most respected professional associations honoured his achievements in aviation with a Fellowship of the Society at the 1994 Farnborough Air Show in the UK.

and the Dubai World Central

J-20 Dragon into PLAAF service

China's Chengdu J-20A Dragon fifth-generation medium and long-range fighter has reportedly gone into service with the People's Liberation Army Air Force (PLAAF) since early 2017. According to informed sources, six low-rate initial production aircraft have been identified by their serial numbers but there are at least two more flying with no numbers applied. The J-20A is operated by the 176th Air Brigade at Dingxin Air Base.

US Navy orders more Super Hornets

According to Boeing, an additional 14 F/A-18E/Fs have been ordered for the US Navy. The deal covers full-rate production and delivery of six Lot 41 single-seat F/A-18E and eight twin-seat F/A-18F aircraft and work is expected to be completed in February 2019. Procurement of the Super Hornet is reportedly to overcome a shortage of strike fighters in the US Navy. The original FY2017 US Navy budget had only earmarked $185m to purchase two Super Hornets, but its 'Unfunded Requirements List' (URL), which was also sent to Congress, sought an additional 14 F/A-18E/Fs. To further address the fighter shortfall, the US Navy is looking to buy at least 80 F/A-18E/Fs over the next five years, a major change from the original plan to end Super Hornet procurement next year. In the FY2018 budget request, the navy is seeking $1.25bn for 14 more F/A-18E/Fs, with additional aircraft to follow as part of the Future Years Defence Programme (FYDP).

Canada to acquire ex-Australian Hornets?

The Canadian Government is considering the possible purchase of second-hand F/A-18A Hornets from Australia rather than procuring 18 new F/A-18E/F Super Hornets from Boeing. Canadian officials have reportedly been to Australia to discuss the potential purchase of the Hornets. Australia plans to start retiring its F/A-18A/Bs in late 2018 when No 3 Squadron begins its transition to the F-35A. Australia's remaining Hornet squadrons will also convert to the Lightning II by 2022, with No 2 Operational Conversion Unit (OCU), No 77 Squadron and No 75 Squadron following at some one-year intervals. The Canadian Armed Forces had received 138 CF-188A/Bs beginning in 1982, of which some 30 remain in service.

F-35I *Adirs* to Israel

Two more F-35I *Adirs* for the Israeli Air Force arrived at Nevatim Air Base in mid-September, the first two F-35Is having been received on 12 December 2016 with another three *Adirs* received in April. With a view to achieving initial operational capability (IOC) by end of the year, 140 'Golden Eagle' Squadron has undertaken both aerial refueling and munition drops. The unit plans to have nine F-35s by December 2017. Israel committed to a first batch of 19 F-35s in 2010, followed by another 14 F-35s in 2015 and 17 earlier this year. Beyond the 50 F-351s currently contracted, the US administration has approved Israel's purchase of up to 75 F-35s. Options could include unmanned aircraft or "other sources of precision fire."

USAF F-35s in Japan

The US Air Force have deployed the F-35A in its first operational overseas move in deployment October 2017. 12 Lightning IIs from Hill Air Force Base, Utah's 34th Fighter Squadron arrived at Kadena Air Base in Japan on 30 October and will remain there for a six-month rotation in the US Pacific Command's (PACAF's) first operational tasking for the F-35A. The F-35A is being deployed under PACOM's Theatre Security Package (TSP) programme, which began in 2004. US Marine Corps F-35Bs have been based

at Marine Corps Air Station Iwakuni, Japan since early 2017. Meanwhile, USAF F-35As from Hill AFB's 34th and 466th Fighter Squadrons deployed to Europe in April. Although officially a training mission, the fighters took part in NATO reassurance sorties.

F-35B cleared for carrier operations

The F-35B short take-off and vertical landing (STOVL) fighter has been cleared to use the 'ski jump' ramp fitted to the flight deck of the Royal Navy's two new aircraft carriers, following a series of tests at Naval Air Station Patuxent River, Maryland. The Pentagon has also announced that Lockheed Martin has been awarded an $11.56m delivery order to provide support for first-of-class flying trials and the release of the military permit to fly for F-35B aircraft to operate from the *Queen Elizabeth*-class carriers. As of mid-October, the UK had 12 F-35Bs in the US, building the UK Force ahead of trials aboard the carrier HMS *Queen Elizabeth* next year. Two more Lightning IIs were due to be delivered by the end of the year. There are 150 British personnel working on the Lightning II programme in the US, and the F-35 integrated Test Force includes five British pilots.

US discussing F-35 for UAE, Gulf allies

According to sources at Washington DC, the US government is in the early stages of discussions about selling the F-35 Joint Strike Fighter to the UAE and other allies in the Persian Gulf. The Israeli Air Force is currently the exclusive operator of Lockheed Martin's stealth fighter in the Middle East region, but the UAE has reportedly asked for a classified briefing on the programme. Reportedly, US President Donald Trump could offer the aircraft to the UAE and other Gulf nations, in a change from the previous administration. "Specifically the F-35, as we look at their requirements here in the Gulf, they share many of the same adversaries and challenges," said US Air Force Vice Chief of Staff Gen Stephen Wilson at a press conference in Dubai. "So we'd look to provide capabilities. The discussion is ongoing now with the new administration on selling F-35s to partner nations that need them and require them."

Brimstone capability for Typhoon

BAE Systems is continuing with the 'Project Centurion' capability upgrade for the RAF's Typhoon fleet, with the test campaign for the MBDA Brimstone precision-guided munition completed in September 2017. A total of nine Brimstone jettisons and nine firing were completed between July and September. The Typhoon Force is due to field the 'Project Centurion' configuration by the end of next year, enabling the aircraft to assume the responsibilities of the Tornado GR4, which is scheduled for retirement in 2019.

Rafale lone-bidder for Belgian fighter plans

France has decided to make a direct proposal to Belgium for the 34 new fighters required by the latter. France's Minister of the Armed Forces, Florence Parly has proposed a partnership between the two countries which, as well as the aircraft supply, would include co-operation in operational, training and support fields as well as industrial and technical co-operation involving French and Belgian

companies. Dassault has confirmed the Rafale was being offered as a replacement for the Belgian Air Component's F-16 fleet, saying that along with its partners, it is participating fully in the "comprehensive partnership offer" made by the French authorities.

Ex-IAF Su-30Ks for Sri Lanka?

Further to the news item in *Vayu V/2017*, it is now learnt that Rosoboronexport is finalising the sale of the last six ex-Indian Air Force Su-30Ks to Sri Lanka. Previously, Angola, which purchased 12 of the 18 aircraft available had considered buying the remaining fighters. However, a report on 22 September confirmed purchase of the six aircraft for the Sri Lankan Air Force (SLAF) was being negotiated, with a contract signing expected by the end of this year. The aircraft have been in storage at the 558th Aircraft Repair Plant (558 ARZ) in Belarus since being shipped from India. Preliminary negotiations for their purchase for the SLAF were held between 2-4 November 2016 when an initial protocol was signed. In June 2014, a technical evaluation report by the SLAF and defence ministry provided a comparison of the Su-30K with the Sino-Pak JF-17 Thunder. It was decided thereafter that the "low cost" of the Su-30Ks made them an attractive option and the purchase "would go ahead".

Greek F-16V upgrades

The US State Department has approved a potential $2.4bn upgrade package for Greece's F-16 fleet, which would bring the Hellenic Air Force's existing 123-strong fleet of F-16C/Ds to F-16V standard and include up to 125 AN/APG-83 active electronically scanned array (AESA) radars; a similar number of Modular Mission Computers (MMCs); Link 16 Multifunctional Information Distribution System – Joint Tactical Radio Systems (MIDS-JTRS); and LN260 embedded global navigation systems/ inertial navigation systems. The Hellenic Air Force currently flies F-16s in Block 30, Block 50, Block 52+ and Block 52+ advanced configurations.

UAE considers the Su-35

According to Russian news agency Tass, the United Arab Emirates wants to buy "more than a squadron of Sukhoi Su-35 fighters". However, this is not the first time that the UAE has been linked with the Sukhoi fighters and in April, Russian officials spoke of a deal involving the sale of "several dozen" of the fighters to the Emirates. The UAE Air Force and Air Defence reportedly requires around 60 new fighters and Rafale, Typhoon, Gripen or additional advanced F-16s have all been linked to potential deals with the Emirates.

"Aggressor" Gripen

At the DSEI exhibition in London in September, a new variant of the JAS 39 Gripen C was revealed, with the same handling and flight characteristics, sensors and data link capabilities as the Gripen C, but no live weapons capability. Saab's head of Gripen marketing and sales Richard Smith then said that the company sees potential for the Aggressor with the US Air Force's Adversary Air and UK Ministry of Defence's Air Support to Defence Operational Training (ASDOT) programmes, the former to provide 40,000 hours of contracted aggressor support training at 12 bases in the United States.

F-16Vs for Bahrain

The US government has approved the planned Bahraini order for 20 new-build F-16V fighters, as well as the upgrade of its current fleet of F-16C/Ds to the same standard. On 8 September, the Defence Security Co-operation Agency (DSCA) made two separate announcements confirming State Department approval of the possible Foreign Military Sales. The $2.785bn new-build deal involves 19 F-16Vs as well as support and equipment including 22 F110-GE-129 engines, 22 AN/APG-83 active electronically scanned array radars and a similar number of modular mission computers, embedded LN260 inertial navigation system/GPS and Improved Programmable Display Generators. Valued at $1.082bn, the proposed upgrade will bring 20 F-16C/D Block 40 aircraft to F-16V configuration.

Kazakhstan orders 12 more Su-30SMs

Recently revealed is Kazakhstan's requirement of an additional 12 Su-30SMs. Kazakhstan previously took delivery of six Su-30SMs from a batch reportedly ordered in 2014. The first two arrived at the 604th Air Base at Taldykorgan on 17 April 2015, with two more the following year.

Singapore and Indonesian F-16s in 'Rising 50' formation flypast

As part of the 'Rising 50' celebrations to mark 50 years of bilateral ties between Indonesia and Singapore, the Indonesian Air Force (*Tentara Nasional Indonesia-Angkatan Udara*, TNI-AU) and the Republic of Singapore Air Force (RSAF) flew in separate and joint formations over Singapore's Marina Bay on 7 September. Each air force contributed 10 F-16s – the Indonesian F-16A/C/Ds were from *Skadron Udara* 3 and 16, while the RSAF was represented by F-16C/Ds from 140 and 143 Squadrons. Witnessed amongst thousands by leaders from both countries, the F-16s flew in unilateral 'arrowhead' formations and jointly in a '50' formation.

More F-16s to Iraq

A further three F-16C Block 52s have been delivered to Iraq to join the Iraqi Air Force's No. 9 (Fighter) Squadron at Balad Air Base. With the arrival of these latest fighters, there will be 21 F-16C/Ds with the country's Air Force.

Super Étendard Modernises for Argentina

According to the Argentine defence minister, five former French Navy Super Étendard Modernisé (SEM) fighters will be transferred to the *Comando de Aviación Naval* (COAN Argentine Naval Aviation Command) for use as "a spares resource." Also included are powerplants installed with another ten engines developed as part of a spares package of 9,000 items. Also included are a flight simulator and test benches for calibration and maintenance. The COAN's fleet of 11 surviving Super Étendards has been stored for the last three years and the spare parts from France will be used to bring them back to service (Ed.: *the Super Étendard saw considerable action during the Falklands War in 1982*).

Mi-35M2s for Venezuela

The Venezuelan Army's air arm has received ten Mi-35M2 'Caribe' attack helicopters, returned after a programme of inspection and modernisation was completed. Their official reception took place as part of the commemoration of the 12th anniversary of the *Comando Estratégico Operacional de la Fuerza Armada Nacional Bolivariana* (CEOFANB, Operational Strategic Command of the Bolivarian National Armed Forces), held on 26 September at El Libertador air base in Palo Negro, Aragua state.

Dutch F-16s sold to Jordan

The first six of 15 former Royal Netherlands Air Force (RNLAF) F-16s sold to Jordan were delivered to the Royal Jordanian Air Force (RJAF) in late October. The F-16s are being transferred to the RJAF under the 'Peace Falcon' VI programme, as part of a €76.46m deal signed between the Netherlands and Jordan on 17 December 2013. Also included in the agreement are support equipment and spare parts, as well as training of technical personnel and pilots. The former Dutch F-16s will re-equip No 2 Squadron, which previously operated 16 ex-US Air Force F-16A/B Block 15 ADFs delivered from 1997-98 under the *Peace Falcon* I programme. The 13 surviving aircraft were transferred to the Pakistan Air Force in 2014.

Indonesian F-16 upgrades

Indonesian Air Force F-16A/B Block OCU fighters are undergoing upgrade at Iswahiudi Air Base, East Java, part of *Skadron Udara* 16, home based at RoesminNurjadin AB, Pekanbaru, Riau. The F-16A/Bs based at RoesminNurjadin are to be replaced by F-16C/D Block 52ID aircraft, the first of which arrived at Iswahjudi in 2016. Deliveries of F-16C/Ds to RoesminNurjadin began earlier this year. The refurbished and upgraded F-16C/Ds are reportedly being transferred to Roesmin Nurjadin in batches of two, with a similar number of F-16A/Bs, originally procured under Project Peace *BimaSena I*, heading in the opposite direction for upgrade at Iswahjudi.

UAE Air Force in F-16 upgrade

Lockheed Martin and the UAE Armed Forces have signed a US$1.65 billion support upgrade contract for the UAE's Block 60 F-16 Desert Falcon fighter jets. The upgrade "would deal with obsolescence issues in the Block 60 aircraft that were ordered by the UAE in 2000." The UAE's F-16 Block 60s have been described as some of the most advanced F-16s operating anywhere in the world and were the first to be equipped with an active electronically scanned array radar and conformal fuel tanks. The aircraft have been extensively used by the UAE supporting operations over Libya in 2011 and more recently in the Saudi-led air campaign in Yemen.

Gripen E goes supersonic

On 18 November, the new generation Gripen E fighter flew supersonic for the first time over the Baltic Sea. The Gripen E flew at speeds greater than the speed of sound, at over Mach 1, as part

of the ongoing flight trials programme. The purpose was to collect data from the aircraft as it achieved and sustained supersonic speed and the aircraft sustained supersonic speed for a number of minutes, whilst carrying out maneouvres. Jonas Hjelm, Senior Vice President and head of business area Aeronautics stated, "Individual milestones such as this supersonic flight demonstrate the thoroughness of our engineering approach and validity of the modelling. It is further evidence that the Gripen E flight test programme is going extremely well, whilst the delivery schedule to our two customers remains our key focus."

Swiss fighter programme takes shape

According to reports, Swiss defence minister Guy Parmelin has requested for a budget of CHF 9bn (£7bn) to buy new combat aircraft for the Swiss Air Force and a ground-based Air Defence System (GBADS). This will fund around 40 aircraft depending on the type selected, which is in direct contrast to the smaller amount budgeted for 22 Gripen E/Fs that the Swiss deferred after a 2014 referendum. The Gripen E/F, Rafale F4 and Typhoon Tranche 3 previously in the running are now joined by the F/A–18E/F and the F-35, which indicates that the new fighters would replace both the F-5E and the F/A-18C/Ds.

MiG-29s for Serbia

Six MiG-29s have recently been delivered to the Serbian Air Force during the first week of October 2017, the jets "donated by the Russian defence ministry to the *RatnoVazduhoplovstvo Protivvazduhoplovna Odbrana* (RV i PVO, Serbian Air Force and Air Defence). The aircraft are to take over quick reaction alert assignment and pilot training in the second half of next year. Current Serbian MiG-29s will be overhauled when they reach their TBO of ten years. The Serbian 101st *lovačkaa vijacijskaeskadrila* (101st Fighter Aviation Squadron) will have ten MiG-29s.

MiG and Sukhoi to "unite"

The Russian United Aircraft Corp (UAC), which has been holding company that controls all fixed-wing aircraft design and production companies in Russia, has announced that RAC MiG and Sukhoi will be combined in a newly established combat aircraft division. Russian Industry and Trade Minister Denis Manturov described the change as a transformation of UAC's corporate structure with new divisions set to be established for each aviation branch: combat, strategic bombers, special-mission, civil and transport. The combat division will have MiG and Sukhoi sharing resources, testing, research and development activities but retaining their brands.

Upgrade of Peruvian MiG-29s

Russian aircraft manufacturer RAC-MiG have signed a contract for upgrade of the *Fuerza Aérea del Perú's* (Peruvian Air Force) fleet of MiG-29 fighters following on to the earlier programme which involved eight Peruvian MiG-29s. The new contract covers an additional batch, upgrade, combined with life extension work should ensure at least 15 more years of service of Peru's MiG-29s.

French AF A330 MRTT progresses

The first of nine A330 MRTT Multi Role Tanker Transports ordered by the French *Direction Générale de l'Armement* (DGA) for the French *Armée de l'Air* made its maiden flight from Airbus Defence and Space's Getafé, Spain facility. The aircraft, which will be known in French service as *Phénix* is the second new-standard A330 MRTT to fly. The aircraft was converted at Getafé from a standard A330 assembled in Toulouse. The Rolls-Royce Trent 700-powered *Phénix* fleet will be equipped with a combination of the Airbus Aerial Refuelling Boom System and underwing Cobham hose-and-drogue refueling pods. While operating as a tanker, the aircraft can carry freight, 272 passengers or be configured for medical evacuation. Delivery of the first aircraft to BA125 at Istres-Le Tubé is due in October 2018, the second in 2019 with the remainder being delivered at the rate of one or two a year. The type will replace the *Armée de l'Air's* fleet of 11 C-135FRs and three KC-135RGs as well as the three A310-304s and two A340-212s of ET3/60.

UAE interest in Kawasaki C-2

Japan's Kawasaki C2 medium-size transport aircraft made its international debut at Dubai Air Show. Four of nine aircraft on order are now operated by the Japanese Air Self Defense Force,

the latest delivered on 1 November to Miho Air Base, where it has joined the others serving the 3rd Tactical Airlift Wing. Keitaro Ohno, Japan's Parliamentary Vice-Minister of Defence told media outside the aircraft that it stopped off at Thailand, India and Djibouti to get to Dubai. The United Arab Emirates are reportedly in discussions with the Japanese Government regarding the purchase of an undisclosed number of Kawasaki Heavy Industries C-2 transport aircraft. If finalised, this would mark the first export sale of the C-2, which is now entering service with the Japan Maritime Self Defence Force following an initial order for nine aircraft. The C-2 is seen at the Dubai Air Show (above).

Germany and Norway order A330 MRTTs

The Netherlands-based Multinational Multi-Role Fleet (MMF) is due to expand after Germany and Norway ordered five Airbus A330 Multi-Role Tanker Transports (MRTTs), the signing ceremony taking place on 25 September. The five MRTTs join the previous two aircraft ordered by the Netherlands and Luxembourg, all of which will be operated under a pooling arrangement. The amendment includes options for up to four additional aircraft, potentially increasing the MMF fleet to 11 aircraft. More nations are expected to join the MMF in the future.

Bangladesh orders more Do228s

The Bangladesh Navy has ordered a further two Dornier 228NG Special Mission aircraft from RUAG Aviation. The deal involves two new production aircraft and was announced on 11 October. Bangladesh had acquired its first two Dornier 228s in July 2011, the first arriving at Kurmitola in June 2013.

Bolivian interest in Pampa III

The Bolivian government is reportedly considering acquiring the IA-63 Pampa III light attack aircraft from Argentina, between eight and 12 Pampa IIIs being selected. The Pampa IIIs would replace AT/T-33s recently retired by the *Fuerza Aérza Boliviana* (FAB, Bolivian Air Force). Following a memorandum of understanding signed by both countries in September 2015, arms transfer began in July.

Meanwhile, the first four from a total of 12 T-6C+ aircraft were delivered to the *Fuerza Aérea Argentina* (FAA, Argentine Air Force) on 2 October arriving in Córdoba province from Wichita, Kansas, to be assigned to the School of Military Aviation. The next four Texan IIs will arrive next June and the last four in December 2018.

Grob G 120TPs for ETPS

Modernisation of the Empire Test Pilots' Schools (ETPS) fleet will be completed with the introduction of two Grob G120TP basic turboprop trainers, which will join two new PC-21s, purchased in December 2016 and four H125 helicopters acquired in March. The G 120TPs will be used to train flight test engineers throughout all stages of development. A spokesman said, "Grob provides a safe and comfortable environment, ideal for new pilots learning the basics alongside their instructor. However, it is also extremely capable, allowing more experienced pilots to carry out advanced manouvers at high g-forces."

Ka-226T flight tests in Iran

Russian Helicopters and Iran Helicopter Support and Renewal Company (IHSRC) have completed testing the Ka-226T in Iran. The light multi-role helicopter undertook hot-weather trials

between August and September, operating at ambient temperatures of up to +50°C. The tests were performed under a MoU between Russian Helicopters and IHSRC. Iran is one of several Middle Eastern countries that are now being targeted for Ka-226T sales, the helicopter considered suitable for various roles including firefighting, patrol and medical evacuation.

Fourth RAAF P-8A delivered

A fourth Boeing P-8A has been delivered to Australia, the Poseidon arriving at its RAAF Base on 7 August. The RAAF has ordered 12 Poseidons to date, the most recent contract being for four aircraft on 30 March. These are the first four of a planned seven additional aircraft, acquisition of which was announced in a Defence White Paper on 26 February 2016. An order for the remaining three, to bring the total to 15, has yet to be placed.

Meanwhile, delivery of the seventh RAAF C-27J was completed on 19 September when it arrived at RAAF Base Richmond, New South Wales. The Spartan is part of an eventual RAAF fleet of ten that will be operated by No. 35 Squadron. The tenth and final RAAF C-27J is also now flying, having taken its maiden flight from the factory at Turin Caselle in Italy on 29 August.

400th UH-72A Lakota for US Army

Airbus Helicopters has delivered the 400th UH-72A Lakota helicopter to the US Army, fulfilling its contract requirements and meeting the Army's rigorous quality standards. The UH-72A

is one of the key helicopter models the Army will operate for the foreseeable future. Army and Army National Guard units operate the Lakota in a variety of missions including flight training, surveillance and reconnaissance, medical evacuations, border security, VIP transport and disaster response.

First RAF P-8 assembled

Boeing has completed final assembly of the first P-8A for the Royal Air Force, of an initial batch on order, out of a planned total of nine. A deal covering long-lead components for these first two RAF P-8s was awarded to Boeing on 18 August 2016. The type will be based at RAF Losseimouth, Moray, where it will be flown by Nos 120 and 201 Squadrons, the first aircraft expected to be handed over in 2019 and arrive in the UK the following year.

Mi-35Ms to Pakistan

The Pakistan Army has now received all four the Mi-35M attack helicopters on order. To be employed for counter-insurgency (COIN) operations in areas bordering Afghanistan in Pakistan's long-running anti-terrorist missions, the Mi-35s are to supplement the AH-1F/S Cobra gunships in service with the Aviation Wing of the Pakistan Army.

Ansat in Pakistan

The Russian Helicopters Holding Company (part of Rostec State Corporation) has started testing multi-purpose Ansat helicopter in Pakistan, the objective being to prove operations in hot-and-high condition. It is planned to complete testing by mid-November 2017 with a conference scheduled in Islamabad for potential Pakistani customers to explore the helicopter's competitive advantages and specific features of operation.

Weapon trials of Airbus Helicopters

Airbus Helicopters has completed a ballistic development test of an HForce weapon system on a H145M in Hungary. The test systems include guns (FN Herstal HMP400), unguided rockets (Thales FZ231) and cannon (Nexter NC621) as well as an electro-optical targeting system by Wescam (MX15) and a helmet mounted sight display from Thales (Scorpion). Next steps prior to the qualification of HForce on the H145M are the development testing of laser-guided rockets in Sweden before the end of the year as well as additional live-firing trials in summer 2018.HForce is an innovative, incremental and integrated high performance weapon system that can be fitted ("plug and play") into Airbus Helicopter's military platforms such as H125M, H145M and H225M for ambitious and smart military operations where flexibility of mission equipment is a vital criterionMeanwhile, qualification of the core HForce system is on track for end 2017, following an extensive flight-test campaign carried out on a H225M testbed.

MR/ASW aircraft for the Philippines

The Philippines have decided to procure new maritime surveillance and anti-submarine warfare (ASW) aircraft for its Air Force. The DND invited bidders to respond to its programme to field a long-range patrol aircraft (LRPA). Two aircraft are sought and these are required to be capable of ASW missions as well as maritime patrol. The Phil.AF currently operates a single Fokker F27-200MPA that entered service in February 1981 and one N22SL Nomad Searchmaster.

Contract for 150 MD530Fs

The US Department of Defence has awarded a $1.4bn Foreign Military Sales contract to MD Helicopters for an estimated 150 MD5300F helicopters. The first deliveries under the contract will be 30 new Cayuse Warriors for the Afghan Air Force, these aircraft configured with MDH's newly certified Block 1 glass cockpit, featuring Howell Instruments' engine instrumentation system, Garmin GDU 620 electronic flight instruments, Garmin GTN 650H communication/navigation GPS and Northern Airborne Technology's cabin audio system. Mission equipment will include an FN Herstal weapons management system, a DillonAero Mission Configurable Armament System (MCAS) weapons plank and fixed-forward sighting system.

Y-12s for Mali

Continuing acquisition of the Harbin Y-12 by the *Armée de l'Air Malienne* (Mali Air Force), two aircraft have been received so far. The aircraft departed Guilin Liangjiang for KummingWujaba in China, with subsequent stops in Myanmar, India, Pakistan, Oman, Bahrain, Saudi Arabia, Cairo and Heraklion, Malta, Algiers, before arriving in Mali.

Bangladesh Army C295W delivered

The Bangladesh Army has received its first twin-engine fixed-wing aircraft in mid-September when Airbus Defence& Space C295W was delivered via Malta following an order for the aircraft in October 2016.The nation has become the ninth to order the C295W, which will become the first multi-engined fixed-wing aircraft to be operated by the aviation branch of the Bangladesh Army. It will be used as a transport for troops and cargo, with applications potentially including paratrooping and medical evacuation, and the contract also covers training and support.

US Air Force adds six more A-29s to Afghanistan programme

Sierra Nevada Corporation (SNC) and its partner Embraer Defence & Security have received orders from the *USAF A-29 Afghanistan Programme* for six more A-29 Super Tucano aircraft, to conduct advanced flight training, aerial reconnaissance, and other A-29 Afghanistan Programme operations. This brings to 26 the total number of aircraft provided to the Programme. The A-29 has been active in Afghanistan since early 2016. Its ability to operate in rugged terrain, extreme climates, and austere locations with a small operational and maintenance footprint has resulted in successful operations from at least four bases in-country.

Emirates order 40 Boeing 787-10s

Emirates Airline signed a memorandum of understanding to buy 40 Boeing 787-10s, on Day One of the Dubai Air Show on 12 November 2017. Importance of the order was underlined by presence of the vice-president and prime minister of the UAE and ruler of the Emirate of Dubai, Sheikh Mohammed bin Rashid Al Maktoum. The order, worth $15.1 billion at list prices has apparently put some spoke to Airbus' hopes of selling the A350-900 to the Dubai carrier. However, the airline is still looking at which engine will power the 787-10s, with a decision expected "very soon". Deliveries will begin in 2022 and continue through the decade. Some will be used to replace older aircraft in the Emirates fleet, others will be for expansion.

Five B-787s for Azerbaijan

Azerbaijan Airlines has signed for another five Boeing 787-8s. Describing the Dreamliner as "a spectacular aircraft." Azerbaijan Airlines' president Jahangir Askarov said the order was the latest chapter in a long relationship with Boeing that had begun in the 1990s with Boeing 757s. Askarov added that he planned to buy two wide-bodies freighters from the US company, either the 777F or the 747-8F. One of Azerbaijan Airlines' group subsidiaries is cargo specialist Silk Way Airlines, which already flies five 747-8Fs.

Qatar Airways equity in Cathay Pacific

Qatar Airways has purchased a stake of some 10% in Cathay Pacific, as the Middle Eastern carrier looks to build its portfolio of airline investments. Qatar bought 378.2 million Cathay Pacific shares from Kingboard Chemical Holdings Ltd, with the deal valued at HK$5.2 billion (US$661.6million). The deal gives Qatar a 9.61% holding in its Oneworld Alliance partner Cathay. Swire Pacific Ltd is the largest of Cathay's shareholders with a 45% stake and Air China holds almost 30%.

Order for A321neos from Cathay Dragon

Airbus has received a major contract for its A321 with the Cathay Pacific Group signing for 32 A321neos to replace the 15 A320s and eight A321s operated from Hong Kong by its Cathay Dragon regional arm.

Philippine Airlines expansion plans

Philippine Airlines plans to expand to a 96-aircraft fleet by 2021, having 87 aircraft today. 18 aircraft have been phased out and 27 new aircraft (12 Q400s, two B-777-300ERs, six A350900s and seven A321neos) introduced. Industry analysts believe the airline is expected to put the 777s and A350s on new trans-Pacific routes as part of its growth plans.

Air Mauritius to help Ghana's airline?

It is understood that Air Mauritius will assist Ghana establish a national airline. According to Ghana's Minister for Aviation Cecilla Dapaah, talks have focused on the possibility of a joint venture between Air Mauritius and Ghana. National carrier Ghana International Airlines had ceased operations in 2010.

The CR929 Russian-Chinese airliner

The planned Russian-Chinese wide body twin-engine airliner was designated the CR929 at a ceremony at the headquarters of its developer, the joint venture China-Russia Commercial Aircraft International Corporation in Shanghai. The CR929-600 will carry 280 passengers and have a maximum range of 6,500 nautical miles (12,000km), with first flight is planned for 2025. Other versions will include the stretched 320-passenger CR929-700 and the 230-passenger CR929-500. Russia and China have also been looking at the potential for joint engine development and aftermarket support infrastructure in conjunction with this programme involving Russia's United Engine Building (UEB) and Aero Engine Corporation of China, a new firm formed by the merger of several companies earlier this year. The engine would be based on UEB's PD-15, which shares a common core design with the smaller PD-14, designed as an alternative powerplant for the United Aircraft Corporation MC-21.

C919 continues flight trials

The prototype COMAC C919 (B-001A) has continued flight trials from Pudong International Airport in Shanghai, the aircraft conducting about 30 test flights before leaving Shanghai to relocate to the China Flight Test Establishment at Yanliang, close to Xi'an, where it will conclude its flight testing and carry out qualifications to obtain Civil Aviation Administration of China type certification. COMAC is aiming for the second prototype C919 to fly before this year's end and the company has scheduled test programme of 4,200 flight hour before the C919 enters service with China Eastern Airlines in 2020.

First Boeing 787-10 for SIA

Boeing has rolled out the first Singapore Airlines 787-10 Dreamliner at its North Charleston final assembly facility. This process will see the 787-10 follow the pre-delivery route for all Boeing airliners, which involves tests on the auxiliary power unit, fuel system, plumbing, pumps, valves, tanks and hardware. Singapore Airlines has 30 787-10s on firm order and has signed a letter of intent to purchase 19 more.

Third ARJ21 for Chengdu Airlines

The third COMAC ARJ21 twin-jet airliner was delivered to Chengdu Airlines (owned by COMAC) in October. ARJ21 production is planned to increase to 15 aircraft in 2018, thirty ARJ21s going to Chengdu Airlines with these deliveries scheduled to be completed by 2020. COMAC has commitments for 416 ARJ21s from 19 customers. While this number apparently includes 116 aircraft for the People's Liberation Army, other customers to bring the current 61 disclosed orders to 300.

LM's LM-100J programme milestone

Lockheed Martin's LM-100J commercial freighter programme has marked the first flight of the second production LM-100J aircraft. The LM-100J is the 17th different mission capability developed for the C-130J Super Hercules and is an updated version of the L-100 cargo aircraft, which Lockheed Martin produced from 1964-1992. Through select design innovations, the LM-100J will perform as a commercial multi-purpose air freighter capable of rapid and efficient cargo transport and is an ideal airlift solution for delivering bulk and oversize cargo, particularly to austere locations worldwide. Like its military counterpart, the LM-100J will be able to support multiple missions, ranging from firefighting to medevac to VIP transport.

Singapore Airlines order 39 Boeing 777 and 787s

Singapore Airlines (SIA) have formally announced orders for 20 Boeing 777-9s and 19 787-10s, the order worth $13.8 billion at current list prices. The airline also has options for 12 additional aircraft, six of each aircraft type.

VietJet Air select PW PurePower Geared Turbofan

VietJet Air have selected the PurePower Geared Turbofan (GTF) engine to power an order of 10 new aircraft. This deal includes a 12-year EngineWise™ Fleet Management Programme order and follows a February 2016 contract signing for GTF engines to power VietJet's 63 newly ordered aircraft. Since entering into service in early 2016, the GTF engine has demonstrated its promised ability to reduce fuel burn by 16 percent, regulated emissions by 50 percent and noise footprint by 75 percent.

Meanwhile, Pratt & Whitney have an agreement with Air China Limited (Air China) and Shenzhen Airlines for 60 Airbus A320neo family aircraft, powered by PurePower Geared Turbofan (GTF) engines. The contract with Air China includes a 15-year Pratt & Whitney EngineWise™ Fleet Management Programme.

FedEx Express for 50 new ATR 72-600F freighters

FedEx Express and ATR have signed a major contract for the firm purchase of 30 ATR 72-600s plus 20 options, the first new ATRs directly delivered from the factory in a freighter configuration. Designated as the ATR 72-600F, this has a brand new windowless fuselage and is equipped with a forward Large Cargo Door (LCD) and a rear upper hinged cargo door. Deliveries of the ATR 72-600Fs to FedEx Express will begin in 2020.

Rolls-Royce Trent 7000 powers Airbus A330neo test flight

The Rolls-Royce Trent 7000 powered the new Airbus A330neo for its first test flight on 19 October with the aircraft taking off from the Airbus facility in Toulouse, in France. The flight also marks an important milestone for Rolls-Royce as it celebrates its third 'first flight' in less than 12 months, the others being the Trent XWB-97 and Trent 1000 TEN, "an unprecedented achievement in the aerospace industry."

MQ-1C ER flight testing

The General Atomics Aeronautical Systems MQ-1C ER Gray Eagle production aircraft has begun flight testing at the Dugway proving ground, Utah, for evaluation, which will demonstrate the MQ-1C ER's mission capabilities. The MQ-1C ER is scheduled to go through logistics demonstration early in 2018 to validate maintainability. Follow-on operational test and evaluation in March 2018 will demonstrate the aircraft's ability to meet US Army operational requirements in preparation for operations, which are planned for August 2018. The MQ-1C ER recently completed a 41.9-hour endurance flight, exceeding the 40-hour flight test target.

Dornier Seastar redux

Dornier Seawings have revealed prototype of the new Dornier Seastar amphibious aircraft, equipped with two 650hp (484Kw) Pratt & Whitney Canada PT6 turboprop engines that power five-blade composite propellers. In 2013, Dornier Seawings was taken over by Chinese companies Wuxi Communications Industry and Wuxi Industrial Development with Dornier retaining a minority share (*the programme was initially offered for co-production with HAL but did not progress nor did that by an Indian private company in Mumbai*).

Relative to the first prototypes, the new Seastar cockpit is equipped with a digital Honeywell Primus Epic 2.0 avionics suite. The aircraft's corrosion resistant landing gear, which features an electromechanically steered nose wheel, was built by Japanese company Sumitomo. The new Seastar is expected to make its maiden flight during the first quarter of 2019, followed by certification in 2020. The first ten fuselages will be built by Diamond Aircraft at its Canadian factory.

DARPA's 'Flying Missile Range'

The United States Advanced Research Projects Agency (DARPA) has begun work on a small drone that extends the range of an AIM-120 Advanced Medium-Range-Air-to-Air Missile (AMRAAM), which could match and even exceed the ever-increasing range of Russian- and Chinese-made missiles. While the latest AIM-120 has a range of around 100 miles, China has been testing a very long-range air-combat missile with a reach of 200 miles. DARPA released its request for proposals for the Flying Missile Rail in early September 2017, the agency proposing to spend $375,000 over the next year or so developing and testing a prototype. "A new advanced generation aircraft typically requires 10 to 25 years to design, develop and build with new technology concepts subject to requirements and other processes which can render them programmatically unrealisable before the technology becomes obsolete. An innovative approach is needed to 'build on demand' and to incrementally enhance existing capability," according to DARPA.

USAF to re-work its rotary-wing training scheme

As part of its effort to increase the number of fighter pilots annually, the USAF is considering eliminating training on the T-6A for prospective helicopter pilots. The USAF currently has a shortage of around 1,000 fighter pilots and according to Air Education and Training Command (AETC), stopping fixed-wing training for helicopter pilots would allow the T-6As to be used to train around 70-120 additional fighter pilots every year. Although T-6A training assists rotary-wing students understand the flying environment, it is not deemed "essential" and its elimination is one of several options being considered by the USAF's *Aircrew Crisis Task Force*.

Rafael Spike LR 2 5th gen missiles for the IDF

Rafael Advanced Defense Systems Ltd. has been awarded a contract with the Israel Defense Forces (IDF) to supply more than one thousand SPIKE LR 2, 5th generation electro-optical,

precision-guided missiles. The SPIKE LR 2 has a range of 5.5 km when fired from ground launchers (an increase of over 35% from the 4 km range of the original SPIKE LR) and up to 10 km when fired from a helicopter (using the RF Data Link). The IDF is a long-time operational user of the SPIKE Missile Family, and the addition of the SPIKE LR 2 will enhance both its infantry engagement range and its lethality against a large variety of targets. The 5th generation SPIKE LR 2 design is based on lessons learned from modern warfare, combined with accumulated data from more than 5000 SPIKE Missiles fired in combat and training across its large user base.

USS *Theodore Roosevelt* deployed

The US Navy's *Nimitz*-class aircraft carrier USS *Theodore Roosevelt* (CVN 71) sailed from its Naval Base San Diego for a scheduled deployment on 6 October. The warship embarks the squadrons of Carrier Air Wing 17 (CVW-17), including Strike Fighter Squadron (VFA) 113 'Stingers' with F/A-18Es, VFA-94 'Mighty Shrikes' with F/A-18Fs, VFA-22 'Redcocks' with F/A-18Fs, Marine Fighter Attack Squadron (VMFA) 312 'Checkerboards' with F/A-18Cs, Electronic Attack Squadron (VAQ) 139 'Cougars' with EA-18Gs, Carrier Airborne Early Warning Squadron (VAW) 116 'Sun Kings' with E-2Cs, Fleet Logistics Support Squadron (VRC) 30 'Providers' with C-2As, Helicopter Sea Combat Squadron (HSC) 6 'Indians' with MH-60S and Helicopter Maritime Strike Squadron (HSM) 73 'Battlecats' with MH-60Rs. The strike group will focus on maritime security operations and theatre security co-operation efforts in both US Fifth and Seventh Fleet areas of operation.

Gowind 2500 for the Egyptian Navy

Naval Group delivered its first *Gowind* 2500 corvette to the Egyptian Navy on 22 September 2017 in Lorient in the presence of Admiral Ahmed Khaled, commander in chief of the Egyptian Navy, Hervé Guillou, and President and CEO of Naval

Group. This vessel, ten units ordered so far, complements the group's extensive range of surface ships and submarines. Delivered just 36 months after the order was placed, the corvette ENS *Elfateh* is the first of the four units ordered by the Egyptian Navy. Six units of the *Gowind* 2500 corvette have also been ordered by Malaysia.

Thales's support for QE-class carriers

Thales has secured a seven year contract to provide through-life support for communications systems of the Royal Navy's fleet. The £100m contract provides an intelligent, unified approach to supporting the Thales communications systems, including those fitted to the *Queen Elizabeth*-Class (QEC) aircraft carriers coming into service. The seven year contract provides Thales with the responsibility to maintain, support and manages through-life the Royal Navy's communications systems across the majority of the Fleet's platforms, from the state-of-the-art systems aboard the new QEC aircraft carriers and the Type 45 Destroyers through to older systems such as those on Landing Platform Dock and many other platforms across the Fleet. The systems fitted to the QEC aircraft carriers, and supported under this contract, enable the ship's company to talk to each other within the vessel, its aircraft, the rest of the Navy and associated taskgroups, allies, civilian vessels and air traffic securely anywhere in the world.

USS *Little Rock* littoral combat ship

Secretary of the US Navy Richard V Spencer has stated that the newest *Freedom*-variant littoral combat ship, PCU *Little Rock* (LCS 9), will be commissioned during a ceremony on 16 December at Buffalo in New York. The future LCS 9 is the tenth littoral combat ship to enter the fleet and the fifth of the *Freedom* variant design. It is the second warship named for the Arkansas state capital and will be commissioned alongside its namesake ship, which serves as a museum at the Buffalo and Erie County Naval and Military Park. "The Littoral Combat Ship (LCS) is a class of Small Surface Combatants with specific capabilities focused to defeat global challenges in the near-show (littoral) environment optimised for flexibility in the littorals with mission reconfigurable capability."

LM to design US Navy's XLUUV 'Orca'

Lockheed Martin will support evolution of the US Navy's family of unmanned undersea systems under a design phase contract valued at $43.2 million for Orca, the US Navy's Extra Large Unmanned Undersea Vehicle (XLUUV). XLUUV Orca is a two phase competition, including the currently awarded design phase and a competitive production phase for up to nine vehicles to meet increasing demands for undersea operational awareness and payload delivery. This long-range autonomous vehicle will perform a variety of missions, enabled by a reconfigurable payload bay with attributes including extended vehicle range, autonomy, and persistence.

Controp EO/IR Payloads for Vietnamese Navy

ContropPrecision Technologies Ltd will provide" a significant number" of maritime EO/IR payloads to the Vietnamese Navy, which is a follow-on order. The iSea-40HD will be used for safety and surveillanceThe iSea-40HD Maritime EO/IR Payload,weighing 29 kg, has a thermal camera with continuous optical zoom, a full HD day camera, four (4) gimbals for high stabilisation, and an optional laser pointer and laser range finder. The iSea Family of maritime EO/IR payloads consists of a variety of payloads in different sizes for different maritime missions and applications – from the iSea-20HD 240mm, 10.7kg system to the iSea-50HD 354mm, 29kg system.

NGC MQ-4C Triton for US Navy

Northrop Grumman has delivered the first operational MQ-4C Triton UAV to the US Navy facility at Point Mugu, providing the service with unparalleled endurance and 360 degree coverage that allows for a vastly expanded maritime intelligence, surveillance and reconnaissance (ISR) mission. Naval Base Ventura County Point Mugu is location to the maintenance detachment of Unmanned Patrol Squadron (VUP)19, with the first two operational Triton aircraft for employment at Guam, scheduled next year. VUP-19, the Navy's first unmanned patrol squadron, is based at Naval Air Station Jacksonville, Florida. Pilots and operators will fly the unmanned Triton aircraft from NAS Jacksonville.

Saab and Raytheon teaming on AT4

Saab and the Raytheon Company are teaming to cooperate on development of new weapons systems for infantry forces to meet near-term US and international requirements. The companies will look into bringing new capabilities to Saab's Carl-Gustaf reloadable and AT4 disposable and shoulder launched weapon

systems. The Carl-Gustaf weapons system, is a world-leading weapon system within the support weapon category, has been constantly modernised and enhanced to meet users' changing needs. The latest version, the Carl-Gustaf M4/M3E1, reduces the weight from 10 kg/22 Ibs to less than 7 kg/15.5 Ibs.

V-22 Osprey fleet exceeds 400,000 flight hours

The Bell Boeing V-22 fleet of tiltrotor aircraft, including both CV-22 and MV-22 variants, has surpassed the 400,000-flight hour milestone, the V-22 Osprey continuously deployed since entering service in 2007 with the United States Marine Corps (USMC) and the Air Force Special Operations Command (AFSOC) in 2009. The aircraft has seen extensive action in Afghanistan as part of Operation *Enduring Freedom*, in Iraq as part of Operation *Iraqi Freedo*m, and as part of a US Central Command (USCENTCOM) Special Purpose Marine Air Ground Task Force (SPMAGTF) supporting a long-range rapid reaction/crisis response force.

IAI's SATCOM Terminal for fighters

Israel Aerospace Industries (IAI) has received first order for its revolutionary SATCOM (Satellite Communication) terminal with a conformal electronic-steered antenna for fighters with ELTA's

ELK-1882T SATCOM network system installed on "very advanced Western fighters", with first deliveries planned for 2021. This network system is the latest technology developed by ELTA Systems Ltd., a group and subsidiary of IAI (IAI/ELTA).

CAE built C295 full-flight simulator for Poland

The Polish Air Force has recently installed a CAE-built C295 full-flight simulator (FFS) located at the 8th Air Base Krakow-Balice in Poland in support of their fleet of 16 Airbus Defence and Space C295 aircraft. The C295 FFS was developed by CAE in cooperation with Airbus Defence and Space and is equivalent to Level D, the highest qualification for flight simulators. The C295 FFS features the Open Geospatial Consortium Common Database (OGC CDB) architecture, an international standard for the creation of synthetic environment databases.

Saab RBS 70 ordered by Brazilian Army

Saab has received an order from the Brazilian Army for deliveries of the RBS 70 VSHORAD (Very Short Range Air Defence) system, deliveries to take place during 2018-2019. The RBS 70 system is in-service with the Brazilian Army and the system played an important role in the protection of the 2016 Olympics in Rio de

Janeiro. The contract signed between Saab and the Brazilian Army includes man-portable launchers, training simulators, camouflage systems and associated equipment for operators and maintainers.

RBS 70 and RBS 70 NG with Irish Army

The Irish Army has conducted a live firings exercise with RBS 70 and the RBS 70 NG "to enhance their soldiers operational capability to engage both aerial and static targets" at the Bofors Test Centre in Karlskoga, Sweden. Besides simulated training and technical support, the soldiers fired ten missiles against aerial and static surface targets. Eight missiles were fired from the RBS 70 system against both target types and two missiles were fired from the latest generation, the RBS 70 NG, also at both target types.

Saab AT4 Systems for US Army

Saab has received an order from the US Army for the shoulder-launched AT4CS RS (Confined Space Reduced Sensitivity) anti-armour weapon system with delivery to take place in 2019. The AT4CS RS is a fully disposable, preloaded weapon system with a specially developed, unique shaped-charge warhead that delivers outstanding behind-armour effect inside the target. It weighs less than 8 kg and has an effective range of 20 to 300 metres. The AT4 family is a range of lightweight, man-portable, fully disposable weapons characterised by ease of use and handling offers great flexibility and is not limited to combating tanks and heavy combat vehicles.

Pratt & Whitney Next-Generation Geared Turbofan

Pratt & Whitney recently completed over 175 hours of ground testing of a next-generation Geared Turbofan (GTF) engine propulsor technology as part of the Federal Aviation Administration's (FAA) Continuous Lower Energy, Emissions and Noise (CLEEN) programme, an FAA NextGen initiative to accelerate the development of environmentally-friendly aircraft technologies. This advancement builds on the completion of 275 hours of fan rig testing of the technology in 2014 and 2015. The demonstrator used an existing development engine from a certified Geared TurboFan product to validate the performance capability of a second-generation, ultra-high bypass fan design.

Elbit CCS for "customer in Asia-Pacific"

Elbit Systems Ltd. has been awarded a US$300 million contract, for the supply of command and control systems to a "customer in Asia-Pacific". The project will be performed over the next three years. Bezhalel (Butzi) Machlis, President and CEO of Elbit Systems, commented: "We are proud to be selected to provide a command and control solution, which is based on Elbit Systems cutting-edge technologies and operational experience. We are considered as one of the world's leaders in the command and control field and we trust that other customers will follow this Asia-Pacific customer".

Continued developments in the world of Airbus

Airbus and Bombardier announce CSeries Partnership

Airbus and Bombardier are to become partners on the CSeries aircraft programme. as per an agreement that brings together Airbus' global reach and scale with Bombardier's newest, state-of-the-art jet aircraft family, "positioning both partners to fully unlock the value of the CSeries platform and create significant new value for customers, suppliers, employees and shareholders." Under the agreement, Airbus will provide procurement, sales and marketing and customer support expertise to the CSeries Aircraft Limited Partnership (CSALP), the entity that manufactures and sells the CSeries. Airbus will acquire a 50.01% interest in CSALP. Bombardier and Investissement Québec (IQ) will own approximately 31% and 19% respectively. CSALP's headquarters and primary assembly line and related functions will remain in Québec, with the support of Airbus' global reach and its scale. Airbus' global industrial footprint will expand with the Final Assembly Line in Canada and additional CSeries production at Airbus' manufacturing site in Alabama, US.

The single aisle market is a key growth driver, representing 70% of the expected global future demand for aircraft. Ranging from 100 to 150 seats, the CSeries is 'highly complementary' to Airbus' existing single aisle aircraft portfolio, which focuses on the higher end of the single-aisle business (150-240 seats). The world class sales, marketing and support networks that Airbus brings into the venture are expected to strengthen and accelerate the CSeries' commercial momentum. Additionally, Airbus' supply chain expertise is expected to generate significant CSeries production cost savings.

A330neo in maiden flight

The first A330neo flew on 18 October at Blagnac in Toulouse for its maiden flight over south-western France. The aircraft, MSN1795, is an A330-900 and the first of three certification flight-test aircraft to fly, powered by the latest technology Rolls-Royce Trent 7000 turbofans. The A330neo's certification development programme itself will last around 1,400 flight-test hours. This will comprise 1,100 flight hours for the A330-900 campaign to achieve its respective EASA and FAA Type Certification around the middle of 2018, plus 300 flight hours for A330-800 version, which will be certified in 2019. Overall, the full A330neo Family flight-test campaign will be performed by three certification flight-test aircraft, plus the first production aircraft (the latter to validate the Airspace cabin prior to EIS).

Launched in July 2014, the latest generation of Airbus' widebody family, the A330neo builds on the A330's proven economics, versatility and reliability while reducing fuel consumption by a further 14 per cent per seat. The NEO's two versions – the A330-800 and A330-900 – will accommodate 257 and 287 passengers respectively in a three-class seating layout,

All on board ! (left to right) Pierre Beaudoin, Bombardier Chairman of the board Tom Enders, Airbus CEO Alain Bellemare, Bombardier President & CEO Fabrice Brégier, Airbus COO & President of Airbus Commercial Aircraft

are powered by the latest-generation Rolls-Royce Trent 7000 engines, accommodate up to 10 more seats, offer new "Airspace" cabin amenities, and feature a new larger span wing with Sharklet wingtip devices.

Emirates welcomes the 100th A380 to its fleet

On 3 November Emirates celebrated the milestone delivery of its 100th Airbus A380 aircraft at a special ceremony in Hamburg, at the manufacturer's delivery centre Sheikh Ahmed bin Saeed Al-Maktoum, Emirates' Chairman and Chief Executive attended the ceremony along with Sir Tim Clark, President Emirates Airline; Tom Enders, Airbus Chief Executive Officer; Dominic Horwood, Rolls-Royce, Director - Customer and Services; Ali Al Ahmed, UAE Ambassador to Germany and Frank Horch, Senator for Economy, Transport and Innovation of the Free and Hanseatic City of Hamburg.

Powered by Rolls-Royce engines, Emirates' 100th A380 is configured in three cabin classes, with 14 private suites in First class, 76 seats in Business and 426 seats in Economy. It also features the airline's newly revamped Onboard Lounge and was also displayed at the Dubai Air Show 2017.

Emirates is the world's largest operator of the A380, flying this double-decked jet to 48 cities on six continents. Including one-off flights, special commemorative services, test flights and other operational deployments, over 70 airports have welcomed the Emirates A380. In the 2016/17 financial year, Emirates received a record 19 new A380 mega airliners.

Airbus' BLADE laminar flow wing demonstrator in first flight

Airbus' A340 laminar-flow BLADE test demonstrator aircraft (A340-300 MSN001) made its maiden flight for the EU-sponsored Clean Sky BLADE project. The "Flight Lab", took off from the Tarbes aerodrome in southern France and after a series of successful tests landed at Airbus' facilities in Toulouse Blagnac. The overall flight time was 3hrs/38mins. The BLADE project – which stands for "*Breakthrough Laminar Aircraft Demonstrator in Europe*" – is tasked with assessing the feasibility of introducing the technology for commercial aviation. It aims to improve aviation's ecological footprint, bringing with it a 50% reduction of wing friction and up to five percent lower CO_2 emission. Airbus' A340 Flight Lab is the first test aircraft in the world to combine a transonic laminar wing profile with a true internal primary structure. A key goal of BLADE is to be able to measure the tolerances and imperfections which can be present and still sustain laminarity. To this end, Airbus will simulate every type of imperfection in a controlled manner, so that at the end of the campaign the tolerances for building a laminar wing will be fully known. The flight lab will perform around 150 flight hours in the coming months.

Thales to train A400M pilots

As part of a long-standing relationship between the two companies, Airbus has awarded Thales a contract for a further two new A400M military training simulators the French and German air forces to received these new simulators in 2019 and 2020. The two new simulators will enable A400M crews to train in complex missions such as in-flight refuelling and low-level tactical operations in a safe environment. Thus far, Thales has delivered five system for A400M FFS and two Flat Panel Flight-Training Devices to France, Germany, the UK and the International Training Centre in Sevilla and a sixth FFS will be delivered to Spain in 2018. Thales is the only provider of A400M Flight Simulators through OCCAR *(Organisation Conjointe de Coopération en matière d'ARmement)*. In France, Thales is also an Airbus industrial partner for support operations for the Airbus A400M training centre at the French Air Force's Orléans-Bricy 123 base.

Irkut's MC-21

Nonstop from Irkutsk to Zhukovsky

On 17 October 2017, the first test MC-21-300 aircraft flew from the Irkutsk Aviation Plant to the Flight Research Institute MM Gromov (Ramenskoye, Moscow Region), to continue flight tests, flying nonstop for 4,500 km over 6 hours at an altitude of 10,000 metres. Oleg Kononenko, the test pilot and flight crew commander, stated, "The flight went in standard mode. All aircraft systems operated without incident."

Yuri Slyusar, the President of United Aircraft Corporation (UAC) and Irkut Corporation stated: "Today we open a new milestone of the MC-21 programme. Ahead, there is a continuation of flight and ground tests, introduction of new aircraft, into test programme, certification and initiation of serial production. Together with Irkut Corporation, a number of UAC enterprises, our partners from Rostec Corporation and leading foreign companies are participating in the MC-21 programme and with this, the programme moves our enterprises to the a technological level and ensures the professional growth of our specialists."

Oleg Demchenko, the First Vice-President and the Chief Designer of Irkut Corporation said, "Flight tests of the MC-21 aircraft performed at Irkutsk Aviation Plant, together with the long flight (from Irkutsk to Ramenskoye) proved declared aircraft characteristics. From today, tests will continue at the Flight Test and Development Facility of Yakovlev Design

Bureau. A new hangar with an up-to-date complex for collection, processing, and storage of testing information, has been built for MC-21 basing."

The new generation MC-21-300 with capacity of 163 to 211 passengers targets the largest segment of the aviation market, providing passengers with a qualitatively new level of comfort, with the widest fuselage diameter of any narrow-body aircraft. This design decision significantly increases space for each passenger, ensures free passage of passengers and service trollies in the aisle, and shortens in airport turnaround time. The MC-21 also has an innovative ergonomic flight deck complete with advanced technical solutions in aerodynamics, engines and avionics.

The MC-21 "is superior to existing counterparts in terms of flight-technical characteristics and efficiency. The major contributor to the enhancement of flight-technical characteristics is the wing made of polymer composite materials, developed for narrow-body aircraft with a capacity of over 130 passengers. As a first, the airliner is offered to the customers with two options of power plant: PW1400G from Pratt & Whitney (USA) or PD-14 from United Engine Corporation (Russia). New-generation engines feature reduced fuel consumption, low noise and hazardous emissions. MC-21 aircraft meets prospective environmental requirements." Projected reduction of direct operational costs for MC-21 is 12-15% lower than its counterparts. The initial portfolio of firm orders for 175 MC-21 aircraft provides utilisation of production capacity in the coming years. All firm contracts are prepaid for. For implementation of the MC-21 programme, competence centres have been established in Russia for development and manufacturing of components made of composite materials. With the purpose of introduction of new technologies, the "radical modernisation" of manufacturing facilities of Irkutsk Aviation Plant (the affiliate of Irkut Corporation) and a number of aviation-building and related enterprises has been implemented. Currently, the first test aircraft is undergoing flight tests, the second test aircraft is undergoing static tests at TsAGI. Four more examples are being built at Irkutsk Aviation Plant. Starting next year, they will be gradually introduced into the test programme.

President of UAC and Irkut at Irkutsk Aviation Plant

Yuri Slyusar, President of United Aircraft Corporation (UAC) and Irkut Corporation visited Irkutsk Aviation Plant in end September 2017 and evaluated the second stage of MC-21 factory completion tests. "The aircraft undergoes tests successfully in accordance with the schedule. We gradually expand operational envelope in altitude, speed, and weight. Recently, the aircraft has reached the altitude of 10,000 metres and speed of 900 km/h. For today, the aircraft confirms to all declared characteristics," stated Yuri Slyusar. Currently, four MC-21-300 test aircraft are under construction. By the end of this year, the second aircraft is planned to be transferred to the Flight Test Facility of the plant. Progress of Irkut Corporation's military programmes was also discussed. Yuri Slyusar expressed confidence that all contract obligations on aircraft deliveries to the Russia's MOD and foreign customers would be timely implemented while plans on future state and export orders for Su-30SM, Yak-130, Yak-152 aircraft were also reportedly discussed.

Full Speed Ahead ! Russia's submarine building

Launch ceremony for Knyaz Vladimir (photo: Oleg Kuleshov)

The Sevmash shipyard launched the first modified Borei-class (Project 955A) nuclear ballistic missile submarine in November. Meanwhile, construction of improved Lada-class conventional submarines continues apace at Admiralty Shipyards in Saint Petersburg.

The fourth *Borei*-class SSBN, and the first of the series to be built to an updated new standard, was launched at the Sevmash shipyard in Severodvinsk on 17 November 2017. The boat, named *Knyaz Vladimir* (Prince Vladimir, named for Vladimir the Great), is a Project 955A design, as opposed to the earlier vessels of the class that were designated Project 955. The Russian MoD has ordered a total of eight *Borei*-class vessels, with three already in service and the remainder all under various stages of construction.

Project 955, developed by the Rubin design bureau, dates to the mid-1980s. The first vessel, *Yuri Dolgorukyi* (Yuri the long-armed, named for the founder of Moscow) was laid down in 1996, but Russia's well-documented financial difficulties in that

Rubin CEO Igor Vilnot looks up at Knyaz Vladimir during the boat's launching ceremony (photo: Oleg Kuleshov)

decade delayed the construction process to 2000. The second and third boats were laid down in 2004 and 2006, respectively.

These first three *Borei*-class submarines were designed some thirty years ago, and their construction commenced using parts from unfinished *Akula*– and *Oscar*–class submarines at Sevmash. The design of the first 'new build' submarine of the class, *Knyaz Vladimir*, was therefore modified to reflect the fact that it would be built from scratch and updated to more modern standards. This design evolved into the Project 955A classification, with broadly similar specifications to the first three ships, but improved noise characteristics, newer on-board systems and sensors, and some minor physical changes. For instance, the distinctive forward swept sail of the first three submarines will be replaced with a more conventional implementation on the 955A.

Russian President Vladimir Putin had attended the keel-laying ceremony for *Knyaz Vladimir* in 2012, where he said, "We plan our actions based on the notion that our country should remain among the leading maritime nations. First of all, this is about further development of the naval component of the Nuclear Triad, and about the navy's contribution to maintaining global parity. By 2020 [the naval component of the Triad] will be upgraded substantially, through commissioning of eight new nuclear submarines of the *Borei* class". As he spoke, *Yuri Dolgorukyi* was completing acceptance trials, *Aleksander Nevski* was commencing harbour trials, and *Vladimir Monomakh* was under construction. Since then, the programme has proceeded broadly to plan, with three submarines operational: *Yuri Dolgorukyi* in service with the Northern Fleet, and *Aleksander Nevski* and *Vladimir Monomakh* with the Pacific Fleet.

With the remaining four vessels of the *Borei*-class already under construction to the Project 955A standard, a further more comprehensively modified variant is already under consideration. At a Russian MoD meeting in early November, General Valery Gerasimov, Chief of the General Staff of the Armed Forces of Russia, noted that a "nuclear-powered underwater cruiser *Borei-B* with upgraded characteristics is being developed." Meanwhile, an all-new future class of Russian nuclear submarines, tentatively named '*Husky*,' is also under development, with preliminary concepts likely to be finalised in 2018.

Lada-class revival

The *Lada*-class diesel-electric submarines *Kronshtadt* and *Velikiye Luki*, second and third boats of the class, are at advanced stages of construction at Admiralty Shipyards in Saint Petersburg.

In October, the last hull butt on *Kronshtadt* was welded, completing the submarine's principal structural work. Pipelines and various auxiliary systems are now being installed in the hull, along with electrical equipment, a shaft line and various optronics masts. On *Velikiye Luki*, the forward and aft pressure hull sections are complete and hydraulic tests of both sections have been carried out.

These two new boats feature a raft of improvements identified during trials and operation of the lead *Lada*-class vessel, *Sankt Peterburg*. At the *Army 2017* defence show held near Moscow in August, Russian Deputy Defence Minister Yury Borisov confirmed that the Russian government would order a further two *Lada*-class boats, taking the class to at least five vessels

Kronshtadt under construction at the Admiralty Shipyards (photo: Rubin)

"Take Charge and Move Out" !

TACAMO Submarine communication systems

The Indian Navy is well regarded as perhaps the pioneer among the Services in strategic thinking and has long anticipated its value as a potential key component of India's emerging, albeit closely guarded, nuclear-doctrine. It was apparent from the outset that nuclear-powered ballistic missile armed submarines (SSBNs) would constitute the most reliable element among assured retaliatory nuclear-strike platforms, for their inherent "stealth" attributes, for being mobile, submerged and out of reach of most electromagnetic frequency bands for detection. A similar view was forcefully held by the legendary Russian Admiral of the Fleet Sergey Georgyevich Gorshkov, and knowing his personal influence on the Indian Navy's strategic thinking and formulation, this was hardly surprising.

Decades later, not only has an Indian Navy SSBN in the shape of INS *Arihant* initiated operational patrol, the strategic punch is being incorporated in conventional hunter-killer submarines (SSK) in the form of specific BrahMos supersonic cruise missiles. The potential is also inherent in possible Indo-Israeli developments in missile technology, especially in areas of Inertial Navigation Systems (INS) and terminal guidance. Yet to be really effective in the strategic sense, the submarines in the area of situational awareness remain inherently handicapped because of their "isolationist nature" and need to be contacted and commanded by National Command Authority (NCA), to issue launch orders, the absence of which cripples the formidable strategic platform and renders it virtually impotent.

Thus little wonder the Indian Navy attached high priority to submarine communications even decades ago and subsequently anticipated the importance of Very Low Frequency (VLF) underwater transmissions. As part of an ambitious naval modernisation programme during the mid-1980s the Indian Navy had constructed a VLF broadcasting station in Tamil Nadu. Although not publicly declared, it was reported that the United States, the undisputed leader of submarine communications actively collaborated in the project, which was completed in September 1986. This facility needs to be viewed as an "initial step" in the quest of development of underwater Very Low Frequency/ Extremely Low Frequency (VLF/ELF) and laser communications for effective coordination of the submarines with the India's NCA. News reports indicate commissioning of INS *Kattabomman* VLF/ ELF station in 2014. However it remains unclear whether it is a new facility or a modernised existing type.

A US Navy Boeing E-6B Mercury TACAMO aircraft (photo: Jason Grant)

The operational VLF facility is used by the Indian Navy to communicate with its SSK fleet of Russian *Kilo* Class and German Class Type 209 with trailing communication buoys at periscope depth of 10 to 20 metres. After the nuclear-powered INS *Arihant* became operational, the VLF facility permits India's NCA to issue launch orders to the submerged submarines at periscope depth. VLF waves propagate to almost a quarter of the globe away and are generally immune to atmospheric disturbances caused by nuclear detonations. Extremely Low Frequency (ELF) waves on the other hand can penetrate to depths of 100 metres but a huge overland infrastructure needs to be built up with at least 80 km long antennae. In this context, as far back as 1986, researchers from the Defence Electronics Applications Laboratory, Dehra Dun, after reviewing the effects of nuclear radiation and EMP on VLF/ELF communication systems, concluded that "ELF radio communication was the only reliable means which could withstand the effects of a nuclear holocaust and was least disturbed by the EMP generated by nuclear explosion". Subsequently classified research and development in these areas was carried out by the National Institute of Oceanography, Goa, Indian Institutes of Technology (IITs) Madras and Bangalore, and Defence Electronics Applications Laboratory, Dehra Dun, although the system in principle relies on fixed terrestrial infrastructure and thus vulnerable to enemy strikes. However on the negative side, the small bandwidth of VLF transmission limits the rate of transmission of data, usually allowing only the operation of slow Teletype messages. Moreover the large terrestrial and static VLF/ELF facility would be vulnerable to enemy strikes as even if the facilities are shifted deep underground in "hardened" shelters, the vital and critical communication antennae would have to be located above ground and would remain vulnerable.

Thus Indian Navy is left with no other option but to develop, ideally with United States assistance, an airborne VLF transmitter similar to the United States Navy (USN) "Take Charge & Move Out" (TACAMO) to ensure survivability of its VLF facility and thus retaining the critical sub-surface nuclear punch. For TACAMO missions the USN initially utilised EC-130A/Q Hercules platforms with a powerful 200 KW transmitter providing the VLF transmissions through a 10 km long trailing wire antennae with a drogue parachute at the end. During transmission the aircraft maintained a flight-profile in a continuous tight circle, which resulted in over 70% of the wire hanging straight down and acting as a relatively efficient vertical antenna.

A Soviet Tu-142MR submarine communication aircraft (photo: US DoD)

Presently the undisputed lead of United States in the area of VLF TACAMO technology is forcefully represented by the Electro Magnetic Pulse (EMP) hardened E-6 Mercury airborne platforms of the United States TACAMO Communications System providing survivable communication links between the United States NCA and Strategic Forces. They are operated by USN VQ-3 'Ironmen' and VQ-4 'Shadows,' Fleet Air Reconnaissance Squadrons under the Navy Strategic Communications Wing. These have their home at Tinker Air Force Base (AFB) in Oklahoma, but also routinely forward deploy out of Travis AFB in California and Patuxent River Naval Air Station (NAS) in Maryland. A derivative of the classic commercial Boeing 707, in-flight refuelling capability ensures E-6 mission ranges of over 6000 nautical miles and endurance of up to 72 hours, thanks to four economical CFM-56-2A-2 high bypass ratio turbofan engines with thrust reversers. The VLF transmitter's limited bandwidth is still enough to transmit Emergency Action Messages (EAM), ranging from execution of limited to full-scale nuclear strikes. The E-6 complements United States ground-based strategic Global Operations Centre in Nebraska, along with land-based transmitters for communicating with the nuclear triad by maintaining the communication link between the United States NCA and nuclear forces, even if ground-based command centres are destroyed by an enemy first strike. Interestingly, France also operated its own TACAMO aircraft until 2001 that included four modified Transall C-160H Astarté, which maintained VLF communications with the French SSBN fleet.

A further enhancement in the form of E-6B fulfils both TACAMO and Airborne National Command Post (ABNCP) missions by incorporating a subset of United States Strategic Command (USSTRATCOMM) EC-135 Looking Glass ABNCP equipment into the E-6 platform along with battle staff positions as determined by USSTRATCOMM (J36). The result is a formidable dual-mission aircraft capable of fulfilling either the E-6A mission or the airborne strategic command post mission and is equipped with an Ultra High Frequency (UHF) Airborne Launch Control System (ALCS) capable of launching United States Inter Continental Ballistic Missiles (ICBM). With at least a pair of E-6 always airborne, the mobility and flexibility of E-6B provides a survivable Command, Control and Communications (C3) force management for the United States NCA via multiple frequency-band communications. The E-6's crew was expanded from fourteen to twenty-two for the command post mission. Additional UHF radios give the E-6B access to the survivable MILSTAR satellite communications network, while the cockpit is upgraded with new avionics and instruments from the Boeing 737NG airliner. The E-6B can be distinguished in photos by its additional wing-mounted pods.

Meanwhile, in a series of technological breakthroughs attention has shifted to laser-based underwater communications. There is an optical window in the blue-green part of the laser spectrum, which enables transmission to penetrate the ocean to substantial distances to depths of 500–700 metres. Power requirements are considerable and the system, at least presently, cannot be installed in artificial satellites. Thus as a tactical improvisation the laser is made ground based, preferably mobile, in perfect conjunction with a space based mirror with adaptive optics being used to produce a cohesive beam. Significantly, data transfer rate will be with "unrestricted speed" somewhat 300 times greater than the ELF system. Laser communications will assume priority significance if they become capable of down-linking satellite imagery of enemy ballistic missile deployment and launch, in friendly submerged submarines to ensure assured retaliatory strike.

In India by the early 1980's work proceeded on laser communication links from the air and ground in a joint project at the Ocean Engineering Centre and the Laser Communication Laboratory, IIT Madras so that by 1985 an experimental facility for measuring the attenuating effects of the ocean surface on laser beam penetration was already in operation. It was concluded "that (hindrance by) ocean waves were not a serious drawback in a laser communication link, as long as the laser had sufficient power to penetrate the atmosphere twice and penetrate ocean water for a distance up to several hundred meters". Measured values of attenuation coefficients, for ocean waters collected from the Arabian Sea and the Bay of Bengal, were presented in due course with the region of minimum attenuation for pure particle-free sea water, were found to be 450–500 nm.

Sayan Majumdar

Saab's Swordfish MPA:
Multi-Role Maritime Air Power

Saab continues to enhance the Swordfish Maritime Patrol Aircraft (MPA). Detailed design studies have expanded operational capabilities, adding new mission equipment and a significantly expanded operational payload. "The Swordfish MPA is the smart solution for the full range of real-world maritime missions that modern customers demand."

The Swordfish is a strategic, multi-role asset that combines the latest operationally proven sensors with Bombardier's ultra-long range Global 6000 platform. "It is a maritime patrol system that can fly further, stay longer on station and deliver superior results in every task that MPAs are required to fulfil across the complete spectrum of national, international and coalition missions."

Recent product development milestones at Saab and Bombardier have validated a significant increase in the available payload carried on Swordfish's four NATO-compatible hard points. Swordfish can now be armed with up to six lightweight-torpedoes for the anti-submarine role. Swordfish can also carry the Saab RBS 15EF anti-ship missile or a mix of missiles and torpedoes to assure total sea control in every aspect. Apart from weapons, the platform can also carry four search-and-rescue pods "underlining its multi-mission capability across the maritime domain."

Another capability that sets the Swordfish apart from competitors is its ASW suite with a world-leading acoustics processor, magnetic anomaly detector (MAD), gravity-launching systems and an operational load of around 200 A, F and G size sonobuoys. This complete and highly-capable ASW suite enables Swordfish to locate, track and classify the most advanced, high-threat sub-surface targets for several hours, with a higher probability of detection.

"We have invested heavily to produce an MPA at the peak of operational capability today and future-proofed for decades to come when new technologies, such as unmanned systems, come online. Anti-submarine warfare is the cornerstone of any MPA and we can draw on Saab's unique design insight into submarines and airborne ISR, underwater weapons and sensors, together with decades of experience from our valued partners including GDMS-Canada, CAE and leading sonobuoy specialists Ultra Electronics UK. The result is an MPA optimised for the demands of ASW, especially at low-level, which is where the game is truly won or lost. The need to classify targets from a passive source remains as relevant as ever and is enhanced by confirmation from other sensors such as the MAD," says Gary Shand, sales director at Saab business unit Airborne ISR.

In parallel with the Swordfish, Saab's multi-role and swing-role GlobalEye AEW&C system continues its successful progress with three units in production and scheduled for on-time delivery. Swordfish shares around 70 per cent commonality with its GlobalEyesistership including the Global 6000 platform, mission management system, electronic warfare and self-protection systems, AESA radar, electro-optics, AIS and the majority of communications systems.

The Swordfish was launched at the 2016 Singapore Air Show and Saab has since received substantial interest from potential users in every corner of the world, many of whom are already experienced MPA operators.

"We are very encouraged by the increasing interest shown in the Swordfish MPA. We have a fantastic product that offers a high-end, strategic capability with much lower acquisition and operating costs compared to airliner equivalents. Our dialogue with the market and the wider anti-submarine warfare community shows there is a clear requirement for a fast, long-range, multi-mission MPA that performs across a range of profiles with smarter ways of operating to reduce costs. Saab continues to invest in this programme and we know that we can deliver a system that will change forever the way users think and act in in the maritime domain," says Emilien Saindon, head of sales and marketing, Saab business unit Airborne ISR.

As proliferation of submarines around the world continues to increase, many countries have a growing need to replace existing, ageing MPA platforms. Regional maritime disputes, anti-piracy, terrorism and security of national waters, borders and lines of commerce mean that the demand for multi-role ISR air power has never been more pressing. "Saab is committed to expanding its presence in Asia Pacific and working with local industries in the region to deliver, support and sustain the Swordfish MPA far into the future."

Courtesy: Saab

Safran unveils the Aneto family

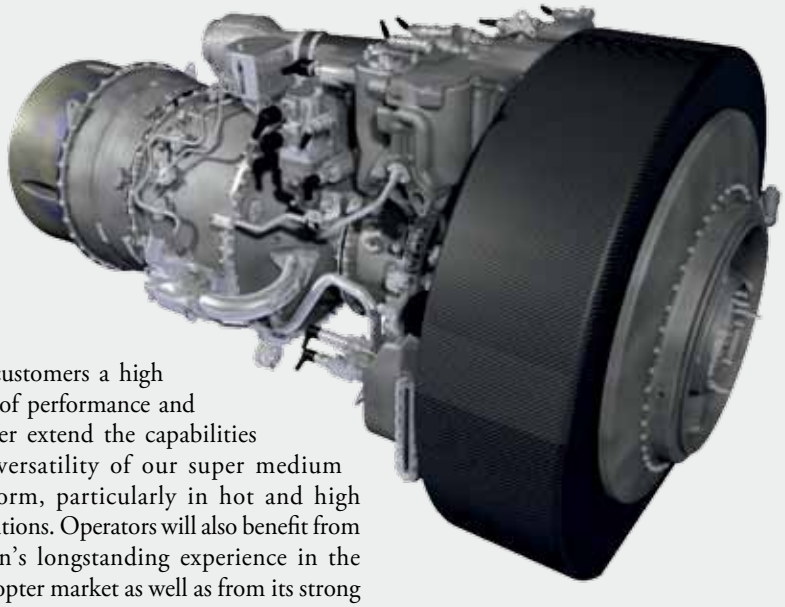
New range of turboshafts for super-medium and heavy helicopters

Safran Helicopter Engines unveiled its brand new Aneto family of high power turbine engines at Helitech International in London in October 2017. Designed for the growing super-medium and heavy helicopter market, it incorporates ground-breaking technologies, developed as part of the Safran Helicopter Engines R&D roadmap. The Aneto family will feature several models covering a power range from 2500 shp to over 3000 shp.

As Bruno Even, Safran Helicopter Engines President said, "Launching the Aneto engine family in Helitech marks a major milestone for Safran Helicopter Engines. It is the result of a long and sustained strategy of technology acquisition and maturation. Today, we are in position to bring to the market a new generation and competitive engine solution for the super-medium and heavy helicopter market, ready to enter service in the fourth quarter of 2018. We are convinced that Aneto will offer a new level of performance coupled with reduced operating costs."

The 2,500 shp model, named Aneto-1K, has been selected by Leonardo (formerly AgustaWestland) to power its twin-engine AW189K. First flight of the Aneto-1K fitted to this helicopter has taken place on March 2017 and entry into service is scheduled for the fourth quarter of 2018. Aneto-1K EASA certification is on track to meet that timetable.

Gian Piero Cutillo, Managing Director Leonardo Helicopters, stated, "We are pleased that the AW189K will be the first helicopter to feature an Aneto engine. This new turboshaft engine will offer our customers a high level of performance and further extend the capabilities and versatility of our super medium platform, particularly in hot and high conditions. Operators will also benefit from Safran's longstanding experience in the helicopter market as well as from its strong worldwide support network."



Safran believe that the Aneto engine family brings significant benefits to customers: "owing to an exceptional power-to-volume ratio, it offers 25 % greater power (when compared to existing engines of same volume), contributing to increased mission capabilities especially during demanding missions requiring more power such as offshore, search and rescue, fire-fighting or military transport, as well as better performance in 'hot and high' conditions."

The Tech 3000 technological demonstrator is a key building block of the Aneto family. It enables Safran Helicopter Engines to validate designs and technologies capable of delivering up to 15 % better fuel economy over today's high power engine models. These new technologies will be gradually incorporated in the Aneto models, depending on the power requirements and entry-into-service timeframe, resulting in improved range and payload and reduced environmental footprint.

Aneto features higher reliability and safety. Its maintainability has been optimised with fewer scheduled maintenance tasks and longer maintenance intervals, and this new range will have connected features like health monitoring (predictive maintenance) and will be fully compatible with BOOST, Safran's online engine maintenance management service.

Although designed for next generation rotorcraft, Safran feel that "Aneto is also a perfect drop-in engine solution for existing models."

Safran Helicopter Engines has traditionally named its engines after features in the Pyrenees Mountains that overlook the firm's Bordes headquarters. Arriel is a famous peak near the French-Spanish border, Arrius is the name of a high-altitude lake, and Makila refers to a traditional Basque hiking stick. Following this convention, Aneto is the name of the tallest mountain in the Pyrenees, at a height of 3,404 metres, which the company says reflects "a commitment to push the limits higher both in terms of technical and in service performance. It also symbolises new levels of power and performance we are now able to reach."

Aneto-1K has been selected by Leonardo to power its twin-engine AW189K

Hush!

Safran to make aircraft quieter

In April 2017, Safran and the acoustics laboratory of Le Mans University in France inaugurated an industrial research unit specialising in innovative acoustics materials for the aerospace industry. This research partnership is part of the group's wider efforts to reduce levels of noise produced by airplanes. Dominique Collin, an eminent acoustics expert at Safran details the project:

First, it is worth pointing out where this noise actually comes from. On the one hand, it comes from the propulsion system, as the turbojet noisily expels hot air and the turbofan noisily turns its rotors. On the other hand, the noise comes from turbulence in the flow of air over the airplane's structure: landing gear, propelling nozzle, flaps, etc. These are the sounds that cause "noise pollution" for residents around airports. Safran is doing all it can to reduce this. Beyond certification criteria, which are increasingly stringent, Safran wants to go further in responding to the specific requirements of certain airports. These are even more demanding than regulations. All these efforts form part of the objectives of ACARE1: halving the noise heard by 2020 than in 2000 and 65% less by 2050.

In aero-engines, an increase in the bypass ratio (the relationship between the flow of hot air the flow of cold air), achieved by widening the turbofan's diameter has greatly contributed to progress made over the past 40 years, and has reduced the speed at which air is expelled and therefore the turbojet's noise. Today, efforts focus more on reducing noise produced by the turbofan itself. The company is optimising the shape of rotors with modeling based on the physics of mechanism that produce noise and improving the efficiency of sound-absorbing materials fitted on the inner linings of nacelles and engine casings. Safran believes that the acoustic footprint of aircraft on the ground has been reduced by 75% overall in four decades. With the CFM56, introduced on the market in the 1990s, and the new LEAP engine, an improvement of 12 decibels on average has been achieved.

The group is involved in demonstration programmes like Clean Sky 2, for producing

next-generation engines, whether those with an ultra-high bypass ratio or systems like the Open Rotor. It also supports basic research, particularly through industrial research units. As such, following ADOPSYS2 for aeroacoustics, Safran is co-funding the MACIA3 research unit specialising in acoustics materials. These are two key areas of research for Safran. Industrial research units bolster their ties with partners and integrate issues into doctoral theses undertaken by students. In this manner the company can test ideas more quickly and speed up innovation.

PowerJet produces 300th SaM146 engine

PowerJet has manufactured the 300th SaM146 integrated propulsion system that powers the Sukhoi SuperJet 100 regional jet. This milestone highlights the successful industrial partnership built by Safran Aircraft Engines and UEC Saturn through PowerJet, their 50/50 joint-venture. Seven years after the first engine's delivery, PowerJet has developed and extended its capacities to keep up with engine deliveries in line with the requirements of SCAC and is expected to deliver about 70 powerplants in 2017 and the same in 2018. PowerJet has already started to discuss with SCAC regarding the number of deliveries in 2019 and 2020.

Within PowerJet, UEC Saturn develops the fan module, the low-pressure compressor and turbine and is responsible for final engine assembly and ground tests in its facility in Rybinsk, Russia. Safran Aircraft Engines develops the high-pressure core, the accessory gearbox, and the control system. The French company is also responsible for propulsion system integration and flight tests. Since starting revenue service in 2011, the SaM146 has logged more than 700,000 flight hours and is operated by 15 airlines around the world. In addition, to optimise its customers' operations, PowerJet provides customers with tailored solutions like on-wing maintenance support teams, engine leasing options, predictive maintenance, and quick turns. The PowerJet MRO network includes two certified shops, one in Saint-Quentin-en-Yvelines near Paris, and one in Rybinsk, Russia.

"Ready for the Future"
Royal Jordanian Air Force PC-21s

The Royal Jordanian Air Force (RJAF) is an air arm with an enviable reputation. With the recent delivery of the first Pilatus PC-21 trainer aircraft, the RJAF takes a step forward in their future fighter pilot training capabilities.

In 2015 the RJAF placed an order for 9 PC-9 M aircraft with Pilatus Aircraft Ltd in Stans, Switzerland. The PC-9 M was to replace the CASA 101CC in service since 1987. The order was amended in April 2016 after further review by the RJAF, and it was decided to procure eight PC-21 aircraft instead of nine PC-9Ms. An option for two additional aircraft was converted to an order in October 2016, and in January 2017 Pilatus announced that the RJAF had contracted for two more PC-21s.

The role of the PC-21 is basic and advanced training, to prepare students for operational fighter squadrons. The RJAF has 43 F-16MLU multi-role fighters in its inventory, three squadrons at Al Azraq air base. The RJAF will soon receive another 15 former Royal Netherlands Air Force F-16MLU aircraft that have been upgraded to the M6.5 standard.

By October 2017, all RJAF instructors had converted to the PC-21, initial training taking place at Stans, Switzerland, where two weeks of ground school were followed by 20 hours of actual flying in the PC-21. Training also included 5 simulator flight sessions. The PC-21s will be delivered to No. 11 Squadron as part of the King Hussein College based at Mafraq air base. The first delivery flight of two PC-21s involved six stages flown over three days, with Pilatus ferry pilots landing the two trainers at Mafraq on 23 August 2017. Pilatus production test pilot Reto Amstutz recalled: "The ferry flight was smooth. That third day we flew from Akkaba in a 40 minute flight to Mafraq." Amstutz is a former Swiss Air Force fighter pilot and has flown the F-18 Hornet. He was also member of the famous Swiss Air Force aerobatic team *Patrouille Suisse,* and is still a Swiss Air Force reserve pilot flying the F-5E Tiger II.

At Mafraq, both aircraft were put through acceptance flights of 40 minutes each on the day of delivery itself. The flights consisted of an extract from the production flight test programme. Through the production and delivery process, the aircraft bear Swiss civil registrations, and only after customer acceptance are they de-registered from the Swiss civil register. That is also when ELT and transponder codes are changed to customer settings.

The ferry flights included stretches over water, therefore the ejection seat personal survival package (PSP) had a dinghy installed, as well as associated water survival equipment. After the ferry flight the packages were replaced by desert PSPs as per RJAF requirements.

Innovations

The RJAF PC-21s have the new Saab mission computer installed. "With the new mission computer came a new Pilot Memory Module (PMM). In the old days we did the flight data recording through a separate recorder. Now the recording goes through the mission computer. In the mission planning you can store several missions on this PMM. You can upload approach plates for example, or load different maps in different scales and bring them up in the Multi Function Displays. You can define different mission loadouts and alternate parameters like tactical parameters. Mission loadout can be air-to-air or air-to-ground weapons or what you like for your specific missions or intelligence line," says Amstutz.

"We have the hardware installed for TERPORM, which is basically a tactical terrain avoidance system. It will work in VFR conditions in any situation, also in inverted flight. It will not only warn you for terrain but also for obstacles. Right now we have started the engineering phase, so it's not certified yet. Actual testing will start in a few weeks time here in Switzerland. When certification is done the RJAF will get the new software installed," according to Amstutz.

Pilatus made a ground-breaking move in the turboprop trainer class with the installation of a dual Flight Management System (FMS) in the PC-21. The RJAF has Esterline CMC CMA-9000 FMS, which can be coupled to the auto pilot. Esterline CMC has also been contract to supply the cockpit avionics for the RJAF aircraft.

The early PC-21 models had one Global Navigation System Sensor Unit (GNSSU) installed. The current PC-21 contains two CMA-5024 GNS Landing System Sensor Units (GLSSU). With the GLSSU, RNAV approaches with lateral guidance can be flown. Now the PC-21 can do GPS based precision approaches on a spaced based augmentation system with vertical guidance.

Advanced Cockpit

Both cockpits are equipped with new state of the art 6x8-inch active matrix LCD displays. Both front and rear cockpit have a centre smart MFD-2068 Multi Function Display (MFD) that functions as a Primary Flight Display. Two CHDD-268 side displays can show additional information such as radar images or system pages.

The front cockpit has a CMC-4000 Sparrowhawk system Head-Up Display (HUD) installed including an upfront control panel. The rear cockpit is equipped with a 'repeater' screen, which shows the camera picture of the outside world and the HUD symbology as seen by the pilot in the front. The HUD has various modes such as flight mode, target mode or approach mode where it gives ILS symbology and glide path guidance. A benefit for Jordanian student pilots is that the symbology used has been adapted to RJAF F-16MLU symbology. To further assist students preparing to fly the F-16MLU, the HOTAS throttle has several buttons reassigned through software to operate the mission systems on the PC-21 as they would on an F-16.

The PC-21 is fully Night Vision Goggles (NVG) compatible for the latest generation systems. For now, NVG are not used by students yet, but in the future for example operational F-16 pilots will be able to use the PC-21 for recurrent NVG training as an alternative to the more expensive F-16.

Smart Training

A huge step forward in training is the mission briefing and debriefing suite that comes with the PC-21. A student can plan the mission to be flown and load it onto the PMM via the Mission Planning and Debriefing System. Once connected to the aircraft, PMM data can be loaded into the mission computer. Every system page is continuously recorded and cockpit images filmed through the HUD camera are also stored on the PMM. During debriefing all this stored data can be retrieved and the student can replay a flight in 3D.

Simulated air-to-air radar training can be accomplished by linking ADS-B signals from other PC-21 aircraft. These signals are computed and presented as realistic radar contacts for students on the mission system displays. Air-to-ground training can be performed by retrieving ground data from a database and presenting it to the student in the cockpit. A training area as large as 100 by 100 miles can be stored in the database.

'Fighter-like flying'

The PC-21 is powered by a Pratt & Whitney PT6A-68B turbo prop engine with Electronic Engine Control (EEC). The engine delivers a maximum of 1,600 shp, and the power output is speed rated and controlled by the EEC to give the aircraft 'jet like handling.' The engine is mounted on the aircraft bulkhead with a 4 degree offset to the right to minimise torque effect and prop wash. The engine drives a Hartzell E8991KX graphite/titanium composite scimitar five-blade propeller.

Two Martin-Baker CH-16C ejection seats with zero-zero capabilities are installed, which can be used up to 400 kts for ejection. Both seats are slightly tilted for crew comfort. The engine drives an air conditioning pump for the updated environmental and pressurisation system. Also crew oxygen is supplied when the engine is in operation. A two-piece canopy gives the crew ample visibility outside the aircraft, and the front windscreen is reinforced with an insert against birdstrikes and has detonation cord embedded for when the ejection seat is used.

The swept low wing structure has 'wet' wings (integral fuel tanks), and the wing leading edges are filled with foam to minimise the impact of bird strikes. Hydraulically operated spoilers are added to reduce the stick force and to increase roll rate, and an auto rudder trim is installed. Both features add to the 'fighter-like' flying characteristics of the PC-21.

RJAF aircraft are equipped with the latest generation LED exterior lighting. Furthermore four fluorescent stripes ('slime lights') are installed on each side of the aircraft for night formation flying training.

And so, the RJAF now has a sophisticated aircraft that has the capabilities to train their students up to the level where they can transfer directly to the F-16MLU squadrons, where they only have to get accustomed to fast jet flying and higher G-load handling. As proven by other PC-21 customers, graduation rate also significantly improves by using this next generation trainer aircraft.

The first RJAF PC-21 being marshalled at Mafraq for its acceptance flight (photo: Pilatus)

Major General Yousef Al-Hunaiti is the current RJAF Commander and head of the committee who sets the configuration and the scope of operation for the future training of RJAF pilots. The RJAF see a benefit in having the PC-21 over the CASA 101CC by transition from analogue to glass cockpit and by mimicing advanced aircraft systems. Plan is to have the first students start training on the PC-21 between January and February 2018. With the PC-21 these new students will be ready for the future!

Patrick Dirksen and Frank Mink, Tristar Aviation (www.tristaraviation.org)

We would like to thank the Royal Jordanian Air Force for their assistance with this article. Also we thank the employees of Pilatus for their help, in particular project manager Mario Aschwanden, regional sales director Frank Beetz and test pilot Reto Amstuz.

The Luftwaffe Exercises

Brilliant Arrow 2017

Exercise *Brilliant Arrow* 2017 (BRAW17), conducted from 11 to 24 September 2017 in northern Germany, was the Luftwaffe's largest exercise this year. The aim was to obtain NATO Response Force (NRF) certification for 2018 from the Joint Force Air Component Command, based in Kalkar in Germany. The NATO Response Force (NRF) is a highly ready and technologically advanced multinational force made up of land, air, maritime and Special Operations Forces components that the Alliance can deploy quickly, wherever needed. In addition to its operational role, the NRF provides a vehicle to demonstrate operational readiness and act as a "testbed" for Alliance transformation. It can be used in the implementation of NATO's Connected Forces Initiative (CFI) as a vehicle for greater cooperation in education and training, increased exercises and better use of technology.

Brilliant Arrow is designed to train NATO air forces who do not routinely train together to share their experience and skills in combined air operations. It prepares the participating units and HQ AIRCOM to assume standby from 2018, ready to react in defence of the NATO region and its interests.

Exercise activities were supported by AWACS aircraft flying out of the NATO Air Base in Geilenkirchen, Germany, an Airbus A-310 MRTT tanker aircraft taking off from Cologne with target simulation aircraft and forces from Hohn, Nordholz and Nordhorn. Moreover, the 26th Surface-to-Air Missile Group in Husum and 3rd Tactical Air Command and Control Group in Holzdorf/Schönwalde with their deployable Control and reporting Centre provided key support to successful training during the exercise.

The aircraft flying in the exercise were:

Wittmund AB

- Luftwaffe from Wittmund AB with Taktischen Luftwaffengeschwader 71 'Richthofen', using four Eurofighter Typhoons
- Polish Air Force from the 31st Tactical Air Base Poznań–Krzesiny with 6 Squadron, a total of 72 persons, with 10 pilots and five F-16s
- Greek Air Force from Souda Bay AB with 340th Squadron of the 115 Combat Wing, a total of 42 persons, with 12 pilots and four F-16s
- Discovery Air Defence provided adversary air assets, with two A-4s as 'red air'

Laage AB

- Turkish Air Force with two F-16s

Discovery Air Defence provided A-4s as aggressors

Poland, Greece and Turkey (latter not pictured) sent their F-16s to the exercise

Hohn AB

- Two C-160 from Lufttransportgeschwader 63 (Air Transport Wing 63)

Norvenich AB

- German Air Force Taktischen Luftwaffengeschwader 31 'Boelcke,' with four Eurofighters
- German Air Force Taktischen Luftwaffengeschwader 74 from Neuburg AB, with four Eurofighters

Cologne

- German Air Force Airbus A310 MRTT tanker

Geilenkirchen AB

- NATO E-3 AWACS

The exercise started a few days late owing to bad weather on the scheduled arrival date of 11 September. The foreign participants arrived the following day, with 22 fighters in total, flying from Wittmund, Norvenich and Laage on a daily basis. With support aircraft, that number reached 30 aircraft flying daily during the morning missions. Afternoon missions were smaller, with fewer aircraft airborne.

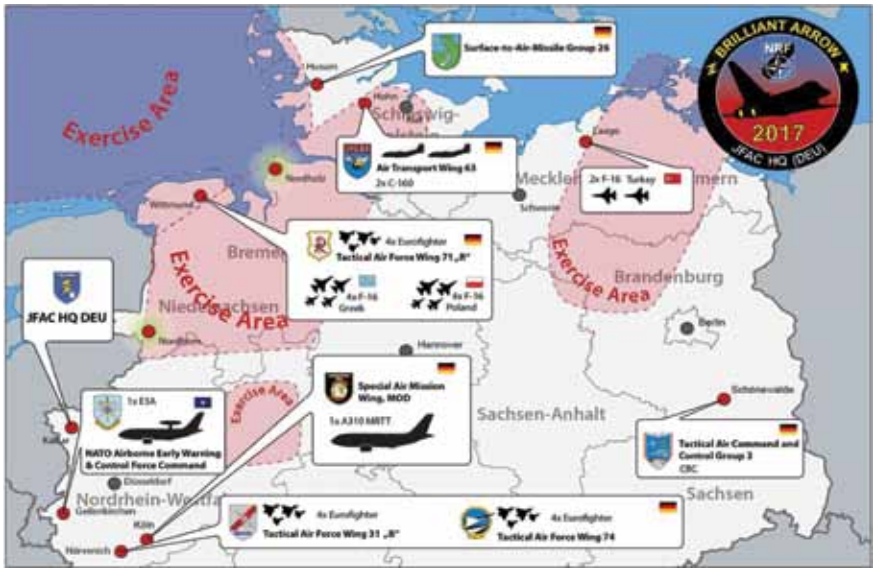
BRAW17 missions were planned at Joint Force Air Component Command in Kalkar, from where the taskings were sent to the participating airbases and units. These orders were interpreted into action by the pilots, with various scenarios sent out from JFAC Kalkar, such as entering an enemy country to perform air operations (Offensive Air) or defending own territory (Defensive Air), including both air-to-air and air-to-ground missions. Briefings before and after the missions, with feedback to JFAC in Kalkar using encrypted videocalls were conducted, while JFAC Kalkar also monitored active flights to keep up with their progress during the exercise itself.

Polish Air Force Major 'STOIWKY' (identified only by callsign) said, "Any time you fly with a different nation, you learn something. We are here to support them (the German Air Force), but we also learn from them. We train more and more and more, because if the real thing happens, there is no more time to train!"

For the German Eurofighters flying from Norvenich AB, air-to-air refueling was involved, while the aircraft already operating from northern Germany (Wittmund and Laage) did not require refueling. To limit the noise affecting neighboring villages, the missions all took place over the North Sea, unless the wave height was above safety limits, in which case missions moved back above land.

Polish pilots hve trained in large exercises like the NATO *Tiger Meet, Brilliant Arrow* and *Frisian Flag*. They have already received their NRF accreditation in May 2017 and will be available for NRF 2017 and 2018. Greek pilots were attending to gain NRF accreditation in 2018. The foreign participants and German squadrons participated to help JFAC Kalkar to obtain their NRF accreditation and they, in turn learn from every exercise.

Text and photos:
Alex van Noije and by Joris van Boven



Geographic extent of the exercise

Operation Market Garden

73rd anniversary of the famous 'Operation Market Garden' was commemorated in Europe with a demonstration carried out by airborne troops from several countries. Alex van Noije and Joris van Boven report from this annual event.

From 11 to 16 September 2017, the international parachuting exercise *Falcon Leap* took place for the third time, this also being the 25th anniversary of the 11th Airmobile Brigade of the Dutch Army. Military personnel from eight different countries trained together by jumping with each other's equipment. The exercise, which encourages collaboration between the various allies, is linked to the memory and commemoration of Operation *Market Garden*, conducted during the Second World War. Operation *Market Garden* was an allied offensive against the Germans in the Netherlands in September 1944, perhaps the most important such in the Netherlands during the Second World War. *Market Garden* was largely unsuccessful, because the last bridge at Arnhem could not be captured. The result of this failure was the 'Hunger Winter' for the northern part of the Netherlands. Operation *Market Garden* consisted of two major sub-operations. The first operation was to drop a large number of airborne troops behind German lines and was called *Market*. The second operation was a ground offensive from Belgium to the Netherlands under the name *Garden*. British, Polish and American airborne troops were to occupy the important bridges across some major Dutch rivers. The ground troops could quickly move from Belgium towards the IJsselmeer in the Netherlands. Operation *Market Garden* was seen as a failure by the Allied Army Staff, with the most crucial bridge at Arnhem not captured. During this major airborne operation, many paratroopers were killed, and are commemorated at the annual Market Garden Memorial.

The official historic anniversary of Operation *Market Garden* started in Brabant in Son and Breugel. On Sunday, 17 September 1944, 4,500 paratroopers landed in the fields west of Son and Breugel in a timeframe of 45 minutes. In addition, there were 53 Waco gliders towed by the Douglas C-47 Skytrains. The Paulushoef farm was chosen as marker for the drop zone, name of this farm was written in big white letters on the roof. People from nearby farms helped the Allies in every way possible after their landing.

Paratroopers board aircraft

Now, on 15 September 2017, to commemorate the opening action of *Market Garden*, a group of parachutists were dropped over Son and Breugel. The paratroopers, from the Round Canopy Parachuting Team (RCPT), landed in the area surrounding the Brouwerskampweg and Sonniuswijk. The RCPT team has members from 26 different countries and operate in the manner of Operation *Market Garden* in 1944, with authentic uniforms and jumping from a C-47 Dakota, to commemorate those who fought for Europe's freedom.

The next day, the RCPT continued to Veghel to conduct a jump there. At 6 pm, they jumped in the Kruigenstraat. The Ham en Havelt area was the scene of fierce fighting on 22 September 1944. That battle entered history books as 'Black Friday.' Finally, on 17 September 2017, around 3.30 pm, there was also a jump on De Horstjens in Eerde. That landing took place on a field of drop zone A, which had not been used since the 3rd Battalion of the 501st Parachute Infantry Regiment landed there in September 1944.

In addition to the RCPT team, which traditionally makes parachute jumps during commemoration activities, there are also international military teams deployed then, facilitated during the commemorations by the Royal Netherlands Air Force. The two highlights were the public events on 13 September, at the Houtdorperveld at Ermelo and the commemoration jump on 16 September, at the Ginkelse Heide at Ede near Arnhem. On both days, between 0800h and 1400h more than 800 parachutists landed in the designated areas.

All aircraft that dropped parachutists operated from Eindhoven Air Base, with the Royal Netherlands Air Force providing a C-130 Hercules for the commemoration. The German Luftwaffe flew in with two Transall C-160 aircraft, the Polish Air Force provided a C295 transport and the US Air Force flew one C-130 from the United States to Eindhoven. In the past, the Belgian Air Force and the British RAF also flew during the commemorations, but not this time.

The paratroopers participating in exercise *Falcon Leap* were from eight different countries: Belgium, Canada, Germany, France, Great Britain, The Netherlands, Poland and the United States. During the exercise, the troops were completely mixed, and therefore able to operate together and use each other's equipment and aircraft. This type of training ensures that the troops are widely deployable and that they are not dependent on their own equipment and aircraft during expeditionary operations. The large and complex final scenario of the exercise was a series of commemorative jumps during the Market Garden Memorial. In some cases, the paratroopers boarded their aircraft with engines running on the apron, adding to the serious training element of the exercise, even though the jump was purely commemorative. Training internationally in addition to conducting the commemoration events, allows both the Royal Netherlands Air Force and the Netherlands Army to effectively execute the exercise objectives of *Falcon Leap* as well as commemorate *Market Garden*.

Luftwaffe Transall C-160 taxiing out

INSPIRED BY ALEXANDER THE GREAT!

Macedonia's Aviation Brigade

Seven months after Macedonia declared its independence from Yugoslavia, the Army of the Republic of Macedonia (ARM) was established on 10 April 1992. The development of the Macedonian Air Force and Air Defence Force started from scratch because the former Yugoslav military controlled all aviation equipment, including combat and training aircraft including the J-22 Orao and J-21 Jastreb. On 10 June that year, the first air force flight took place using a UTVA 75 A21 basic training aircraft leased from the Macedonian Aeronautical Union. To commemorate this historic flight, this date is now celebrated as *Day of the Air Force* (the Macedonian air arm is officially named the Aviation Brigade of the Army of the Republic of Macedonia).

Colonel Robert Malezanski, Commander of the Aviation Brigade, with flight experience on the MiG-21 and Super Galeb and an instructor on the Zlin 242, spoke about Macedonia's sole Mi-17 squadron: "The Air Force was formed with a combat helicopter squadron, a transport helicopter squadron and a fixed wing aviation squadron. The first helicopters, Mi-17s, were bought in 1994, painted white because at that time the United Nations Security Council (UNSC) had imposed an embargo on purchasing weapons and military equipment. But since the Mi-17 is civilian version of the Mi-8, they could be purchased." The embargo was lifted in 1995, and the white Mi-17s were re-painted in their distinctive green camouflage patterns and provided with military serial numbers.

In February 2001, a militant group called the Albanian National Liberation Army (NLA) began attacking the security forces of the Republic of Macedonia. In order to increase its capabilities during this conflict, the air force fleet was substantially expanded in short time.

The first major delivery of new aircraft to the Macedonian Air Warfare and Air Defence Forces was made on 23 March 2001: Ukraine donated four Mi-8MT combat helicopters that had served with Ukrainian contingent of KFOR to Macedonia, and as a part of an earlier agreement, delivered two Mi-24V Hind-E gunships. Greece also demonstrated solidarity with the Macedonian Government with delivery of two UH-1H Huey helicopters. Later that year eight more Mi-24s followed from the Ukraine. In December 2001, the Macedonian Air Force received two Mi-24K Hind-G2 (photo-reconnaissance and AOP version of the Mi-24) helicopters from Ukraine.

The Ohrid Framework Agreement, signed on 13 August 2001, brought a formal end to the armed conflict. In the following years, the Aviation Brigade was reorganised. The former Greek UH-1s were taken out of service.

Bases

Near Skopje, the capital of Macedonia, is named *Alexander the Great* Airport. Part of this international airport serves as the Republic's only military air base, Petrovec. The base houses the Combat Helicopter Squadron and the Transport Helicopter Squadron as well as the Pilot Training Centre and Technical Maintenance Centre.

Missions

Colonel Malezanski introduced the Transport Helicopter Squadron: "The squadron has six helicopters, two of them are Mi-17, and the rest are Mi-8MT." There

used to be two more, but they were lost in accidents. "We've lost one in 2001 and the second one in 2008 on its way back from a EUFOR mission in Bosnia near the airport."

Malezanski explained missions of the transport squadron: "The main mission of the squadron is to transport the troops of the Macedonian Army. Additionally, they are trained to perform forest fire fighting, search and rescue, transport of cargo including external cargo, sling loads and of course, the training of new pilots. We don't receive fully ready pilots in the squadron."

Mi-8 and Mi-17 instructor Lieutenant Colonel "Taurus" Bogdanoski, with over 1,100 flight hours added: "We fly VIP transport for our government, our Minister of Defence, and our general staff as well." Casualty evacuation is also among the unit's tasks, although the Mi-17 and Mi-8s are not fully equipped for MEDEVAC missions. "Because of this, we are performing just casualty evacuation, have no medics on board, but provide transport out of an area of conflict."

Colonel Malezanski noted: "Most of the civilian missions for search and rescue are executed by the police in the past couple of years. But we do search and rescue for the military, and of course combat search and rescue."

The Mi-8 is of course a combat helicopter, can carry weapons and rockets, while the Mi-17 is used only for transport. Bogdanoski said: "We are using the Mi-8 with launchers to fire S-5 unguided rockets. The Mi-8 is not used for attack missions, the weapons are mainly for self-protection from ground troops."

Many missions are flown in cooperation with special forces. Fast roping techniques, infiltration, and exfiltration techniques are taught, as well as parachute training with the special units.

But the most demanding task is firefighting. In the summer time, there are several mountain and forest wildfires. Lt Col Bogdanoski explained: "You have to take a lot of water in one hour. For example, one cycle is around five or ten minutes, which means every five minutes, you have to take water, and in the next five minutes you have to drop the water on the target." He recalls a particularly hard fight: "In 2007 we flew firefighting missions seven hours per day for a few days in succession. It was totally exhausting."

Because of its lack of equipment, the Macedonian Aviation Brigade has not participated in missions or exercises abroad in recent years. Bogdanoski's last exercise abroad was in 2012, at Szolnok in Hungary. "In that exercise pilots from Slovakia, Poland, Hungary were flying the same types of helicopters. At the end of the exercise, we had a crew exchange, where we flew in each other's aircraft. When you are using one type of helicopter, for example, Mi-17, you must follow the rules for that type, flying with more or less the same principles. It was a good experience for us to fly with other helicopters."

Maintenance

Maintenance is done on base at Skopje-Petrovec as well, but the budget is tight. Colonel Malezanski explains that there are three stages of maintenance: "On these types of helicopters, the first level of maintenance is done at the squadron, the second level is done at the maintenance squadron, and the third level of maintenance is the overhaul, generally in the overhaul factory." During our visit, the Mi-24s were in overhaul at the AVIAKON Aviation Repair Facility located in the town of Konotop in Ukraine.

But Bogdanoski loves the Mi-8/17's ruggedness : "This type of helicopter is very robust, it's very useful and you have a lot of power, and can carry a lot of cargo. You are able to land on high mountains. Because I started my career flying fixed wing aircraft, before I continued on helicopters, I can say that flying helicopters may be two or three times harder than flying fixed wing."

Experience

So what is it like to fly the Mi-8/17 ? Bogdanoski explains: "I have experienced flying the Gazelle helicopter, while I was already flying the Mi-8. When I was flying the Gazelle, the first few hours I was thinking: I don't know how to fly a helicopter anymore, because the difference between the Gazelle and the Mi-8 was very big."

"Every flight in a Mi-8 or Mi-17 is a special experience. You can find something interesting in every flight. We have a lot of flights, we have a lot of missions." The most interesting flights are international ones for the colonel. "When we have a mission in Bosnia, we fly from Macedonia to Bosnia over Albania and Croatia. Flying over the sea is special, as Macedonia is a landlocked country. The views are spectacular."

This type is transport backbone of the Air Force, "In the basic version, we have 24 seats in the cargo compartment. But there is a possibility to mount a fuel tank inside to extend the range, limiting the capacity to 15 fully armed personnel. Inside we can carry four tonnes of cargo. Without the extra fuel tank, the range is about 500 kilometres, with the additional fuel tank inside it is 750 kilometres."

Pilot Training Centre

Training of Mi-8 and Mi-17 pilots also takes place on the air base. ELMAK (Elbit Macedonia) has won a 43 million euro ($61 million) contract to set up a helicopter pilot training facility for Macedonia's military and police.

Shraga Yaari, director of the Helicopter Pilot Training Centre (PTC), has an impressive track record of over 7,000 flight hours, most of which were on the AH-1

Mi-17 at Petrovec

Bell 206s are used for training

Cobra. He retired as a Squadron Leader in Israel before Elbit selected him to set up and run the Pilot Training Centre in Macedonia. Candidates for the PTC start with an air screening process on the Zlin 242, "This is a kind of evaluation, we have special drills, our examiner will perform first, and the student has to try to copy it, and we try to analyse if they can complete this specific course in a set time frame," says Yaari. After a year of ground schooling, and more training on the Zlin, students transfer to the Bell 206B-3. "The first six months on the Bell are what we call basic training session, that is kind of a transition to the helicopter world, including a solo, and touching all of the relevant manoeuvres that the helicopter can perform. After that comes an additional six months of advanced training, related to instruments, emergencies, tactical air navigation, and missions."

Every pilot in the Aviation Brigade must clear a certain number of hours on the helicopter in real flight, and a number of flight hours on the simulator every year. The simulators are also used for new pilots to make transition from the Bell 206 to the Mi-17 and from Bell 206 to Mi-24. The training centre has two advanced simulators, Mi-17 and Mi-24. Those two simulators, produced by Elbit subsidiary Simultec in Romania, are for use by military and police pilots. And it is not only Macedonian pilots that make use of the simulators: "We have a lot of slots for international trainees. Just recently we've had pilots from Cameroon that made their transition to Mi-24, so we did all the ground schooling here. We've placed one of the Mi-24 in our hangar to study the systems. We've had Nigerian trainees, we've had trainees from Bosnia, and some from Croatia." Mr Yaari is very proud of the simulators, and not without reason: "In the world, there are many simulators for the Mi-17 and even for the Mi-24, but none of them are full motion, and none of them are equipped with such specific upgraded avionics."

The PTC is in close contact with the Macedonian Aviation Brigade, and Yaari tries to see the centre as a unit of the Brigade. "Any of our changes in the flying syllabus, or ground school topics we do in consultation with the Military Academy and with the Aviation Brigade. We are limited by the Israeli Ministry of Defence on transfer of doctrines, but helicopter flying is the same whether it is a Cobra, Mi-17 or Bell 206. We believe we can share a lot of our experience and that is what we try to do."

Upgrade programmes

Elbit however does more in Macedonia: they have started modernisation programmes for the Mi-24 and Mi-17. In December 2003 the Macedonian Government awarded Elbit a US $2 million contract for an upgrade of two Mi-17 and two Mi-24V helicopters. The helicopters have been upgraded with the Aviators Night Vision Head-Up Display (ANVIS/HUD) system, a helmet mounted display. By equipping its aircraft with this system, the Macedonian Air Force became one of the very few operators of night-operation Mi-24 helicopters worldwide, even before NATO-member countries Poland, the Czech Republic, Hungary, and Bulgaria.

All four aircraft involved in this modernisation are now operational again and have redesigned cockpit layout, adapted for night vision goggle (NVG) operations, and are also equipped with ANVIS/HUD System.

According to Colonel Malezanski, there will be a second stage of upgrade for the two Macedonian Mi-17s that were involved in the first stage: "The second level will include an ILS (Instrument Landing System), a moving map, a mission computer with multifunctional displays and a new type of radio for communication." The new Talon radios and secure communications are also important as Macedonia wants to join NATO, but in order to be compatible, has to adopt NATO standards for communication. There are also plans to equip the helicopters with chaff and flares, as they presently lack countermeasures.

The future

For now, NATO membership for Macedonia is not in sight. Macedonia's budget for the entire military was just over 91.5 million Euro, or just 1.09% of the Macedonian GDP, while NATO requires members to spend at least 2% of their GDP on defence. Budgets remain an issue with the Aviation Brigade. The current transport fleet is estimated to be able to operate for seven more years in its current condition. After that, it will be hard to conduct maintenance, and a replacement will have to be in place. There are a lot of uncertainties when it comes to the equipment.

Text and photos: DutchAviationPhoto.com

Ancient Aviator Anecdotes

Air Vice Marshal Cecil Parker recollects...

Life on the Edge

Seven decades ago, the ancient aviators of today were young lads, many of whom were fascinated with the idea of flight and dreamt of becoming pilots some day. Pre-independence, very few Indians were in the profession of aviation. In those days most parents considered 'flying' as a dangerous occupation that kept one living on the edge. However, unforeseen events often influence mind-sets and a sudden medical crisis in our family brought about a re-think on the part of my father and co-incidental consequences for me. Most of the medical descriptions that follow, were told to me by my mother much later as I had been unconscious for long periods of time.

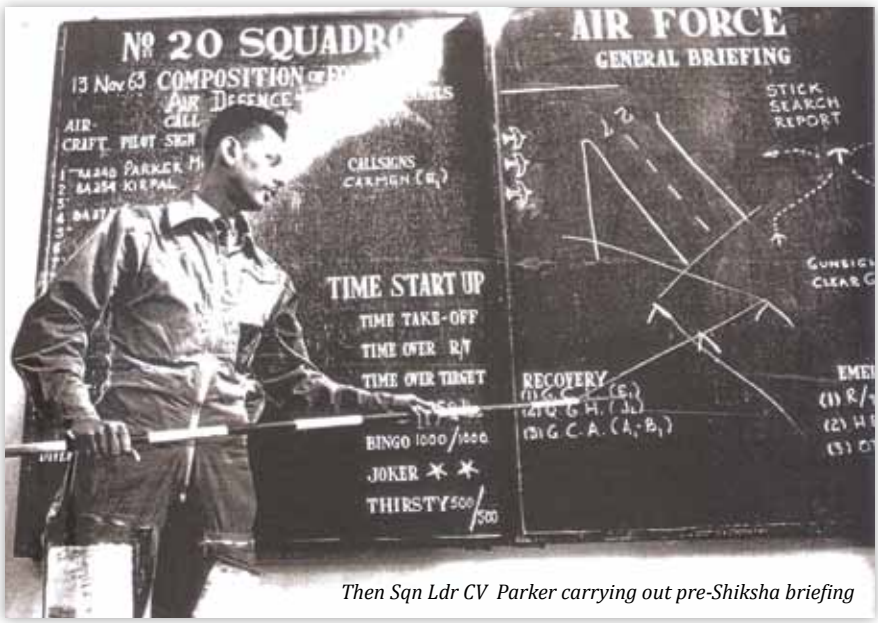
In 1946, as a young teen-aged school boarder, I came home for the summer holidays running a low fever. As the temperature kept rising and I went off food, our family doctor recommended immediate hospitalisation. I was admitted into the PG hospital in Calcutta where my condition continued to worsen. I grew listless and responded to no treatment. The hospital had diagnosed my condition as an acute case of typhoid which was then endemic. There was a youth of my age in the next bed with similar symptoms and, in the few periods that our consciousness coincided, we communicated briefly. One morning I regained consciousness to find that his bed was empty. In response to my query, my mother said he had gone home (it was only much later that I understood what she had meant). My condition got critical and the hospital prepared my parents for the worst; in fact, I was measured for a coffin.

Suddenly my fever broke, I opened my eyes and felt weak but better, had no idea that 22 days had elapsed but I slowly regained strength sat up in bed and kept down fluids. A very cheerful doctor, along with the ward nurse, visited me frequently and assured me that I was going to be fine but away from school for a few months till I recovered fully. He told my parents that he had no explanation for my 'return from the edge', did not believe in miracles but had just seen one. He was an ex-army Major from Secunderabad who, before the war, had many years of practice in a tea estate in Jalpaiguri.

Five years later, with the active support of my mother and the reluctant consent of my father, I found myself as a flight cadet in the Air Force Academy in Secunderabad. At a social function I was introduced to a pretty young lady teacher with the same surname as the doctor. In fact she was his niece and informed me that her uncle had married the nurse and the couple had immigrated to Australia. I courted the young lady for five years before we married in 1956. Over the next 30 years we moved 15 times on postings while she adapted and coped with running a house, raising two wonderful children, kept teaching, carried out all her commitments as an air force wife and stood by me through all the ups and downs of life on the edge. It was many years before we could build a house of own to retire in. Now, in the 62nd year of our marriage, she is busy overseeing the travel arrangements for our next trip abroad to be present at the wedding of the first of our six grandchildren who are spread over three continents, on both sides of the equator. Notwithstanding the risk element in any fighter pilot's career, 'life on the edge' has been very good to this ancient aviator and his family.

'Exercise Shiksha' : 1963

In 1963, the Indian Air Force (IAF) had six Hunter Mk.56 squadrons of which four were deployed in the west, and one each in the central and eastern sectors. *Exercise Shiksha* ('Learning') was one of the consequences of the 1962 Sino-India clash a year earlier. It was a multinational air defence exercise by four air forces for the very first time; the RAF based Gloster Javelins at Kalaikunda, the RAAF based their Canberras at Agra and the USAF based a detachment of F-100 Super Sabres at Palam plus radar units both in the east and the west. These three air forces provided the aggressor element against IAF air bases whose air defence was by Hunter and Gnat aircraft in all three sectors over the period 15-18 November.



Then Sqn Ldr CV Parker carrying out pre-Shiksha briefing

I was then a Squadron Leader and the Flight Commander of No.20 Squadron, a Hunter unit based at Palam and tasked with air defence of Delhi, for which we were under the radar control of our signals unit at Najafgarh. Our CO was called to Command / Air HQ for a series of meetings after which he informed us that we would be participating in Ex *Shiksha* purely in the air defence role from our ORP (Operational Readiness Platform). I was required to give a brief for an air interception sortie and thereafter lead a pair to demonstrate a 'scramble' from our underground ORP. This was for the benefit of the USAF personnel to familiarise them with our SOPs (Standard Operating Procedures) two days before the exercise commenced. I carried out the briefing on 13 November (*see picture*) and then, along with my wingman, demonstrated a live scramble under control of our SU where representatives of the three aggressor air forces were observers.

I have no knowledge of the totality of Ex *Shiksha*, which is no doubt buried in some file or data base in the archives of Air HQ. Our squadron undertook four to six scrambles per day and my log book tells me that I flew four air interception sorties during the exercise. The success rate was directly proportional to the altitude, i.e. at higher levels the intercept rate was good but at lower heights, less so. The F-100s and Canberras that we intercepted were briefed to take no evasive action and we were permitted to use our camera guns but had to break-off by 200 yards. The major exercise debrief was held at Command/Air HQ and, apart from being informed by our CO that we had performed very well, I really have no knowledge of overall lessons learnt.

I do, however, have recollections of Ex *Shiksha* for two personal reasons. On the penultimate day, the USAF offered the IAF a sortie in the Super Sabre. The offer reached my CO who very kindly suggested that I accept it. I was delighted to go across to their detachment, was welcomed, briefed, kitted out by my counterpart (Major Holly), who then took me up in the rear cockpit of F-100F (63974) I thoroughly enjoyed my very first experience of an aircraft with a reheat engine. On return I suggested to our CO that we reciprocate the gesture. He got through to the AOC-in-C who authorised me to give Major Holly a sortie in our Hunter trainer, which incidentally has side-by-side seating. On the last day of the exercise I took him up in Hunter Mk66 (BS 364) for a 50-minute sortie. He was absolutely thrilled with the handling characteristics of the aircraft. After deplaning, we informally exchanged 'wings' and, though 54 years have elapsed, I still remember his goodbye: "Thanks Cecil, *Shiksha* has given me a great dollar ride in a truly wonderful kite." I am certain all old Hunter pilots will endorse that view!

Celebrating an anniversary!

No.58 Pilots Course – at 65!

On 30 August 2017, No 58 Pilots Course celebrated its 65th anniversary. The course story actually goes back to March 1951 when 50 young lads from all over India reported to No. 1 Air Force Academy at Ambala. We new flight cadets were given a military welcome which included a sharp haircut and a strict financial restriction of Rs 40 per month! Flying standards were exacting and, after 18 months pilot training on Tiger Moth and Harvard aircraft, only 30 of us newly commissioned pilot officers received our wings from Subroto Mukherjee on 30 August 1952 at Begumpet. Of these, 17 went off to Agra for their twin-engine conversion on Dakotas a while 13 of us reported to Hakimpet for single-engine conversion on Spitfire and Tempest IIA aircraft.

Post their transport conversion, the 17 went on to fly the Liberator, Canberra, Avro, Viscount, Il-42 and An-12 with two also converting on to rotary wings on the Chetak heicopter. At FTW meanwhile, grounding of the Tempest fleet midway through our fighter conversion, saw the 13 of us posted directly to the first jet squadrons where, for the next many years we flew the Vampire, Toofani, Mystere, Hunter, Gnat and MiG-21. Including their instructional flying on HT-2, Prentice, Iskra and Kiran aircraft, these 30 pilots have a collective experience of just over 100,000 flying hours on 20 different IAF types over a period of 37 years (1951-88).

Of the original 30 pilots who graduated 65 years ago, today 12 coursemates, with an average age of 86 years, are very much around and continue the course ritual of a get-together as frequently as possible. Advent of the internet certainly helps us all keep in touch with each other and with the families of departed coursemates too. Six of the 12 air veterans are in the NCR (Gurgaon / Noida / Delhi), two in Telengana, one in Goa, two in Australia and one who commutes between Mumbai and London! On 30 August 2017, there was a Reunion Anniversary lunch at the Golf Club at Air Force Station New Delhi while in Secunderabad a smaller gathering (*see picture*) took place at a private residence for lunch and reminiscence. Notwithstanding spectacles, dentures, hearing aids and walking sticks, there was excellent bonhomie at both gatherings with children / grandchildren quite amused at the tales and recollections of those octo-pilots in their salad days!

The last of our coursemates retired in 1988 and our course can look back with pride at it's contribution to our air force. Its members participated in both the 1965 and 1971 Indo-Pak wars, produced 15 COs, 11 QFIs, two test pilots, one air attaché and one MVC gallantry awardee. The 18 members who have preceded us (four through flying accidents) no doubt looked down with equal pride on 30 August 2017 as they already know that old pilots do not die but only fly away…

25 Years Back

From Vayu Aerospace Review Issue VI/1992

Progress on LTA Project

Russia has come forward to be a partner in NAL's Light Transport Aircraft (LTA) programme for the manufacture of the twin-engine 14 seater turboprop aircraft. Of the Rs 80 crore outlay for design and manufacture of the prototypes, Russia has offered to share the cost, according to Prof Roddam Narasimha, Director, National Aeronautical Laboratory (NAL), Bangalore. The NAL team, headed by Dr K Yegnanarayana, has come out with the fifth refined configuration of the aircraft. Three prototypes are to be manufactured, two in India and one in Russia.

Officials of the Russian agency Myasisehev are in touch with NAL on the project, and a team arrived in Bangalore recently, the third such visit by the Russians. According to present indications, if the arrangement with the Russians works out, two prototypes of the LTA will be flight-tested in 1993-94.

Golden Jubilee of Nos. 6, 7, 8 Squadrons

1st December 1992, marked the 50th year, or Golden Jubilee, of three of the Indian Air Force's premier combat squadrons, Nos 6,7 and 8. Raised during World War II, when the Japanese threat to India became real, the three squadrons were equipped with the Hurricane fighter and Vengeance dive-bomber and saw extensive action in Assam and Burma till the war's end in August 1945. No.6 Squadron is presently operating flights of Jaguar maritime strike aircraft and Canberras, No.7 is flying the Mirage 2000 and No. 8 continues with the MiG-21FL.

IAF Interest in Tornadoes

Inspite of official denials by both the Air Force and MoD, there are persistent reports of the interest being displayed by India in the Panavia Tornado multi-role combat aircraft. Media reports have it that Sharad Pawar, the Defence Minister, has met officials from British Aerospace in the UK twice in the past few months and that both the IDS (interdiction) and ADV (air defence) versions have been considered, a figure of 36 aircraft being mentioned. Although the Indian Air Force has no formal air staff requirement for a Tornado-type aircraft, the reasons behind interest in the Tornado are said to be "largely political" with the Indian Government continuously looking at non-Russian sources for new or additional aircraft and equipment.

SS-250 for the IAF

According to media reports from New Delhi, the Prithvi SS-250 medium range ballistic missile, which is presently undergoing technical clearances, will be inducted into the Indian Air Force service by 1995. With a design range of 250 km and a warhead of 500 kg, the SS-250 is likely to be deployed for "strategic targeting", more for disruption with conventional warheads than destruction of vital targets, either of military or political significance.

China's Arms-buying Spree

China is on a shopping spree for modern weapons, making its neighbours increasingly nervous trying to figure out why. China has bought 24 Su-27 jet fighters from Russia, and is negotiating to purchase MiG-31 aircraft; the sales could include technology transfers allowing China to produce both airplanes. Beijing's military has also been considering buying an aircraft carrier under construction in a Ukraine shipyard, and it wants to acquire transport aircraft that extend the reach of its air force by providing mid-air refueling. Moreover, it is said to be in the market for surface-to-air and cruise missiles.

Indo-US Naval Exercises

The Indian and the US Navies are planning their second round of exercises and for the first time these will held around a tactical setting in the Indian Ocean. The details and dates will be fixed in January 1993 when Admiral L Ramdas of the Indian Navy is to inaugurate a joint Naval Steering Committee. The Admiral spoke about his recently concluded US visit stating that these exercises were part of Naval diplomacy. The US political and military leadership had assured him that their country was keen to work closely with India and better understand the Navy.

Meanwhile, submarines and warships of both the Western and Eastern Fleets of the Indian Navy are to participate in a major tactical exercise scheduled off the Coromandel coast in the Bay of Bengal in the first half of 1993. Apart from naval aircraft operating from the second carrier of the Indian Navy, the INS *Viraat,* Indian Air Force Jaguar maritime strike fighters and Canberra bombers will also participate in the exercise.

New Carrier for the Navy

As part of a 15-year planning programme for the Indian Navy, amongst other equipment, there is a requirement for another aircraft carrier to replace the *Vikrant* which is to be mothballed by 1997. India has two options and they are either to indigenously build a carrier in the 15,000 tonne category (to cost approximately $300 million) or else purchase one from the Ukraine. If the carrier has to be built indigenously it could get off to a good start as countries like France, Italy and Britain have shown willingness to provide technical assistance.

In a surprise move Russia has offered the Indian Navy one of its large carriers from its Pacific fleet. This offer has its advantages over the Ukrainian *Varyag* as this ship is in the disputed Black Sea fleet and under the joint control of Russia and Ukraine until 1994. Secondly and more importantly Russia is willing to accept half of the cost of the carrier in foreign exchange and the other half through 'barter'.

Tale Spin

We are in the Navy now !

After considerable discussion and debate, the Indian Navy has recently inducted women pilots in their maritime patrol squadrons but are still not clear as to whether women should go to sea in warships (many other Navy's have faced similar situations). So, there were many red faces when it was discovered that an Indian Navy sailor while on leave had undergone a sex-change operation to become a woman. When discovered, he/she was discharged, evoking the clause of "service no longer required" under the Navy Regulations Act.

Not my fair lady !

Amenities for fighter pilots

Here are some incentives for fighter pilots landing on the Agra-Lucknow Expressway, which was opened for landing/take offs by Indian Air Force aircraft in November 2017.

The Uttar Pradesh Expressways Industrial Development Authority have in a recent advertisement invited EOIs from interested agencies to provide 'World Class Amenities including Food Plazas, Recreation Areas for kids, Free Wi-Fi, RO, Lavatory …' along that stretch of highway.

Flying was never such fun !

Tagline of India's airlines

Indigo : We beat our customers

Jet Airways : We beat our competition not our customers

Air India : We don't beat our customers. We get beaten by our MPs

GoAir : We don't have customers

Air Vistara : We don't have planes

And as for *Kingfisher* : bring our boss back and we will beat him !

Contributed by Lalit Nirula
Cartoon by : Satish Acharya

Unidentified Flying Object (hic)

As it is, driving in the Khasi hills after dark, especially around the capital city of Shillong, is an exciting experience (after liberal partaking of the famed Kiad rice wine), but some villagers halfway between Cherrapunji and Shillong must have had a tipple too much ! They testified seeing a saucer-shaped flying object over the Lum Swer forest, emitting loud explosive sounds as it hovered around the dense woods, destroying the vegetation as it did so. Eastern Air Command of the Indian Air Force was duly informed and they are reportedly probing into the mysterious incident.

No J-10 that ?

What, Where, When ?

Ok, so what is the bulbous object on the left doing over one of the World's best known monuments ? (*Hint* : Part of an aeroplane over Agra, but no more clues ! First correct answer gets free annual subscription to the *Vayu*).

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