

IV/2017

# VAYU

## *Aerospace & Defence Review*



**The Dragon's Claws**  
**China's Military Modernisation**  
**Paris Air Show 2017**

**India-Israel Relationship**  
**Israel's Defence Industry**  
**The Baltic Connection**



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Cover : The Chengdu J-20 fifth generation fighter (Artwork by Priyanka Joshi)

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Printed at Aegean Offset Printers

The opinions expressed in the articles published in the Vayu Aerospace & Defence Review do not necessarily reflect the views or policies of the Publishers.

# VAYU

## Aerospace & Defence Review

IV/2017

### 38 A New Era for India-Israel



Prime Minister Narendra Modi's State visit to Israel has heralded a new era in the political ties between the two nations. Steadily over the years, Israel has become India's most trusted national security partner and defence supplier and this visit has been qualified as elevating the bilateral relationship to 'new heights'. A slew of India-Israel joint ventures have followed the visit.

### 46 Israel's Defence Industry



The Nation's ever innovative defence industry continue to unveil new and cutting-edge technologies, exemplified by Elbit's SkEye WAPS, Rafael's SPIKE LR II, IAI's Green Dragon, Controp's High Definition Cameras, RADA's Tactical Radars and the Aeronautics Tactical VTOL UAS. All these and others are of relevance to Indian requirements.

### 54 The Dragon's Claws



With recent state-enforced organisational reforms, institutional restructuring and the induction of a variety of fourth and fifth-generation combat platforms over the last decade, the Chinese People's Liberation Army Air Force (PLAAF) is on course towards becoming a most assertive instrument for regional dominance and international influence for China.

Sameer Joshi reviews status of the PLAAF restructuring and reforms, mission strategy and combat capabilities, along with focus on its indigenous Air Superiority Fighter (ASF) force, concluding with an assessment of the PLAAF vs IAF scenario over Tibet in the coming years.

### 74 The PLAAF in 1962



The US Central Intelligence Agency (CIA) had made an assessment of Chinese air capability and its effectiveness in operations against India during the frontier war in the high Himalayas in October-November 1962 this has been de-classified 50 years after and is reproduced for Vayu readers.

### 78 China's Military Modernisation



China's military modernisation and its implications are reviewed by Dr Manoj Joshi who opines that the options before India are not too many and we would have to evolve asymmetrical systems of our own to deter the Chinese - and thus lower the nuclear threshold.

### 87 The 52<sup>nd</sup> International Paris Air Show



For the Vayu editorial team, covering the biennial Air Show at Le Bourget in June 2017 is now virtually routine, the Journal having been at the Salon International since 1975, or for over 40 years. At the same location there obviously were new shapes (and sounds), the Dassault Rafale dominating the military and Airbus A380plus the civil sectors. The to-be-expected sales rivalry between Airbus and Boeing was vigorous but there were new players

including Bombardier and Embraer, even as ATR notched steady orders. Some highlights of the Paris Air Show 2017 are included.

### 99 Visit to Thales in France



Vayu was amongst select media persons from around the world who attended a three-day detailed session on Thales and their activities which included factory visits and live demonstrations of some of their innovative products. There were Drones, C-UAV, radars and airport security systems on display.

### 104 The Baltic Connection



Vayu's Angad Singh visited a number of Russian shipyards on the Baltic Sea, reporting on several key programmes relevant both to India and the broader Russian-shipbuilding industry.

### 131 5 Centuries of Maritime Prowess



DCNS, which has just changed its name to NAVAL GROUP, traces its routes back to 1631 and is assuredly one of the world's leading shipbuilder and integrator.

Also: Irkut MC-21's Maiden Flight; INIOHOS 2017; FAMEX 2017.

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## Why 2017 is not 1962

When Chinese editorials of its controlled media were baying for Indian blood and suggesting that Indians should ‘not forget history lessons’ of 1962, the sharp rebuttal from defence minister Arun Jaitley that ‘the situation in 1962 was different, the India of today is different’, was not a political tit-for-tat but a cold reality that needs to be reiterated, stripped of any hyper-nationalistic import. The defence forces of India are specially guarded and weigh each word thoroughly through the prism of hard facts, as opposed to any political posturing. Herein, the underpinning calculus of the Indian Army Chief’s stoic comment that ‘India was ready for a two-and-a-half-front-war’ this was a further confirmation of the Indian preparedness towards any eventuality. This is a fact, despite the numerical and material superiority that China has maintained over India since the 1962 war, and even during the 1967 border conflict at Nathu La and Cho La, as indeed now in 2017. It is equally true that China’s military investments are approximately thrice that of India’s (\$151 billion as opposed to \$51 billion for India in 2017), and that its standing Army is nearly twice that of India’s (2.3 million to 1.3 million), or even that its estimated nuclear warheads are more than twice that of India’s (260 to 110).

However, none of these statistics count in a restricted war in an isolated theatre. Intrinsically and perversely, the reality of nuclear warheads at the disposal of both the Chinese and Indian regimes fundamentally alter the dynamics as compared to 1962. It acts as a deterrent against escalation to a full-scale war — no two nuclear-armed countries have ever gone to a full-scale war. Principles of ‘calculated ambiguity’ and ‘second-strike capability’ in nuclear doctrines militates against any unilateral approach to undertake one decisive strike, using both conventional and nuclear arms. So, in essence, the equanimity afforded by the joint nuclear status constrains conflicts between warring nations to be restricted to a limited theatre, like Doklam. Excerpts from the leaked Henderson Brooks report, which studied the debacle of 1962 in detail, plot the morass that afflicted the Indian preparedness in 1962 at various levels, like organisational, policy, planning and overall preparedness. From blatant political interference in key command positions, lack of quality intelligence by the agencies, amateurish ‘forward policy’ (overruling professional military concerns from the field commanders) and an overall lack of investment and equipment was reversed and corrected as soon as 1965. For those who state that the 1965 war was an India-Pak war and therefore cannot be equated with the Sino-Indian war dynamics, the following 1967 conflicts at Nathu La and Cho La entailed the Sino-Indian dynamics and the Indian forces came up victorious fair and square in the ‘restricted’ theatre. The high point of Indian military’s professionalism was in 1971 and reiterated in ‘Kargil’ in 1999. So 1962 was a forgotten chapter by 1965 itself, let alone 2017.

The ongoing steely stare down that is playing out in Doklam sector today, involving 6,000 foot soldiers, has more in common with a similar standoff in 1967, when a People’s Liberation Army attack on Nathu La was successfully repulsed, leading to a bloody nose for the PLA. No amount of numerical ‘paper strength’ mattered for much in the eventual outcome that led to a humiliating fatality count of 400 PLA soldiers and an estimated 70 fatal casualties for the Indian infantry battalions. Significantly, the Chinese are not oblivious

to the professionalism of the Indian soldier when they state in their columns, “India’s military has more experience in mountain combat”. Localised logjams like Doklam have their own dynamics and operational imperatives that are bereft of the ‘paper strengths’ of hypothetical full-scale wars. Structurally also, the independent PLA is a potential threat to its own regime of the Communist Party of China. Hence, the PLA swears its allegiance to the CPC and not to the country! So the ‘party Army’ necessitates that all company-level PLA officers are also CPC members, and they have ‘political officers’ as apparatchiks to ensure control. The non-military advisory CPC committee members have major say on military matters as opposed to the PLA itself. Amidst all this, ‘political work’ is a significant part of the PLA training that entails wasteful propagandist indoctrination of the CPC’s, civilian sensibilities.

Unlike the Indian armed forces, who have been frequently involved in cross-border wars and insurgencies since 1962, the Chinese have had no major combat experiences. Its famed technological prowess is ‘reverse engineering’ at best with unproven efficacy, whereas the bulk of Indian defence equipment and composition has either been bloodied in combat or is of a credible Western technological origin with proven capabilities. Never mind India, China’s perennial bug bear Taiwan has defied all Chinese belligerence and military bullying, three waves of ‘Taiwan Strait Crisis’ have not altered Taipei’s resilience or sovereignty. With all its numerical strength, supposed ‘blue water’ Navy capabilities, cutting-edge military platforms like the fifth generation Chengdu J-20, burgeoning nuclear weaponry, world’s largest army of cyber warriors and hackers, second largest fleet of drones and unmanned aerial vehicles, Chinese remain unsuccessful in their quest to wrest Taiwan, which is hardly 100 nautical miles from their mainland, equipped at a fraction of China, but with just about enough to give the Chinese a bloody nose!

It is in this context and realm of holding ground approach of the Indian narrative as opposed to the ‘expansionist’ instincts of the Chinese that the Doklam standoff needs to be evaluated and appreciated. The Chinese are past masters of both muscle-flexing and impressive posturing. However, it is with the careful analysis of the PLA track record, evolution of the emerging global dynamics (India-US angularity) and the inherent battle preparedness of the Indian armed forces that the statements made by the Indian defence minister and the Chief of Army Staff need to be decoded. Like the last Sino-Indian skirmish in 1987 in the Sumdorong Chu Valley, it is expected that the thaw will soon ensue and diplomacy will take over to de-escalate tensions. However, history also suggests that the same happens with the Chinese only when the opposing nation has reciprocated the bullying and expansionist tendencies, like in Doklam.

**Bhopinder Singh, From *The Asian Age***

## Giant Leap

Indian Space Research Organisation’s successful launch of GSLV Mk III from the Satish Dhawan Space Centre in Sriharikota has placed the country’s heaviest satellite GSAT-19, weighing 3,136 kg into a Geosynchronous Transfer Orbit, which is a giant leap in space, but comes almost two decades late. The delay, no doubt, was beyond the control of ISRO and it gave room for China to steal a march over India by spreading its wings to assist neighbouring Afghanistan, Maldives and Nepal with their satellite projects.

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The most significant aspect of the GSLV Mk III launch is the use of a cryogenic engine developed entirely with indigenous technology. The rapid development of ISRO from its humble beginnings, launching of small sounding rockets to study the magnetic equator from Thumba, near Thiruvananthapuram, to launching of lighter satellites into predetermined orbits from Sriharikota has posed a threat to the near monopoly of the USA and the European Space Agency in the business of multibillion dollar commercial rocket launch vehicles.

The USA masterminded the Missile Technology Control Regime in 1987 which placed an embargo on transfer of technology, to deny India joining the space age. Glavkosmos of the erstwhile USSR came to ISRO's aid by the outright sale of seven cryogenic engines. Through reverse engineering ISRO scientists were able to crack cryogenic technology. Cryogenic engines used in earlier GSLV flights were based on Russian designs but the one used on the GSLV Mk III is entirely of indigenous design based on gas generator cycle instead of the combustion cycle of the Russian model.

To make it operational, ISRO will have to undertake one more developmental flight of GSLV Mk III which can take anywhere from six months to one year. Meanwhile, ISRO has scheduled its next two satellites, GSAT-18 weighing 3.3 tonnes and the other weighing 5.8 tonnes, to be launched by the European space agency's Ariane spacecraft from Kourou in French Guyana. Once GSLV Mk III becomes operational India will cease its dependence on foreign launch vehicles. India has the potential to become a leader in launching satellites because of cost benefits.

So far, ISRO has launched 180 lighter satellites from 23 nations using its Polar Satellite Launch Vehicles. Buoyed by the success of Monday's launch, ISRO has set its eyes on a 10-tonne payload launcher for which a semi-cryogenic engine is being developed. The heavy launcher also has the potential to undertake manned flights. The semi-cryogenic engine is part of ISRO's plan to develop Unified Launch Vehicle for different payloads in a single launch vehicle and Reusable Launch Vehicle. Semi-cryogenic engine is cost effective compared to engines that use solid and hypergolic liquid propellants. Its propellants are eco-friendly, safer to handle and to store. While many nations across the world have the ability and capacity to develop satellites, few have the capacity to launch them. India has now joined this select group of nations and it is cause for cheer. See *Vayu 25 years Back (Issue IV/1992)*.

From *The Statesman*

## China's Trillion-Dollar Foreign Policy

To hear the world leaders who gathered in Beijing boast about China's ambitious plans to spend more than \$1 trillion on roads, ports, energy and other major projects in 60 countries, linking Asia, Europe and Africa, is to be reminded how America's vision and influence have shrunk under President Trump. While Donald Trump pushes an *America First* agenda of isolationism and protectionism and embroils himself in controversies that raise doubts about his competence, President Xi Jinping of China exudes purpose and confidence as he tries to remake the global economic and political order and lure nations into Beijing's orbit.

Mr Xi held the Beijing forum to showcase his *One Belt, One Road* initiative, which is aimed at creating a modern version of the Silk Road, a network of trading routes from China to Africa and Europe. Dozens of world leaders, including President Vladimir Putin of Russia,

attended. Many of them praised Mr. Xi's vision, which he first voiced in 2013, and were enthusiastic about locating projects in their countries, financing them, building them or managing them. The plan offers many ways countries can participate; Britain and Singapore, for instance, seem eager to handle private financing.

China's leader has advantages in promoting his agenda. He's in control. His government has lots of money to invest. His propaganda machine is disciplined and relentless. And Mr Xi himself is a Barnum-like salesman. "Development holds the master key to solving all problems," he said at the forum, as if *One Belt, One Road* were the ultimate cure-all. No less important, many countries are desperate for infrastructure investment and jobs. China itself is eager to open new markets to nourish its own growth and to absorb an overproduction of steel, cement and machinery. Completing just a small fraction of the projects could help lift millions of people out of poverty and stabilise poor nations.

Still, there are reasons to wonder how much of this grand plan can be achieved. There will be security risks in regions torn by sectarian and political warfare; legal obstacles in nations with different laws; and bureaucratic hurdles in countries with inept governments and corrupt officials. The biggest challenge of all may be financing. So far, investments have been focused on Pakistan, Afghanistan, Kazakhstan, Uzbekistan and other countries that are geopolitical priorities for China but have weak economies. Conference delegates expressed concern that such countries would find it hard to pay back loans from Chinese companies and banks and emphasised that more projects must be "high quality" and commercially viable.

There is also the issue of how local people feel about a project. Whatever the economic benefits, a project cannot be allowed to run roughshod over individuals or trample on the environment. Mr Xi stressed that consultation, transparency and people's "well-being" are vital, but China's track record is not encouraging. One example: Kyaukphyu, Myanmar, where a Chinese-Myanmar oil and gas pipeline was pursued in secret, stomped on farmers' property rights and did significant environmental damage. China clearly aims to dominate the international system. If it succeeds—shaping how vast sums are spent and where, and which laws are followed or not—it could upend a system established by Washington and its allies after World War II. And there are military concerns: For instance, many Burmese and foreign experts worry that China could use the Kyaukphyu ports for military purposes.

Mr Trump has already ceded ground to Beijing by withdrawing from the Trans-Pacific Partnership that President Barack Obama negotiated to ensure that the United States and its allies set the rules for Asian trade. This has led many Asian countries to question America's commitment to the region and to look more seriously to China. Like most of its Western allies, the United States has been wary of Mr Xi's initiative. While Mr Putin sent himself, it was only at the last minute that the Trump administration upgraded its delegate to the forum from a Commerce Department functionary to Matthew Pottinger, Mr Trump's senior Asia adviser. American companies eager for a share of the *One Belt, One Road* business hope for greater enthusiasm going forward so their interests will be protected. Whatever obstacles lie ahead for *One Belt, One Road*, it is no exaggeration to say that if the United States and its Western allies turn inward, Mr Xi could prevail by default.

From *The New York Times*

# Make in India

HAPPY INDEPENDENCE DAY

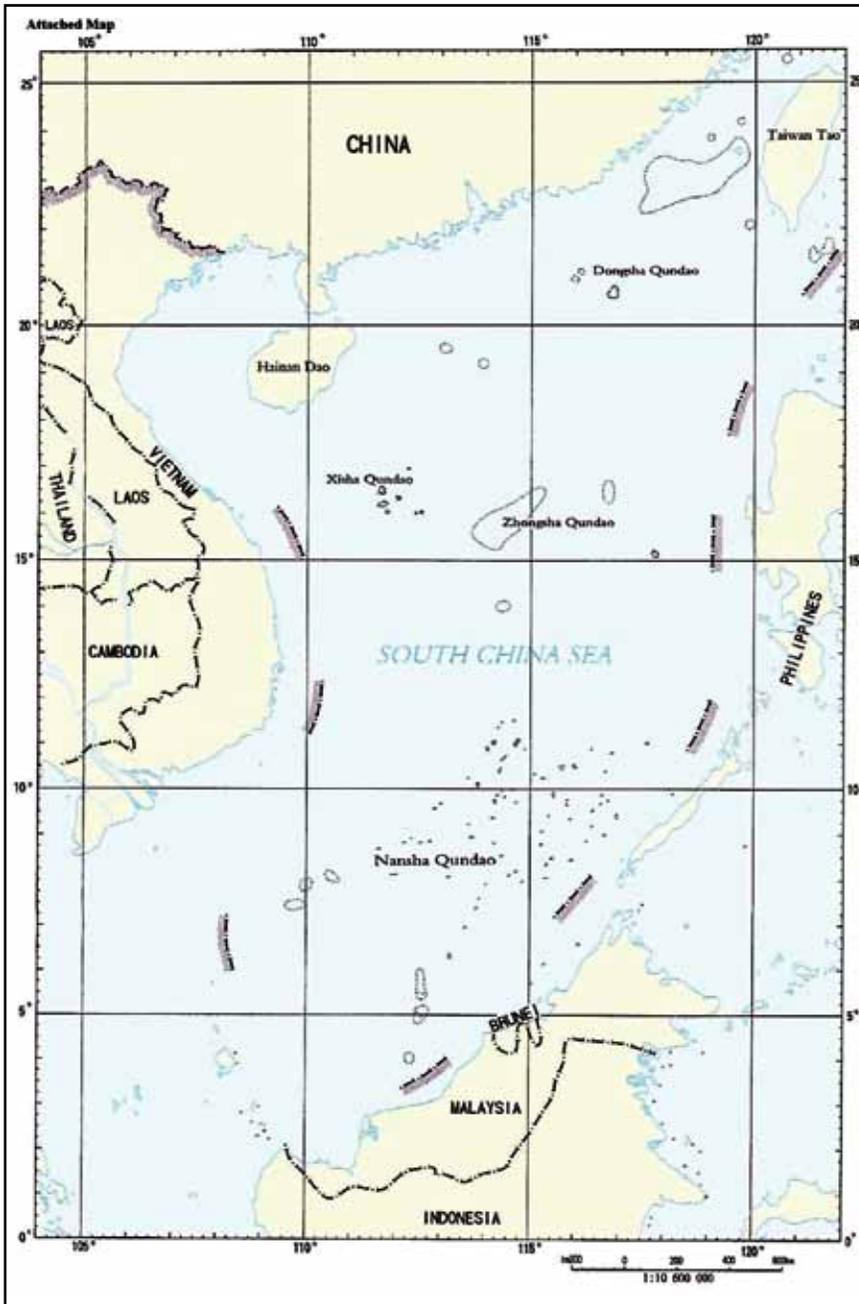


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## Admiral Arun Prakash on *The Menace of a Delusional Dragon*



*China's 'Nine-Dash Line' map, illustrating its claims to extended portions of the South China Sea, including the Paracel Islands, Spratly Islands, Pratas Islands, the Macclesfield Bank and Scarborough Shoal (photo: 2009 Chinese submission to the UN)*

China's state-owned *Global Times* newspaper reported recently that the People's Liberation Army Navy's (PLAN's) second aircraft-carrier, referred to as 'Type 001A' is nearing completion and that another carrier, dubbed 'Type 002' is also under construction. The Type 002 represents not only a much bigger class of ship, but will incorporate modern design and operational features, including a catapult and early-warning aircraft. A senior Chinese official was quoted as saying: "China needs two carrier strike groups in the Western Pacific and two in the Indian Ocean. So we need at least five to six aircraft-carriers."

Other manifestations of China's unfolding grand-strategy abound. It has built runways and fortified seven artificial islands created in the Spratleys group in the South China Sea (SCS), thereby leap-frogging the mental and physical barrier posed to the PLAN by the 'first island chain'. India is slowly being encircled by a growing ring of Chinese power and influence. To the north, garrisons, airfields and missile-sites linked by modern road-rail networks underpin China's dominant posture on the Tibetan plateau. Ominously, the Xining-Lhasa rail-link is progressing towards Nepal, where China has made significant political inroads. To our east, China's Yunan province will gain access to the Bay of Bengal via rail, highway and pipeline linking it to the deep-water port being built by China at Kyaukpyu in Myanmar.

A parallel endeavour on India's western flank, dubbed the China-Pakistan Economic Corridor (CPEC), will create access to the Arabian Sea from Xinjiang to the Pakistani port of Gwadar via Gilgit-Baltistan. Described by Foreign Secretary Jaishankar as violative of "...Indian sovereignty because it runs through Pakistan-occupied Kashmir", CPEC forms the bedrock of China's South Asian strategy, with a commitment of over \$50 billion.



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## F/A-18E/F SUPER HORNET



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Further west, China has set up its first overseas military base at Djibouti on the Bab el-Mandeb. To our south, China has built a new harbour in Hambantota and modernised Colombo port for Sri Lanka. All three ports could provide bases or sanctuaries to PLAN ships and submarines deployed in the Indian Ocean. There already is news that the PLAN intends to deploy its expanded marine corps to Djibouti and Gwadar. The recent Chinese sale of eight diesel submarines to Pakistan and two to Bangladesh provides conclusive evidence of India's 'strategic encirclement'.

India's decision-makers are, almost certainly, receiving divergent counsel about the Dragon's actions and intent. China's left-leaning sympathisers scoff at the 'encirclement' thesis and maintain that China neither wants war, nor seeks further territorial gains, but only economic engagement and tangible proof of friendship, which India has consistently failed to provide by playing the Dalai Lama card, cozying up to the US and withholding cooperation on the 'Belt and Road' initiative. Before the recent re-naming of Indian towns by Beijing, the demand for Tawang was explained away as a 'bargaining ploy' and India was advised to find a *modus vivendi* in order to somehow befriend China.

Even as we dismiss these inducements to appeasement, we must recognise the many serious dichotomies that distort our perception of this Asian hegemon. While China looms large in India's security perspectives, the former does not regard India as a threat – or even competitor. For Chinese strategists, asymmetry is inherent in such relations, and they bluntly advise that rather than obsessing with futile dreams of parity, India must reconcile itself to a subaltern status vis-à-vis China.

In a novel explanation of China's conduct, American scholar, John Garver has termed it an 'autistic state.' The analogy refers to an individual, whose delusions and fantasies prevent him from comprehending the motivations and emotions of others owing to to this neurological disorder. For example, there is firm conviction in China that the root causes of the 1962 conflict were India's 'forward policy' and its putative ambition to seize Tibet.

There is also evidence of Chinese schizophrenia. While dismissing India as a weak and effete state on one hand, PLA

ideologues also vilify it as an ambitious and expansionist power, waiting to avenge its 1962 military defeat. Most irksome to them is India's 'proprietary' attitude towards the Indian Ocean and its growing maritime relations with the US, Japan and Australia.

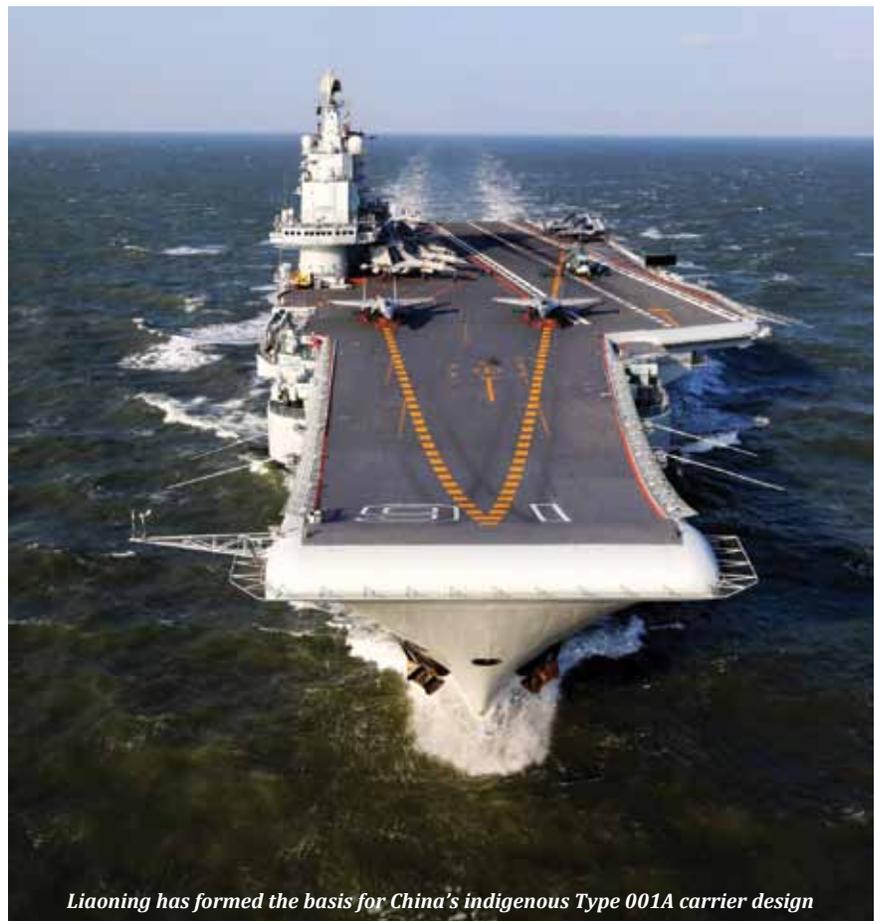
While China's self-perception has always been that of a benign and benevolent great power ('middle kingdom') in another example of Freudian self-deception, the Chinese simultaneously nurture a deep-seated 'victim mentality' as relic of China's subjugation and humiliation by foreign powers during the 19th century. And yet a strong streak of realism has ensured that China's post-Civil War leadership retained a crystal-clear vision of their aims: hegemony in Asia, acquisition of nuclear weapons and incorporation of Tibet into the People's Republic.

As Indian diplomats and security experts struggle to resolve the manifold 'Chinese conundrums,' they need to take note of two strategic realities that emerge from the dramatic growth of PLAN and creation of SCS island-fortresses. These bases can now be used to forward-deploy

ships, aircraft and missiles to threaten US or other naval forces, and such deployments could extend the operational range of PLAN surface and air forces by as much as 600-900 miles.

This is also the distance by which the Chinese are, now, closer to India's Andaman & Nicobar Islands. While Port Blair is 900 miles from Chennai, it happens to be 1,900 miles from the Fiery Cross reef, via the Malacca Strait. In the near future, when the PLAN is the world's second most powerful navy, it may feel confident enough to contemplate a re-enactment of 1962 in the Bay of Bengal to cut India to size again. How prepared would our political leadership and the armed forces be to react against a PLAN amphibious assault, on the Andamans, supported by one or more aircraft carriers?

This may, indeed, sound far-fetched; but so did Pearl Harbour in 1941 and Namka Chu in 1962. We, too, will soon have a robust and modern navy at sea but without a national security doctrine or strategy, will we know how to use it as an instrument of state policy?



*Liaoning has formed the basis for China's indigenous Type 001A carrier design*

# In Debt to the Dragon

Vice Admiral Arun Kumar Singh on China's 'Cheque-Book Diplomacy'



*Strategic Chinese investments in developing countries around the IOR mean PLAN submarines will become an increasingly familiar sight at ports in the region (photo: Reuters)*

With a \$12 trillion economy and still growing at about 6.5 per cent annually, with \$3 trillion in foreign exchange reserves, China is moving very rapidly to become a true global power with a two-ocean Navy. Its annual defence budget of \$152 billion is nearly four times that of India's modest \$40 billion, while the Chinese Navy's share of the defence budget is about \$50 billion, as compared to approximately \$5 billion allocated to the Indian Navy.

All this at a time when disturbing media reports indicate that a bankrupt American Westinghouse (owned by Toshiba) is still trying to sell six civilian nuclear reactors to India, even as the US is trying to get Pakistani

help in extricating its forces from Afghanistan, is now expected to "rehyphenate" Pakistan with India by offering it a similar nuclear deal, and India's open wooing of the USA since 2006 has alienated our age-old strategic partner Russia, who is now selling arms to Pakistan, and supported China's "one belt, one road (OBOR)", at a time when tensions are rising further with Pakistan sentencing Kulbhushan Jadhav to death for "spying"!

In fact, China is using "cheque book diplomacy" to make friends and also acquire real estate in strategically-located foreign lands as part of its global OBOR, which using the China-Pakistan Economic Corridor (CPEC) will connect it to Europe by sea and land for "trade."

On 12 July 2016, when the Permanent Court of Arbitration (PCA) at The Hague ruled against China stating that it had "no historic rights based on the Nine-Dash Line" and creation of artificial islands in the South China Sea, the Chinese waived-off all outstanding loans of Cambodia, which prevented the ASEAN nations from issuing a joint statement supporting the PCA ruling about the South China Sea. Similarly, it offered aid and assistance to the Philippines, whose new President, Rodrigo Duterte, has been making overtures to Beijing.

The first nation to learn a bitter lesson from China's "cheque book diplomacy" was Sri Lanka, which under the previous pro-China President Mahinda Rajapaksa,



*The deep water port at Gwadar in Balochistan is key to China's economic and strategic ambitions in South Asia*

allowed the Chinese to build a new railway, a new container terminal at Colombo port, super highways connecting Colombo to the tourist centre of Galle and then onwards to the new Chinese-built port of Hambantota, with the new Chinese-built Mattala Rajapaksa International Airport also near Hambantota. Today, both the new Hambantota port and its nearby airport, lie unused and have become a financial burden on cash-strapped Sri Lanka. The Chinese invested about \$9 billion, and when the Sri Lankans expressed inability to start repayment of the loan (about \$1.1 billion for the Hambantota port), a controversial agreement is being worked out as “debt relief”, which would permit a Chinese company to hold 60 to 80 per cent of the management control for a 50- or 99-year lease. If this agreement between Sri Lanka and China is finalised, a Chinese naval base in Hambantota port and airbase in the nearby airport may well become a reality.

To resolve its “Malacca Dilemma” in 2016, China agreed to invest \$14 billion in building a new Malaysian port named *Melaka Gateway* to be initially ready by 2019, with other facilities to replace Singapore as a “tourist-cum-commercial hub” by 2025, with the ability to handle 100,000 ships annually.

While the new Chinese base at Djibouti (expected to be fully operational by September 2017) will give it a presence in this Red Sea choke point, China has also moved to invest in the land near the brand new Duqm port, in Oman. In 2016, Oman announced that China had been permitted to invest \$10 billion to build an industrial park by 2022 in an area adjacent to the Duqm port and that Chinese companies building this industrial park would be “allowed to lease the land to Chinese investors”. Duqm port is strategically located as its near the Oman oil fields and faraway from the Strait of Hormuz, where global oil exports by merchant ships are vulnerable to blockade.

India has also shown some interest in Duqm port for industrial investment and connectivity, and as an “energy corridor”. China has also invested \$800 million in the Maldives to construct a second 2.5 km runway on Hulhulé Island, is building a 1.39 km sea bridge to connect Hulhulé Island to Male and a 15 km road on Laamu Atoll. Maldives relies on tourism and majority of the tourists are Chinese, so its economy is now dependent on China, which will invariably demand a military base—in India’s backyard.

China is investing \$56 billion in CPEC and Pakistan’s loan repayment starts in 2020

at an annual rate varying between \$2.5 to \$3.5 billion, with a total debt burden of \$90 billion to be repaid in 30 years. Pakistan will be in no condition to repay this enormous debt. Hence, we are likely to see another “lease agreement”, or handing over some strategic parts of Pakistani territory to the Chinese.

Experts predict that the next 10 years will be critical for India as the “economic gap” with China will continue to widen, but after 2027 this gap will start to “reduce.” To expedite Indian growth, Prime Minister Narendra Modi needs to urgently amend our laws to encourage FDI from Japan, South Korea, Taiwan and the UAE. Other Indian counter measures will involve deterring war by doubling its naval budget, modifying its no first use nuclear doctrine, finding an asymmetric non-nuclear response to China’s growing sea power and using some of our 1,197 offshore islands as military bases, and also as attractive foreign tourist destinations akin to the Maldives.

And finally, media reports indicate that Singapore, Malaysia, Indonesia and Thailand are expected to include Indian Navy warships in their joint/co-ordinated patrols of the strategic Strait of Malacca. This move, if true, will go a long way in regional maritime cooperation to counter the “Sea Dragon”.

# National Imperative!

Admiral Arun Prakash, former CNS warns the country to

## Beware the Rhyme of History

“It is peace for our time”, declared British Prime Minister Neville Chamberlain on 30 September 1938, as he returned from the Munich Conference having tamely agreed to the German annexation of Czechoslovakian territories. This was to be the penultimate act of appeasement before Germany triggered World War II by invading Poland on 1 September, 1939.

Well before it sparked this global conflagration, Germany had provided enough evidence of its hegemonic intent and utter disdain for the 1919 Treaty of Versailles, crafted for the purpose of preventing German re-militarisation. In contravention of its provisions, Adolf Hitler introduced conscription, sent his military to gain combat experience in the Spanish civil war and then, in 1936, re-occupied Rhineland. Emboldened by the passivity of Britain and the European powers, this was followed, in 1938, by the forcible union (*Anschluss*) of Austria with the Third Reich because of its German-speaking majority. Craven appeasement and hopeless optimism had set the stage for the *Gotterdammerung* that was to follow, exactly a year after Munich.

History, according to Mark Twain, “does not repeat itself but it rhymes”. On the 100th anniversary of World War I, Canadian historian Margaret MacMillan had pointed out uncanny similarities between the contemporary geopolitical landscape and the Europe of 1914. She argued in an essay that the same structural forces that led to the Great War a century ago could be in action in 2014. Mercifully, the centennial of WW I came and went peacefully, but MacMillan endorses Mark Twain with her advice: “If we can see past our blinders and take note of the telling parallels between then and now... history does give us valuable lessons.”

Till recently, most of us were convinced that the power of economics and globalisation would not permit another great war. President George Bush was articulating all our fond hopes when he said that, “the spread of democracy and free trade across the world would form the surest guarantee of world peace.” Yet, the extraordinary growth of trade and investment between China and the US has not served to dampen suspicion and tensions.

On the contrary, says China expert Michael Pillsbury, there has been a belated realisation in the US that eight Presidential administrations following Nixon’s have actively assisted the ascent of a militaristic China in the mistaken belief that they were helping a weak and victimised country become a liberal, democratic nation. There is angst in America over the notion that by handing over sensitive information, technology, military know-how and expert advice, the US has actually helped the achievement of the “Chinese dream”.

Termed *tianxia* in Mandarin, the “Chinese dream” envisages establishment of a hegemonic Chinese Empire as the centre of world authority to which other nations must show deference. This may explain the Chinese foreign minister’s patronising remark at the 2010 ASEAN conference to his Singaporean counterpart: “China is

a big country and other countries are small, and that’s just a fact.” A brief look at post-1949 events reveals the inherent bellicosity of the Chinese state.

Soon after end of China’s Civil War in 1949, the People’s Liberation Army (PLA) drove into the East Turkistan Republic and incorporated it into the Xinjiang Uyghur Autonomous Region. Ever since then, the Peoples Republic of China (PRC) has been engaged in serial strife: The occupation of Tibet and the entry of the PRC into the Korean War in 1950; suppression of the Tibetan uprising in 1959; the Sino-Indian War of 1962; involvement in the Vietnam War from 1965 to 1969; a seven-month long conflict with the USSR in 1969; a major conflict with Vietnam in 1979. Skirmishes in the South China Sea (SCS) and tensions across the Taiwan Strait have occurred with regularity all the while.

Given its growing economic and military strength, revisionist outlook and past record, China can be expected to push its influence in the region, grab territory and re-write the rules of international conduct to suit its own interests. A recent manifestation of China’s belligerence is the campaign of “cartographic expansion” that it has mounted through the “9-dash line” in the SCS and repudiation of the 1914 McMahon line on the India-China border. Other examples of Chinese intransigence are the illegal creation and militarisation of artificial islands in the SCS and its contemptuous dismissal of UN arbitration on these sovereignty issues.

The choices for India in the face of Chinese hegemony are stark. The constraints of India’s political system render it unlikely that it can bridge the economic and military gap vis-à-vis China within a reasonable time. Distracted as they are by intense political activity, and their preoccupation with interminable election campaigns, our political elite seem incapable of applying themselves to strategic thinking or planning. Even though the Sino-Indian equation is tilted in China’s favour, as a democracy, a nuclear weapon state and a significant economic and military power, it is incumbent upon India to stand firm as a bulwark against regional hegemony.

As it seeks its own “manifest destiny”, India badly needs breathing space for growth and consolidation within a democratic framework. But Beijing, hard-nosed as ever, is dropping unsubtle hints that it could be “peace for our times” if China gets to keep Aksai Chin and India surrenders Tawang. Ironically, this is the time that India’s defence budget has hit a historic low of 1.6 per cent of GDP and its arsenal is full of voids.

Neither appeasement, nor empty bluster—as PM Nehru found to his cost in 1962—will work with China. The pundits on Raisina Hill are, once again, chanting the mantra of *“jang nahin hogi”* (there will be no war). Should this prophecy prove correct, it will be great news for the country. But chances of it coming true will rise exponentially if India keeps its powder dry by crafting a grand strategy, by initiating urgent reform of our archaic defence structures and by reviving our comatose military-industrial complex.



# VAYU

## At International

### Honour for Vayu on eve of the Paris Air Show !

*In 'Celebrating Excellence in Aerospace Publishing', organisers of the 2017 Aerospace media event held a glittering function at the Aero Club de France, 6 rue Galilee, in Paris on 18 June 2017, eve of the Paris Air Show.*

*The 'Vayu Aerospace Review' was nominated for the 16<sup>th</sup> running year for a prestigious international award in Aerospace publishing, alongside the world's leading journals including Aviation Week and Space Technology, Flight International, Aviation International and others.*

*The article, 'Red Star over Syria' by Sameer Joshi, a former IAF fighter pilot and great air enthusiast appeared in Vayu's Issue III/2016,*



*which was judged as the 'Best Military Aviation Submission'. This actually follows the 'tradition' of the past decades where Vayu, as the only aviation journal being nominated from Asia, has received such recognition. The first was in 2001 concerning the Tejas light combat aircraft and over the years, Vayu's editorial team has garnered awards ranging from Angad Singh's 'Best Young Journalist', to the 'Lifetime Achievement Award' given to Pushpindar Singh, Founding Editor of the journal.*

*As the Chief Organiser Peter Bradfield put it, "The last 12 months has been some dramatic changes, not only globally and nationally but also within our own aviation media industry. It is fair to say that it has been a challenge to put together the elements that go to make up the Aerospace Media Dinner. I am sure you may have noticed some changes in Sponsors and Award categories. Nevertheless, I am delighted to say that in spite of the obstacles we are once again able to celebrate the very best in aviation journalism and publishing. This is largely due to the gracious and generous support of our sponsors. I would like to thank those sponsors who have been kind enough to stick with us and welcome, and thank, our new sponsors. Lockheed Martin, Nammo and Bell Helicopter."*

*AMD Judge Adam Konowe added, "This year, most categories garnered more*



# Flies High

## Aerospace Media Awards

*submissions than ever before. In fact, many categories attracted two or even three dozen entries. Under these circumstances, I hope you'll agree the old adage 'It is an honour just to be nominated' is fitting here as well. Every shortlisted candidate should be proud of his or her accomplishment, even without a call to the stage. Your work is truly among the very best from the past year. Moreover, your words and images have a global impact on an industry that enables, enhances and even protects the lives of millions. So, in spite of turbulence in politics and elsewhere, just remember, Plus ça change, plus c'est is meme chose."*



# Danger at Doklam

The standoff between Indian and Chinese forces on the Doklam Plateau has gone on well beyond a month. India and China have both miscalculated, with potentially dire consequences. China clearly did not appreciate the sensitivity that India attaches to any Chinese presence on the Jampheri Ridge south of the plateau and the implications for the security of the Siliguri Corridor that connects eastern India with the rest of the country. A decade ago, for example, Indian soldiers training the Royal Bhutanese Army in Bhutan challenged a Chinese foot patrol that was discovered along the ridge.

India, however, clearly did not appreciate the degree to which China believes it has already established a presence on the plateau, which forms part of China's dispute with Bhutan in this area. In either the 1980s or early 2000s, China built a dirt road from the Chumbi Valley in Tibet to Shenche La that Bhutan views as the border with China, and then onto the Doklam Plateau. In fact, this road terminates perhaps just 100 metres from the Indian outpost at Doka La, near the site of the current standoff. Probably at the end of the 2000s, China enhanced or regraded the road and added the "turning point" where Chinese vehicles turn around to return to the Chumbi Valley. The road is likely used only in the summer months to facilitate patrols in the area (including surveying Indian presence at Doka La).

For India, any Chinese presence on the Doklam plateau is worrying. And any extension of the road toward the Jampheri Ridge would constitute a real change to the status quo. Yet for China, India's actions are also unprecedented. As former Indian Foreign Secretary Shyam Saran wrote a few weeks ago, "This is the first time that Indian forces have engaged China from the soil of a third country." Specifically, the Indian Army moved forces beyond the international border to pre-empt Chinese efforts to start extending the road toward the Jampheri Ridge.

Unfortunately, the 1890 convention delimiting the border between Tibet and Sikkim may worsen the situation. The convention contains a contradiction that allows each side to claim it supports its own position. Article 1 states that the border begins at Mount Gimpochi, roughly 3 km south of the Chinese road and the western point of the Jampheri Ridge. Article 1 also states that the boundary will follow the watershed. Unfortunately, however, Mount Gimpochi is not the start of the watershed, and the convention did not explain how to square this circle. Sometime between 1907 and 1913, Britain published a map of the area showing the border starting at Batang La, 6 km north of Mount Gimpochi, effectively changing the terms of the convention.

Unsurprisingly, India and China have chosen the starting point of their border in the region that maximises their interest. But this also creates a conflict between the black letter of 1890 convention, which Britain and China ratified, and the main principle of delimitation. Moreover, these divergent interpretations bear a disturbing resemblance to the dispute over the Thag La ridge and Dhola post in the eastern sector of the China-India border dispute, the proximate spark for the 1962 war.

In the eastern sector, India maintained that the China-India border was delimited by the McMahon Line from the 1914 Simla Convention. McMahon's line generally followed the watershed between present-day India and China. Unfortunately, for the last 25 km or so, the line did not follow the watershed but was drawn south of the Thag La Ridge. The post at Dhola that the Indian Army established in June 1962 lies in the area between the watershed to the north and the McMahon Line to the south. China challenged the Indian post as being located in undisputed Chinese territory. The gradual escalation of tensions over Dhola played a key role in Mao Zedong's final decision to launch a wider war on 22 October 1962.

To be sure, the analogy to the present is imperfect. Overall, India-China relations

are stable, including on the border. Neither side has deployed large numbers of forces nearby on Doklam. Unlike Dhola, where China dominated the high ground, the local geography favours India, which can easily deploy forces already in Sikkim. China must rely on the single road in the area that climbs more than 1,400 meters from the Chumbi Valley to the Doklam Plateau.

Despite the imperfections of the analogy, it highlights the danger of the present situation. China believes the black letter of the 1890 convention not only supports its presence on the Doklam Plateau but also its right to extend roads in the area south to Gimpochi. India believes the border lies to the north at Batang La, which justifies its challenge of China beyond its borders on the Doklam Plateau. But this is based on the principle contained in the convention and what appears to be Britain's subsequent map.

The longer the standoff lasts, the more easily these positions will harden. For example, given the unprecedented Indian presence in territory disputed by China and Bhutan, China may conclude that it needs to strengthen its physical position on the Doklam Plateau. Beijing could build more permanent structures a kilometre or two behind the 'turning point' at Doka La. That is, China may use the Indian challenge to justify further steps to consolidate its presence on Doklam. India would then be faced with accepting a larger, more permanent Chinese presence or escalating further to stop it. The most realistic outcome would be restoration of the situation before June. This would mean the return of Indian troops to Indian territory and the withdrawal of Chinese construction crews from the area. India may demand or hope that China will vacate the Doklam Plateau, but China is unlikely to leave an area where it believes it had already maintained a presence for decades. The danger inherent in the current stand-off demands a quick resolution.

**M Taylor Fravel,**  
*In The Indian Express*

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### CAS flags concern on depleting fighter strength



In his interview with a leading national daily in mid-June, Air Chief Marshal BS Dhanoa, Chief of the Air Staff has stated that the shortfall in number of fighter squadrons in the IAF is a challenge to “dominating a two-front conflict” and likened this to “a cricket team playing with seven players instead of 11.” The Chief of the Indian Air Force also said that while the IAF is ready for the use of air power against Pakistan in response to a terrorist attack, it is an option that has to be exercised by the government. The IAF’s authorised strength of 42 fighter squadrons “is the minimum strength necessary to dominate a two-front conflict”, the CAS said. The IAF currently has 32 fighter squadrons, and is tasked with tackling a two-front collusive threat from China and Pakistan.

Asked whether the IAF had given options to the government about some kind of an “aerial surgical strike” inside Pakistan occupied Kashmir (PoK), the Air Chief said: “The use of air power in response to heinous acts or terrorist attacks is an option that is to be taken by the government. The IAF is prepared for any eventuality.”

### Indian Air Chief in France



Air Chief Marshal Birender Singh Dhanoa, Chief of the Air Staff IAF visited France on 17-20 July 2017 “to further strengthen the existing defence cooperation between the Air Forces of the two countries.” The areas of cooperation presently include exchanges in military training courses, mutual visits by aviation experts and joint air exercises. The Indian CAS also visited Headquarters of the French Air Force and some operational air bases, besides interacting with representatives of military aviation industry in France and the Indian Rafale Programme Management Team (PMT). “The Rafale is capable of carrying nuclear weapons and will be equipped with the latest missiles that will give the IAF greater potency”.

Following his sortie in the Rafale from St Dizier (*see image*), Air Chief Marshal BS Dhanoa was quoted as saying “I flew a Rafale in a two-versus-two mission involving two Rafales against two Mirage 2000D opponents. I am impressed with the superior swing role capability of the Rafale and its highly integrated weapon sensor and survivability suite”. The Air Chief also interacted with senior executives of Dassault Aviation who briefed him about progress in the programme to supply fighters to the IAF. According to various sources, the company Dassault have set sights on supplying up to 200 Rafales to India over next decade.

### “India as Major US Defence Partner”

With President Donald J Trump hosting Prime Minister Narendra Modi on 26 June during his official visit to Washington, DC, the leaders resolved to “expand and deepen the strategic partnership between the countries and advance common objectives. They pledged to deepen defence and security cooperation, building on the United States’ recognition of India as a ‘Major Defence Partner’. The United States and India look forward to working together on advanced defence equipment and technology at a level commensurate with that of the closest allies and partners of the United States. ‘Reflecting the partnership, the United States has offered for India’s consideration the sale of Sea Guardian Unmanned Aerial Systems, “which would enhance India’s capabilities and promote shared security interests”.

### General Atomics Sea Guardian ‘cleared’ for India



The US State Department has issued necessary licences for the export of 22 Predator Guardian drones to India, days after Prime Minister Narendra Modi and President Donald Trump had their first bilateral meeting at the White House. A DSP-5 category license is issued for the permanent export of military hardware as found in the US Munitions List which is defined by the International Traffic Arms Regulations.

The Guardian drones will enhance India's maritime surveillance capabilities in the Indian Ocean region and are estimated to cost around \$2 billion and are being built by General Atomics. "We are extremely pleased that President Trump and Prime Minister Modi have had excellent deliberations and the path forward for a game-changer in US-India defence relations has been charted," said Vivek Lall, Chief Executive, US and International Strategic Development, General Atomics. Given the Sea Guardian's capabilities, the US offer demonstrates a major change in US policy because this type of aircraft capability is only exported to a very select few of America's closest defense partners. Such an offer represents tangible implementation of the United States Congress' designation of India as a 'Major Defence Partner'," continued Dr Lall.

## Armed Forces seek \$416 billion for defence projects

India's Ministry of Defence have reportedly sought an allocation of Rs 26.84 lakh crore (\$416 billion) over the next five years for military modernisation of the defence forces in face of collusive threats from Pakistan and China as well as to safeguard India's expanding geo strategic interests. According to the defence ministry, the 13th consolidated defence five year plan for 2017-2022 was presented at the Unified Commanders' Conference on 10-11 July.

Defence Minister Arun Jaitley, who addressed the conference, assured the armed forces that capital expenditure for modernisation projects will be "a priority area" with resource availability increasing within the Indian economy. But it is also true that the actual annual defence budgets have shown a discernible trend of declining defence budgets, unspent funds and a skewed revenue to capital expenditure ratio, which have meant that the Army, Navy and IAF continue to grapple with critical operational gaps on several fronts. With an eye firmly on China, there is also a separate section in the plan on "capability development" of the strategically-located tri-Service Andaman and Nicobar Command, which was set up in October 2001 but has suffered from relative neglect and lack of infrastructure.

## Increasing 'Jointness'

As per Prime Minister Narendra Modi's directions for increasing jointness in the armed forces, the three Services chiefs have reportedly met to discuss the integration of some facilities for training in intelligence gathering and handling military communications and logistics. The recommendations were submitted to the defence ministry by the Lt Gen DB Shekatkar Committee and the MoD has reportedly cleared a large number of these recommendations and sent these to the three services for further implementation.



In this context, the Committee has suggested that there should be joint training schools for the three services where personnel can be trained jointly for better coordination in the future. Besides, there will be the establishment of a Joint Services War College for middle-level officers even as there are three separate war colleges currently, at Mhow, Secunderabad and Goa, for the Army, Air Force and the Navy respectively.

As for the proposal to appoint a permanent Chairman, Chiefs of Staffs Committee, this too was "moving ahead steadily" while the Committee has also suggested "optimising" non-combat support arms in the army such as the supply corps, ordnance and electrical and mechanical engineers.

## "Army ready for wars on two-and-a-half fronts" : General Rawat

Chief of the Army Staff General Bipin Rawat has recently stated that "The Indian Army is fully ready for a two-and-a-half front (China, Pakistan and internal security requirements simultaneously) war". The Army Chief added that even though India is ready for a multi-front war, there are effective mechanisms available to defuse an adverse situation.



"Even the PM has stated that for the last forty years not even a single bullet has been fired on the Indo-China border," said the COAS. General Rawat also stated that the new Mountain Strike Corps (XVII) is being raised for such operations. General Rawat went on to discuss modernisation plans of the Army, saying that the government "is aware of our all needs and is supporting us in every manner". *Make in India* is a good initiative, it will give results in two to three years, he said.

## Chinese ratchet up confrontation in India's north east

On 17 July 2017, the Chinese Army conducted fire power exercises in Tibet, close to India's border in Arunachal Pradesh, amid the ongoing standoff between Indian and Chinese troops at



Map courtesy: India Today



the Doklam area in the Sikkim sector. The Chinese 6<sup>th</sup> Brigade that reportedly conducted the drills was from the PLA's Tibet Military Command and is one of two plateau mountain brigades (part of their 141 Division in the Chumbi Valley). Reportedly, this brigade has long been stationed around the middle and lower reaches of the Brahmaputra (Yarlung Zangbo in Chinese) river which flows into India and Bangladesh and is responsible for frontline combat missions. The exercise included the quick reinforcement of troops and different military units working together on joint attacks. The vital Siliguri corridor is defended by the Indian Army's XXXIII Corps, of which the 17<sup>th</sup> Mountain Division is integral and whose 63<sup>rd</sup> Brigade is reportedly guarding this sector.

Earlier a PLA spokesman Col Wu Qian spoke in tough language while making a reference to the 1962 Sino-India conflict, saying that New Delhi should "learn historical lessons". Qian described Indian Army Chief General Bipin Rawat's remarks that India was ready for a "two-and-a-half front war" as "extremely irresponsible". Thereafter, Indian Defence Minister Arun Jaitley had made New Delhi's stand clear when he said the India of 2017 was different from that of 1962. Of the 3,488-km-long India-China border from Jammu and Kashmir to Arunachal Pradesh, a 220-km section falls in Sikkim.



## Indian Army gets first M-777 howitzers

The Indian Army has received the first two M-777 ultra-light howitzers, which are part of the 145-howitzer order from the US for \$700 million. The Army is in the process of acquiring



five different types of artillery guns under a Rs. 22,000 crore modernisation plan, the air portable 155mm/39 calibre guns, with maximum range of 30 km, being manufactured by BAE Systems. An official of the company said the guns had arrived ahead of schedule. "We continue to support the US government in integrating its weapon systems with the Indian Army's artillery modernisation programme," he added. Out of 145 guns, BAE will deliver 25 guns and rest will be assembled in India by Mahindra.

## Exercise 'Malabar' 2017

On 11 July 2017, India, Japan and the United States commenced the trilateral *Malabar* naval exercise featuring 95 aircraft, 16 ships and two submarines, seeking to forge "deeper" military ties amid growing Chinese assertiveness in the region. USS *Nimitz*, the world's largest aircraft carrier participated in the five-day exercise in the Bay of Bengal, which aimed at "achieving deeper military ties between the three nations." "The 21st edition of the *Malabar* exercise, conducted ashore and at-sea, assumes significance as it was held at a time when China has become more assertive and the forays by their submarines in the Indian Ocean region have increased."

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Some 95 aircraft, 16 ships and two submarines from the three countries took part in the naval exercise. Besides USS *Nimitz* (CVN68), guided missile cruise ship USS *Princeton* (CG59), guided missile destroyers USS *Howard* (DDG83), USS *Shoup* (DDG86) and USS *Kidd* (DDG100), a P-8A Poseidon aircraft as well as a Los Angeles fast-attack submarine took part in the naval drills. Japan Maritime Self Defence Force ships JS *Izumo* (DDH 183), JS *Sazanami* (DD1 13) along with INS *Jalashwa* and aircraft carrier INS *Vikramaditya* also participated in the exercise.



In the picture above, USN Super Hornets fly over INS *Vikramaditya* with IN MiG-29Ks on the deck, while that below is that of a mixed formation of Super Hornets and MiG-29Ks

## 'Rukmini' satellite in surveillance of Chinese ships

With China increasing its naval presence in the Indian Ocean Region, the Indian Navy is reportedly keeping a watch on Chinese warships with the help of its satellite GSAT-7, the Navy's own dedicated military satellite that was launched on 29 September 2013. The 2,625-kg satellite, named 'Rukmini', has helped the Navy monitor the Indian Ocean Region (IOR) with its 2,000 nautical mile 'footprint'. The multi-band communication-cum surveillance satellite, which is operating from a geo-stationary orbit (at 36,000km altitude), provides real-time inputs to naval warships, submarines and maritime aircraft for networking capabilities to its naval assets on the high seas. With the help of shore-based operational centres, 'Rukmini' (INSAT-4F) has not only helped the Navy keep an eye on both Arabian Sea and Bay of Bengal but also augment communication and surveillance capabilities from Persian Gulf to the Malacca Strait. The satellite, which has a payload power of 2000W, has a mission life of nine years.

## Additional C-17 for the IAF



The US State Department has approved the sale of another C-17 heavy lift transport aircraft for India, at an estimated cost of \$366.2 million. Alongside, the Government of India has requested four F-117-PW-100 turbofan engines, plus one AN/AAR-47 Missile Warning System, one AN/ALE-47 Countermeasures Dispensing System (CMDS), one AN/APX-119 Identification Friend or Foe (IFF) Transponder, precision navigation equipment, spares and repair parts, maintenance, support and test equipment, publications and technical documentation, warranty, quality assurance, ferry support, US Government and contractor engineering, logistics and technical support services, plus other related elements of logistics and programme support.

## Boeing support of IN P-8Is



The Indian Navy presently operates eight P-8I long-range maritime reconnaissance and anti-submarine warfare aircraft at INS *Rajali*. Boeing is also contracted to deliver four additional P-8I aircraft to the Indian Navy, with deliveries to begin in 2020. Boeing has now been contracted for three more years in support continuation of the Indian Navy's fleet of P-8I maritime patrol



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aircraft. In addition to field and logistics service, the contract includes engineering, support and planning, robust material support, including a 737-based component services programme, which will be executed in conjunction with Boeing Commercial Aviation Services' Fleet Services division. "With this contract, the Indian Navy can be assured of achieving exceptional operational capability and readiness of the P-8I fleet," said Pratyush Kumar, president of Boeing India and vice president of Boeing International.

### Indian Navy P-8I fleet achieves 10,000 flight hours

Boeing has congratulated the Indian Navy and Indian Naval Air Squadron 312A on achieving 10,000 flight hours with their P-8I fleet since their induction in 2015 and for receiving the Chief of Naval Staff's unit citation for "outstanding operational performance".



### India and Russia co-operation in defence

On 1 June, India and Russia signed a much-awaited agreement for two more units of a nuclear power plant in Tamil Nadu and also decided to give a "new direction" to the defence cooperation



between the two "great powers". The two Governments also decided to hold the first tri-Services exercises *Indra-2017*, this year and start joint manufacture of frigates, adding to the planned co-production of Kamov Ka-226 military helicopters. These decisions were taken during the wide-ranging talks between Prime Minister Narendra Modi and Russian President Vladimir Putin during the former's visit to St Petersburg, which covered a range of issues, including terrorism and increasing trade and investment.

In related news, representatives of Rosoboron export, a member of Rostec, took part in the 17th meeting of the Indo-Russian Intergovernmental Commission on Military and Technical Cooperation co-chaired by Defence Ministers S Shoigu of Russia and Arun Jaitley of India in Moscow during mid-June 2017.

### India and Israel in "strategic alliance"



India and Israel have elevated their ties to the "strategic partnership" level with the aim to do "much more together" to combat growing radicalisation and terrorism and have pitched for "strong measures" against those financing and providing sanctuaries to terror groups. The issue of terror and "strategic threats" along with various other topics like cooperation in defence and security, water, agriculture, space figured prominently in the talks between Prime Minister Narendra Modi and his Israeli counterpart Benjamin Netanyahu (pictured meeting on the former's arrival at Tel Aviv).

Following the wide-ranging talks, the two sides signed seven pacts covering areas including innovation, water conservation, agriculture and space. India and Israel also agreed to set up a \$40 million fund for industrial Research and Development, and an innovation fund, with both countries contributing \$20 million each.

### Indo-Thailand HADR 'Table Top' Ex 2017

Indo-Thailand Humanitarian Assistance and Disaster Relief (HADR) *Table Top* Exercise 2017 was held at Chiang Mai, Thailand 22-26 May 2017, which included personnel from the

Indian Air Force and Royal Thailand Air Force (RTAF), the second such exercise conducted between the two Services, with the aim to evolve SOPs for planning and executing relief missions during unforeseen natural calamities like Tsunami, earthquakes, cyclones, floods etc. The objective was to enhance interoperability between the two Air Forces, while conducting combined air operations triggered by such crisis.

## C-in-C Myanmar Armed Forces visits India



Commander-in-Chief of the Myanmar Armed Forces, Senior General Min Aung Hlaing visited India on an eight-day visit starting from 14 July 2017, calling on PM Narendra Modi, defence minister Arun Jaitley and national security advisor Ajit Doval. According to sources, India is to increase military supplies to Myanmar as part of the overall plan to expand defence cooperation with ASEAN countries under the 'Act East' policy. The Government of India is reportedly providing 105mm artillery guns, rocket launchers, rifles, radars, mortars, bailey bridges, communication gear, night-vision devices, war-gaming software and road construction equipment as well as naval gun-boats, sonars, acoustic domes and directing gear to Myanmar. A \$37.9 million deal for supply of lightweight torpedoes was also recently finalised. In the photograph above, General Min Aung Hlaing is seen inspecting an Indian Naval Guard of Honour at Eastern Naval Command, Visakhapatnam.

## Indo-Sri Lanka joint exercise

Indian and Sri Lanka Air Forces concluded a joint exercise at Colombo on 9-14 July 2017 "to strengthen their co-operation". This exercise offered an opportunity to the IAF and SLAF contingent members to observe each others' Standard Operating Procedures as well as exchange ideas on joint operations. A transport aircraft of the IAF had ferried a contingent of 65 IAF personnel on 9 July 2017 to Sri Lanka including a sky diving team along with the *Air Warrior Drill Team*.

## Afghan General visits India



Lieutenant General Abdul Wahab Wardak, Vice Chief of General Staff (Air), Afghanistan National Security Forces reviewing Guard of Honour at Air Headquarters in New Delhi during his official visit to India on 3 July 2017.

## COAS at AFS Bhisiana

On 27 May, Air Chief Marshal BS Dhanoa, led a MiG-21 'Missing Man' formation in flypast over AF Station Bhisiana to honour the valour and supreme sacrifice of the Kargil martyrs.



The Arrow Formation of MiG-21s, leaving a gap which depicts the 'Missing Man', was in memorium to Sqn Ldr Ahuja of No 17 Squadron, which was led during the Kargil 1999 operations by then Wg Cdr BS Dhanoa. Later, in a simple, yet poignant ceremony, he laid a wreath at the Memorial to honour those who made the supreme sacrifice in the line of duty.

## Uncertainty on more Hawk AJTs

The Indian Air Force's plan to induct 20 more Hawk advanced jet trainers for the *Surya Kiran Aerobatic Team* (SKAT) has not progressed over the issue of steep increase in aircraft prices. The IAF had moved the proposal to buy these 20 AJTs from BAE Systems



during the UPA regime as it wanted to replace the Kiran Mk IIs. “The deal has been stuck over the price issue for more than two years now as the price demanded is way beyond the benchmark which the Defence Ministry had set for the project,” according to IAF sources.

## IAF's first women fighter pilots to fly Su-30s



India's first women combat aircraft pilots are reportedly to be posted to Sukhoi Su-30MKI squadrons after they complete last phase of their flying training in September. The three women pilots, Bhawana Kanth, Mohana Singh and Avani Chaturvedi are currently training on Hawk advanced jet trainers at IAF Kalaikunda in West Bengal after being commissioned as flying officers in the IAF last June. “There are varied options but we are working on plans to assign the women fighter pilots to fly Su-30 fighters,” a senior IAF officer stated.

## BEL wins six awards

Navratna Defence PSU Bharat Electronics Ltd (BEL) has won six Raksha Mantri's Awards for Excellence for the years 2014-15 and 2015-16. M V Gowtama, Chairman & Managing Director and other senior officers of BEL received the awards from Defence Minister Arun Jaitley and Subhash Bhamre, RRM at a ceremony at New Delhi on 30 May 2017. These include the Raksha Mantri's



Group/Individual Award for ‘Design Effort’ during the year 2015-16 for the Test Bed for Automated Air Defence Control and Reporting System (ADC&RS) developed by the D&E Division of Network Centric System (NCS) Group/Air Defence Control and Reporting System/NSC SBU of BEL-Ghaziabad, for the Indian Army.

## 'Awards for Excellence' for HAL



HAL has received the Raksha Mantri's award's under the categories of ‘Excellence in Performance’, ‘Innovation’, ‘Indigenisation and Design Efforts’ and ‘Best Performing Division’. The award for ‘Excellence in Performance for the year 2015-16’ was received by T Suvarna Raju, CMD-HAL along with V M Chamola, Dir (HR) and CV Ramana Rao Dir (Fin) from Defence Minister Arun Jaitley.

HAL's Aircraft Upgrade Research and Design Centre (AURDC), Nasik was given the RM's award for ‘Design Effort’ and ‘Innovation’ in the group/individual category for the year 2014-15 and 2015-16 respectively, received by D K Venkatesh, Dir (Engg, R&D). The RM's award for ‘Innovation’ for successful completion of integration of BrahMos Missile on Su-30MKI aircraft was received by Daljeet Singh, CEO (MiG Complex). The RM's award for ‘Excellence in Indigenisation for the year 2015-16’ was presented to HAL's Engine Division-BC, for ‘Low Pressure Compressor Vane-1 Assembly’ of Adour Mk-871 engine and received by R Kaveri Renganathan, CEO (BC)-HAL. Award for ‘Best performing Division of DPSUs for the year 2014-15’ was given to HAL's Avionics Division, Hyderabad.



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## HAL MoU with MoD



On 12 July 2017, T Suvarna Raju, CMD-HAL signed a Memorandum of Understanding (MoU) with Ashok Kumar Gupta, Secretary, Department of Defence Production for the financial year 2017-18, which outlines targets on various performance parameters for the Company during the year 2017-18. The revenue from operations has been targeted at Rs. 17,900 crores, the highest ever. HAL has also laid specific emphasis on capacity building, modernisation, solar power plants, aiming to achieve capital expenditure of Rs. 1300 crores, besides focussing on 'Make in India' projects such as Hindustan Turboprop Trainer-40 (HTT-40), Light Combat Helicopter (LCH) and Light Utility Helicopter (LUH). Among the important milestones targeted to be achieved include clearance by DGCA for civil version of the Dornier 228, Jaguar DARIN-III and Mirage 2000 upgrade.

## HAL LUH (PT-2) in maiden flight

Maiden flight of the second prototype of HAL's Light Utility Helicopter-PT-2 was made on 22 May 2017 at Bengaluru, with Chief Test Pilots Wg Cdr Unni K Pillai and Wg Cdr Anil Bhambhani at the controls. The LUH PT2 has a modified tail boom and incorporates improvements based on feedback from testing of LUH PT1. The first flight of PT1 was carried out in September 2016 and further envelope expansion flights are in progress. HAL plans to carry out further flight testing on PT1 and



PT2 in the months ahead so as to freeze the helicopter configuration by end of 2017. The LUH has a glass cockpit and will be deployed for reconnaissance, surveillance roles and as a light transport helicopter, being powered by TM/HAL Ardiden 1U/Shakti 1U single turbo shaft engine.

## Tata Advanced Systems deliver CH-47 Chinook assemblies

Tata Advanced Systems Limited (TASL) have delivered the first crown and tailcone assembly for the Indian CH-47F Chinook helicopter. Manufactured by TASL in Hyderabad, the parts will be delivered to Boeing for final assembly of the 15 helicopters on delivery to the Indian Air Force. Deliveries will begin in 2019. TASL is already delivering crown and tailcones for CH-47 Chinook helicopters for the US Army and international customers. The CH-47F Chinook is the advanced multi-mission helicopter which is being operated by the US Army and 18 other defence forces around the world.

## DRDO's Aeronautical Test Range inaugurated



Defence Minister Arun Jaitley inaugurated DRDO's Aeronautical Test Range facilities at Challakare, Chitradurga on 28 May 2017. Speaking on the occasion the Minister emphasised that this major national facility would well serve the country's defence preparedness. He was optimistic that the high tech entities being set up would give a major boost to the eco system of this region and enable it to "earn a place in the global map". ATR is the key facility for integrating and testing various Unmanned Aerial Vehicles as well as to test various aeronautical systems being developed by the Aero Cluster Laboratories of DRDO.

## BMP-2s to be upgraded

The MoD has awarded the Ordnance Factory Board (OFB) and Bharat Electronics (BEL) a major contract for upgrading 693 BMP-2 infantry combat vehicles (ICVs). According to



a statement, “The Ministry has approved the upgrade and modernisation of armoured fighting vehicles in the ‘Buy Indian (Indian designed, developed and manufactured)’ category, at a cost of Rs 2,400 crore”. In awarding the contract to the OFB-BEL combine, the ministry “ignored” multiple private sector requests for competitive tendering, which would allow private firms to continue their work in developing thermal imagers and integrated fire-control systems for the army’s BMP-2s.

### Quick-reaction missile test-fired



On 3 July 2017, the indigenously developed Quick Reaction Surface-to-Air short range missile (QRSAM) was test-fired from a test range in Odisha. The missile has a range of 25 to 30 km and involves an all-weather weapon system capable of simultaneous tracking and firing. The missile was test-fired from a truck-mounted canister launcher from launch complex-3 at the Integrated Test Range (ITR) at Chandipur, near Balasore. “All technologies and sub-systems incorporated in the sophisticated missile have performed well, meeting all mission requirements,” stated the DRDO.

### New indigenous assault rifle

The Indian Army has commenced user trials of a new, indigenously developed assault rifle being developed to replace the problem-prone INSAS, even as it is evaluating other options globally. The search for an assault rifle began in 2010 and continues till date with firms like Colt and Sig Sauer from the US, Israel’s IWI, Italian Beretta and Ceska from the Czech Republic being



short listed. The new indigenous rifle (7.62mm x 51mm) has been developed by the Rifle Factory Ishapore (RFI), West Bengal, in association with the DRDO and is in line with the Army’s staff quality requirements (SQRs). “Until about a year-and-a-half ago, the Army wanted a 5.56mm category of rifles, the same class as the INSAS. However, with changing threat perceptions and increasing terrorism and other factors, the doctrine has changed and they now require a ‘shoot-to-kill’ weapon, something that can kill and not just incapacitate enemies as earlier,” according to SC Bajpai, Chairman Ordnance Factory Board.

### PPP and SPs for small arms sector

On 30 May, the Ministry of Defence announced the proposal to bring four defence hardware manufacturing items under the PPP (public-private-participation) model, in keeping with the central government’s intent to increase private participation in the sector. This was announced at a meeting chaired by Ashok Kumar Gupta, Secretary (Defence Production) and Ordnance Factory Board Chairman S C Bajpai. “While there were indications of privatisation in general, a member of the Niti Aayog proposed that four small arms factories be converted into PPP units,” according to the statement. The four units identified for the PPP model are Small Arms Factory (SAF) in Kanpur, Ordnance Factory Tiruchirappalli (OFT), Rifle Factory Ishapore (RFI) in Bengal and Ordnance Factory Korwa in UP. Sources, however, added that no private player had been identified yet. The four factories manufacture 9mm carbines, 7.62mm rifles, light machine guns (5.56mm), rifles (5.56mm), artillery guns and other infantry weapons.

### AUSINDEX-17

Indian Naval Ships *Jyoti*, *Shivalik* and *Kamorta*, on a port visit to Freemantle, Australia participated in the AUSINDEX-17, held 13-17 June 2017, being the second edition of bilateral maritime exercises between the two navies. The exercises aimed to increase interoperability and are in consonance with the growing cooperation between the two countries. Indian Naval assets have been increasingly deployed in recent times to address the main maritime concerns of the region. In addition, considering the Indian Government’s vision of SAGAR (*Security and Growth for All in the Region*), the Indian Navy has also been involved in assisting countries in the Indian Ocean Region with EEZ Surveillance, Search and Rescue, and other capacity-building and capability-enhancement activities.



### L&T launches Navy's floating dock

On 20 June 2017, Larsen & Toubro launched a Floating Dock (FDN-2) designed and built for the Indian Navy at Kattupalli shipyard, near Chennai. L&T was mandated by the Ministry of Defence in May 2015 to design and build the FDN-2 for an order value of Rs. 468 crores. The Floating Dock will be delivered at Port Blair and put through a series of harbour trials before delivery to the Navy. Once operationalised, it would enhance the technical repair infrastructure of the Navy for ships based at the Andaman & Nicobar Islands as well as for visiting Naval ships. The Floating Dock is 185m long and 40m wide, and is designed for docking warships and submarines of up to 8000 tonnes displacement with draughts of up to 7 m, during both day and night and is provided with a hauling-in system to handle a ship's docking and undocking operations. It can also support ships berthed along side and meet their logistics requirements.

### Sea trials of INS Khanderi



INS *Khanderi*, the second of six *Scorpene*-class submarines being built in India at MDL in collaboration with DCNS of France, has commenced trials from Mumbai for her maiden sea sortie. It was also the first major trial for her propulsion plant and an important milestone in the construction programme, which has moved the submarine a significant step closer to her induction by the Indian Navy later this year. She will now be put through

her paces via a rigorous set of trials, which are designed to test her operating envelope to the maximum. The first *Scorpene*, INS *Kalvari*, is presently being prepared for delivery in July / August 2017, after having been put through a gruelling set of trials over the past one year, including successful live missile and torpedo firings.

### Air India Delhi to Washington direct flight



The first non-stop Air India flight from Delhi to Washington DC took place on 7 July. The flight, AI 103, was accorded a water cannon salute and traditional gate-side prayer ceremony upon its landing. Indian Ambassador to the US Navtej Singh Sarna, Air India Chairman and Managing Director Ashwani Lohani and Commercial Director of Air India Pankaj Shrivastava were among passengers on the inaugural flight to Washington.

Air India has deployed its 238-seat Boeing 777-200LR aircraft to cater to the new direct service to the US, with eight seats in first class, 35 in business and 195 in economy class. The non-stop flight service is expected to bring in additional 30,000 leisure and business travellers and USD 30 million annually to the National Capital Region.

### Over 1000 airliners on order by Indian carriers

With over 1,000 airliners on order or option, India is poised to become the third-largest buyer of commercial passenger aircraft in the world after the US and China. The aircraft order book of the Indian airline industry will soon touch 1,080, which would mean that for every aircraft in service, there will be 2.2 aircraft on order, according to a report released by the *Centre for Asia Pacific Aviation (CAPA)*. There are an estimated 480 airliners in service at present, with another 880 on order, most of these placed by low-cost carriers such as IndiGo and SpiceJet. Jet Airways and Vistara are expected to add to the total and take this to a four-digit number even as more than 700 are scheduled for delivery within the next decade, and 400 within the next five years.

In March 2017, India became the third-largest domestic aviation market in the world, surpassing Japan. India's domestic air passenger traffic stood at 100 million in 2016 and was only behind the US (719 million) and China (436 million). In the year ended 31 March 2017, Mumbai airport surpassed London's Gatwick to become the world's busiest airport with a single runway.

## SpiceJet commit to purchase 40 Boeing 737 MAX



SpiceJet and Boeing have signed a memorandum of understanding for 40 737 MAX airliners. The agreement, valued at approximately \$4.74 billion, is split evenly between 20 new orders for the 737 MAX 10 and conversions of 20 of the low-cost carrier's 737 MAX 8 airliners of its current order to 737 MAX 10s. "As a Boeing 737 operator and current customer of the 737 MAX, we are proud to be a part of the launch of the 737 MAX 10 and to be the first airline in India to order this newest version of the 737, which will enable us to maximise revenue on our dense routes while having a lower unit seat cost," stated Ajay Singh, Chairman and Managing Director, SpiceJet. "With the introduction of our 737 MAXs next year, we will be able to further expand our network, while keeping our costs low for our customers". SpiceJet operates a fleet of 35 Next-Generation 737s and 19 Bombardier Q400s. The carrier plans to grow its operational fleet to 100 airliners by 2020 and looks to expand regionally with the new 737 MAX family. SpiceJet will take delivery of its first 737 MAX in 2018.

## More Bombardier Q400s for SpiceJet

SpiceJet has also signed a letter of intent (LOI) with Bombardier Commercial Aircraft for up to 50 Q400 turboprop airliners and purchase rights on an additional 25 aircraft. "I am delighted to announce this new order for 50 Q400 planes. SpiceJet operates India's largest regional fleet and is the only organised operator in this space," said Ajay Singh, Chairman and Managing Director,



SpiceJet. SpiceJet operates a fleet of 35 Next-Generation 737s and 20 Bombardier Q400s. Since 2010, SpiceJet has taken delivery of 15 Q400 aircraft and the airline currently operates 20 Q400 aircraft in a 78-seat configuration to domestic and international destinations. When concluded, this fleet expansion will provide SpiceJet the ability to grow profitably and leverage the robust demand forecast in the world's fastest growing regional aviation market.

## Vistara receives first A320neo



Airbus has delivered the first A320neo to Vistara, first of seven aircraft to be leased from BOC Aviation. The aircraft sports a unique A320neo Vistara star symbol livery on its underbelly. The CFM-powered aircraft is configured in a three-class layout with 158 seats (8 business class, 24 premium and 126 economy class). According to Vistara, they have taken inputs from the growing number of frequent fliers and redesigned the cabin with even more comfort and relaxing features such as mood lighting and increased seat pitch. Vistara currently operates 13 A320 aircraft on domestic India routes.

## IndiGo wins Airbus' 'Best Operational Excellence Award'

IndiGo has been awarded the 'Best Operational Excellence' award by Airbus for the second consecutive year at a worldwide level, outperforming 46 airlines of international repute. IndiGo's

consistent performance in effective utilisation of its Airbus A320 aircraft and maintenance of top-notch dispatch reliability has given the company this recognition amongst established global carriers at the A320 Family Symposium. The selection criteria for the award is based on data covering two years of operation and taking into consideration number of aircraft in the fleet, daily utilisation rate, technical reliability and the number of delays caused due to operational reasons. With a fleet of 134 aircraft, IndiGo operates the largest single-aisle A320s and A320neo fleet in India.

## GMR in BOT for new airport in Crete

**G**MR Airports Limited has been selected to develop, operate and manage the new international airport of Heraklion at Crete in Greece in partnership with Greek infrastructure firm Terna SA. This will be the second project to be handled by this subsidiary of GMR Infrastructure Ltd in Europe, after it developed Istanbul's Sabiha Gokcen airport. The company will be the designated airport operator in the consortium for this project. "The scope of the project involves design, construction, financing, operation, and maintenance and exploitation of the New Heraklion Crete International Airport. The concession period for the project will be 35 years, including phase 1 construction of five years."

## Air India to defer fleet expansion ?



**A**ir India has reportedly put fleet expansion plans on hold after the government initiated talks on privatising the company that has run up debts of Rs 55,000 crore. Senior Air India executives confirmed that discussions on buying new aircraft were shelved after the aviation ministry said that the airline's fate is being discussed by the finance ministry. "The aviation ministry has asked us not to go ahead with any expansion plans because the government has started a discussion on the privatisation," said an Air India official. "While we cannot hold back on induction of aircraft that were already committed, we have immediately put on hold discussions on getting new aircraft."

The airline was otherwise in the process of adding 17 aircraft, 10 more ATRs for Alliance Air and 7 more Airbus 320 neos (new

engine options) for Air India to strengthen its short haul regional and international presence. Presently, the company is adding 10 ATR aircraft for Alliance Air and 22 Airbus 320 (neos) for Air India, the induction of these 32 aircraft being already committed.

## Investigations on Air India-Indian Airlines merger

**T**he CBI is investigating some major decisions made on Air India when the United Progressive Alliance was in power, including the merger of Air India and Indian Airlines, purchase of 111 airliners by the national carriers and giving away of profitable routes to private (rival) airlines. In a statement, the CBI said it started the probe following orders from the Supreme Court. Air India had placed an order for 111 aircraft: 68 from Boeing and the balance from Airbus. According to the statement, the purchase for about Rs 70,000 crore caused an "alleged financial loss" to the "already stressed" national carriers. The third FIR, filed against unknown officials of the civil aviation ministry and Air India for giving up profit making routes, said this had caused a huge loss to the national carrier. The agency is making an inquiry into the role of unknown officials in the civil aviation ministry in the 2007 deal to merge the two airlines, allegedly causing a loss of Rs 10,000 crore. Air India and Indian Airlines were merged to create Air India despite opposition from both state run airlines.

## SpiceJet launches two flights under UDAN

**O**n 13 June 2017, SpiceJet announced the launch of two flights under the UDAN (*Ude Desh ka Aam Naagrik*) scheme starting from 10 July, connecting Mumbai to Porbandar and Kandla in Gujarat. Ajay Singh, Chairman SpiceJet stated, "It has been our constant endeavour to enable the common man to fly since we began operations 12 years back. We will connect many more small towns and cities in times to come".

## Options for disinvestment of AI

**T**he government of India is looking at three options for Air India's disinvestment, including holding up to 49% in the national carrier, even as it is almost certain to take over a large part of the debt burden to make the airline more attractive for buyers. Sources said that while there has been a recommendation to completely exit the perpetually loss-making airline, another possible route to follow is "the Maruti model," where the government handed over majority control to Suzuki, for which it received a premium. Later the government reduced its stake further through a public issue. A portion of government shares were also sold to Indian banks and financial institutions through a bidding process, which was more like warehousing them before being off loaded in the markets.

The Air India divestment has gathered momentum with NITI Aayog recommending up to 100% stake sale, along with writing off debt. Finance minister Arun Jaitley too has backed the idea and has

held at least one round of consultations with civil aviation minister A Gajapathi Raju, with sources indicating that the entire process will be “speeded up”. Reportedly, “various options are being looked into and a final decision will be taken by the Union cabinet.” But the civil aviation ministry has to decide if foreign airlines will be permitted to hold a majority stake in the airline.

## Delta Airlines examining stake in Jet Airways

Jet Airways is increasing its relationship with Delta Airlines, which reportedly could even mean the US carrier picking up a stake in Jet Airways, in which Abu Dhabi’s Etihad Airways already owns a 24 per cent stake. However, Jet Airways are fine-tuning plans for a commercial joint venture with Delta and Air France-KLM. Separately, Jet Airways Chairman Naresh Goyal is reportedly discussing further fund-raising with the Etihad management.

## Air Asia India to commence international flights



AirAsia India aim to scale up to a fleet of 20 aircraft by September-October 2017 and commence international operations thereafter, according to its CEO Amar Abrol. AirAsia India currently has a fleet of 10 Airbus A320s. Abrol said the initial international destinations in the airline’s plan would naturally be those in Southeast Asia, the stronghold of its parent Air Asia Berhad. As a precursor, the airline is launching *Fly-Thru*, a service which facilitates seamless check-in for passengers through to the final destination. Abrol said this is in its testing stages. Air Asia India would stick to its earlier target of doubling revenue and passenger traffic this year although he declined to give any projection on profitability.

## Safran and Maini Precision Products in LEAP engine contract

Safran Aircraft Engines have contracted with Bengaluru-based Maini Precision Products MPP to manufacture low-pressure turbine (LPT) guide vanes for LEAP engines. Dominique Dupuy, Senior Vice President for Purchasing at Safran Aircraft Engines, and Gautam Maini, Managing Director of Maini Precision Products

Limited, signed this ten-year contract, with Bruno Durand, Senior Vice President, Manufacturing & Supply Chain, Safran Aircraft Engines, also in attendance. These sophisticated guide vanes will be manufactured at a new MPP plant now under construction in the Bommasandra Industrial Area in Bengaluru, and will also pave the way for Safran and Maini to examine other opportunities for the manufacture of critical aero-engine parts in India, besides significantly expanding Safran’s presence in India.

## Wipro and Israel Aerospace to make aircraft structures

Wipro Infrastructure Engineering (WIN), a unit of Wipro Enterprises, and Israel Aerospace Industries (IAI) are to make composite aerostructure parts and assemblies for various aircraft. Wipro Enterprises is a unit of information technology (IT) services major Wipro and focuses on two major businesses: consumer care and industrial engineering & aerospace. The strategic alliance was announced during Prime Minister Narendra Modi’s three-day visit to Israel (4-6 July), the first by an Indian prime minister. A spokesperson of Wipro said: “The facility will make composite structures in India for global markets and address the compliance requirements of IAI, other OEMs (original equipment manufacturers) and Tier-1 suppliers to meet defence offset guidelines detailed by the Ministry of Defence, Government of India.”

## Lockheed Martin and Tata partner for F-16s

During the Paris Air Show in June 2017, Lockheed Martin and Tata Advanced Systems Limited (TASL) signed a letter of intent to produce the F-16 Block 70 in India. “This agreement builds on the already established joint venture between Lockheed Martin and Tata and underscores the relationship and commitment between the two companies,” stated N. Chandrasekaran, Chairman of Tata Sons. This was supported by Orlando Carvalho, executive



vice president of Lockheed Martin Aeronautics, who stated that “Our partnership significantly strengthens the F-16 ‘Make in India’ offer, creates and maintains numerous new job opportunities in India and the US, and brings the world’s most combat-proven multi-role fighter aircraft to India.”

In the picture are seen Sukaran Singh, CEO/MD of Tata Advanced Systems Limited and George Standridge, VP Strategy and Business Development, Lockheed Martin Aeronautics, in presence of Ratan N Tata, Chairman Emeritus, Tata Sons and Orlando Carvalho, Executive Vice President, Lockheed Martin Aeronautics.

## CBRN support equipment

The US State Department has approved a possible Foreign Military Sale to the Government of India for CBRN support equipment at an estimated cost of \$75 million. The Government of India (GoI) has requested 38,034 M50 general purpose masks; Joint Service Lightweight Integrated Suit Technology (JSLIST), which consists of 38,034 each suits, pairs of trousers, pairs of gloves, pairs of boots and NBC bags; 854 aprons; 854 alternative aprons; 9,509 Quick Doff Hoods and 114,102 M61 filters. Also included in the potential sale is training; technical data; US Government technical assistance; staging/consolidation; transportation; and other related elements of logistics support.

## Tata Power SED to supply CIBMS to BSF

Tata Power’s Strategic Engineering Division (Tata Power SED) will supply Comprehensive Integrated Border Management System (CIBMS) to the Border Security Force (BSF) for round the clock surveillance of Indian borders and to ensure that the ‘Area of Interest’ is kept under vigil. The Comprehensive Integrated Border Management System (CIBMS), an indigenously designed & developed System will not only boost ‘Make in India’ initiative, but also allow BSF to have in-country lifecycle support & upgrades. Furthermore, Tata Power SED will be in position to extend the system to all types of terrain as and when required by the BSF.

## Thales and Reliance Defence JV on Rafale programme

Thales and Reliance Defence Limited have formed an Indian Joint Venture (JV) with the proposed share holding of 49% and 51% respectively. Leveraging Thales offset commitment as part of the massive Rafale contract, “the JV is to develop Indian capabilities to integrate and maintain radar and electronic warfare sensors and to develop skills and activity in the Special Economic Zone of Mihan-Nagpur together with an Indian supply chain for the manufacturing of microwave technologies and high performance airborne electronics”.

In related news, Dassault Aviation along with its partner Reliance Defence hosted some 200 delegates from the aerospace industry, from different parts in India representing over 60 Indian



companies and 25 French companies in New Delhi on 14 June 2017. This event in cooperation with Rafale Industrial Partners including Thales, Safran and MBDA was to promote Business to Business (B2B) interactions between the French and Indian aerospace manufacturers “to deepen existing links, create new opportunities of collaboration and work towards establishing a full-fledged defence manufacturing eco-system in India”.

## Air Marshal PN Pradhan is DCIDS (OPS) at IDS

Air Marshal PN Pradhan AVSM took over as Deputy Chief of Integrated Defence Staff (Operations), HQ IDS on 12 May. Commissioned as a pilot in the transport stream of the Indian Air Force in 1981, he qualified on all operational roles, especially in forward areas and ALGs in the North-East and J&K. He is a Qualified Flying Instructor and has been a pilot examiner on the Boeing 737 and An-32 aircraft and was closely associated with the induction and operationalisation of Embraer-135, BBJ and C-130 in the IAF. He has had four command tenures including command of two operational bases & an Air Force Selection Board. He has held several important appointments at Command and Air Headquarters which include Assistant Chief of Air Staff (Transport and Helicopters) and Assistant Chief of Air Staff (Personal Airmen & Civilians) at Air Headquarters and as the Senior Air Staff Officer of Southern Air Command.





**VCAS flies the MiG-21**

Seen in this picture is Vice Chief of the Air Staff, Air Marshal SB Deo, who flew in a MiG-21 trainer during his visit to the Aircraft & Systems Testing Establishment (ASTE) at Bangalore. The Establishment was originally formed as the A&ATU at Kanpur on 23 August 1972 and later renamed as the ASTE. The present Dy Chief of Air Staff, Air Marshal R Nambiar was Commandant of ASTE till his promotion.

## Moon mission of 'Team Indus'

*Team Indus*, the private Indian initiative to land a Rover craft on the Moon, aims to raise \$40 million through a mix of corporate sponsorship and crowd funding before its scheduled lunar rover mission launch in December. The aerospace startup, which has been financially backed by a host of senior personalities including Ratan Tata, Nandan Nilekani, Sachin Bansal and Binny Bansal, as also Accel Partners', Subrata Mitra and Shekhar Kirani, has raised \$20 million so far in equity funding and another \$20 million in payload partnerships for carrying third party payloads in the spacecraft.

Founded in 2011 by IIT-Delhi alumnus Rahul Narayan, Team Indus is part of the Google Lunar XPrize competition to land a privately-funded rover on the Moon by December. It will carry 11 payloads in the spacecraft along with its own rover. The spacecraft and rover are under construction at the National Aerospace Laboratories (NAL) but the final assembly of the rover and spacecraft will happen at the Team Indus facility in North Bengaluru.

Team Indus is supported by companies including Tata Communications, L&T Engineering and Saskaen, as also many current and former ISRO scientists. The company sees a huge opportunity in beefing up its knowledge in launching and managing communication satellites, given the explosive growth in communication in India. "We have also built strong relationships with the space agencies of France, Japan and the UAE," Narayan said.



# INDIA IN SPACE

## GSLV MkIII launches GSAT-19

The first developmental flight (GSLV MkIII-D1) of India's heavy lift launch vehicle GSLV Mk-III was successfully conducted on 5 June from Satish Dhawan Space Centre SHAR, Sriharikota with the launch of GSAT-19 satellite. This first orbital mission of GSLV MkIII was mainly intended to evaluate the vehicle performance including that of its fully indigenous cryogenic upper stage during the flight. Weighing 3136 kg at lift-off, GSAT-19 is the heaviest satellite launched from India.

After a 25.5 hour smooth countdown, the mission began with launch of the 640 ton GSLV Mk-III at 5:28 pm IST from the Second Launch Pad as scheduled with the ignition of its two S200 solid strap-on boosters. Following this, the major phases of the flight occurred as scheduled. The upper stage of GSLV MkIII vehicle is a new cryogenic stage (C25) indigenously configured, designed and realised by ISRO. The cryogenic stage used liquid hydrogen and liquid oxygen as propellants with a



GSLV-Mk III D1 on its way to Launch Pad



Lift off!

total loading of 28 tons, the stage powered by a 20 ton thrust cryogenic engine (CE20) operating on 'gas generator cycle'. The performance of the engine and stage during the mission was "as predicted." About sixteen minutes after lift-off, GSAT-19 satellite was successfully placed in orbit.

Soon after its separation from GSLV, the Master Control Facility (MCF) at Hassan in Karnataka assumed control of the satellite. GSAT-19 is a high throughput communication satellite.

Over the next few days, the GSAT-19 orbit was raised from its Geosynchronous Transfer Orbit (GTO) to the final circular Geostationary Orbit (GSO) by firing the satellite's Liquid Apogee Motor (LAM) in stages. During the final phase of this operation, the solar panels and antenna reflectors of the satellite were deployed.

### HAL as key partner in GSLV Mk III

All structural assemblies and propellant tankages of GSLV Mk III were produced at HAL's Aerospace Division, including the tallest ever Payload Fairing which protected all the sensitive crucial equipment during the launch phase. T. Suvarna Raju, CMD of HAL said that HAL's Aerospace Division was the only facility available in the country that manufactured such huge space worthy complex structures. "We congratulate Space Voyagers of India - Indian Space Research Organisation (ISRO) for its successful launch", he added. Twenty types of riveted structure, six types of welded structure and GSAT-19 bus structure were manufactured at the Aerospace Division of HAL and delivered in time for the GSLV MKIII D1 mission. The fabrication of the composite OPLF Heat shield (Ogive Payload Fairing) which is five metres in diameter and 11 metres in height is "a significant achievement."

HAL and ISRO have a five decade old partnership "which is growing stronger by the day." HAL contributes significantly to ISRO programmes - the PSLV, GSLV Mk II and GSLV Mk III - by way of supplying light alloy structures, tankages and satellite bus bars. "HAL has acquired new capabilities and modernised its facilities continuously over time to develop next generation hardware for future space missions." Currently the booster rockets of GSLV MKII integrated by HAL are used directly on the launch pad.

# PSLV-C38 launches 31 satellites in a single flight

ISRO's Polar Satellite Launch Vehicle PSLV-C38 launched the 712 kg Cartosat-2 Series Satellite along with 30 co-passenger satellites on 23 June from Satish Dhawan Space Centre SHAR, Sriharikota, this being the 39<sup>th</sup> consecutively successful PSLV mission.

PSLV-C38 lifted off at 0929 hrs from the First Launch Pad. After a flight of about 16 minutes, the satellites achieved polar Sun Synchronous Orbit of 505 km inclined at an angle of 97.44 degree to the equator (very close to the intended orbit) and in the succeeding seven and a half minutes, all the 31 satellites successfully separated from the PSLV in a predetermined sequence beginning with Cartosat-2 series satellite, followed by NIUSAT and 29 customer satellites. The total number of Indian satellites launched by PSLV now stands at 48.

After separation, the two solar arrays of Cartosat-2 series satellite were deployed automatically and ISRO's Telemetry, Tracking and Command Network (ISTRAC) at Bangalore took over the control of the satellite. The satellite will be brought to its final operational configuration following which it will begin to provide various remote sensing services using its panchromatic (black and white) and multispectral (colour) cameras.



*Hoisting of PSLV-C38 second stage during vehicle integration*

One of the 30 co-passenger satellites carried by PSLV-C38 was the 15 kg NIUSAT, a University/Academic Institute satellite from Nurul Islam University, Tamil Nadu, India. The remaining 29 co-passenger satellites carried were international customer satellites from USA (10), United Kingdom (3), Belgium (3), Italy (3), Austria (1), Chile



(1), Czech Republic (1), Finland (1), France (1), Germany (1), Japan (1), Latvia (1), Lithuania (1) and Slovakia (1).

With this successful launch, the total number of customer satellites from abroad placed in orbit by India's workhorse launch vehicle PSLV has reached 209.



*Panaromic view of fully integrated PSLV-C38 seen with mobile service tower*



Boeing F/A-18s

# Super Hornet offered to Indian Navy

On 30 May 2017, at a two-day seminar on ‘Building India’s Future Navy,’ Chief of the Naval Staff, Admiral Sunil Lanba, noted that the Navy’s Request For Information (RFI) regarding 57 ‘Multi Role Carrier Borne Fighters’ (MRCBF) had received responses from four foreign OEMs. Naval officials later confirmed that these were RAC-MiG, which has already supplied 45 MiG-29K/KUBs to the Navy, Dassault with the Rafale M,

Boeing with the Super Hornet and Saab with the Gripen Maritime. Admiral Lanba also re-iterated his hope to see the programme was completed within “the next four to five years” (i.e. by 2021-2022), and stated that IAC-1, which would be the first IN carrier to operate the MRCBF, was expected to enter sea trials in late-2018 or early-2019, before being commissioned and worked up to operational status over the next few years.

The MRCBF RFI broadly called for a day/night and all-weather capable fighter, to be employed for Air Defence (AD), Air to Surface Operations, Buddy Refuelling, Reconnaissance, and Electronic Warfare (EW). The document also made clear that the MRCBF would be required to operate from the STOBAR IAC-1 and CATOBAR IAC-2.

Boeing’s Dan Gillian, Vice President, F/A-18 and Electronic Attack programmes at Boeing spoke on ‘Transformation in Aviation Sector: Challenges and Opportunities for the Aerospace Industry’ at the seminar in May, making a detailed presentation on ‘Next Generation Carrier Base Fighters,’ with a focus on the Company’s Super Hornet offering, in particular the recently-approved Block III configuration. The new specification, according to Gillian, “enhances the existing Block II’s survivability by including an advanced cockpit system, long-range detection with Infrared Search and Track and longer range with conformal fuel tanks.” He also noted that Boeing “can and will improve the Super Hornet’s stealth performance as part of this package.” Opining that fighters of the future will need to be “networked and survivable,” Gillian highlighted the ability of the Block III Super Hornet “to be a ‘smart node’ on the network” with new capabilities being incorporated from the EA-18G Growler programme, such as a new computer, the Distributed Targeting Processor-Networked (DTP-N), and a new high-bandwidth data link called TTNT.



## Seminar on

# Defence and National Security

*The 11<sup>th</sup> Edition of what is now regarded as an important part of regular discourse on India's Defence and National Security matters was held at the historic Kasauli Club in the Simla Hills on 13 June 2017. As earlier, the Vayu Aerospace Review supported the function and its role in recording and analysing matters concerning the country's defence was appreciated by convener of the Strategic Studies Cell, Lt Gen Kamal Davar (retd), who was the first Director General of the Defence Intelligence Agency (DIA).*



*Lt Gen Kamal Davar and Brigadier Sharma at the Kasauli Club Seminar*



*Vayu was the supporting media at the Seminar*

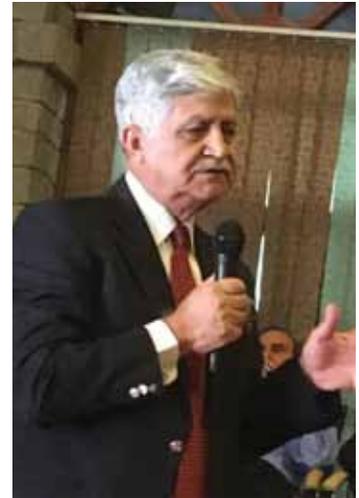
**F**ormer Chief of Army Staff, General VP Malik (retd), in his keynote address on 'Contemporary Security Challenges facing India', highlighted the changing defence scenario in the light of China and Pakistan's growing alliance. He said there was an urgent need to enhance the budget of the defence sector and involve its officers in strategic decision-making.

Lt Gen Balraj Nagal (retd), former GOC-in-C, Strategic Forces, gave a well-supported talk on 'Evaluating India's Nuclear Deterrence: Future Perspectives' and apprised the gathering about the defence preparedness of India's key neighbours, China and Pakistan. His presentation was supported by an overview of China's nuclear forces, their delivery systems, missile bases in China, particularly those relevant to India, as also those of Pakistan, whose Army Strategic Forces Command is India-specific.

A perspective on 'Media and National Security' was presented by Dr Harish Khare, Editor-in-Chief of *The Tribune* group of newspapers. He said the inept handling of crisis situations by a section of the media had derailed crucial decision-making in the past. Certain defence officers, he felt, need not add to the ugliness of the political system by making frequent high-pitch television appearances. He said the defence authorities were losing their sheen through such actions and thus losing the moral edge they enjoyed in the nation.

Vice Admiral Shekhar Sinha, former FOC-in-C Western Naval Command and CIDS, dwelling on the 'National Security - The Maritime Domain', said the unresolved border disputes with China and Pakistan were the key issues in shaping the Indian Ocean region strategy and the need of the hour was to engage China through economic and trade ties rather than confront it. He flagged some dangers ahead, with China now making strategic inroads in the strategic Maldives Island chain, akin to what it is attempting in the South China Sea.

The present GOC-in-C, Western Command, Lt Gen Surinder Singh made an clear statement to the distinguished gathering, which included a large number of retired senior army officers and members of the Club, stating that the defence forces were well-equipped to handle the challenges posed by hostile neighbours and are confident of facing challenges as they appear. However, the real problems of the country remain poverty alleviation, meaningful employment of the increasing population as also countering fundamentalist threats of various kinds.



*General VP Malik, former COAS, making his keynote address*



*Lt Gen Surinder Singh, GOC-in-C Western Command speaking to the audience*

# A NEW ERA IN



# INDIA-ISRAEL RELATIONSHIPS

On 4 July 2017, Prime Minister Narendra Modi arrived in Israel on a State visit and was received by his Israeli counterpart Benjamin Netanyahu. This has certainly heralded a new era in the political ties between the two nations, exemplified by the manner in which Israel rolled out the red carpet for the Indian Prime Minister. Only a select few world leaders have received such a grand reception at Ben Gurion International Airport, the others being President of the United States and the Pope. Israeli Prime Minister Benjamin Netanyahu and his Cabinet were on the tarmac to greet Modi as he exited his Air India Boeing 747 in Tel Aviv.

As political observers opined, “If diplomacy can generate national catharsis, then Prime Minister Narendra Modi has achieved it with his epic visit to Israel. By treading with aplomb in a country where not one of his 13 predecessors dared set foot, he has simultaneously redefined India’s external self, and vindicated Israel’s identity. Gone are the diffidence and the gingerliness that previously defined how India interacted with Israel. In their place, Modi has injected

confidence and certitude about wearing India’s choices and national interests on its sleeves. Banished are the overcautious, hypocritical and domestically poisoned lenses for approaching Israel, and ushered in are bold, dispassionate and objective ways of handling this key West Asian power.”

Prime Minister Modi’s crossing of the ‘Rubicon’(as it were) by visiting Israel is the finishing touch to a saga of 25 years of

progressively warming bilateral relations. From that day when India’s then Prime Minister PV Narasimha Rao decided to end the Cold War-era estrangement and launch full diplomatic ties with Israel in 1992, the two countries have never looked back. Steadily over the years, Israel climbed up the ranks as India’s most trusted national security partner and defence supplier. The latter was forged virtually on the frontlines



*The two leaders inspect the Israeli Guard of Honour*



IAI is honored  
to welcome the  
Prime Minister of India  
**Shri Narendra Modi**  
on his historic visit  
to Israel

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WHEN RESULTS MATTER

during the Kargil conflict in 1999 when Israel pulled out all stops to provide the Indian Air Force with advanced systems enabling laser-guided bombs to be launched against key targets in the high mountains.

Ties between India and Israel have accumulated and remain unaffected by New Delhi's continued support for Palestinian statehood and its strategic equation with Israel's *bête noire*, Iran. The Indian PM has accomplished far more with Israel than merely flying the flag in the country. Under his leadership, India has signed with Israel one of its most vital defence deals, for surface-to-air missiles, while opening up a number of new vistas for cooperation including innovative technology transfer.

As per commentators, "Modi has also twinned his 'Make in India' with Israel's 'Make with India', positing Israel as a core partner for India's economic modernisation. Geopolitically, Modi has completed a full circle with his much-awaited Israel trip. His personal diplomacy with Gulf Arab nations, Turkey and Iran in the past three years have yielded material benefits for India. But there was this little chink in his 'Look West' policy armour — the most powerful West Asian state, Israel, was eagerly awaiting his presence. Now that Modi has done that, been there, the natural partnership has been freed from a sense of incompleteness and will gallop exponentially."

PM Modi's three-day trip covered the breadth of Israeli industry from agricultural and water management to tech startups and commerce. Seven major agreements were signed, dealing with water, agriculture and space technology, the two countries also creating a \$40 million dollar research and development fund for joint innovation.

Amongst the historical – or sentimental – programmes for Modi and Netanyahu was to visit the Indian Army Memorial, which commemorates the role played by Indian Cavalry in the Palestine campaign of 1917-18. This was at the battle of Haifa in September 1918, perhaps the only time that a fortified city had fallen to action by horsed Cavalry. The two leaders also spent time with members of India's Jewish diaspora, a community of more than eighty thousand Jews now living in Israel who can trace their roots back to the subcontinent. A poignant meeting was with 11-year old Moshe Holtzberg, whose parents were victims of the Pak-sponsored terrorist attacks in Mumbai in 2008.

During their formal press conference, Modi and Netanyahu reaffirmed their commitment to cooperate in areas of defence and security. Israel has provided weaponry to India even before the establishment of diplomatic relations and today, about 40 percent of Israel's defence exports go to India making Israel its third largest defence supplier.

Just a few months earlier, in April 2017, Israel Aerospace Industries (IAI) announced a deal worth nearly \$2 billion making it the largest defence contract in Israel's history, the package being for sophisticated air and missile defense systems for the Indian Army.

Looking to deepen ties beyond high-dollar defence deals, the two leaders presented a series of agreements between India and Israel for cooperation on satellite technology, water and agriculture, as well as the creation of a \$40 million innovation fund. Modi vowed to increase cooperation with Israel on a wide range of fields, notably water technology, agriculture and counter-terrorism. "Israel and India live in complex geographics," Modi said. "We are aware of strategic threats to regional peace and stability. We have witnessed terror, so has Israel. Prime Minister Netanyahu and I agreed to do much more together to protect our strategic interests and also combat growing radicalisation, including in cyberspace".



Flash back to 1918: Indian Army Cavalry entering Haifa city



Prime Minister Narendra Modi at the Indian Army Memorial

According to the joint statement, both prime ministers reiterated their strong commitment to combat global terror. "They stressed that there can be no justification of acts of terror on any grounds whatsoever". The statement also hailed bilateral defence cooperation, noting that India and Israel agreed that "future developments in this sphere should focus on joint development of defence products, including transfer of technology from Israel, with a special emphasis on the 'Make in India' initiative". India is the world's biggest importer of defence equipment and Israel has become one of its major suppliers.

*With inputs from Sreeram Chaulia*

# Importance of the India-Israel relationship



Many observers have qualified Prime Minister Narendra Modi's visit to Israel as historic, with the potential to elevate the bilateral relationship to 'new heights'. However, not one of these accounts has properly defined what these 'new heights' will actually look like. The visit is symbolically overdue, as Modi was the first Indian prime minister to travel to Israel 25 years after the two countries established diplomatic relations, and 14 years after Israeli prime minister Ariel Sharon's visit to New Delhi.

One could also argue that the efforts towards diversification of ties beyond defence exchanges and improve bilateral trade figures (which have plateaued since 2013) would be welcome developments in the maturing of this bilateral relationship. However, Indian and Israeli press coverage seems to have raised expectations. Should we then expect a departure from the present transactional relationship?

It is a particularly difficult exercise to evaluate the state of India-Israel ties given the unique historical nature and evolution of this relationship. From Nehru to Modi,

India has cautiously balanced its policy towards various actors and coalitions in West Asia, at the expense of normalising its ties with Israel. Since 1992 however, both the Congress party and the BJP have developed significant defence and trade relations with Israel while also maintaining a strong commitment to the creation of a Palestinian state. Given this historical legacy, it is not clear whether the current Modi government itself has a clear idea of where it wants to take this relationship.

As chief minister, Modi had regularly expressed his admiration of Israel's military, agricultural and technological achievements, notably during a visit to Tel Aviv in 2006. For decades, the BJP also promoted a political rapprochement with Israel. In a first symbolic move, the Atal Bihari Vajpayee government welcomed Sharon to New Delhi in 2003. However, the path to Tel Aviv since Modi became prime minister in May 2014 has proven to be more arduous than anticipated. In light of Modi's personal and ideological predispositions, one would have expected a more radical tilt towards Israel.

Initially, Modi showed an interest in upgrading the relationship by regularly meeting with Israeli Prime Minister Benjamin Netanyahu, prematurely announcing his visit to Israel in June 2015, and encouraging a gradual revision of India's consistent support for Palestine in multilateral organisations. However, after originally signaling this pro-Israel shift, Modi embarked on a course correction by mid-2015 and effectively resumed the policy of multi-engagement of all relevant West Asian actors. Before traveling to Israel, Modi had visited the UAE, Saudi Arabia, Qatar and Iran. In anticipation of the Israel visit, Modi also hosted Palestinian President Mahmoud Abbas in May 2017 and reasserted India's traditional support for an independent Palestinian nation "at peace with Israel". These various developments show that the Modi government's policy towards West Asia has yet to be coherently formulated.

As a result, can we expect any substantial shift in India's position? The current transactional partnership which has emerged over the last decade holds at least four advantages. First of all, it benefits both India

and Israel, especially in the defence sector. India is Israel's biggest arms market, with an average of \$1 billion of defence sales per year. Israel has become one of India's most important weapons suppliers, after Russia and the US.

Second, unlike in the recent past, trade and defence ties have developed in isolation from the fluctuation of political events, whether these were regional crises (for instance, in Gaza) or domestic political transitions (across the Congress and BJP). Third, present ties have attracted limited uproar from regional Arab allies. Finally, the current nature of the partnership means that chief ministers and their state governments can directly seek collaborations and investments in agricultural and water technologies from Israel.

Nevertheless, there is a sentiment within some Indian elites, and certainly in the BJP, that Israel has regularly supported New Delhi in times of duress, notably by providing military and political

support during the Kargil conflict. As a consequence, this visit comes as a timely public acknowledgment of this partnership. The visit also coincides with waning support for Israel in the US and Western Europe.

Furthermore, the standalone visit from Modi, breaking with the traditional pattern of jointly traveling to Tel Aviv and Ramallah, has also been broadcast as a deliberate effort at de-hyphenating relations with Israel and Palestine. Recently, Modi also compared the post-Uri surgical strikes to covert Israeli operations, possibility indicating ways in which the Indian military could emulate Israeli forces in counter-terrorism strategies.

These public gestures should however not be interpreted as indicators that Modi will promote any type of political and strategic alliance, but rather as a public commitment to a partnership he personally values. In spite of Modi's admiration for Israel's achievements in the fields of internal security and counter-terrorism, the

structural differences between Indian and Israeli national security situations, world views (notably on Iran), and the absence of explicitly shared enemies (beyond an abstract notion of global terrorism) limit any stronger strategic rapprochement.

There has for instance not been any attempt by the current government to revive the idea formulated by the BJP's National Security Advisor Brajesh Mishra in 2003 of forming an alliance to fight the common threat of terrorism.

As a result, while observers have generally hinted at personal willingness from Modi to change India's traditional approach to the region, notably by decisively tilting towards Israel, it seems that both regional pressures and opportunities have compelled Modi to recalibrate back to a more neutral approach. That being said, given the unique nature of this bilateral relationship and of the visit, a paradigmatic shift remains a possibility.

*Courtesy : Nicolas Blarel,  
Indian Express*

## Garware-Wall Ropes and Israel's Aero-T in MOU for Aerostats

**G**arware-Wall Ropes Ltd. (GWRL), a leading manufacturer of technical textiles for the Indian and global markets, have signed an MOU with Israel's Aero-T to combine their capability for manufacturing and supply of advanced aerostats for Indian Air defence. Aero-T is a subsidiary of Israel based RT LTA Systems, a designer, developer and manufacturer of Aerostats. Aero-T possesses complete know-how for developing and operating a variety of aerostats based on cutting edge technologies accumulated over 30 years of Lighter Than Air (LTA) operations.

The intended co-operation will entail GWRL establishing an aerostat envelope production facility and Aero-T providing the technology, know-how, integration, acceptance and continuous support for the aerostats development and production. Simultaneously, there will be co-operation with Indian R&D establishments, such as DRDO/ADRDE and the end customers to understand their needs and co-develop customised solutions.



Aeronautics Group congratulates  
the P.M of India Mr. Modi  
on his visit to Israel to mark  
25 years of diplomatic ties  
between the two countries

ORBITER 4  
*Small Tactical UAS*



# Ahead of Time

ORBITER 3  
*Small Tactical UAS*



DOMINATOR XP  
*Medium Altitude  
Long Endurance UAS*



ORBITER 1K  
*Loitering Munition UAS*



# SLEW OF INDIA-ISRAEL JOINT VENTURES

## IAI agreement with Dynamatic Technologies and Elcom Systems for UAVs

During the visit of Prime Minister Modi to Israel, Israel Aerospace Industries Ltd. (IAI), Dynamatic Technologies Ltd (DTL) and Elcom Systems signed an agreement on production, assembly and support of UAVs in India. The co-operation agreement supports the existing infrastructure in India for current MRO (Maintenance Repair and Overhaul) programmes, while advancing the Indian government's 'Make in India' initiative. The co-operation between the three companies will provide the best solution for the Indian armed forces, based on the transfer of state of the art UAV technology and production capabilities from IAI to DTL and Elcom, in order to enable indigenous capability for UAV systems.

Seen on the right are Shiv Vikram Khemka, Elcom Systems Private Ltd., Joseph Weiss, IAI's President and CEO, Udayant Malhoutra, CEO & Managing Director Dynamatic Technologies.



## IAI Strategic Teaming Agreement with Wipro

Israel Aerospace Industries and Wipro Enterprises (P) Limited have signed an agreement to collaborate in manufacturing of composite aero structures in India including establishing a facility for this purpose. The agreement stipulates that IAI will transfer technology and assist Wipro in building a plant for manufacturing and assembly of aero structures for the civilian sector. The agreement forms the foundation for broader future collaboration between the two companies in India and is expected to support IAI's leadership in this arena while supporting the implementation of future projects.



## IAI LR-SAMs for Indian Navy

Israel Aerospace Industries (IAI) has been awarded an additional \$630 million contract for supply of LR-SAMs air and missile defence systems for four warships of the Indian Navy.



LRSAM trial

The contract will be carried out with BEL, which serves as the main contractor in the project as part of India's 'Make in India' policy. Prior to signing the contract, the system was successfully tested in India as part of operational interception trial aboard INS Kochi, demonstrating the System's operational capabilities in a representative scenario with genuine target.

## IAI expands JV with Kalyani Group

Executives from Israel Aerospace Industries (IAI) and Kalyani Strategic Systems Ltd. (KSSL), subsidiary of Bharat Forge Limited, have signed a Memorandum of Understanding (MOU) addressed to expand the Joint Venture that the companies are establishing. The new MOU covers the establishment of a maintenance centre for selected advanced air defence systems in Hyderabad. The two companies have also agreed on expanding their joint operations for development, manufacturing and marketing of precise ammunition systems. In February 2017, IAI had signed an MOU with Kalyani Strategic Systems Ltd. (KSSL) for establishing a joint venture that will develop, build, market and manufacture selected air defence systems and light weight special purpose munitions, in accordance with the Indian Government's 'Make in India' policy.



## Elbit Systems-Cyclone & Mahindra Aerostructures collaborate

An MOU to collaborate on the production of aerostructures parts and assemblies has been signed between Elbit Systems-Cyclone of Israel and Mahindra Aerostructures of India. Under this arrangement, Cyclone will source content for their existing work packages from Mahindra, and the two companies will also team up on new work opportunities, leveraging each other's strengths, capacities and capabilities.

Mahindra currently operates a large aerostructures manufacturing facility near Bengaluru. The plant produces parts for its global customer



base, which includes reputed OEMs and Tier 1s, and is also exporting primary structural assemblies for the Mahindra Airvan 8 aircraft. Cyclone, a wholly-owned subsidiary of Elbit Systems Ltd., serves as Elbit Systems' design and manufacturing centre for composite and

metal structural aircraft assemblies and parts for leading aerospace companies and OEMs.

In the photograph are (left to right): Arvind Mehra, Executive Director & CEO, Mahindra Aerospace; SP Shukla, Chairman, Mahindra Aerospace and Group President-Aerospace & Defence, Mahindra Group; Yoram Shmueli, Executive Vice President & GM, Aerospace Division, Elbit Systems; David Vidan, General Manager, Elbit Systems-Cyclone; Eitan Cohen, VP, Business Development & Programmes, Elbit Systems-Cyclone.

## Alpha Design Technologies and Elbit expand existing JVC

Alpha Design Technologies Pvt. Ltd., of Bengaluru have signed an agreement with Elbit Security Systems Ltd (ELSEC), Israel for expansion of their existing JVC 'Alpha-Elsec Defence & Aerospace Systems Pvt Ltd'. This agreement enhances the scope of operation of the JVC into niche technological areas such as new generation thermal imaging equipment's, state-of-art fire control systems, unmanned aerial systems (UAS) under the mini, medium sized UAV category, in addition to night vision devices, laser range finders, laser pointers, reflex sights, amongst the others.

Elad Aharonson, Executive Vice President and General Manager – Elbit - ISTAR Division, stated, "Together with Alpha Design, we have successfully completed two major contracts for the upgradation of armoured vehicles : thermal imaging sighting kit, 969 sets for the BMP-2 and thermal imaging based fire control systems, 1000 sets for the T-72, including providing installation and life cycle support for these systems to the Indian Defence Forces".



# Israel's defence industry

## Unveiling new, cutting-edge technologies



### Elbit Systems SkEye WAPS

Elbit Systems has revealed its innovative wide area persistent surveillance solution, SkEye WAPS. Developed specifically to address requirements raised by defence and law enforcement agencies, responding to natural disaster recovery events, terrorism and homeland security threats, SkEye WAPS comprises advanced capabilities in the field of imagery intelligence gathering, providing a complete high-resolution picture and up to 80 square kilometre coverage of the Area of Interest (AOI) to a large number of users.

SkEye WAPS provides a clearer picture in lesser time, thus exponentially increasing trust in the decision making process. While looking over a large Area-of-Interest (AOI), operators can zoom into multiple Regions of Interest (ROI) simultaneously and understand the connection between them. This is achieved without neglecting rest of the area, which is still being recorded and constantly analysed. At heart of the system is an airborne segment consisting of the EO sensor unit, an advanced image processing unit, a large mass storage unit and analysis applications. Via an embedded data link, the relevant information is transmitted from the aircraft to the SkEye, Control and Management Center (SCMC) (fixed or mobile), which can be integrated with the customer's Command & Control (C2) solution.

### Elbit introduces the SkyStriker

At the 2017 Paris Air Show Elbit Systems launched the SkyStriker, a remotely operated electro-optical, precise guided Loitering Munition (LM) designed to "seek, locate and engage" various targets for the tactical level corps. SkyStriker is able to locate, acquire and strike operator-marked targets enabling high-precision performance. The system's electric propulsion provides a low acoustic signature and enables covert low altitude operations. Owing to its flight speed capability, it can cover a distance of tens of kilometers within minutes. Upon reaching the target area, it can loiter and pursue the target for up to two hours.



SkyStriker offers quick deployment and ease of operation in the field, provides forces with the ability to observe and identify an enemy target before delivering a rapid precision airstrike. Its remote operation capability reduces operators' exposure to detection or enemy fire while guiding the LM to its target. In addition to high accuracy, long range and a significant loitering time, the SkyStriker is capable of carrying up to ten kilogrammes of munitions. The system also provides significant flexibility such as the ability to choose any target, to engage at any direction and in various angles (shallow to steep) while significantly decreasing costs. Moreover, SkyStriker enables the operator to abort a strike up to two seconds to impact, to re-engage and in case of lack of authorised targets to order a safe return home.

### Controp's unique, compact UAS payload



Controp Precision Technologies Ltd launched the *T-Stamp-XR*, its unique, compact payload for UAS with "exceptional thermal sensor optics" at the Paris Air Show 2017.

*T-Stamp-XR*, a new member of the Controp Stamp family of gyro-stabilised miniature EO/IR payloads for UAS, weighs only 3.5kg. It is comprised of a high sensitivity HD day camera, a cooled thermal imaging (TI) camera, and an optional laser designator or laser pointer. The built-in INS on the Line-of-Sight provides precise and accurate target coordinates, geo-location, hold-to-coordinate and point-to-coordinate capabilities. The optional laser pointer is available for onboard target pointing. Additional features include

onboard automatic video tracker, image enhancement, local automatic gain control (AGC), picture-in-picture (PIP), digital video output, and optional H.264 video output. The *T-Stamp-XR* enables tactical interoperability with other platforms in the theatre, and has low life-cycle costs due to a unique and high endurance cooled TI detector.

### Controp Helicopter EO/IR payloads

Controp has announced sale of several *iSky-20HD* (formerly *Shapo-HD*) and *iSky-50HD* (formerly *DSP-HD*) EO/IR payloads to the Israeli Police, to be installed on new helicopters and integrated with Churchill Navigation Mission Systems.

Controp's line of six medium and long-range aerial payloads (*iSky-20*, *20HD*, *30*, *30HD*, *40* and *50HD*) were uniquely developed for the challenging and often turbulent aerial environment and they provide solutions for most medium and long-range aerial surveillance platforms. Features include a continuous optical zoom lens in the day (or high definition-HD) and thermal imaging (SD/HD) cameras, gyro-stabilised gimbals and multi sensor options including Eyesafe Laser Range Finder (ELRF) and/or Laser Pointer, all of which provide "outstanding" capabilities. The *iSky* systems can be installed on helicopters, fixed wing aircraft and unmanned aerial systems (UAS), and may be integrated with the platforms' systems. Ideal for manned or unmanned airborne platforms, all of the *iSky* systems include real-time Image Enhancement Features, built in INS, automatic target tracking and are successfully operated, fully integrated and deployed by Search and Rescue (SAR), border surveillance, law enforcement, special operations, maritime patrol and force protection units.



### Rafael's new SPIKE LR II

Rafael Advanced Defense Systems have unveiled the Spike LR II, a new 5<sup>th</sup> generation variant of the Spike Family that can be fired from vehicles, helicopters, ships and ground launchers. The new missile was presented for the first time at the Paris Air Show in June. Rafael has meanwhile supplied over 27,000 Spike missiles and systems to over 26 countries.

Spike LR II is an advanced multipurpose missile, weighing only 12.7 kg, designed for modern warfare with almost full commonality to the Spike missile legacy and can be launched from any Spike launcher. For increased lethality, Spike LR II includes two unique state-of-the-art advanced and highly capable warhead configurations: a tandem HEAT warhead configuration, enhancing armour penetration capability by more than 30% and a new multipurpose blast warhead which includes controlled fusing (by the gunner) for control of the desired effect.



Spike LR II has a range of 5.5 km when fired from ground launchers (an increase of more than 35% beyond the 4 km range of the original Spike LR) and up to 10 km when fired from a helicopter (using alternative option of RF Data link). The Spike LR II has a modern electro-optical seeker which includes a high quality un-cooled IR sensor and an advanced high definition colour day sensor. The new seeker includes capabilities of a smart target tracker with AI features.

Spike LR II was designed against new modern targets with low signature, time-sensitive characteristics. To counter this, Spike LR II includes an embedded IMU (Inertial Measurement Unit) for missions of third party-target allocation, allowing the firing of the missile to grid target coordinates, including advanced armour and protection systems. The Spike LR II is one of the only missiles in the world with an inherent CAPS capability.

### Rafael's missile from Protector USV

Rafael Advanced Defense Systems recently completed the development of an additional mission module for its Protector Unmanned surface Vehicle (USV), in use by a number of naval fleets around the world, including the Israeli Navy. The development was completed as part of a series of successful tests performed by Rafael, in which a number of missiles were launched from the Protector and hit simulated enemy targets. This was the first-ever missile firing from an operational, remote-controlled USV.

During the test Rafael fired a number of Spike missiles, a family of precise, electro-optical, precise missiles that can be launched from aerial, land and naval platforms. This new capability allows pin-point attack of land or naval targets, enabling safe vessel operation from, with no risk to the operating force, from a remote command and control room or from aboard other naval platforms.

The Protector has been in use since 2004, allowing its developers and engineers to accumulate vast experience to continue its spiral development. Rafael has recently supplied a significant number of Protector USVs to a number of fleets and civilian bodies around the world, in accordance with the growing need for a remotely-operated vessel with modular payload carrying capabilities, based on mission needs.

### IAI's Long Range Artillery Weapon System tested

Firing trials of Israel Aerospace Industries' (IAI) LORA (Long-Range Artillery weapon system) have been completed, following trials which consisted of launching a long-range LORA missile to a pre-planned target at sea. "This was one of the most complex trials we held over the past few years and a technological breakthrough for IAI's missile development operations. The trials were held according to a full operational outline, including an assessment of the system's manoeuvring, assault and precision capabilities," stated Boaz Levi, Executive Vice President and General Manager of



Systems, Missiles & Space Group. "The impressive results attest for the system's maturity and advanced capabilities," he added.

Designed as an artillery weapon system which consists of a long-range tactical ground-to-ground missile developed by IAI's MALAM division, the LORA is intended for strike scenarios with a range of up to 400 km and boasts precision range of 10 meters or better. The LORA missile weighs approximately 1,600 kg.

### IAI's Green Dragon Loitering Munition for Naval use

Israel Aerospace Industries (IAI) has introduced a new variant of its Green Dragon loitering munition for naval use. IAI's loitering munitions were on focus at the Paris Air Show and the tactical land version of the Green Dragon was successfully demonstrated in a series of trials recently in a full operational scenario. To meet the specific requirements for use in the naval arena and for operation from navy vessels, IAI has made several adjustments to the Green Dragon canister and communication antenna. The naval variant of the Green Dragon tactical, low-cost loitering munition has been designed to provide significant situational awareness and firepower in a compact envelope to combat ships, offshore patrol vessels and patrol boats. Green Dragon has up to 3 kg warhead and extremely high accuracy. The electric





electro-optically guided munition has a loitering time of 90 minutes, during which its operator can collect visual intelligence of surrounding area areas – especially in congested waters and shore targets at a range of up to 40 km.

The Green Dragon is launched by a small rocket-assist motor from a sealed, marine approved canister and as many as 12 units can be carried even on a small vessel. IAI's family of loitering munitions includes the Harpy, Harpy NG, Harop, Rotem and Green Dragon.

### **Elbit Systems' multi-mission Seagull USV demonstrated**

Seagull, Elbit Systems' Multi-Mission USV, recently participated in the bi-national MCM trials for unmanned maritime systems that were organised

by the Directorate General of Material Resources (DGMR) of the Belgian Defence Ministry. Taking part in the trials conducted at the beginning of June off the Belgian Zeebrugge Naval Base, were several companies operating different types of unmanned underwater and surface vehicles. Seagull is a 12-metre long USV that can be operated from a mother-ship or from shore stations. It provides multi-mission capabilities including Anti-Submarine Warfare (ASW), Mine Hunting & Mine Sweeping (MCM), Electronic Warfare (EW), maritime security and underwater commercial missions, leveraging modular mission system installation and offering a high level of autonomy. It features inherent C4I capabilities for enhanced situation awareness and mission endurance of more than four days.



### **Elbit Systems introduces the SPEAR MK2**



Elbit Systems has unveiled its latest version of the Spear mortar system : the Spear MK2, an upgraded version of the operationally proven Spear mortar system, which is a 120 mm fully autonomous modular mortar system. The Spear's latest version has a high recoil reduction capability, while not affecting the Cardom mortar system and the Spear's well known effectiveness. The mortar system is easily installed on a variety of lightweight combat vehicles allowing agility and performance of tactical operations. The upgraded system provides improved situational awareness, wider area coverage, quick deployment and has autonomous or manual activation requiring only two-three crew members. The mortar system is deployed and operational within only sixty seconds, equipped with a command and control system providing battlefield management and situational awareness capabilities, fire missions' prioritisation and monitoring of personnel assignments.

### **Elbit Panoramic Cockpit Display for the F-35**



Elbit Systems of America have been awarded a contract by Lockheed Martin Aeronautics to develop a cockpit display replacement for the F-35 fighter. The development contract is for the Technology Refresh 3, Panoramic Cockpit Display Unit. The award further expands Elbit Systems of America's work on the F-35, which already includes power amplifiers, structures,

and sustainment work. In addition, Elbit Systems of America, together with Rockwell Collins, also supplies the F-35 Helmet Mounted Display System, through their joint venture Rockwell Collins ESA Vision Systems (RCEVS).

### Controp's High Definition EO/IR Camera Payloads for small boats



Controp has revealed its new iSea-20HD - High Definition (HD) EO/IR camera payload for small boats. The introduction of the new iSea-20HD completes Controp's iSea family of four EO/IR payloads with HD capabilities, including the iSea-30HD, iSea-40HD, iSea-50HD and now the new iSea-20HD. The new iSea-20HD is a compact and lightweight (9.4-inch, diameter 24 lbs.) payload, which includes a high resolution thermal camera with x15 continuous zoom lens, HD colour continuous zoom Day Camera with Low Light Mode and an Eyesafe Laser Range Finder (ELRF) and/or Laser Pointer as options. This addition of the new iSea-20HD to Controp's family of EO/IR payloads compliments Controp's wide variety of options for all maritime missions and platforms – from the iSea-20HD 9.4-inch, 24 lbs. system up to the iSea-50HD 14-inch, 66 lbs. system. These camera payloads are used worldwide for Coast Guard and Maritime surveillance/ observation applications and provide an “outstanding” man-machine interface (MMI) and flexibility.

### UVision unveils Extended-Range Loitering Munition System



*Hero-400EC Long-Range Lethal Loitering System by UVision*

UVision Air Ltd, has unveiled the Hero-400EC, its new enlarged, extended-range, “extremely precise” loitering munition system. The system's cruciform aerodynamic design delivers high-accuracy and reduces collateral damage. Its electric motor enables it to loiter silently above a target, ready to instantly respond to pop-up threats. The Hero-400EC is a “revolutionary Loitering Munition System using man-in-the loop technology and advanced Electro-Optical/ Infra-Red (EO/IR) payloads that can locate, track and strike static or moving targets with pinpoint accuracy and surprise”. The system features a low noise and thermal signature modular multi-tube launcher that is adaptable to a wide range of platforms, thereby offering air, land, and sea capabilities. The abort capability allows automatic reentry into the loitering mode, re-engagement of the enemy, or return to the recovery area using a parachute. The Hero-400EC has a maximum take-off weight of 40 kg and a warhead weight of 10 kg, with an endurance of up to 2 hours.

### RADA testing “On-The-Move” capabilities of its Tactical Radars

RADA Electronic Industries Ltd. has announced successful completion of a major milestone, significantly advancing the operability of its tactical radars for the manoeuvre force, providing ‘On-the-Move’ (OTM) capability, which is a highly desirable and very important operational requirement by tactical manoeuvre forces, especially when encountering low, slow and small-sized threats such as armed drones and tactical unmanned aerial vehicles (UAVs).



This capability was recently demonstrated to “a strategic customer” under a field test which was highly successful. The radar's demonstrated early detection, continuous and accurate tracking of a wide variety of small-sized, low and slow aerial targets from a continuously moving vehicle on varied terrain. RADA's upgraded RPS-42 MHR-based counter-drone radar systems with OTM capability will be delivered to this particular customer, as well as others, in July 2017.

RADA has implemented the OTM capability on its family of Multi-Mission Hemispheric Radars (MHR) and Compact Hemispheric Radars (CHR) by integrating its radars with Inertial Navigation System (INS). In addition, it has implemented and completed the testing of the sophisticated algorithms and signal processing techniques required for OTM.

### IAI EHUD Systems for Israeli Air Force

Israel Aerospace Industries (IAI) will provide EHUD, ACMI System to the Israeli Air Force to be used for training between combat aircraft and the Lavi. The Israeli AF has ordered the air combat maneuvering instrumentation (ACMI) systems from IAI's MALAM division. EHUD will be mounted on various combat aircraft as part of the training schedule until installation of fixed systems. In this manner, 4th generation combat aircraft will be able to undertake combat scenarios with the Lavi, which are already equipped with the EHUD communication system. MALAM is IAI's system house and the developer and manufacturer of the “esteemed, long-standing EHUD training system”. To date, over 1,000 air combat manoeuvre instrumentation systems have been shipped as well as hundreds of debriefing systems. EHUD is also the standard ACMI of NATO nations.



and Subsidiary of IAI (IAI/ELTA) and is an integral part of the combat systems installed on the missile ships.

The Alpha is a rotating AESA radar, capable of producing a large number of simultaneous beams for maritime and aerial targets, and to provide a high quality situation picture in the most extreme marine environment. The radar can perform several tasks at the same time, such as: detection and classification of naval targets, tracking of a large number of targets, and integration into guided missile systems for defence and attack. Owing to its size, it can be installed on small and medium-sized vessels such as corvettes, missile ships and medium-sized patrol ships. In addition, the radar provides a solution for upgrading existing navy vessels or installation on new platforms.

### IAI's Heron 1 UAS for Maritime Patrol

The Israeli Air Force is replacing its manned Sea Scan maritime patrol aircraft, with Israel Aerospace Industries' (IAI) maritime version of the Heron 1 (Shoval) unmanned air vehicle systems set to take over in this role. The Air Force have ordered additional Heron 1 UAV Systems equipped with a maritime radar and electro-optical payload that will make them more suitable for their growing role in carrying out maritime patrol and intelligence gathering missions on everyday bases. The maritime model of Heron 1 consist an advanced electro-optical payload - the MOSP, made by the TAMAM division of IAI and the lightweight airborne maritime surveillance radar made by ELTA. The maritime Herons will provide comprehensive protection of naval borders and strategic infrastructures to meet the operational needs.



### IAI installs Alpha Surveillance Radar on OPV

Israel Aerospace Industries (IAI) has recently completed the installation of the advanced Alpha (Advanced Lightweight Phased Array) ELM-2258 radar system on Israeli Navy's Saar 4.5 missile boats, which have proceeded on operational sea trials. The Israeli Navy is expected to receive two more ALPHA radars by the end of 2017, a total of 11 systems, to be installed on the Navy's missile ships. The light weight innovative radar system is based on full digital AESA technology by ELTA Systems Ltd., a Group



# The Aeronautics Orbiter 4 and Pegasus 120 Tactical VTOL UAS

Aeronautics Group, a leading UAS manufacturer, presented its wide range of comprehensive defence solutions and UAS platforms at the recently concluded Paris Air Show. The company revealed its newest UAS, the multi-mission Orbiter 4, which can carry and operate two different payloads simultaneously. For example, the Orbiter 4 can carry a maritime patrol radar (MPR) together with a cellular interception sensor, and conduct land or maritime ISTAR missions beyond Line Of Sight.

Alongside its line of UAS's and for the very first time, the company also presented the Pegasus 120: Aeronautics' first multi rotor platform. Relying on its wide knowledge and experience in the field of unmanned aerial solutions, Aeronautics has recently stepped into the field of multi-rotor platforms, with vertical take-off and landing (VTOL) solutions designed especially for defence and security missions. With its ability to carry payloads weighting up to 75 kg, the Pegasus 120 "is ideal for special missions and Special Forces".

Together with the Orbiter 4 and Pegasus 120, Aeronautics also presented the Orbiter 1K loitering unmanned system, Orbiter 3 Small Tactical UAS and the Aerostar tactical UAS.

According to Amos Mathan, Aeronautics' CEO: "Aeronautics Group keeps on developing innovative yet cost-effective solutions, which offer maximum abilities with minimum constrains. Today's advanced technology allows us to miniatures sensors, computers and communications, so that we can offer our customers small tactical airstrip independent UAS's with high performances and a small logistic footprint. Aeronautics group provide comprehensive solutions comprised of UAV's, multi rotors, aerostats, radars, and many other different sensors, that can be integrated together to one command and control center. We see a growing need for advanced UAV platforms in the international defence market, and I can say that a number of clients have already signed contracts to purchase our newest UAV, the Orbiter 4."

The Orbiter 4 STUAS/NSUAS is an advanced multi-mission platform with the ability to carry and operate two



different payloads simultaneously. With its open architecture, the Orbiter 4 can be specially adjusted for the needs of each operation or mission. The Orbiter 4 is continuing the evolution of the Orbiter line and the small tactical UAS, which deliver "top mission performance with the lightest, most versatile, and most advanced covert platform available today, and is ideal for both land and maritime operations". Based on the aerodynamic structure and properties of the Orbiter 3 STUAS, Orbiter 4 exclusive abilities include maximum endurance of more than 24 hours, maximum takeoff weight of 50 kg, maximum flight attitude of 18,000 feet and an ability to carry and operate two different payloads simultaneously.

The Pegasus 120 is Aeronautics' first multi rotor platform. With a maximum payload weight of up to 75 kg and an ability to carry multiple payloads including COMINT, VISINT and Logistics, the Pegasus 120 is designed especially for defence and security missions.

The Orbiter 1K is a loitering unmanned system. Given a specific waypoint, the loitering Orbiter 1K can detect and destroy a moving or a stationary target. The system can also operate on the base of a given area range: the Orbiter 1K independently

scans the area, detects and destroys the target – moving or stationary. In case the target is not detected or in any change of plans, the system's recovery capability allows it to return to its base camp and land safely using a parachute and an airbag. Launched from a catapult, the Orbiter 1K can fly for 2-3 hours, carrying a multi-sensor camera with day-and-night channels.

The Orbiter 3 STUAS is a compact and lightweight system for military and homeland security missions, providing an operational range of up to 100 km and up to 7 hours of endurance. Carrying a triple sensor payload with day-and-night, thermal image and laser pointer, the system has significant tactical UAS capabilities in a mini-aerial platform body. Assembled in 20 minutes, the fully-autonomous, vehicle-mounted system enables static and on-the-move operation.

The Aerostar advanced tactical UAS "is ideal for a wide range of short range and medium range ISR and artillery missions, as it is equipped with a large payload bay, and capable of carrying many types of payloads, including day and night EO/IR sensors, radars, and various electronic intelligence sensors (COMINT, ELINT). The Aerostar advanced tactical UAS has a proven capability for take-off and landing using very short runways and in high altitude environments. The Aerostar platform, which weighs 230 kilograms, is capable of reaching ceiling altitudes of 18,000 feet and operating at ranges of over 250 kilometres from its ground data terminal, which is connected via network to the ground control station. The drone UAS has been purchased and operated by 15 customers worldwide."

*Inputs from Aeronautics*



# Rafael - supporting 'Make in India'

Rafael Advanced Defense Systems Ltd. designs, develops, manufactures and supplies a wide range of high-tech defence systems for air, land, sea space and cyber applications for the Israeli Defence Forces and the defence establishment, as well as for customers around the world. The company offers its customers a diversified array of innovative solutions at the leading edge of global technology, from underwater systems through naval, ground and air superiority systems to space systems.

Rafael prides itself in being able to create partnerships with international leading aerospace and defence companies overseas. Offset activities and industrial cooperation have been set up with over 20 countries worldwide.

India and Israel are strategic partners and Israel has always supported India's urgent operational necessities during times of crises. For Rafael too, India is a strategic and significant partner. Rafael has always stood by India to supply systems at short notice during various operational contingencies. Accordingly, Rafael has been more than willing to create structures to ensure technological transfer to India.

As per a Rafael spokesman, "We already work with the different branches of the Indian military and the Indian security apparatus and have cooperated to integrate our electro-optical systems, advanced ordnance, as well as



air defence systems. We have done so while maintaining and implementing our strategy to forge local partnerships and address India's Make-in-India policy."

Rafael has been working steadily to create technology partnerships or joint ventures with major Indian companies to address projects which have been awarded or are about to be rewarded. By working through these Indian companies, Rafael expects downstream MSMEs also to be given high technology work in their specialised fields, which will feed into the joint venture. A significant work share of Rafael contracts is being manufactured in India while investing in infrastructure, technology transfer, training with its partners and sub-vendors which most are MSMEs.

For the Litening weapon designation pods to the Indian Air Force, Rafael went above the expectations of merely providing 30% offsets, and instead is producing large

scope of the pod in India through a tech tie-up with Defsys located in Gurgaon near Delhi.

Kalyani Rafael Advanced Systems (KRAS) JV has been formed to ensure that the maximum Indian component manufacturing of the advanced precision tactical munition (Spike ATGM), which is to be integrated by Bharat Dynamics Lt., is done in India. This JV will also produce other future munitions.

Rafael is creating a JV company, Astra Rafael Communications (ARC) with Astra Microwave, Hyderabad so as to be able to maximise the indigenisation of the Software Defined Radio (SDR) and EW systems.

For air defence and air to air domain, Rafael is forming a JV company with Reliance, Rafael Reliance Advanced Defence Systems (RDS). The JV will be able to provide the MoD with these missiles from an indigenous manufacturer and support the ongoing programmes.

"Rafael is looking at creating a strong and long lasting partnerships to allow future exports from its JVs in India to other international markets. In addition to JVs, Rafael is also working closely with other Indian companies to provide the best technology to the Indian Armed Forces."

*Courtesy: Rafael*



*Spyder-SR Missile Firing Unit*

# The Dragon's Claws

## Assessing China's PLAAF today

*With recent state-enforced organisational reforms, institutional restructuring and the induction or flight testing of a variety of fourth and fifth-generation combat platforms over the last decade, the People's Liberation Army Air Force (PLAAF) is on course towards becoming a most assertive instrument for regional dominance and international influence for China.*

*Sameer Joshi reviews the status of PLAAF restructuring & reforms, mission strategy and combat capabilities, along with focus on the PLAAF's indigenous Air Superiority Fighter (ASF) force, concluding with an assessment of the PLAAF vs IAF scenario over Tibet in the coming years.*

The long-term, wide-ranging modernisation of the armed forces of the People's Republic of China (PRC) entered a new phase in end-2015, as President Xi Jinping unveiled sweeping organisational reforms to overhaul the entire military structure. These included creation of Theatre Commands in place of Military Regions and formation of the Strategic Support Force (SSF), an exclusive arm to conduct Information Warfare

along with the PLA, PLAAF, PLAN and the re-designated People's Liberation Army Rocket Forces (PLARF), formerly the Second Artillery Force. These reforms aim not only to strengthen the Chinese Communist Party's (CCP) control over the military, but enhance China's ability to fight short-duration, high-intensity regional conflicts at greater distances from the Chinese mainland. China's growing military, diplomatic, and economic clout

*A flight of 16<sup>th</sup> Air Regiment J-11As over Tibet near Shigatse*

to advance its ambitions to establish regional dominance and international influence, will not be possible without it portraying a strong and modern military capability, a major burden of which arguably falls on the wings of the People's Liberation Army Air Force (PLAAF).

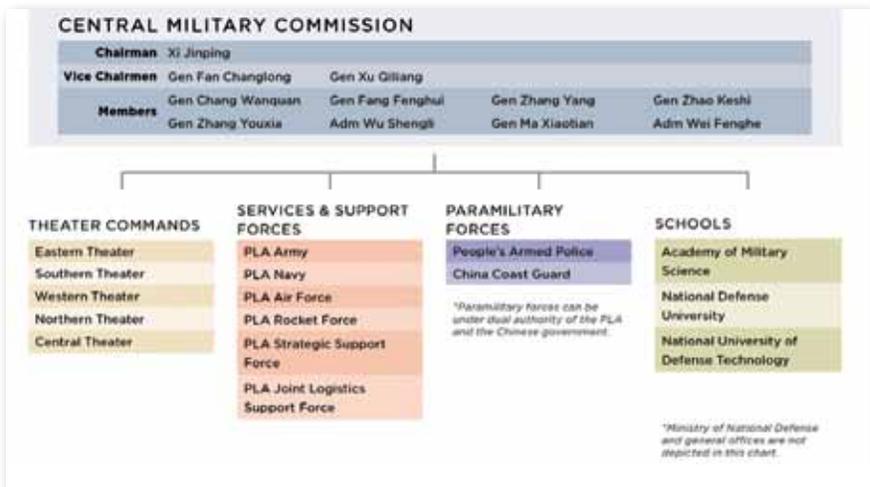
# A Resurgent PLAAF

The PLAAF is the third largest Air Force in the world, with some 2,700 aircraft (excluding UAVs) including 2,000 combat aircraft (fighters, bombers, and attack aircraft), which have been subject of considerable modernisation since the first Gulf War. After the United States' military adopted a paradigm shift towards information adaptive and deep-strike style of warfare against Saddam Hussein's similarly-equipped forces, the People's Liberation Army's (PLA) became acutely aware of just how wide the capability gap had grown. The overwhelming use of air power in that conflict signalled a dramatic step up in capabilities of the PLAAF due to its critical role in any Taiwan related conflict. The Taiwan Straits crisis in 1996 reinforced the PLAAF's capability concerns even further. Pivoting around this need, it has since then rapidly closed the gap with western air forces across a broad spectrum of capabilities including aircraft production, technologies, tactics and training. The rise of China as a modern world power has given the military a plethora of new missions to carry out and capabilities to achieve by end of the next decade. Looking at these capabilities through a mission analysis of a Taiwan centric campaign, the list includes an effective A2/AD capability, the ability to dominate/ suppress/ saturate modern air defences, LR strike, tactical/ strategic medium and heavy airlift, special missions through unmanned and manned assets and flexible air-to-air refueling capabilities. As of mid-2017, the PLAAF continues to field additional fourth-generation aircraft (now over 600), as well as flight test two fifth generation air superiority platforms, with one type being declared to have achieved initial operating capability (IOC). While it still operates many older second and third-generation platforms it will probably become a majority 'fourth and fifth generation' force by 2025.

While principal focus of the PLAAF remains preparation for a potential conflict in the Taiwan Strait, there is little doubt that interests of the Chinese air arm, like those of the PLA, have expanded well beyond this region. It aims for greater influence in conducting offensive operations over potential hotspots in the East and South China Seas, where China has operationalised Woody Island airfield in the Paracel Islands,



*Xi Jinping confers military flags on the five newly-established theatre commands of the PLA.*



along with construction of three new airfields in the Spratly Islands, as well as in the Tibet Autonomous region (TAR), where after Gonggar (Lhasa), Shigatse and probably Ngari Gunsa airfields are being converted into all-weather airbases, capable of accommodating regular rotation of fourth generation fighters like the J-11 and J-10. In this theatre, the PLAAF recognises the quick reaction ability of the Indian Air Force (IAF) well and expects the IAF to deploy rapidly to conflict zones during hostilities.

It was a pair of J-11As of the 17<sup>th</sup> Air Regiment on detachment at Gonggar which on 12 October 2012 scrambled towards a flight of IAF Su-30MKIs, observed flying over Tawang by a JL-3D-90 long range surveillance radar at Lhasa. The J-11s would have had intermittent contact with the IAF jets with their N001VE Pulse Doppler radars, finally breaking off near Kuono, 20 km north of Tawang, perhaps realising that the IAF jets had no intention of crossing into Tibet.

Two Chinese J-11B fighters intercepted a US Navy Lockheed Martin EP-3E Aries II SIGINT aircraft in international airspace over the South China Sea (SCS) on 17 May 2016, and ‘buzzed’ the aircraft to within 50 feet, before carrying out a barrel roll around the dazed USN aircrew. And recently on 19 May 2017, a Su-30MKK flew at 100 feet above (and inverted) over an American WC-135 special mission aircraft in the East China Sea, the pilot perhaps wanting to recreate a scene out of the Hollywood

flick ‘Top Gun’. Antics apart, the PLAAF is clearly seen as upping the ante, favouring aggressive patrolling over zones of potential conflicts. However, can it ‘walk the talk’ on a sustained air campaign, with multi theatre operations?

### Decree for the PLAAF

The CCP’s expectations from the PLAAF are definitively laid out in its Military Strategic Guidelines (MSGs), the “core and collected embodiment of military strategy”. The scope of these guidelines includes both general principles about the whole process of military operations, and specific principles for certain types of operation. The May 2015 Chinese national security strategy White Paper further explains what is expected of the PLA in the coming time. The mission list comprises of many traditional, as well as ‘new historic’, missions which the Chinese Communist Party expects the PLA forces to be able to carry out efficiently in the coming 15 to 20 years. These are:

- ◆ To resolutely safeguard the unification of the motherland
- ◆ To safeguard China’s security and interests in new domains
- ◆ To safeguard the security of China’s overseas interests
- ◆ To maintain strategic deterrence and carry out nuclear counterattack
- ◆ To participate in regional and international security cooperation and maintain regional and world peace

- ◆ To strengthen efforts in operations against infiltration, separatism and terrorism to maintain China’s political security and social stability
- ◆ To perform such tasks as emergency rescue and disaster relief, rights and interest protection, guard duties, and support for national economic and social development

The above mission set is broad and intentionally vague in many aspects to leave room for future refinement and redirection if needed. However, the missions clearly reflect the diversified and global range of interests of China as a ‘rising power’ rather than one content with the status quo.

### The PLAAF’s Doctrine

Since 2010, the Chinese doctrine has hinged around its initiative to take the battle away from the Chinese shores and add forward defensive depth to the mainland. The nine-dashed line is an attempt to formalise this defensive loop, which adds 500–1000 km of penetration gravity for the opposition, providing decent early warning for the Chinese. Based on this, the PLAAF’s doctrine has principally pivoted towards ‘Large Area defence’, instead of ‘Vital Area/ Vital Point’ (VA/VP) defence. This ensures early warning, with engagements occurring as far forward as possible.

The doctrine envisages development of China’s air force capabilities in four clear areas, which are

- ◆ Offensive capability to protect national security and national interests from the air and space.
- ◆ Integrated air defensive and anti-missile capability for monitoring both air and space flying objects and attacking them.
- ◆ Superior capability over its main opponents (Taiwan, Japan, India) and certain counter-information capability against its strategic opponents (the United States and to some extent Russia).
- ◆ Strategic airlift capability to conduct both airlift and airdrop operations.

To accomplish the above capabilities, the PLAAF identifies *Air Offensive Campaigns; Air Defence Campaigns; Air Blockade Campaigns; Airborne Campaigns*.

These can be either air force only campaigns or air force-led joint campaigns with other services. In most air operations, a



PLAAF fighter pilots march past J-10s



The PLAAF is heavily investing in improving pilot training standards as part of the ongoing reforms

combat subjects, topics, exercises, and methods as the basis for transforming its military training system and improving its level of operational effectiveness. Although themes associated with ‘actual combat’ have been featured in key strategic training guidance documents for years within the PLAAF and Chinese armed forces as a whole, it appears that senior PLAAF leaders have redoubled their efforts at instilling discipline and offering honest assessments of shortcomings across all levels of aviation unit training. Newer training modules on Lead-In Fighter Trainers (LIFT) such as the JL-10, as well as frontline units, include flying under challenging environmental conditions, such as at night and extreme weather patterns; flying at low altitudes through valleys and mountains and over water; cultivating ‘free air combat’ skills among aviators with decreased altitude restrictions; and holding sophisticated cross branch/service exercises under complex electromagnetic environment and formidable air defence scenarios to replicate actual battle conditions, which a potential military adversary may present.

great deal of emphasis is placed on surprise, camouflage, use of tactics, meticulous planning and strikes against critical targets. With intended operations against Taiwan and the defence of forward stationed assets in the East and South Sea, offensive air defence missions, with a greater role for counterattack is the key control strategy in place. These missions factor mobile ambushes, coverage, as well as seek & destroy sorties to boost China’s ability to fight short-duration, high-intensity regional conflicts at greater distances. However, execution of this doctrine is still ‘work in progress’, requiring moderns AD and multi-mission platforms, amplified C4ISR assets, evolved air/ ground crew training levels and a synchronised A2/AD network. The PLAAF certainly grasps these inadequacies, while closing the gaps at a prodigious rate.

towards preparing for future operations is a change in the training philosophy. The PLAAF has been taking elements of actual

### Major Reforms

To accomplish its desired military strategy, the PLAAF is undertaking a major programme of reforms, which address training and education, development and acquisition of modern weapon systems and equipment, the way these systems are operated, as well as structural reform of the overall command system. While the most publically visible amongst them – induction of new aircraft types in a big way, including displaying the fifth-generation aircraft under development at Zhuhai airshow over the years – and perhaps the most significant



In a significant shift from prior practice, pilots in some units are now given the responsibility to create their own combat training profiles and have full autonomy over their sorties with little guidance from ground control as in the past.

### Flexible Restructuring

At an operational level, the PLAAF is undergoing a very flexible process of restructuring, which has seen some Air Regiments disbanded, some units merged with others, as well re-assigning of roles. Probably the most important structural change has been the introduction of defined 'Bases' with subordinate Brigades. These have been formed where former Divisional Headquarters and Command Posts (CPs) were located and then merged. Combat units have also been re-located to more modern and upgraded air bases in line with the re-equipment process, as well as for providing space towards the urban development drive in Chinese cities. In a significant move, China's military established five regional commands for its operations on 1 February 2016, in line with the CCP's effort towards consolidating seven military regions into five 'battle zones'. Before the reforms, there were seven Military Regions (MRs), including the Beijing MR, Shenyang MR, Jinan MR, Lanzhou MR, Chengdu MR, Guangzhou MR and Nanjing MR. These regions have now been reclassified into five battle theatre commands or battle zones, being the East,

West, South, North, and Middle theatre Commands.

For many years, the Chengdu MR had served as the major PLAAF group responsible for the defence of southern and southwestern China including a major part of Xizang (Tibet) and the municipality of Chongqing. This comprised the entire border region from Vietnam to Nepal (excluding Vietnam, which was responsibility of the Guangzhou MR). The Chengdu MR was merged as part of this reform with the even larger Lanzhou MR, to create the Western Theatre Command (WTC). The Lanzhou MR was made responsible for complete Air Defence of the Western and South Western sectors, including autonomous regions of Ningxia hui, Qinghai, Xinjiang Uyghur, as well as the Ngari prefecture. Consequently, the WTC, headquartered at Chengdu, has become the largest of the five commands in terms of area of responsibility and defence.

The Western Theatre Command's main importance lies in its proximity to the boundary with India and Central Asia. It also houses some of China's most secretive military oriented installation, including Base 21 (the 'Lop Nor' nuclear research site). The WTC is also the custodian of the China Pakistan Economic Corridor (CPEC), a \$54 billion initiative between China and Pakistan to upgrade the infrastructure and economy of Pakistan. This is part of the 'One Belt, One Road' (OBOR) policy of Xi-

Jinping, wherein China is reactivating old trade routes "to revitalise the economy", but actually increasing geopolitical dominance of China as a *bona fide* world power. Future economic exploitation of the CPEC, especially with India skipping the recently held One Belt One Road Summit in Beijing in May 2017, protesting sovereignty and territorial integrity violation with the CPEC passing through POK, will ramp up the WTC's liability in the region significantly.

With the current Indo-China dispute on the Doklam plateau, the Chinese are rapidly mobilising PLA assets into this region, making WTC among the most volatile regions in the world.

### The PLAAF in Tibet

The PLAAF has 14 Air Bases available within the Tibet Autonomous Region (TAR) and Xinjiang, besides another 20 airfields in the region, which can be further upgraded for military activity. While most of these airfields are used by civilian aircraft, Gonggar at Lhasa is the primary operating base for undertaking combat operations in Tibet. However, in a tactical shift over the last few years, the PLAAF has begun developing infrastructure and operating from dual-use airfields at Ngari Gunsa, Nyingchi Mainling, Qamdo Bamda, Shigatse and Nagqu Dagrang in the WTC. Of these, Shigatse is being converted for all weather operations like at Gonggar, followed in



*The first Russian made Su-35 jet landing at Cangzhou in Hebei province in northern China on 25 Dec 2016. The Su-35 is the most potent fighter in PLAAF's inventory*

the future probably by Ngari Gunsa. Although no frontline PLAAF fighter elements are based there, regular rotation deployments to Tibet are an important part of the training doctrine, with most formations usually coming from the former Chengdu MR. High altitude of these airfields considerably restricts performance of these jets and China is likely to develop additional all-weather strips in the future. With threats from the Indian Air Force in mind, a quick reaction element of J-11A/B or Su-27SKs is always available at the Gonggar AFB at Lhasa.

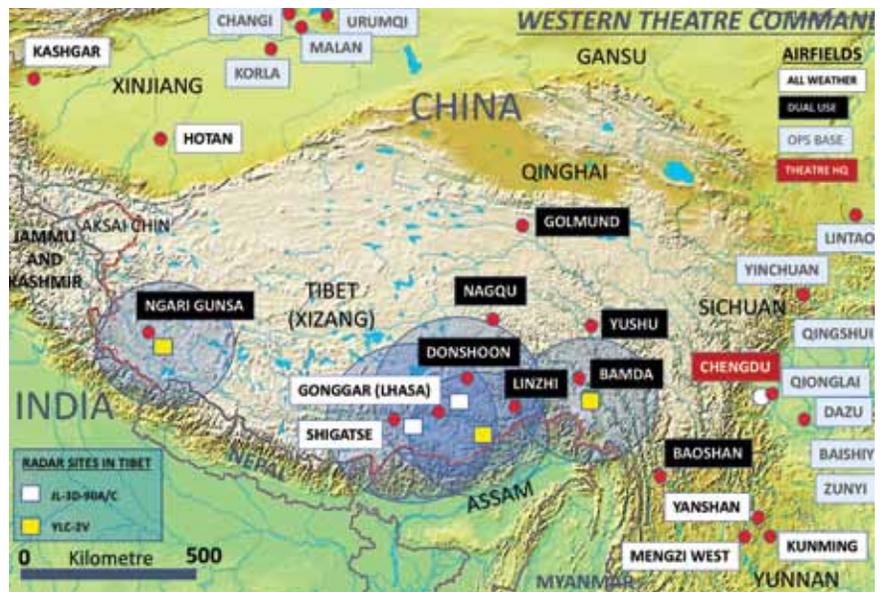
The PLAAF Air Defence component in the WTC comprises of two Air Regiments of J-11A/B/BS (98<sup>th</sup> AR and 111<sup>th</sup> Brigade) and one mixed Regiment of Su-27SK and J-11Bs (16<sup>th</sup> AR). By 2020, there will be a minimum of 3 ORP detachments (with at least 8 aircraft) available all through the year in Tibet, with probably a full-time squadron deployment at Shigatse by 2025.

## Assessment of PLAAF Capabilities

### Air Superiority

The PLAAF has made meaningful progress in closing its fighter capability gap with the United States and its main Asian rivals. It considers long term strategic superiority difficult to achieve and is instead focusing on achieving tactical superiority capabilities, that would be concurrent with larger offensive operations aimed at local campaigns. Recent force assessments of the PLAAF have noted the continuous induction of more modern aircraft, while decommissioning second and third-generation aircraft from its fleet. By 2010, modern fourth-generation fighters accounted for almost 30 percent of the force. In 2015, the figure was 50 percent, and by end 2017, it will reach roughly 65 percent. Between 2010 and 2015, China's inventory of fourth-generation fighters increased from 383 to more than 600.

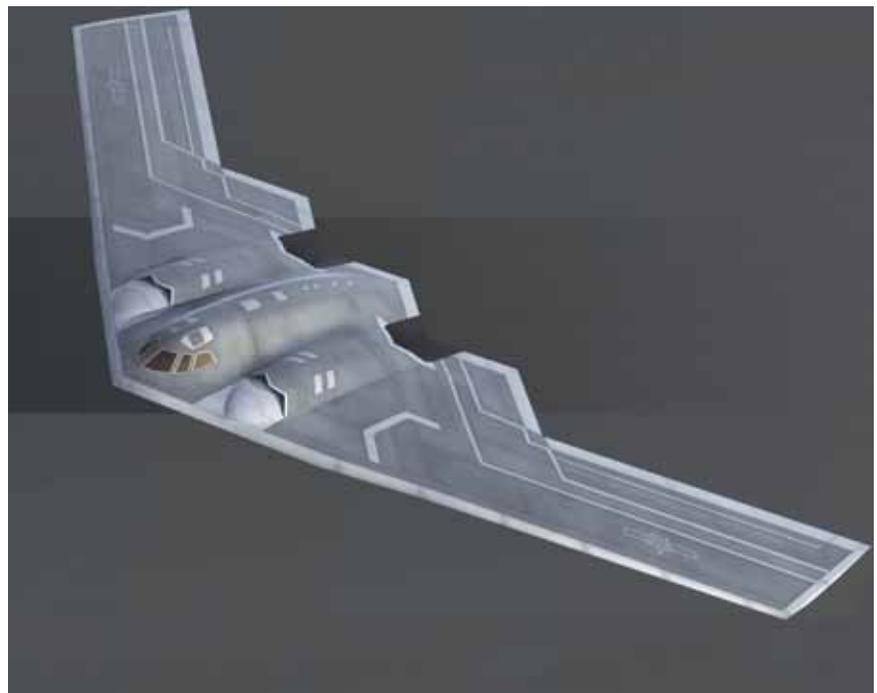
The Type J-11 fighter is an example of an advanced 4th generation platform brought into service, which can effectively contest airspace against the F-15 and F/A-18 class. However, early third generation types like the J-7 (MiG-21 variants) persist throughout the PLAAF and are of limited effectiveness against modern air assets. The newly inducted Sukhoi Su-35, equipped with the Irbis-E AESA, is the most advanced aircraft in the Chinese inventory at present, with



a total of 24 of this type to be delivered to China from Russia by end 2018. However, a clear distrust exists between Russia and China, with the latter earlier having reverse engineered a large amount of Russian aerospace intellectual property/technology to yield home-grown aircraft types/components. Aero engines are one of these critical technologies, and virtually all indigenous Chinese aircraft lack quality engines capable of operating for longer than a few hundred hours, with dismal performance

from the locally developed high performance turbofans of Russian origin such as the WS-10. Maintenance requirements for these systems will potentially sideline large numbers of systems in the event of long term operations. Thus, the PLAAF's ability to maintain strategic long term superiority remains suspect, at least for the next 15 to 20 years, reinforcing its focus on short term/range campaigns.

On the other hand, China is the only country outside the United States to have



An artistic image of the H-20 bomber, being designed by China's 603 Technical Institute, which resembles the Northrop B-2 bomber to a large extent

two ongoing stealth fighter programmes, the J-20 and the J-31. The J-20's airframe suggests a stealth interceptor designed to counter the opposition at long ranges. The J-31's frame suggests a modern air-to-air fighter, with a multi-mission capability, that will be combat ready in the next 5 years. The true capabilities of the J-20 and the J-31 are yet to be seen, but they do represent the PLAAF's progression towards a fully modern air force, capable of delivering offensive deep strike missions against similar modern air defences. These Fourth and Fifth Generation PLAAF Air superiority fighters are covered in detail in the later part of this article.

H-6K was developed to primarily carry under its wings six nuclear/non-nuclear (CJ-10/20) land-attack cruise missiles, each of which has a maximum range of 1,500/2,200 km. It can also carry the electro-optically-guided KD-63 land-attack cruise missile, with a range of 200 km. The H-6K could well saturate the Taiwanese and Indian A2/AD setups during time of conflict operating out of hinterland Chinese bases, but will nowhere threaten mainland US targets. Recent PLAAF literature has emphasised the need for 'super bombers' able to carry out larger volume strike missions, with increased survivability and a more global spanning

### Airlift Capabilities

The Chinese military's lack of meaningful air transport capability was apparent in air evacuation operations from countries like Libya and Yemen in the past and the PLAAF has worked to correct the glaring deficiency since then. The Chinese military is estimated to require at least 100 heavy lift aircraft of the Il-76 class. With only 20 Il-76 in service, the PLA's strategic lift requirement could be as massive as 500 such aircraft by 2030. Indigenous development of the Y-20 (the 50-ton capacity airlifter, 'inspired' from the C-17 and the An-70) heavy lift transport has been China's long term response to this perceived short fall and has entered service

*Chinese aircraft including an H-6K bomber armed with CJ-20 cruise missiles and an Su-30MKK fighter, over the Miyako Strait near Okinawa. The PLAAF routinely carries out flights over Japanese-claimed regions for area dominance*

### Tactical/ Long Range Strike

For tactical strike, the PLAAF relies on its fleet of JH-7/JH-7A fighter bombers. Though underpowered, the JH-7 equipped with the excellent JL-10A terrain following radar has a good low level penetration performance. However, its role is being transitioned onto the multirole J-10/11/16s and the Su-30MKK/ Su-35 types which can be equipped with a wide variety of guided/ unguided air to ground ordnance.

The PLAAF's long range strike capability has lagged behind many of its other capability enhancement initiatives. The PLAAF relies upon the 120-unit strong H-6 family of strategic bombers derived from the Soviet Tu-16 'Badger' bomber. This design is over 50 years old, having undergone numerous modernisation packages that keeps it a viable, but is not a truly impressive standoff strike platform. First revealed in 2007, the D-30KP turbofan-powered

range. Such literature reflects a yearning of the PLAAF that remains unfulfilled and is unlikely to be fulfilled in the next 15 to 20 years, so tempering China's LR strike capability for decades to come.

Development of a new long range stealth bomber is reportedly underway at China's 603 Technical Institute. Designated the H-20, the aircraft design features a wing design similar to the Northrop Grumman B-2 Spirit, with components already being manufactured. It will carry an internal payload of cruise missiles and bombs. Analysts note that the Xian-manufactured bomber may enter service by 2025 and will seek to replace China's existing fleet of Xian H-6K bombers. Certain contributions to the H-20 project were made by one Noshir Gowadia, a design engineer who previously worked for Northrop Grumman. He had also contributed to the B-2 Spirit development but in 2011, was convicted and sentenced to 32 years for selling classified information to China.

in 2016, providing timely enhancement in this area.

However, plagued with limited supply of DK-30 turbofans for the Y-20, the Y-20A is expected to be equipped with the under development WS-20 turbofan, to enhance capability to 66 tons as originally planned. The Y-20A has benefitted from MBD and ADT design and development techniques, signaling Chinese willingness to cut short development and manufacturing time to meet operational requirements. The Y-20A is likely to become the common platform serving next generation multi mission needs including AEW&C, EW, Air-to-Air Refueling and able to operate out of airfields in Tibet with ease. However, like all Chinese indigenous aircraft,



*The Y-20 is the next generation heavy lift transport aircraft for the PLAAF*

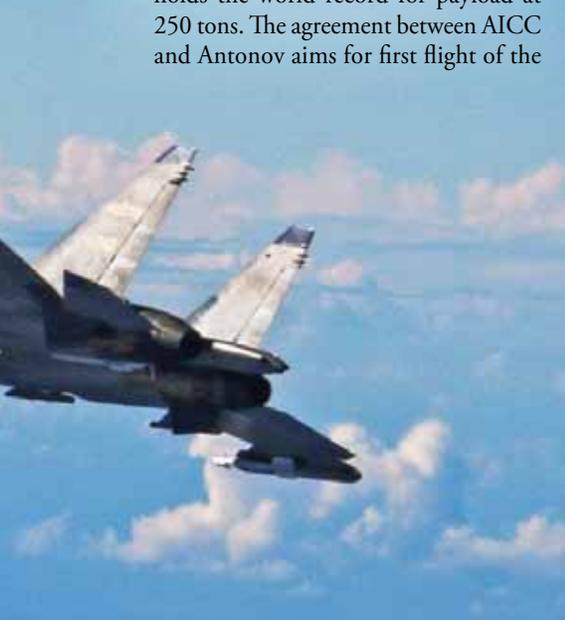
the Y-20 suffers from engine quality control issues, that make sustained use of the upcoming fleet difficult in the long term. On the other hand, introduction of the Y-9 (22-ton capacity) and a small (44 numbers) Y-8 medium transport fleet would fulfill the much in-demand C-130- class medium-lift capability. The Y-30 is another Medium-Lift transport under development in the 30-tonne payload class.

In 2016, the Aviation Industry Corporation of China (AICC) and Antonov Corporation signed an agreement to restart production of the An-225. This massive 640 ton, six-engine transport is the world's largest aircraft. Measuring 84 metres in length with a wingspan of over 88 metres, it holds the world record for payload at 250 tons. The agreement between AICC and Antonov aims for first flight of the

new An-225 in 2019. The second stage of the project will involve the complete transfer of technology, including the 23-ton thrust Progress D-18T turbofan engines, to China, for licenced production of a modernised version in Sichuan Province. The An-225 would open incredible new avenues in commercial and military air transportation, and there are plans to open 6 international logistics hubs in China for operations of medium & heavy lift transport. On the military front, the An-225 would provide China with the kind of large and global lift that not even the US has possessed. The Type would be certainly able to airlift strategic assets like ICBMs, space rockets/shuttles, S-400 SAMs and MBTs across all deployable locations, thus reducing strategic response time.

The Commercial Aircraft Corporation of China (COMAC), has developed its C-919 airliner which can seat up to 168 passengers and is intended to compete with the single-aisle jets, such as the Airbus A320 and Boeing 737. The 80-minute first flight of the C-919 took place recently on 5 May 2017, at Shanghai's Pudong airport. This is another platform which could well be modified for troop transport, special missions and for MR/LR ASUW/ASW employment.

As an assessment, the training regimen required to effectively carry out large scale air lift operations at extreme ranges from rapid deployment of assets has yet to be fully realised. Training is lacking for most capabilities in the PLA when compared to Western standards and such air lift operations are no exception. This training



*The An-225 is the world's largest aircraft. The first Ukraine manufactured An-225 will be handed over to China in 2019*

*The COMAC C-919 will be available to the Chinese military for various roles from 2020 onwards. Shown is an AEW&C concept based on the C-919*



communications (C3), or intelligence, surveillance, and reconnaissance (ISR) capabilities has been the PLAAF's most urgent priority.

Older recce and EW aircraft are being supplemented by newer types like the KJ-2000 (Il-76 AWACs), KJ-500 (Y-9AEW&C), ZDK-03 (Y-8 AEW&C), KJ-200 (Y-8 AEW&C) and the Tu-154 (ISR/ELINT/ EW). The KJ-2000 was developed in China after the US forced the Israeli's to cancel sale of its EL/W-2090 Phalcon AESA radar for the Chinese

deficiency will handicap any potential of the PLAAF's airlift capability in high pressure situations. The other issue is the non-availability of homegrown aero engines, critically limiting the competency and number of types required for sustaining long range air transport operations. Still, China's plans to enhance its global airlift capabilities mirrors the immense gains made in global sea transportation, investing deeply its reach across the globe in coming years.

### Mid-Air Refueling

Air-to-air refuelling is another logistical capability which the PLAAF has been steadily enhancing. It has been capable of carrying out mid-air refuelling for some time, however it has not operationally mastered this at a strategic level. The PLAAF's mid-air refuelling capability is restrained by a lack of aerial tankers, which besides the converted H-6D/Us fleet, has only a limited number of modern Il-78 platforms (3 Il-76 tankers acquired from Ukraine). Compounding the numbers issue is a lack of refueling commonality between the two PLAAF tanker types. This mismatch likely means that the future Y-20 transport may only refuel Chinese types as a tanker type while the handful of Il-78s will support fighters such as the Su-27, Su-30 and Su-35s, which form the bulk of the PLAAF's high end air superiority and offensive air support capability. Thus the small number of aerial tankers available will remain a handicap in improving long range superiority capabilities in such areas as the South China Sea and the Tibetan region.

### Special Missions

Over the past decades, increasing focus has been placed on leapfrogging measures to close the PLAAF's cyber and electronic warfare (EW) gap with the United States and Western Europe. The development of sophisticated command, control, and



*H-6D refueling pair of J-10s*



*H-6U tanker refuels a J-10S combat trainer over the Guangzhou coastline*

A-501 programme. As of date, with engine availability plaguing the Il-76 fleet, the readiness of the KJ-2000 fleet too is limited. The KJ-500 employs 3-faced fixed AESA radars on the top of a modified Y-9

Unmanned Combat, C4ISTAR and EW, also serving as launch platforms for various weapons, and acting as decoys or A-A targets. The Chinese are only next to the American in the areas of 'Autonomy' and 'Swarm' based

MALE UAV similar to the Predator and the *Xianglong* (Soaring Eagle), a HALE UAV similar to the Global Hawk. The Soaring Eagle is a HALE UAV, featuring an unusual joined, tandem wing plane. While not a true stealth aircraft, the Soaring Eagle appears to sport some accepted stealth features such as its outward canted V-tail arrangement, chinned fuselage body, and S-duct work used to aspirate the WP-13 turbojet engine within.

There are at least three Chinese UAVs designed to carry precision strike weapons, being the *Wing Loong/Yilong* (Sky Sabre,) and the *Lijian* (Sharp Sword), which is the PLA's first stealth drone. The Lijian is actually China's first official foray into a jet-powered, stealth-minded UAV and is believed to serve the role of technology demonstrator for a possible future combat system. The design was photographed during a taxi run in May 2013, officially marking its appearance in the Chinese aircraft inventory. The third is a supersonic design under development called the *Anjian* (Dark Sword), which may have dogfighting capabilities.

China has recently started deploying the potent Shen *Diao* (Divine Eagle) HALE UAV, which was reportedly first tested in 2015. This is a twin-fuselage aircraft, with long-range air to air/ground surveillance and strike coordination capabilities, that could advance China's A2/AD capabilities literally by leaps and bounds. Flying at



**China's KJ-2000 AEW&C is equipped with an AESA LR radar based on the Type H/LJG-346 SAPARS phased array system developed by No. 14 Research Institute**

aircraft, which can track over 60 aircraft at ranges of up to 470 km. This arrangement offers continuous 360° radar coverage. The KJ-200 system, employing a 'balance beam' phased array radar and based on the Y-8F-600 platform, can locate targets out to 400km. In February 2017 a Lockheed P-3 Orion of the US Navy and a KJ-200 inadvertently came close to each other over the South China Sea but avoided collision.

Such different variants being developed indicate that the Chinese are yet to consolidate on a preferred AEW&C type for their long term needs, with the KJ-500 emerging as a stable contender from the present stock, and likely to replace the KJ-2000 platform by 2022. Availability of the Y-20A and the C919 will certainly address this issue in the coming decade even though the PLAAF will be severely limited in its capacity to deploy overwhelming number of AEW assets over multiple battle areas at the same time till 2030. Hence, induction of special mission aircraft will be a priority for the PLAAF in the coming decade, seeking consolidation of aircraft types.

### Unmanned Aerial Vehicles

China has developed a variety of advanced military-use UAVs in recent years. The range of UAVs, from hand-launched to taxiing models with extended loiter times, being capable of multiple missions, including

drone operations, which aim to attain local superiority over conflict zones.

Amongst the most advanced of these unmanned systems are the *Caihong* CH-4/5 (Rainbow), an unmanned combat aerial vehicle (UCAV) similar to the US MQ-9 Reaper, the BZK-005/HY-01 medium-altitude long-endurance (MALE) UAV, the *Wing Loong* (or *Yilong*), a



**A Chinese CH-4 Rainbow drone fires a AR1 guided ASM. This UAV has been exported to many countries around the world**



**The 'Soaring Eagle' HALE UAV prepares for a flight test mission**

altitudes up to 25 km (79,000 feet), the twin bodied fuselage of the Divine Eagle has electromagnetic permeables, which are likely to house the Divine Eagle's long range anti-stealth radars, indicating that its radar arrays are 10 metres long, suggesting transmission of lower frequency (L and S Band) radar waves for stealth aircraft detection. VHF wave length starts at one metre and in fact requires the length of the Divine Eagle. Since VHF wavelength is one metre and higher, very few VHF T/R modules can be placed in the radomes. Thus, owing to the constraints imposed by physics, the only place to locate a VHF AESA radar with reasonable resolution is along the length of the fuselage and to achieve interferometry, it would require two fuselages at a fixed distance from each other. The Chinese Divine Eagle anti-stealth UAV fulfills both requirements.

Formations of Divine Eagle UAVs could provide an early warning line to detect threats to China's airspace, such as from cruise missiles and stealth bombers, also taking on such missions as hunting for aircraft carriers in the open waters of the Pacific. One presumes that the Divine Eagle would also be able to find targets for the notorious DF-21D 'carrier killer' anti-ship ballistic missile.

In the absence of adequate manned ISR and special mission assets, the PLA will rely heavily on unmanned platforms to engage in ISR roles and provide unique capabilities like precision strike and wide area persistent surveillance, which will give an undeniable edge to the PLAAF over future battlefields.



The JY-27A anti stealth radar has evolved from the JY-27, which appears to be copy of the Russian 1L13/ 119 Nebo SV VHF radar series

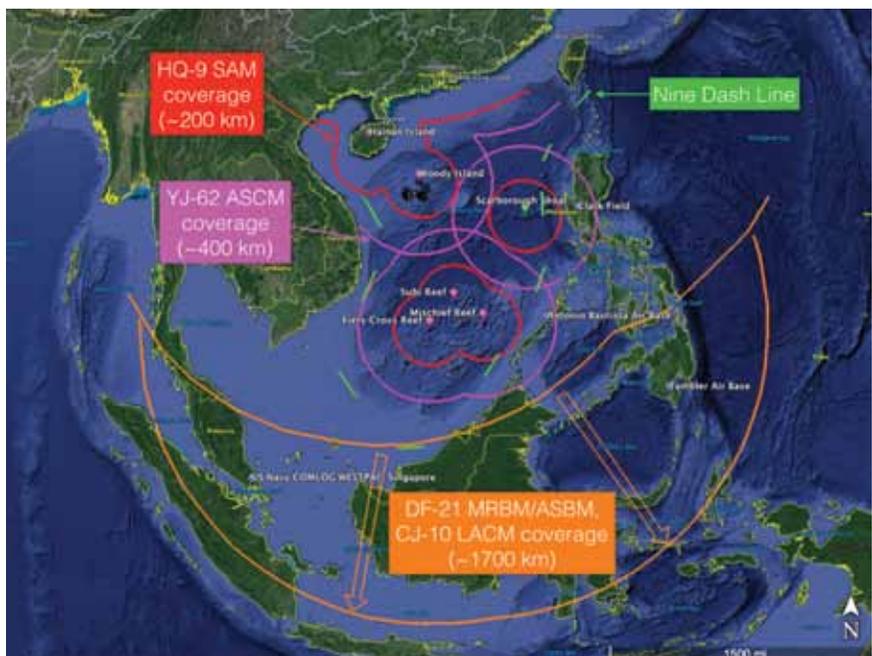
### Anti-Access/ Area-Denial (A2/AD) Defence Capability

Chinese A2/AD capabilities have considerably improved over the last 20 years and all signs point to it continuing to improve even further. The PLAAF has

moved from static and short range surface to air missile (SAM) systems of the 'Cold War' to mobile systems with a substantial range to cover most of Taiwan when deployed on the Fujian Coast. Since the 1990s, China has relied upon a mix of imported Russian systems like the S-300PMU-1 to cover



Based on the S-300V system, the potent HQ-9 SAM uses the HT-233 PESA radar system and has a range of 200km



swaths of A2/AD zones even as China has successfully reverse-engineered Russian and Western technologies and incorporated elements from both the S-300 and Patriot family of SAM systems to develop the indigenous HQ-9 system. The HQ-9, with a 200km range, represents China's strongest attempt yet to create a modern LR-SAM component. China concurrently developed the 50-km-range HQ-12 SAM, which has been followed by the HQ-16 SAM.

Supplementing these is the recent acquisition of Russia's S-400 'Triumph' (SA-21) SAM, the most modern non-western system in the world with even longer ranges and enhanced tracking capabilities. China will reportedly be receiving the first six S-400 batteries by mid-2017 and may simultaneously develop its indigenous CSA-X-19 (HQ-19) to provide the basis for a ballistic missile defence capability.

China's principal radar manufacturer, the China Electronics Technology Group Corporation (CETC), exhibited air defence radars at Zhuhai 2016, which claims detection of low-observable aircraft such as the Lockheed Martin F-22 Raptor and F-35 Lightning II. One of these, the JY-27A 3-D is a VHF band AESA LR surveillance/guidance radar. The second is the JY-26 Skywatcher-U, which operates in the VHF/ UHF bands. Both have a claimed range of 500 km. Over the Horizon (OTH) detection HF based radars have also been deployed by China to monitor back scatter returns from the East and South China Seas. These are complex and large systems, which use multiple sites to detect flying objects and surface vessels, including stealthy aircraft. A Quantum radar is also reported to be under development by the CETC's 14<sup>th</sup> Institute. Quantum radars can theoretically defeat stealth by using subatomic particles, instead of radio waves. Conventional signature reduction techniques and jamming cannot defeat 'Quantum' detection and although details are sketchy, detection range of 61 miles has been achieved as per Chinese media. As part of its anti-ballistic missile (ABM) defence network, China is developing phased array long-range early warning radar system, similar to the US PAVE PAWS, capable of detecting targets up to 5,500 kilometres distant. The experimental sets are positioned in Heilongjiang, Xinjiang and Fujian provinces which can monitor space vehicles, as well as



The HQ-9 is deployed extensively in the South China Sea on Chinese claimed islands and reefs. It, along with various land attack and anti-ship systems provides a defensive depth to the Chinese mainland

reentry targets and appear to use derived technologies from the Soviet era 'Hen House' ABM radar systems.

The PLAAF's SAM systems and their degree of integration with defensive interceptor aircraft are not fully known of as of now, especially along some of the world's most densely populated radar networks around the East and South China Seas. Without constant coordination and training, Chinese fighter interceptors and

missiles will not be able to operate in the same environment without severe risk of friendly fire, giving a sense of mixed progress. Notwithstanding issues of integration and control, the S-400/300/HQ-19/9 LR SAMs, along with a contemporary LR detection radars, will form a formidable A2/AD shield, capable of defending China against the next generation offensive platforms of the United States and other regional powers.

## PLAAF Combat Aircraft Strength in 2017

BOMBER	TRANSPORT	TRAINER
H-6 series : 120	IL-76 : 17	JJ-7 : 35
FIGHTER/ FIGHTER BOMBER*	MA-60 : 9	K-8 : 170
J-7 : 388	Tu-154 : 6	Y-7 : 13
J-8 : 96	Y-7 : 60	JL-10 : 25
J-10 : 240	Y-8 : 44	SPECIAL MISSION
J-11 : 130	Y-9 : 7	B-737 : 2
Su-27/30/35 : 300	HELICOPTERS	An-30 (EW) : 4
JH-7 : 71	Mi-17 : 16	Challenger 870 (Recce) : 5
TANKER	Z-8 : 34	IL-76 (KJ-2000 AEW) : 4
IL-78 : 3	Z-9 : 20	Tu-154 (EW) : 3
H-6 : 12		Y-8 (KJ-200 AEW/EW) : 7/17
		Y-9 (KJ-500 AEW) : 4
* Obsolescent types such as F-6/Q-5 are excluded	PLAAF TOTAL - 2159	

# The Dragon's Fighters

## Chengdu J-10

**L**ong regarded as a beneficiary from the cancelled Israeli Lavi fighter aircraft programme, the Chengdu J-10 is perhaps the most successfully designed frontline combat aircraft in service with PLAAF, matching capabilities with its western opponents like the F-15/ F-16/ Mirage 2000.

Its development started as a requirement to create a fourth-generation fighter aircraft in 1983 at CAC. Meant to be a J-7 replacement, the first prototype flew in 1998,

largely helped by the Israelis and Russians. A single Russian AL-31FN (series 1) turbofan powered the J-10 prototype and the first J-10A regiment was formed in 2004. The J-10 currently equips nine PLAAF frontline units, as well as the PLAAF's Aerial Demonstration team *Ba Yi* (August First), which was formed in 2009.

The final J-10A rolled off the production line in Chengdu in 2014. Its armament consists of the PL-12 AAM, LS500J PGMs and the K/JDC-01 FLIR targeting pod. In 2009, the J-10B was unveiled with a new fixed diverter less inlet (DSI), a flatter radome, an Infra-Red Search & Tracking Unit (IRST) and a holographic HUD. Although powered by the Russian AL-31FN (series 3) turbofan, it is believed that the domestic WP-10B engine has been mated to this version by 2013. The radar sensor is a X-band passive electronically scanned array (PESA) developed by No. 607 Technical Institute. The first frontline J-10B unit was formed

*Clearly displaying its resemblance to the Israeli Lavi, the J-10B is part of the PLAAF's potent fourth generation fighter force and replacing the older J-7/8 fleet*

in 2015 and at the same time the first J-10C, equipped with an AESA radar developed by the 14<sup>th</sup> Institute, and manufactured with greater use of composite material and the WS-10B made an appearance at Chengdu in late 2014. The Block 02 J-10C will replace the Block 01 J-10B on the production lines and probably all J-10 variants will be brought to the J-10C standard by 2022. By mid 2016, a total of 350 J-10s had entered active service with the PLAAF. Though not part of the WTC forces, J-10As have been consistently seen operating out of Gonggar and Shigatse in Tibet over the past few years. In all probability, some of the WTC regiments will be re equipped by this type by 2018. In June 2017, a J-10C flew with a PL-15 BVRAAM for the first time.



*The clean lines of the J-11B, the Chinese copy of the Su-27SK, are visible clearly. The Chinese aerospace industry has done well in achieving high standards of aerospace manufacturing in the last 20 years, even if 'reverse engineered' to a great extent*



When faced by issues concerning supply of avionics and other parts from Russia, the Chinese then cancelled the contract in 2000, with about 100 kits supplied as part of the original deal. The Chinese, in their usual manner shrewdly reverse engineered the original Su-27SK into a version called the J-11B, which used Chinese-made parts instead of the original Russian components. Though accused by the Russians of flying an unlicensed copy of the original Su-27SK, the Chinese went

### Shenyang J-11

The Chinese leaned towards Russia in the 1990s for supply of a fourth-generation fighter aircraft. After due diligence in 1991, a contract was signed between Russia and China to equip the PLAAF with the Su-27SK air superiority fighter, which consisted of direct supply of the Sukhois from Russia, as well as assembly of KnAAPO's knocked down Su-27SK kits in China. 200 of these were to be license produced at Shenyang by China under the designation J-11. In 1999, an upgraded version of the J-11, equipped with new N001V/ VE radar flew for the first time and was designated the J-11A. Seven PLAAF units are equipped with this variant.



*The J-11D prototype (D1101) under testing. The J-11D will be the most advanced version of the J-11, rivalling the Russian Su-35 in many areas. Note the flattened Radome*

# J-11 Variants

Type	Role	Loc	Air-To-Air Refueling	Radar	Engine	Remarks
J-11A	Air Superiority	1999	No	N001V/ VE Pulse Doppler	AL-31F	Chinese assembled Su-27SK from Russian-made kits
J-11B/BS (BS is twin-seat)	Multirole	2007	No	1478/KLJ-4 Pulse Doppler	AL-31F, WS-10A	Copies of the Su-27SK.
J-11D	Multirole	2015	Yes	AESA	WS-10B?	The most advanced Chinese version of the J-11, uses an advanced AESA andIRST
J-15/S (S is twin-seat)	Multirole	2012	Yes	1478/KLJ-4 Pulse Doppler	WS-10A	STOBAR carrier variant based on the J-11B, incorporating structural elements from a Su-33 prototype purchased from Ukraine in 2001. Uses J-11B Avionics
J-16 (Only twin-seat)	Multirole / LR Strike	2012	Yes	PESA	WS-10A	Twin-seat strike fighter based on Russian Su-30MKK sold to China in 2000
J-16D (Only twin-seat)	Electronic Warfare	2015	Yes	PESA	WS-10B?	EW version. Has wingtip pods resembling the AN/ALQ-218.

ahead with the production of the J-11B in 2007, equipping these with the Type 1474 or 1478/KLJ-4 pulse Doppler radar, a glass cockpit and after the initial run with Russian AL-31Fs, the WP-10A 'Taihang' turbofan. By 2014, J-10Bs equipped three PLAAF regiments, with the likelihood of the J-11As being upgraded soon to this standard in terms of avionics.

The J-11D prototype (D1101) made its first flight on 29 April, 2015. The J-11D features an upwardly canted radar dome, carrying an AESA radar, as well as further use of composites and stealth coatings in the fuselage to reduce weight. The fighter's Infrared Search and Tracking (IRST) pod has been relocated starboard of the cockpit, to accommodate a retractable inflight refueling (IFR) probe. The J-11D is also believed to have improved weapons hard points to carry the latest Chinese weapons,

such as PL-10 AAMs, the long range PL-15 missile and YJ-12 anti-ship missile. As a cross development of this platform, the J-15 is a carrier-based variant of the J-11BS, with canards, a strengthened under carriage, and folding wings, and is deployed on the Chinese aircraft carrier *Liaoning*. Another version, the J-16, is a twin seat strike oriented platform, which is a copy of the Russian Su-30MKK design.

In November 2016, a Chinese J-16 test-fired a gigantic hypersonic missile, reportedly destroying the target drone at very long ranges. The missile is 19 feet long, with range exceeding 300 km. The VLRAAM flies 15 km upward of its launching fighter to a 30 km altitude, guided by a combination of long range radars and satellite navigation, before dive bombing at hypersonic speeds onto enemy aircraft, including stealth fighters, stealth bombers and AEW&C aircraft. This

weapon will add a punch to the Chinese air dominance effort against the threat of US combat and AEW&C aircraft, and may be designated as the PL-21.

## Chengdu J-20 Stealth Fighter

First revealed by the US Office of Naval Intelligence in 1997 as Project 718, the J-20 is envisaged as China's next generation fighter aircraft with advanced stealth features. In early 2002, Shenyang (SAC), was chosen to develop the fighter, but owing to unknown reasons, the project was handed over to Chengdu at its Factory 132. While little is known of its development in the interim period, in November 2009, the PLAAF's Deputy Chief had stated that China's next generation fighter "would soon fly", with projected initial operational capability by 2019. He revealed that the design would imbibe four 'S'

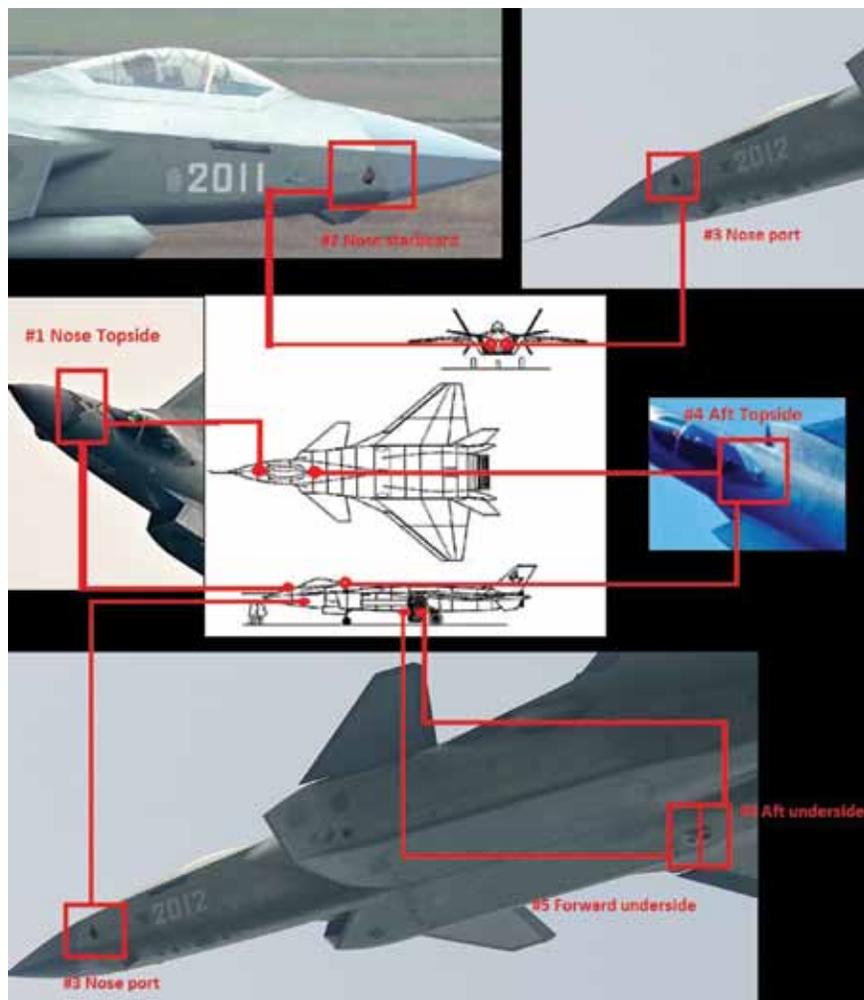


An early version of the J-20 as seen in 2013

capabilities : *stealth, super cruise, super maneuverability* and *short take off*. By 2010 two prototypes (No 2001 and 2002) were under development, with the first flight performed in January 2011 from CAC's home base at Chengdu Huangtuanba. By 2012 four airframes had been built (2001, 2002, 2011 and 2012). Around that time, it received several unofficial appellations such as Black Eagle, Black Silk or the *Wei Long* (Mighty Dragon).

The J-20 incorporates design aspects of the F-22 Raptor, with a sharp diamond shaped nose and single piece cockpit. Other fuselage aspects have been borrowed from the F-35 Joint Strike Fighter as well as the cancelled MiG 1.44 project. It is possible that the Chinese, in an industrial espionage coup, stole part of F-22 and F-35 designs from US contractors, reverse engineered the design and implemented domestic innovations. This was reinforced in 2016 when Su Bin, a Chinese national pleaded guilty with US authorities to conspiring with two unnamed military officers in China to acquire plans for F-22 and F-35 fighters and Boeing's C-17 military transport aircraft by illegal means (controlled by the PLA's Technical Reconnaissance Bureau as part of 'Operation Byzantine Hades').

By 2013, Chengdu had began weapons integration of the J-20 with the PL-10 and PL-15 AAMs. A large internal weapons bay accommodates the various armament, in addition to external hard points. Major improvements were done from the third prototype onwards featuring stealth coating, re-designed intakes, retractable refuelling and vertical stabilisers and a new canopy. It had an electro-optical targeting system mounted under the nose which sensor could be Beijing A-Star Science and Technology's EOTS-89 electro-



Locations of the J-20's six Electro-Optic Passive Detection System apertures

optical targeting system (EOTS). At the same time, the J-20 is equipped with six discrete, low profile window apertures around the aircraft, also suspected to house electro optic sensors. The apertures are arranged in the aircraft in such manner whence they appear to provide 360-degree spherical coverage around the aircraft and

the placement and configuration of the apertures are like the placement of the six apertures for the F-35's AN/AAQ-37 Distributed Apertures System. Therefore, some Chinese military watchers have described J-20's Electro-Optic Passive Detection System as a 'DAS'. However, much like the EOTS name, the AN/AAQ-37 DAS is a very specific product with specific capabilities for the F-35, and it is unknown if the J-20's EO PDS will boast similar capabilities.

There are indications that this Chinese jet carries an AESA radar, possibly the Type 1475 (KLJ-5), which is supposedly being tested on a China Test Flight Establishment (CETE) owned Tupolev Tu-204C airliner. Reports suggest that either the NPO Saturn 117S series engine (used on the Russian Su-35) or its predecessor, the AL-31FN series 3 variant, will power the J-20. However, as seen on the present prototypes, the AL-31FN (series 3) cannot generate sufficient



A camouflaged J-20 seen in Tibet as part of High Altitude testing in September 2016



*As part of its first public appearance, a pair of J-20s carried out a pass over eager onlookers at the Zhuhai airshow in early November 2016*

thrust for the J-20 to reach super cruise. Hence the Chinese were keen to get their hands on the Su-35 with its Saturn 117S (AL-41F1S) engines, until the indigenously developed WS-15 ‘Emei’ enters service (which is being flight tested on an Il-76 platform). There may also be issues with RCS reduction due to use of canards, which indicates that the Chinese may be facing stability issues on the J-20.

With at least 10 aircraft having been built by late 2016 and a variety of test profiles and certifications being undertaken (including high altitude operational testing in Tibet in September 2016), it appears that the J-20 is on its way for low rate initial production (LRIP), with all older prototypes being delivered to the Flight Test and Training Centre (FTTC) for development of tactics, weapon testing (PL-10 and PL-15 firings) and testing of the full flight envelope.

The J-20 was publically shown for the first time at the Zhuhai Airshow in early November 2016. Two J-20s flew a rather

sedate flypast in front of disappointed onlookers at the show, clearly indicating that the development challenges on the J-20 were far from over and beyond the regulation chest thumping, the programme was still work in progress, awaiting a ‘worthy’ engine for the platform.

In November 2016, the appearance of four J-20s with serial numbers from 78271 to 78274 was disclosed on the Internet, such serial numbers being PLA air force numbers. All these J-20s have low visibility coating. In addition, a satellite photo showed two J-20s at Dingxin Air Force Base in Jiuquan City, Gansu Province. The J-20s were obviously taking part in the annual large-scale ‘Red Sword’ combined drill in November. Dingxin may well be the first J-20 base of the PLAAF.

On 9 March 2017, Chinese state television reported that the J-20 ‘Mighty Dragon’, China’s first purportedly stealth combat aircraft, was operational, without giving further details. Still, what China defines as “operational” is a matter of

conjecture, however Pentagon officials say the announcement means the J-20 has entered formal operational test and will be flown in conjunction with a variety of other Chinese military aircraft to familiarise the service with the jet’s capabilities and experiment with concepts of operation. Operationally, the J-20 in its present profile, will have limited stealth characteristics, with abilities tweaked towards a BVR combat scenario. Given the production rate of 12-15 aircraft annually, the PLAAF may not receive its first operational J-20A regiment before 2019. Still, and whenever this happens, without doubt, the J-20 will have significant impact in the balance of power in Asia and the Pacific region.

### Shenyang J-31/ FC-31

During Zhuhai 2014, the Aviation Industry Corporation of China (AVIC) and Shenyang Corporation showcased the J-31 (export version designated FC-31), at a very early stage of its development programme, especially when one considers that the project was started in 2012. Project 310, as it is known in China, is reportedly also inspired from ‘stolen’ F-35 designs.

The J-31 is being designed as a multi role tactical fighter, to serve alongside the more focused J-20 as a private AVIC venture through the SAC. It was officially named ‘Falcon Eagle’ at Zhuhai with a strong inclination to market this fighter as a stealth platform for export to “friendly allies”, notably Pakistan. The Pakistan Air Force is reportedly “very interested” in this fifth generation fighter but Observers point out that the aircraft is still under development and “immature”, although the production version will be considerably improved from the present prototype (No. 31001), with better performance and enhanced operational capabilities. The changes will include better RCS reduction with clipped tailfin and wing trailing edge corners for ‘edge alignment’, completely redesigned vertical fins and a single piece cockpit canopy. Presently flying with the Russian RD-93 engine, it is to be fitted with the under development WS-13A turbofan, which will help the J-31 achieve super cruise capability. As with the J-20 the biggest question concerns availability of a modern medium sized high thrust





*The sleek profile of the J-31 bears striking resemblance to the USAF's F-35 Lightning II*

Chinese sixth-generation fighter aircraft for some years now and this was officially confirmed in an award ceremony for winners of 'Feng Ru Aviation Tech Elite Award' held on 16 September 2015. According to Shenyang Aircraft Institute's general designer Wang Yongqing, who has been working on 'special mission aircraft, the next would be sixth-generation, following the J-20 and J-31 fifth generation types. China's Aviation Research Institute No. 611 is working on the J-28, reportedly a sixth-generation multi-function stealth fighter jet. This is to be a hypersonic platform, capable of sub space operations, nuclear capable, have stealth technology, heightened awareness and autonomous characteristics with artificial intelligence, prepared for advanced electronic/cyber warfare of the futures and coated in 'smart skin.' It is assumed that the J-28 would be armed with high yield laser weapons, to engage targets from surface to Low Earth Orbit (LEO) level. Helped by testing of experimentation hypersonic vehicles like the DF-ZF (WU-14), the first prototype is likely to appear around 2030 – ready to take part in the next generation 'Star Wars' air combat !

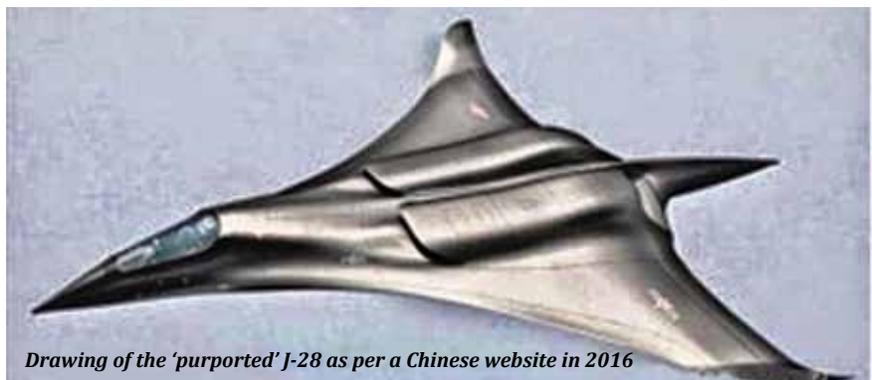


*Black smoke from the Russian RD-93 engine is very visible during various maneuvers from the J-31. China is looking out for a potential replacement engine for the J-31*

turbofan, which factor will probably decide whether the project succeeds or fails. With such woes plaguing various aircraft programmes, China has recently established a new company, the Aero Engine Corp of China (AECC), tasked to research, develop, and manufacture aircraft engines for Chinese aviation programmes. The J-31 sensors include the EOTS/IRST and an AESA radar. Western reports indicate that the J-31 will be a fourth generation + fighter. Hence in theory, it will be a strong contender to replace PLAAF's J-7/8 fighters and complement the J-10 and J-11s in the coming years. A less reported single engine VTOL version of the J-31, possibly the J-18 is believed to be in existence, the future of which may be severely impacted because of the lack of a suitable engine.

### **The Rumoured 'Sixth Generation' J-28**

In line with sixth generation air combat fighter developments in the US, Russia and Japan, there have been rumours of a



*Drawing of the 'purported' J-28 as per a Chinese website in 2016*

# The PLAAF vs IAF over Tibet : A Capability Assessment

The Indian Air Force surely appreciates the PLAAF's continued introduction of newer aircraft types and upgradation of A2/AD capabilities. While continuing to acquire newer air superiority fighters, such as the Su-35 from Russia, China's domestic aeronautical research efforts have yielded dramatic gains with new aircraft, sensors, weapons, and signature reduction advances, which will have the IAF face more serious challenges from the PLAAF. Despite induction of the Rafale and more Su-30MKIs in the coming years, the IAF does not have 'adequate' number of fighter aircraft to simultaneously protect the western and north-eastern borders. Compared with the PLAAF, which is likely to have 800 plus 4<sup>th</sup>/5<sup>th</sup> generation types in service by 2020, the Indian Air Force has been limited by the 'Government Authorised Establishment (GAE)' of 42 squadrons by 2027, against a 'wish list' of 60 squadrons for a two-front war.

In case of any major operations/full scale war with India, the PLAAF will be expected to defend the skies over its area of responsibility and along with elements of the PLA rocket Forces (PLARF), take the war into Indian territory, neutralising Indian military bases and infrastructure in the North East, Jammu & Kashmir and other parts of continental India. The IAF thus faces a formidable challenge, wherein it will need to fight a highly mobile and technologically imposing war to safeguard its limited bases, while dominating the skies, supporting offensive and defensive Indian Army operations in WTC. Nonetheless, *Terrain, Technology & Training*, will assuredly give IAF an edge over the PLAAF in Tibet and southern Xinjiang, counterbalancing numerical superiority of the PLAAF, at least for some years to come.

The Tibetan plateau is rightly referred to as roof of the world, with an air density of 20-30% compared to sea level (SL). The high-altitude nature of Chinese airfields in Tibet, along with prevalent extreme climatic conditions seriously restrains the performance of aircraft, which reduces

the effective payload capacity and combat radius by an average of 50%. Significantly, the PLAAF's Su-27/30/J-11/J-10s also face a reduced look-down radar detection capability in the mountainous terrain, leaving the PLAAF's meaningful early warning capability limited to medium and high altitudes. This is not helped by the five ground based Radar Regiments deployed in Tibet and South Xinjiang, which face the same detection issues and are unable to cover the entire Indo-China border. Operating from airfields located near sea level elevations in plains, the IAF has no such restrictions and will effectively undertake deep penetration and air superiority missions in the Tibetan Autonomous Region with full complement of payload and fuel. The IAF Su-30MKIs and Mirage 2000s, along with soon-to-be inducted Dassault Rafales, have a technology edge over the existing Chinese combat jets deployed in the WTC. Operating under the IAF's Integrated Air Command & Control System, supported by multimission types like the Phalcon AWACs, small groups of Su-30MKI/Mirage 2000 will be able to counter larger PLAAF forces, confining the Chinese to anchored ground based radar cover around key communication nodes. While the IAF shares Russian-supplied weapon heritage with the PLAAF, combat efficacy of home-produced Chinese weapons is yet to be tested in combat.

Most combat will take place beyond visual ranges, with the PLAAF preferring low level, snap up ambush nests over Tibet, compared with more aggressive patrols by

the IAF to saturate the A2/AD network of the Chinese. Incidentally, the soon-to-be deployed MBDA Meteor Active guidance BVR missile carried by IAF Rafales, will offer a multi-shot capability against long range manoeuvring targets in a heavy ECM environment, with ranges exceeding 100 km. This will give an edge to the IAF, that is until operational induction of the recently tested VLRAAM missile and PL-15 in the PLAAF, the success of which will largely depend on increased availability of LR detection assets. Electro Optical & NCTR identification protocols will need to be revised, considering common emission characteristics of the Sukhois on both sides, which may cause IFF issues. Terrain hugging fighters, masked by innumerable mountain valleys of TAR, will be a major factor for the both sides, delaying crucial early warning to the defenders.

C4ISR missions conducted by the PLAAF will rely majorly on unmanned platforms of varied capability. Any PLAAF offensive sweeps into India will need to be backed by great concentration of multi capability platforms and a drawn-out logistical chain which will be difficult to sustain over longer durations. However proliferating UCAV drone operations can be expected, with swarm-based saturation attacks against the IAF's point defence systems and C3I networks. The balance will tilt towards the Chinese once the stealthy J-20 becomes operational, backed by increased number of AWACS and refueling types based on the Y-20 platform, which has a good high altitude operational capability. The IAF however



J-10B fighters recorded on deployment at Gonggar (Lhasa) airbase in Tibet

is expected to maintain its combat edge in multi mission training at least till 2030, with autonomy of effort, unlike Chinese air crew who are still largely dependent on a ground control AD environment. The IAF focusses much more on experience in air combat and varied weapon delivery, backed by exposure at multinational exercises, to maintain a 'qualitative' edge over its foes. Though the Chinese have started training towards combat scenarios associated with newer training modules, including flying under challenging environmental conditions and combat autonomy, the resultant honing of aircrew standards will be only visible after 2030.

The PLAAF really cannot sustain the 'Large Area' defence CONOPs doctrine in Tibet, and will be forced to revert to a 'Vital Area / Vital Point' (VA/VP) defence strategy, with focus on short term campaigns. It realises this gap in functional capability, choosing to ingest the A2/AD environment with modern S-300, HQ-9 and HQ-12 SAMs, all of which pose grave danger to the IAF although they are reliant on early detection for success. Major SAM complexes have been identified in Xinjian and TAR, which guard the likely ingress routes of the Indian Air Force. These effective SAM nests would be countered with multi-tier saturation attacks by IAF, using standoff weapons like the potent BrahMos supersonic cruise missile and precision attack munitions. On the other hand, PLAAF's aviation units, operating out of Yunnan province and interdicting the Brahmaputra valley, or via an interdiction of the Indus valley by air forces based in Xinjiang and long range raiding Special Forces dropped in the Brahmaputra valley will always remain a threat. Also, the H-6K bomber fleet, operating out of other Theatre Commands, will pose a serious threat with standoff cruise missiles like the CJ-20.

To pre-empt such situations, the Indian Army and the Air Force would need to allot high priority for its networked air defence, as has been done in the west against Pakistan. Undoubtedly, the IAF and its infrastructure is vulnerable to mass strikes by tactical SRBM/ IRBMs at the disposal of the PLA Rocket Forces, which considering the PLAAF's operational restrictions in Tibet, could lead the key strike effort over India. While efficiency of the PLARF will be worn down with operationalisation of the Indian ABM shield by 2025, the PLARF's DF-11/15/16 missiles deployed in Tibet and protected by bomb proof tunnels in the Himalayas, will present a clear and present danger to India, remaining a priority target

## PLAAF aviation assets in the Western Theater Command (WTC) facing India

Unit (Division/ Regiment)	Base	Aircraft Type
<b>4th Transport Division</b>		
10 <sup>th</sup> Air Regiment	Chengdu - Qionglai	Y-8C, Y-9
11 <sup>th</sup> Air Regiment	Chengdu - Qionglai	Y-7
12 <sup>th</sup> Air Regiment	Chengdu - Qionglai	Mi-17V5, Y-7, An-26
<b>6<sup>th</sup> Fighter Division</b>		
16 <sup>th</sup> Air Regiment	Yinchuan/ West	Su-27SK, J-11
17 <sup>th</sup> Air Regiment	Jiuquan Qingshui	J-7B
18 <sup>th</sup> Air Regiment	Lintao	J-7H
<b>33<sup>rd</sup> Fighter Division</b>		
97 <sup>th</sup> Air Regiment	Dazu	J-7B
98 <sup>th</sup> Air Regiment	Baishiyi	J-11, Su-27SK
99 <sup>th</sup> Air Regiment	Zunyi-Xinzhou	J-7BH
<b>Urumqi Base</b>		
109 <sup>th</sup> Brigade	Changi	J-8F/G/H
110 <sup>th</sup> Brigade	Urumqi - South	JH-7A
111 <sup>th</sup> Brigade	Korla -Xinhiang	J-11B/BS
112 <sup>th</sup> Brigade	Malan	J-7B

for the IAF's offensive air and deep strike missions in Tibet.

Unlike other Theatre Commands, the PLAAF's ability to maintain strategic long term superiority in Tibet will remain diminished for the next 10 years. Beyond 2025 however, PLAAF will be a majority 4<sup>th</sup>/5<sup>th</sup> gen air force. Reinforced by an extended all-weather infrastructure capability in Tibet, newer generation Chinese warplanes will end any technical asymmetry with India, while imposing a clear numerical ascendancy in the Western Theatre Command.

### Air Power Balance

While the effect of restructuring and reforms is yet to be seen, the PLAAF has made meaningful progress towards achieving the near-term Wide Area Dominance capabilities needed for its mission set in the next 15 to 20 years, largely in form of better technologies, and systems. From fighter aircraft/ UAVs (Stealth & UCAV Drone swarms), to associated avionics and weapons systems, China is closing the technology gap with the West and the Russians. Conflict score cards have noted that the PLAAF has consistently moved from failure assessments to reaching near parity levels with the United States in any conflict over Taiwan. Doctrine and training issues remain the largest weight on the PLAAF's capability, which aims at building initiatives across multiple arenas. Outcome of these will be visible in the years to come. Meanwhile the planned development of China's fifth-generation

fighter force will bolster the underway modernisation of the PLAAF in a big way. These types, which could enter service as early as 2019, will significantly support China's existing fleet of fourth-generation aircraft towards gaining regional air superiority in meaningful manner.

Recent muscle flexing by North Korea and the strained THAAD deployment in South Korea, US Navy FONOPS in the South China Sea, as well as the Doklam stand off with India have inadvertently pumped up the Chinese military towards a posture of combat readiness in the region. As Chinese fighters scramble to patrol these 'hot spots', the PLAAF is getting more formidable, projecting aggressive ability, being effectively used as an instrument of Chinese projection and statecraft by the CCP, while actively helping to dramatically change the power balance in some of the most security sensitive areas of the world.

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*His earlier article 'Red Star over Syria' published in the Vayu Aerospace Review, was selected for Special Award at the Paris Air Show 2017.*

# The Chinese PLAAF in 1962



## An assessment by the CIA

*The US Central Intelligence Agency (CIA) had made an assessment of Chinese air capability and its effectiveness in operations against India during the frontier war in the high Himalayas in October-November 1962. This has been de-classified 50 years after and is re-produced for Vayu readers.*

From a humble beginning in 1949 the Communist Chinese Air Force has developed rapidly into a significant force; indeed, in combat strength it is now the third largest Air Force in the world. Initially, and for a number of years, its expansion was made possible by the technical advisers, instructors, and aircraft by the USSR. An impetus to development was given by the Korean War. An aircraft industry was built up with extensive aid from the Soviet Union and the manufacture of relatively modern Soviet types, such as MiG-17 fighters was started in the late fifties.

### Economic and Political Considerations

The development of the aircraft industry was part of a wide programme of forced industrial development, designed to transform China into a powerful self-sufficient industrialised nation in the shortest possible time. Initial progress was impressive but in 1958 the regime ordered the adoption of radical programmes which attempted to accelerate greatly the pace of production and development. At the same time they introduced communes in the countryside. It is now clear that those policies failed and aggravated by bad weather conditions in the past three years, they have resulted in poor harvests and a severe setback to the economy as a whole. A serious food shortage caused a pronounced deterioration in the health, strength and morale of a significant part of the populace. A drastic reorganisation of economic priorities in 1961 has now resulted in heavy industry being placed after agriculture and light industry. A slight improvement in the food situation has been experienced in 1962.

The abrupt withdrawal in 1960 of most of the Soviet engineers, technicians and economic advisers, plus the sharp reduction in imports of Soviet equipment, have seriously reduced production in industries of defence importance. Unless this situation is remedied, China will be unable to build such equipment as modern aircraft (e.g., the MiG-21 and Tu-16) in significant quantities for some years.

We believe that as a result of the discord in Sino-Soviet relations, the Soviet Union has not supplied any modern offensive aircraft to China in the past two years, although she has been willing to make them available to other countries such as Iraq, Indonesia, and the UAR. We consider that as long as the serious rift in relations remains, the Soviet Union will be reluctant to supply modern aircraft to China and China will be faced with growing obsolescence in her Air Forces. Even in the unlikely event of her economic problems and ideological differences being resolved in the near future, it would be several years before China could significantly improve her air capability, unless combat aircraft were directly supplied by the USSR.

### Organisation of the Air Force

The Communist Chinese Air Force (CCAF), subordinate to the Ministry of Defence, is organised as a single entity encompassing all phases of air operations and has no operational commands. However, in most other respects it reflects Soviet concepts and principles. CCAF headquarters is located at Peking and consists of operational, logistic and training elements. The Communist Chinese

Naval Air Force (CCNAF) is an integral part of the Navy with its Headquarters also at Peking.

The air defence system is controlled from Peking through at least seven district air defence headquarters, which are responsible for the co-ordination and control of activities in their particular areas. During air defence operations naval fighter units are under the operational control of the CCAF, through these district headquarters.

### Strength and Deployment

The CCAF and CCNAF have a combined strength of about 2,650 aircraft; the majority of which are jet fighters (1,920) deployed along the coastal periphery and adjacent to major inland centres. The Il-28 light jet bomber force (325), the piston Tu-2 light bombers (105), the special ground attack aircraft (40 Il-10 and 30 MiG-15), and a few obsolescent Tu-4 medium piston-engined bombers (15) are deployed mainly in northern areas.



We estimate the strength of the transport force to be approximately 195 obsolescent piston-engined short-range aircraft, made up mainly of the Li-2, the Il-12 and the Il-14. (These are very similar to the DC-3, and resemble the Convair 240).

There is a well-developed airfield system in China. Approximately 260 airfields are distributed throughout the country, including 135 which are suitable for jet fighters or light jet bombers, and 30 which can be used for medium jet bombers.

The distribution includes a network of airfields stretching some 400 miles inland, providing a strong support for the coastal bases. It also provides facilities for redeployment of aircraft (mobility is stressed in the CCAF/CCNAF) to any sector in eastern and coastal regions from North Korea to the Indo-China borders.

Most Chinese airfields adjacent to the Indian border are at very high altitudes and have natural or gravel surfaces, rendering them generally unsuitable for sustained jet operations. However, the Chinese do possess some airfields in the area which are not at very high altitudes and which would be usable for light bomber or fighter action against India. The airfields most likely to be used for operations against the Ladakh-Jammu & Kashmir area, are Hotien (Khotan) at 3,000 feet elevation with a crushed rock runway, and Soche (Yarkand) at 4,400 feet elevation with a sod or natural surface.

High elevation and natural runway surfaces alone would not prevent the Chinese from conducting militarily significant jet operations. A number of operational factors must be considered. Air temperature as well as runway length is important in estimating required take-off distances. We do not believe that reduction in radius of action and/or bomb load would arbitrarily be required in all instances. For example, at Lhasa, at 14,000 feet elevation and 0° Centigrade, we believe that Il-28s could take off with a full load using less than 5,000 feet of the available 13,000 foot runway.

### Offensive Capability

The CCAF light jet bomber force has had no operational experience, but has been carrying out operational training for several years in the bombing role. It probably has a limited radar bombing and ECM capability, and we estimate that it has the ability to mount reasonably effective operations. A piston-engined light bomber force is still retained but its effectiveness in the face of opposition would be very low.

The medium bomber force possesses a very limited strategic bombing capability due to its small size. The Tu-4, a piston-engined bomber dating from 1948, would be highly vulnerable to jet interception.

The Tu-2, with a 440 nautical mile (nm) radius and normal bomb load of 3,300 pounds, would be the most reliable aircraft for tactical strikes because of its slower take-off speed and greater maneuverability at low levels. The Il-28 could bomb targets in northern India from bases in Szechuan (Cheng-Tu), Tibet, Yunnan, and possibly Sinkiang. The Tu-4 and the Tu-16, with combat radii of over 1,600 nautical miles, could cover northern and northeastern India, including New Delhi and Calcutta, from their base in Sian.

### Defensive Capability

The CCAF/CCNAF is basically a defensive force. About three-fourths of its aircraft are fighters, of which less than 10 percent have an all-weather capability. Its air defence role is restricted by lack of the most modern types of aircraft, insufficient flying time

for combat proficiency, lack of air-to-air missiles, and logistical weaknesses in POL and aircraft engines and parts for sustained combat.

A comprehensive radar network exists long the coast from Hainan in the south to the Soviet frontier. Inland there is a partial coverage up to a depth of about 500 miles.

Despite the deficiencies listed above, as well as weaknesses in pilot proficiency and fighter tactics, in China proper the CCAF/CCNAF would have a good chance of intercepting intruding aircraft during daylight hours in clear visibility.

The Chinese are not equipped to handle tactical intercept air operations from bases in Tibet. The nearest jet fighter unit is probably located at Chengdu, but units could be swiftly redeployed to Tibet and Sinkiang.

Within China proper we have firm evidence of a small number of surface-to-air missile sites at Peiping, San Yuan (near Sian), and at the Shuang-cheng-tzu missile test facility. Moreover, China has a well co-ordinated conventional anti-aircraft defence system in her coastal provinces. Inland, however, the scale of defence decreases rapidly and only the more important cities are known to have reasonable AA cover.

### **Air Transport capabilities**

The operating capability of their transport force is low by Western standards. Air transport plays an important part in Chinese defence plans. The main task is to provide logistic and tactical support of all armed forces. In view of China's size and comparatively poor transport facilities, the available air transport effort is inadequate. However, a considerable part of the small civil air force is regularly used for carrying freight, and conversion to military use of a small part of this fleet could quickly be effected.

The Chinese Communists would use transport aircraft in airborne operations; however, extensive airborne operations are unlikely if they would cause a major disruption of essential air transport operations. The Chinese are severely handicapped by a lack of aircrew trained for airborne operations, and by lack of suitable transport aircraft with a 'heavy drop' capability. Nevertheless, in favourable circumstances a limited operation might be undertaken. Supply dropping could also be carried out.

### **Air Operations against India**

Communist China is extremely sensitive to the possibility of an attack by nationalist China in the present period of economic difficulties, but we do not believe the resulting desire to maintain a strong air posture in China proper would seriously handicap Communist China's ability to wage an air campaign against India.

Even so, it is unlikely that the Chinese Communists could deploy and logistically support more than 290 tactical aircraft for operations against India (i.e., 180 jet fighters, 50 light jet bombers, and 60 light piston bombers).

### **Logistic Support**

The key to air operations against India would be the amount of logistic support, particularly POL, which the Chinese could provide to forward bases. We have little evidence of stock-piling of air supplies in the Tibetan area. Theoretically, if the Chinese exerted a maximum effort, they might be able over a short period to deliver a total of 2,240 tons daily to the Tibetan area for all purposes. Of this daily total 2,000 tons would come by road and

240 tons by air (assuming the use of virtually all available military and civil transport aircraft). It is not likely that the Chinese would choose to make such an all-out effort. Despite the recent border fighting, the total tonnage currently delivered into Tibet is estimated to be no more than 500 to 700 tons daily, virtually all by road.

Because of Army demands, the amount that could be brought in by land routes to support air operations against India would be limited. However, we believe that up to 50 transport aircraft could be diverted to support such air operations without imposing unacceptable restrictions on the overall Chinese air transport system. Under optimum conditions, these 50 transports could supply some 60 tons daily for a sustained period from railheads in China proper. This daily tonnage by itself would suffice to support the following alternate operations:

- 6 light bomber sorties at 3 short tons per flying hour, or
- 16 piston light bomber sorties at 1 short ton per flying hour, or
- 28-31 jet fighter sorties at 1 ½ short tons per flying hour, or
- 32-37 jet ground support sorties at 2 short tons per flying hour.

Stockpiling prior to operations would, of course, allow an increased effort.

There is no reason, however, to assume that Chinese Communist tactical air operations would be restricted to supplies which could be delivered by air. Of the potential daily maximum tonnage which could be supplied by ground and air to the frontier areas of Tibet and Sinkiang in all-out effort, we believe some 500 tons could be allocated for the support of the 290 tactical aircraft listed earlier.

Strategic air operations by medium bombers from bases in China proper are unlikely to be restricted by logistic considerations.

### **Offensive Operations**

There is no evidence of light bomber deployment into South-West China or Tibet. However, if China adopted such a course, a few jet light bombers, operating from Lhasa or, more likely, from Nagchhu Dzong, could carry out attacks in the NEFA area. Il-28s, operating from Kunming or Cheng-Tu could also cover most of the NEFA area. The piston-engined Tu-2s would be suitable for operations, and in comparison with jet aircraft, would probably give a higher rate of utilisation. However, it would be highly vulnerable to jet interception. The Chinese could only provide very limited close support of their troops; in some areas terrain would limit the effectiveness of such attacks.

By day, in a strategic role, Il-28s could also operate against cities such as Delhi and Calcutta from Soche (Yarkand) and Nagchhu Dzong. By night, because of difficulties of operating from Tibetan airfields, we do not consider it likely that the Chinese would attempt such operations with the Il-28 aircraft. However, we believe that the light bomber force is probably capable of night operations and that a new sporadic raids could be mounted. The medium bombers, operating from such bases as Hsi-ning, Ka-erh-mu (Golmo), and Lhasa, would have the capability to reach strategic targets such as New Delhi by day or night. Approximately four to six Tu-4s could be launched in an attack, but these aircraft would not have long-range fighter protection and would be vulnerable to jet interception if detected. If either of the two Tu-16s previously identified should be operational, they could be employed with considerably more effect in a limited strategic bombing role.

It is reasonable to assume that the continuing expansion of early warning radar facilities in China has by now placed some radar equipment in the north western frontier area, and if such is the case, that a limited air defence radar capability exists in the general Ladakh region. It would be possible to operate a few fighters in the air defence role in Tibet although our evidence does not suggest that fighters are currently deployed there. Such aircraft would encounter difficult operating conditions, and terrain would limit radar effectiveness. In southwestern China air defences would attain a higher standard but effectiveness would be very limited at night or in poor weather.

### Airborne and Air Supply Operations

In view of the limitations of and other calls upon the transport force, extensive airborne operations are unlikely. The air situation, however, would not necessarily be unfavourable to the Chinese in all areas where they might contemplate limited airborne operations.

### And so....?

Although the Communist Chinese Air Forces are numerically large, the aircraft are obsolescent, few have an all-weather capability, they lack such advance weapons as air-to-air missiles, and pilot combat proficiency is only fair. Moreover, China is unlikely to obtain more than a few modern combat aircraft in the next few years, either from their own industry or from the Soviet Union.

China's ability to wage a tactical air campaign against India would be seriously handicapped by difficulties in the provision of logistic support. The scarcity of suitable airfields in Tibet and Sinkiang would constitute an added hindrance. Although the Chinese could deploy and support approximately 290 tactical aircraft for operations against India without seriously weakening their defence posture toward Taiwan, we estimate that they would initiate tactical air operations only if the leadership considered it necessary for the achievement of basic objectives. We believe that China is unlikely to undertake air attacks deep into India except in retaliation or in the event of a change in their military objectives.

The Chinese could mount only light, sporadic raids against India with piston bombers (Tu-2s and Tu-4s) and such aircraft would be highly vulnerable to jet interception if detected. However, it is likely that Chinese Il-28s could be effective against Indian targets in sustained operations involving limited numbers of aircraft. If China's two Tu-16s should prove to be operational, they could play a small but important strategic bombing role. Moreover, we would hesitate to ignore or minimise the psychological significance of even token Chinese raids on Indian cities and military targets.

Although Chinese air defences in the Himalayan frontier area generally are weak, we believe the Chinese Air Force could provide adequate defence for a few localities. The five airfields in the Sinkiang-Tibetan area most likely to be used in operations against India (Hotien, Soche, Lhasa, Nagchhu Dzung, and Yu Shu) would be vulnerable to air attack. However, we do not believe that this alone would deter the Chinese from mounting operations from them.

We believe that the Chinese are capable of undertaking limited airborne operations, although this appears unlikely in present circumstances. There is some evidence that limited supply drops have already taken place.

*[Ed: Indian Air Force transport aircraft were majorly employed for airdrop supplies in NEFA and fly in heavy equipment, including tanks in Ladakh during the 1962 operations]*

## The Indian Air Force Principal Combat Aircraft Types in 1962

In 1962, the Indian Air Force had some 20 combat squadrons, the most potent types being the Hawker Hunter (6 squadrons), Mystere IVA (3 squadrons), Gnat (2 squadrons), Ouragan (3 squadrons), Vampire (3 squadrons) and Canberra (4 squadrons).

Totalling some 350 plus aircraft, and operating from various airfields at virtually sea level, piloted by well-trained aircrew, professional assessment is that the IAF would have outperformed the PLAAF over the high Himalayan battlegrounds.

*Hawker Hunter F.56*



*Dassault Mystere IVA*



*Folland Gnat*



*Dassault Ouragan (Toofani)*



*English Electric Canberra B (I) 58*



Not to scale

Dr. Manoj Joshi on

# China's Military Modernisation



## And its Implications

China's military modernisation began a long time ago. In the 1990s to be precise. But from 1990, when the PLA was overwhelmingly equipped with reverse engineered Soviet-era weapons, till the beginning of this decade, the focus was on enhancing the quality of PLA weapons and systems. We are now witnessing the latest phase as of 2015 when China launched a comprehensive reform to its military organisation. The focus of its modernisation is in shifting the balance from its Army to the Navy and Air Force and on integrating C4ISR systems. In addition, China is making major efforts to leap frog over US advantages through investments in futuristic technologies.

According to specialists on the PLA, they have moved from 'digitalisation' to 'networkisation' and now they aim to achieve 'intelligentisation'. This third stage involves the use of emerging technologies including artificial intelligence (AI), with big data and cloud computing to enhance the PLA's C4ISR capabilities.

In general terms, modernisation involves a qualitative upgradation of older doctrines, organisation and structures – and equipment. It has to take place in the context of specific threats and capabilities of perceived adversaries and their modernisation trajectory.

The main focus of the Chinese military remains possible conflict over the Taiwan straits and newer contingencies in the South China Sea and the seas of Japan and Korea. A sense of urgency has been brought into the reform given the standoff with the US on the issue of the South China Sea and Japan over the Senkaku islands.

All this involves two aspects: first, the reshaping of the PLA organisation, its doctrine and its command and control structure. The second is the upgradation of its military hardware.

The past year has been extremely significant for organisational changes that have led to the creation of Theatre Commands in place of the older military regions, a completely reorganised higher

command system emphasising joint operations, the upgradation of the force dealing with its nuclear deterrent and the creation of a new strategic support force.

In the first phase, Chinese strategy was to have systems "good enough" to fight a regional war. It would play catch up often using asymmetrical strategies like fielding large numbers of ballistic missiles, including A2/AD systems.

Now it is looking at the next phase, where instead of catch up, China seeks to leap-frog, even while simultaneously developing technologies which will degrade US systems. In line with this, it is pursuing technologies related to hypersonics, directed energy and counter-space. Doctrinally, it is emphasising joint, and integration of, Command, Control, Communications, Computers, Intelligence Surveillance and Reconnaissance (C4ISR).

China is enhancing its missile force for regional contingencies. These include cruise missiles, short, medium and IRBMs, a new generation of fighters, integrated air defence

systems, information warfare capacities, plus amphibious capabilities.

Its counter-space capacities focus on offensive cyber operations and electronic warfare. The C4ISR or reconnaissance strike complex is growing based on integration of satellites, land based radars, microsatellites and UAVs. China has one OTH (Over-The-Horizon) backscatter radar and will probably cover its maritime periphery with similar radars over time. The new PLASSF (PLA Strategic Support Force) is aimed at better integrating space, cyber and EW capabilities.

The goals of the organisation are domestic-political, as well as external military. So at one level, the reform has led to a tightening of the role of the CPC and its Chairman over the military high command, a.k.a. the CMC. From the military point of view, they seek to enhance (a) the ability to conduct joint operations (b) to be able to do so in what the Chinese call informationised conditions and (c) to do so further and further away from its mainland.

All these aims segue into the 'China Dream' of a strong military that will give it a great power status by 2049, which can provide China diplomatic payoff, enhance its regional pre-eminence and as well as protect its interests across the globe.

## The Strategy

Chinese strategy as defined in the White Paper of 2015 remains "strategic defence and operational and tactical offence" using new principles of autonomy, featuring integrated combat forces, featuring information dominance and precision strike. There is a special stress on PLAN to prepare for "maritime military struggle" and the preparations for such a struggle.

The PLAAF must shift from territorial air defence to aerospace dominance, the PLASAF strengthen its nuclear deterrent through S&T developments and the PLAPF ensure social stability. All this is not defensive as stated and there is enough leeway for pre-emptive strikes, "active defence" in any case has emphasised the readiness for pre-emptive counter-strike. PLA's concept of operations is shifting from "local wars under informationised conditions" to "informationised local wars".

This means emphasis on joint operations and technology to link units both vertically up the chain of command and horizontally with other combat arms and services in different domains. Emphasis is on system versus system operations, where according to Kevin Pollpeter, "the contest is between network of systems where the operation of every system and subsystem affects the performance of the entire system."

In the earlier 2013 version of the *Science of Military Strategy*, the authors had termed space as the new high ground without which China would be disadvantaged in all other domains. In this White Paper, for the first time, China officially identified outer space as a domain of war which means the use of space for military operations, as well as counter-space ops to deny the adversary use of space.

## The Organisation

The CPC Central Committee's 3<sup>rd</sup> Plenum called for optimising the size and structure of the army, adjust interservice balance and reduce non-combat institutions and personnel. At present the PLA has 73 per cent, PLAN 10 per cent and PLAAF 17 per cent of personnel. Also announced was

a "Joint Operation Command Authority under the CMC, and a theatre joint operation command system."

After two years, details became clearer. At the 3 September 2015 military parade, Xi called for a 300,000 reduction in personnel to bring the force down to two million. In November 2015, the reform working group of the CPC's CMC met and Xi laid out the reform proposals. Xi declared that current Military Area Commands (a.k.a. Military Region) would be regrouped into new battle zone commands (Theatre Commands) supervised by the CMC. A three-tier system would be created, and a separate administrative chain of command would link the four service HQs to units. These would be responsible for organisation, manning and equipping units. All of this would take place in the next five years. The key feature of the system was the increased authority of Chairman CMC, Xi Jinping, with the changes being termed the "CMC Chairman Responsibility System." The flatter command system emphasised the slogan "Commission directs, the theatre commands fight and the branches build". All these provide a slight correction to the PLA dominance.

On 31 December 2015, Xi established the PLA's new HQ, the upgradation of the PLASAF to PLARF and a new PLA Strategic Support Force. 11 January 2016 saw a new CMC organisation set up with 15 functional departments, commissions and offices.

On 1 February, five new Theatre Commands were announced, each with its own integrated operational command system. The Chiefs of Staff were deputy commanders with Rear Admiral Wei Gang becoming Chief of Staff of the Southern TC



Chinese J-10s and KJ-2000 AWACS in flypast

and AF Major General Li Fengbiao taking the position in Central TC.

In January 2017, China got a new Navy chief, as well as a naval vice-admiral as the Southern Theatre commander. VAdm Shen Jinglong, fleet commander of the Southern TC was made PLAN chief, while VAdm Yuan Yubai former commander of the North Sea fleet became the new C-in-C of the Southern Theatre command.

### Nuclear Strike

The goal is to achieve assured second strike capability against the USA. The PLA Second Artillery Force has been renamed as

late 2000s, a newer generation of long range missiles are coming into service such as the TEL based DF-31 and -31A, MIRVs DF-5B and -5C. The development of a longer range MIRV-capable and mobile DF-41 is underway.

China currently has five *Jin* or Type 094 SSBNs, but has not quite got the ability to use its JL-2 missiles on them as yet. In the future, China could field a more advanced SSBN as well as cruise missile launching submarine (SSGN).

China fields a variety of IRBMs and LACMs, ASBMs like the DF-21D and the so-called 'Guam killer' DF-26 for A2/AD.

Till now, however, there is no evidence of an overwater test of 'uncooperative target,' in relation to the ASBM (Anti-Ship Ballistic Missile). The *Science of Military Strategy 2015* suggests that the holding of conventional and nuclear force elements by the PLARF is deliberate strategy. Missiles like the DF-26 are both conventional and nuclear.

### Space Surveillance

China is seeking to master the sensor-to-shooter loop. So far 30 Beidou navigation satellites have been launched, some of which are now outdated, but plans for 35 satellite constellations by 2020. There are some 40 Yaogan satellites so far, for ship tracking, targeting and ISR network. According to *Jane's* satellites are placed in triangular formations comprising of an EO surveillance satellite, SAR satellite and a signals and ELINT satellite.

The Haiyang Ocean surveillance satellite and the Gaofen series of geostationary high resolution earth observation satellite can provide near real-time global surveillance (6 Gaofens have been launched since 2013) and Jilin high definition multi-spectral imaging satellites are currently 4, but by 2020, a total of 60 Haiyang, Gaofen and Jilin satellites will give 30 minute updates and by 2030, 138 satellites will provide all-day, all-weather acquisition capability to observe any part of the world with 10 minute revisit capability.



PLA Rocket Force and upgraded to a full service. Till the 1980s, it dealt with only nuclear missiles, but since mid 1990s has also got conventional missiles. The force is directly under the CMC and is around 130,000 strong, operating from six main missile bases, equivalent of PLA Group Armies. China follows the no-first use (NFU) principle and according to the 2006 White Paper, it said these weapons were for "self defence and to prevent others from using the weapons against China." Further it would "never be first to use them and would never use or threaten to use them against non-nuclear states and regions." However, there are question marks about what would happen in the event of precision guided munitions against Chinese nuclear storage or missile sites or in the Taiwan contingency.

The Chinese nuclear arsenal is estimated at 260 in 2015 by SIPRI, which is double of what it was in 2006, so it is a growing arsenal. Weapons are demated. Since the



China plans to launch the core module of its space station in 2018, followed by the lab modules in 2020 and 2022. This launch activity is centered around the lift capability provided by the Long March 5 rocket which can boost 25 tonnes to the LEO and 14 tonnes to the GTO. The space station will add unspecified military capacity for the PLA.

### Counterspace

Chinese believe that US relies on space for 70-90 per cent of its intelligence and 80 per cent of its communications. Loss of critical sensors would drastically degrade US military capability.

China has been involved in a direct ASAT test in 2007 when an old met satellite was destroyed by a kinetic kill vehicle. Since then, it has conducted eight ASAT tests, though the Chinese claim some tests to be missile defence tests. The Chinese BMD and ASAT capability is linked through the SC 19 missile which was used to destroy the satellite in 2007, being a ground based kinetic kill vehicle. In January 2010, it used the SC-19 missile to destroy a CSS-X-11 MRBM and carried out another test in January 2013 and again in 2014. The US is the only other country to do this technically challenging feat.

The US National Air and Space Intelligence Centre (NASIC) says that “China has the most active and diverse ballistic missile defence programme in the world.”

In May 2013, China used a sounding rocket, Dong Neng 3 (DN3) to reach 10,000 kms in space and release a barium cloud to study the magnetosphere. The US contradicted this and said that the rocket had a ballistic trajectory close to geosynchronous orbit. In other words it was intended to knock out a target in a geostationary orbit by actually ramming it.

In another test in August 2010, one Shijian 12 satellite bumped into a Shijian 6F causing it to drift from its orbit. The US suspects this could be another kind of ASAT test.

In August 2013, China conducted the test of a robotic arm where one of the Shijian satellites acted as a target and the other with the robotic arms grappled with it. In June 2016 China launched an Aolong satellites equipped with a robotic arm to remove satellite debris.

### PLAN Strategy

PLAN Strategy has evolved from coastal or inshore defence which focused on preventing infiltration from sea and

supporting land engagements in the 1950s and 1960s. In the 1980s, China began to look at defence of its crucial offshore waters of the Yellow Sea, East China Sea and the South China Sea in terms of LOC defence, possible Taiwan contingency, as well as preventing an invasion and protecting maritime rights and interests.

In this millennium, PLAN has moved from offshore defence to open waters defence. This means strengthening offshore defence, even while having the ability to protect Chinese interests overseas and participating in international security cooperation. Chinese military modernisation often tends to focus on individual platforms like aircraft carriers or subs. There has been a sharp accretion in the strength of the PLAN with the acquisition of the *Luhu* (052), *Luhai* (051B), *Sovremenny*, *Luyang* (052) and *Luzhou* (051C) class destroyers, *Jiangwei* (053) and *Jiangkai* (054) class frigates, the *Jin*, *Song Yuan* and *Kilo* class subs, the *Shang* nuclear powered attack subs, the aircraft carrier *Liaoning* and 100 fourth gen fighters which include J-10, J-11, Su-30, plus 30 H-6 bombers with air-to-surface missiles.

But this is in fact a broad based effort ranging from ASBMs to ASCMs, destroyers, frigates, LPDs, C4ISR systems and so on. The increasing focus is on *quality* rather



A PLAN 'Song-class' submarine



*Shenyang J-15 carrier fighters are a key element of the PLAN's naval modernisation*

than quantity. Still, it has weaknesses in operating with other services, poor ASW and anti-mine capabilities and for long range targeting.

### **Now, the PLAAF**

The PLAAF had a long period of stagnation when its Soviet-derived technology became obsolete. It then sought western technology, but even that was blocked post-Tiananmen in 1989.

Evolution of the PLAAF has been encouraged by RMA, balance of power with Taiwan and greater presence in the sea. The Gulf War brought out the value of long-range precision strike, using integrated intelligence, surveillance and reconnaissance networks. In the mid-2000s the perception that Taiwanese airpower “was stronger,” encouraged efforts to modernisation.

The Military Strategy 2015 called for integrated aerospace operations with simultaneous offensive and defensive operations. What does this mean? Building

an air force relying on surveillance and early warning, air offensive campaigns, air and missile defence and strategic force projection. So we are talking of integration of information systems, long range force projection and strong attack.

The PLAAF plans to induct 5<sup>th</sup> generation fighters like the J-20 and a modernised H-6K bomber with a range of 3,500 km and the ability to carry six CJ-10 land attack cruise missile. In the AEW&C area, China has four KJ-2000s capable of

*The J-20 fifth-generation fighter has yet to receive definitive indigenous engines*





24 hour operations and is developing more advanced aircraft. The PLAAF already uses some 300 UAVs including the CH-4A and Bs. It is acquiring the Su-35 from Russia with its advanced radar and is testing the J-31, the other 5<sup>th</sup> generation fighter.

The key action areas for the PLAAF is in the area of engine technology. It has developed the WS-9 and WS-10 in recent years under licence from UK and Russia, but focus is on its own WS-18 and WS-20 for its new fifth generation aircraft, the Y-20 transport and the H-6K bomber.

### Emerging systems

Hypersonic weapons technologies are either boost-glide weapons or cruise missiles attaining supersonic speed using scramjet. China has conducted a great deal of research in this area and there are reports that it has flight-tested a scramjet engine that can be used for sustained hypersonic flight. Boost glide systems are launched on a rocket and then at the edge of the atmosphere or a little above it, they re-enter and glide to

the target. They are a by-product of the terminally guided re-entry vehicles like DF-21D warheads.

China has conducted seven tests of hypersonic boost glide vehicles beginning January 2014, the last in April 2016 to ranges of 2,000 kms. Experts like James Acton say that it is less advanced than US whose Advanced Hypersonic system has been tested over 3,800 kms. How hypersonic vehicles will be used remains a question, though they will reduce the effectiveness of mid-course missile defences and extend the operational range ballistic missiles.

Space-based C4ISR is needed for power projection and precision strike. Long range cruise and ballistic missiles need this as well as to deploy forces for operations far from the homeland.

According to the US expert Richard Fisher, China has made large investments in energy weapons development (lasers, railguns and high-power microwave). US developments are a benchmark of what the Chinese are working on. A US Electromagnetic launch gun or rail gun may be developed by the mid-2020s and could be deployed in nuclear or electric powered ships like the USS *Zumwalt*. The US already deploys a small Laser Weapon System to defeat drone swarms and small ships at close range and is also near success in High Power Microwave weapons which use some parts of microwave spectrum to defeat electronic targets.

China, for quite a while, has focused on anti-missile lasers since the 1980s. In 2006, there was a report of Chinese ground-based laser blinding a US optical surveillance satellite. There have been some Chinese articles on the feasibility of space-based laser weapons in satellites, in particular a 5-ton platform. Chinese companies are also working on electric-powered fibre optic lasers capable of dealing with plastic drone swarms.

China's 863 Programme may well have also developed High Power Microwave systems. In January 2017, Huang Wenhua, an HPM expert at the Northwest Institute for Nuclear Science won the first prize in national technology awards for developing an HMP weapon capable of defending warships from anti-ship missiles.

China fields an impressive array of UAVs and UUVs but these are mostly tactical. Their missions include ISR, EW,

data relay and guidance for missiles in OTH targeting. Recent breakthroughs in swarm intelligence and swarm warfare aim at asymmetric attacks on US platforms particularly aircraft carriers. In November 2016, China Electronic Technology Group (CETC) a state owned enterprise (SOE) specialising in AI showed a video of its 70-drone swarm operating autonomously and simulating reconnaissance and strike missions. In February 2017, there was a display of a swarm of 1000 UAVs at the Guangzhou Air Show. The key to drone swarms is that they are not centrally controlled, but each member of the swarm uses software for coordination. As of now these may be good for light shows, and can be easily countered, but the future may be different. (The US DARPA has contracted four teams to develop drone swarms for disrupting air defence by acting as decoys, or as jammers in a coordinated and distributed manner so some do decoys, some jamming and others radar detectors.)

Now, the PLA has begun fielding advanced multi-mission UAVs. Their R&D focuses on high-altitude, long endurance UAVs with stealth or anti-stealth, supersonic and precision strike capabilities. China has exported its Yilong HALE which has integrated recon, precision strike and EW capabilities.

There is also focus on intelligent unmanned systems that can operate autonomously in difficult electromagnetic environments.

Still, on balance, the Chinese are not as advanced as the US, and still face challenges on engines and data links.

### Futuristic systems

In the military technology area, it takes anywhere between 15-20 years for a technology to go from concept stage to deployment. Some future systems are indicated by Chinese technology testing in quantum communications, pulsar navigation and electromagnetic drive. In these cases, China has, according to Kevin Pollpeter, introduced technologies ahead of programmes, signalling the end of an era where Chinese copied concepts and re-engineered the technologies of others.

Quantum technology is a cutting edge area which can be divided as three : quantum computing, quantum encryption and quantum sensing. These use mind bending concepts of super position and



**China is rapidly developing an innovative indigenous UAV capability, and has commenced exports of locally-developed unmanned systems**

entanglement and information captured in terms of qubits. Currently a Canadian company makes some kind of quantum computer, but Google, IBM, NASA, Alibaba, and the Chinese Academy of Sciences are working hard to make a real quantum computer.

Quantum encryption is said to be unbreakable and a potential disrupter in intelligence. Quantum sensing is the ability to use for very precise measurements in clocks, radar, navigation and compasses with possible applications in precision strikes.

Cutting edge research being done by the Anhui Quantum Communication Tech Ltd headed by Pan Jianwei. The 5<sup>th</sup> Plenum of the Communist Party's Central Committee listed this as a technology targeted for breakthroughs. It figures in the 13<sup>th</sup> Five Year Plan and the National Key R&D Plan. Pan Jianwei says that a global communications network could come up by 2030.

According to US experts, China has recorded notable achievements in encryption. A Quantum Communications Satellite, Micius, the first ever was launched by China in August 2016, can according to the Xinhua report, "establish hack-proof" communications from space to ground. Chinese had earlier experimented by sending quantum communications over fibre optic cables.

However, this is still nascent in quantum computing but doing well in that the claimed radar could defeat all stealth. China

feels that quantum information science may be the place where it will get payoffs in civil and military areas, so leapfrogging ahead of the US.

*Electromagnetic drive:* China announced in December 2016 that it had developed a prototype drive that was being tested in space, the first country to do so (the UK and US have tested it on earth). It involves use of microwaves for propulsion and does not require propellants to be carried, thus virtually halving the weight of a satellite.

*Pulsar navigation:* In November 2016 China launched the XPNAV satellite to test pulsar navigation tech. NASA is expected to do so in the ISS later this year and use pulsar star pulses for more accurate navigation satellites. These would also give more autonomy for satellite flight plan.

A major area of focus is *Artificial Intelligence*. This is one area in which the Chinese government is pushing companies like Baidu and Tencent to become dominant players in the world. A White House assessment of artificial intelligence research indicates that today China, with 350 publications, leads the field with the USA at number two with a little over 250. All other players UK, Australia, Canada, Japan, Germany, Singapore, South Korea or France produce a little over fifty or little less than that. This is not just an absolute lead, as the same set of figures looking at their being cited by other researchers (a measure of their influence) indicates China remains as number one.

An example of the Chinese influence comes from the fact that Baidu runs a huge centre for AI research in San Jose, the Silicon Valley where its chief scientist, Andrew Ng (who resigned earlier in April 2017) is also an associate professor at the Stanford University's computer science department. This centre employs some of the top level AI researchers in the USA.

### **The clear trend**

The clear trend in China's modernisation efforts is towards creating a world class military, capable of taking on the United States. This may appear to be a tall order today, but things could look quite different 15 years from now. The US, of course, has huge advantages because of its research capabilities which are based on its ecosystem of companies, universities and engineers who are selected from virtually all over the world. The Chinese have been skilfully locating their research facilities in the US to tap this talent, acquiring a number of cutting edge Western companies and also funding many American start ups.

These developments have implications for countries such as India because we are, as it is, finding it difficult to get some momentum in the current modernisation deficit. We do not have the resources to put into futuristic technologies or an R&D and manufacturing ecosystem to develop them. The options before India are not too many and we would have to evolve asymmetrical systems of our own to deter the Chinese - and thus lower the nuclear threshold.

# China's 'Ace': Yang Wei, fighter designer

There are arguably thousands of engineers around the world in the realm of new aircraft design, but ace designers only come along once every few decades. In the 1930s, there was Reginald Mitchell of Spitfire fame, Sydney Camm who designed the Hurricane, Willy Messerschmitt and his line of famous fighters, Claude Dornier and his bombers and seaplanes, Kurt Tank and the FW 190, several Soviet designers including Tupolev, Yakovlev and so many others. In the 1950s, the United States had Kelly Johnson, designer of the Starfighter and SR-71 Blackbird; the Soviet Union's Mikoyan and his classic MiGs and more lately Mikhail Simonov of the Sukhoi Su-27 family. Each of them were highly skilled,



**The J-20**

but they also owed much of their success to circumstance. They came along when their respective governments invested millions—or billions—of dollars into transforming brainpower into cutting-edge combat aircraft.

This mixture of engineering genius and unrestrained spending appears to have produced a new ace designer – this time in China. Over the last decades, a relatively unknown engineer named Yang Wei has rapidly risen to the leadership of the Chengdu Aircraft Design Institute, China's major fighter manufacturer and responsible for most of the PLAAF's present new gen fighters. These are the J-20, China's first stealth fighter and the more modest, but one which will make very important impact amongst air forces in the third world notably Pakistan, the JF-17 Thunder.

Yang Wei was born in 1963 and enrolled at the Northwestern Polytechnical University in 1978 at the age of just 15. He completed two degrees and became a

control systems engineer at Chengdu. At 35, he became the youngest-ever director of such an important military research and development institute. Yang is considered as the main designer behind China's innovations in electronic 'fly-by-wires' controls in the 1980s, and furthermore, is described as the main architect behind the PLAAF's introduction of all-digital aircraft simulation tests. As a result, Yang is hailed as the "man who broke the blockade of foreign technology."

In fact, Yang has been responsible for the Chinese evolutionary approach to designing and building combat aircraft. Instead of designing and building a brand-new aircraft from scratch, he has unabashedly borrowed from other designs, integrated some imported and/or indigenous technology, and produced them at a fraction of the cost.

A prime example is the J-20, designed with foreign technology in the way of 'stealing' the blueprints for the F-35 Lightning II and the F-22 Raptor. While no numbers are available for what the J-20 is going to cost, another, related Chinese stealth fighter, the J-31 *Gyrffalcon* will reportedly cost some \$75 million. How much the F-35 will end up costing is anyone's guess, but according to Robert Farley, "somewhere around \$100-120 million is a possibility".

The J-20 may not be a complete "game-changer," probably not be as effective as the F-35 or certainly the F-22 (not least due to



China's persistent problems with under-powered engines). However, in a little more than a decade, China went from having no stealth fighters to entering the select club of countries in the fifth generation fighter stakes. One can expect, owing to Yang's design philosophy, that whatever the J-20 becomes, it will not be radically different from what is already flying.

In case of the JF-17 (photo below), Yang's philosophy shines through in a different way. This aircraft has been massively upgraded by the incorporation of advanced imported and indigenously designed tech and is supposed to be comparable to earlier models of the F-16. Again, not a revolutionary aircraft, and probably in the bottom half of the current fourth generation fighter ranking, but considering the price tag at \$25 million, quantity becomes a quality in itself!

*With inputs from Benjamin Baker and Robert Beckhusen*



# China's Civil Challenge



C919 passenger jet taking off at Pudong International Airport in Shanghai

## The Comac C919 is airborne

China's first indigenous designed and built passenger jetliner the C919 made its first public flight test on 5 May 2017. The aircraft with a green-and-blue striped tail, underwent a lengthy preflight check before the test flight that lasted about an hour.

Still, the C919 is years, if not decades, behind those aircraft made by Airbus and Boeing that are cheaper to fly and easier to maintain. Safety regulators in Europe, the United States and elsewhere still have to certify the aircraft before it can be sold outside China, which includes the engines, its cockpit and many systems. The C919 has gear manufactured by western companies including General Electric and Honeywell.

"We used to believe that it was better to buy than to build, better to lease than to buy," President Xi Jinping of China told workers during a recent visit to the plant. "We need to spend more on research and manufacturing our own airliners." China's investment in civilian aircraft manufacturing is enormous! The Commercial Aircraft Corporation of China, universally known as Comac, unveiled the extent of its activities for the first time on 4 May, showing off a complex of more than 110 buildings.

The second C919, coated in green anti-corrosion paint but not yet displaying any airline's colours, will not be ready until September, said Bao Pengli, Comac's deputy director of project management for manufacturing and final assembly. Only after building six prototypes will Comac

decide whether it is ready for large-scale production, he said.

Comac already has 570 orders from 23 buyers, but these have almost entirely come from Chinese companies with a couple of small overseas air carriers, having links to China. A notable exception is an order for 20 airliners from General Electric Capital Aviation Services, which is also a big supplier to the C919 programme.

The C919 is designed to compete with the Airbus 320 and the Boeing 737, single-aisle aircraft that are workhorses of the world's airlines. For Comac, the aircraft represents culmination of decades of design & development effort. For Airbus and Boeing, this is a clear challenge to a profitable duopoly that has endured for decades. But it is still unclear that China can produce aircraft that are as efficient and reliable as even the current generation of Boeings and Airbuses.

China has imbibed much in recent years on how to build single-aisle aircraft, by making many parts for Boeing 737s and by assembling entire A320s for Airbus. Decades later, these experiences and a fast-developing aviation sector — China the world's second-busiest behind the United States — mean there are few doubts about the C919's integrity.

For China, the C919 is just the beginning. Even if the aircraft proves less fuel-efficient than western counterparts, the state-controlled airline industry may still buy it, and the Chinese aviation market in the coming years is expected to rival only the American in size—and perhaps even surpass it.

And although the aircraft represents a new challenger for aircraft sales, Airbus and Boeing, increasingly dependent on Chinese airlines for sales as well as on Chinese suppliers for parts, have welcomed its debut. "The C919 will bring new competition to the market," Airbus said in a statement. Yukui Wang, a Boeing spokesman, added: "We'd like to take this opportunity to congratulate Comac for successful development of the C919 aircraft."

Comac is already looking beyond the C919, on the design and manufacture of a wide-body jet that would compete with larger airliners like the Boeing 747 and the A340. Steven Lien, the president for Asia at Honeywell's aerospace division, said that Russia and China were in the final stages of negotiating a plan to jointly design and produce this (*see separate item*).



A second C919 aircraft being built



52<sup>nd</sup> INTERNATIONAL PARIS AIR SHOW  
LE BOURGET  
JUNE 19 - 25, 2017

52<sup>e</sup> SALON INTERNATIONAL DE L'AERONAUTIQUE ET DE L'ESPACE  
PARIS LE BOURGET  
19 - 25 JUIN 2017



*Dassault's Rafale at the static display*

## Le Bourget 19-25 June 2017

At 38°C one could be forgiven if you thought you were in India! Throughout the Paris Air Show 2017, at Le Bourget, it was hot, hot and hotter! Two years ago, at the same event and dates, it rained continuously for the entire week; if one was drenched in rain then, we were drenched in sweat this time! But Paris is Paris and, *Vayu* loves the Show!

To rattle off numbers, \$150 billion worth of orders were announced including 897 aircraft plus purchasing commitments making a catalogue value of USD 115 billion, for a total of 934 commercial aircraft. On display were 140 aircraft

including the Airbus A321neo, Airbus A350-1000, Boeing B787-10, Boeing B737 MAX9, Kawasaki P1 maritime patrol aircraft, Mitsubishi MRJ90, Lockheed Martin F-35 at Le Bourget for the first time. Dassault Aviation's Rafale and Falcon 8X, the Airbus A380 and A400M, the Airbus Tiger and NH90 Caiman helicopters were, as usual, dominant at the Show.

There were a total of 2,381 exhibitors (3% more than in 2015) from 48 countries (the same as in 2015). 54,000 sqm of stands, 340 chalets amounting to 37,500 sqm of covered space, 40,000 sqm of outside space, 27 national pavilions. Some

290 official delegations from 98 countries and 7 international organizations visited, including 160 official defence delegations from 86 countries and 4 organisations (NATO, the UN, OCCAR, the EU) involving 16 foreign ministers, 40 Chiefs of Staff, 20 deputy ministers or Secretaries of State.

"This 52nd Paris Le Bourget Air Show was a remarkable success with a record number of exhibitors and 150 billion dollars' worth of orders announced, despite the slight drop in the number of visitors. The impressive demonstration flights of Dassault Aviation's Rafale, the Falcon 8X business

jet, fly bys of the A380, aerobatic displays by the French *Patrouille de France*, the Airbus A350-1000 and A400M, and other aircraft delighted the French President, as well as the public, from the first to the last day of the show” declared Emeric d’Arcimoles, the Paris Air Show’s Chairman and CEO. “The Careers Plane exhibition which has now amalgamated with GIFAS’ Job-Training Forum, enabled 55,000 mainly young visitors to discover forty or so aeronautics and space sector careers through French aerospace group employees. There are immediate recruitment needs for these jobs. Paris Air Lab, the new attraction that puts the spotlight on the research and innovation efforts of the major groups and institutions such as start-ups, attracted 50,000 visitors,” he added.

### Airbus Developments

Providing strong evidence that the commercial aircraft market remains healthy, Airbus announced \$39.7 billion worth of new business during the 2017 Paris Air Show. The company won commitments for a total of 326 aircraft, including firm orders for 144 aircraft worth \$18.5 billion and MoUs for 182 aircraft worth \$21.2 billion. A320 Family aircraft sales and commitments remained robust, with business accounting for a total of 306 aircraft worth \$33.8 billion which comprises 132 firm orders worth \$14.7 billion, and MoUs for 174 aircraft worth 19.1 billion. In the wide body segment, Airbus won firm orders for 20 aircraft worth \$5.9 billion, comprising 12 firm orders worth \$3.6 billion and MoUs for eight aircraft worth 2.3 billion.

As John Leahy, Chief Operating Officer Customers, Airbus Commercial Aircraft said: “Our commercial success this week at Paris extends our already diversified order backlog to a new industry record of over 6,800 aircraft, with 326 orders worth \$40 billion.” Further to the new orders, the show also saw a repeat order from DHL Express for four more A330-300 Passenger-To-Freighter conversions, in partnership with EFW and ST Aerospace.

At this year’s Paris show, Airbus not only marked a solid sales tally but also extended its value offering at both ends of its commercial product portfolio. In the single-aisle family Airbus decided to offer the Airspace Cabin brand – which, on the A320, includes the biggest overhead bins in its class. For the A380, Airbus has increased

revenue-earning potential with even better fuel efficiency, owing to enhanced large winglets, greater cabin capacity and a new higher take-off weight capability to increase its payload-range.

Airbus presented a development study for an enhanced A380, the ‘A380plus’. The study includes aerodynamic improvements, in particular new, large winglets and other wing refinements that allow for up to 4% fuel burn savings. Added to an optimised A380 maintenance programme and the enhanced cabin features first shown at Aircraft Interiors Expo (AIX) in April, the overall benefit is a 13% cost per seat reduction versus today’s A380. John Leahy, Airbus COO Customers, explained: “The A380plus is an efficient way to offer even

better economics and improved operational performance at the same time.” John added: “It is a new step for our iconic aircraft to best serve worldwide fast-growing traffic and the evolving needs of the A380 operations. The A380 is well-proven as the solution to increasing congestion at large airports, and in offering a unique, passenger-preferred experience. “

The new winglets measure approximately 4.7 metres in height (an uplet of 3.5m, and a downlet of 1.2m). It is designed to improve aerodynamics and reduce drag. The A380plus will have an increased maximum take-off weight (MTOW) of 578 tonnes providing the flexibility of carrying up to 80 more passengers over today’s range (8,200nm) or flying 300nm further.

*Airbus presented its enhanced A380: the “A380plus”*



*Entering service this year, the A350-1000 has a wingspan of almost 65 metres, a range of 14,800 km and seats 366 passengers (photo: Airbus)*

## Enter the MAX

Boeing too made important announcements and multi-billion dollar orders and commitments for commercial airliners and commercial and defence services at the 2017 Paris Air Show. The company launched the 737 MAX 10, newest member of the 737 MAX family, with more than 361 orders and commitments from 16 customers worldwide. This wide market acceptance has endorsed the 737 MAX 10 as the “industry’s most efficient and profitable single-aisle airplane”. Commercial customers announced incremental orders and commitments during the week for a total of 571 Boeing aircraft, valued at \$74.8 billion at list prices.

Boeing revealed its 2017 Current Market Outlook, raising its 20-year outlook to more than 41,000 new aircraft, valued at \$6.1 trillion. Boeing also forecasts significant growth in the Aerospace Services Market, projecting \$2.6 trillion demand in commercial and government services for the next 10 years. Boeing confirmed its new global services business remained on track to be up and running soon.

Boeing Global Services announced multi-year services agreements valued at up to \$6 billion during the show. Airplane Development Vice President Michael Delaney laid out the deliberate, disciplined and driven approach that Boeing Commercial Airplanes was following with execution on the MAX, 787-10 and 777X development programmes and the study of how to optimally address middle of the market in the next decade. Looking further into the future Product Development Vice President Mike Sinnett explored the possibilities for advancing autonomous technology to help enhance safety, decision-making and traffic management in the face of continued projected growth in air transportation.

Boeing also announced the launch of Boeing AnalytX, which has brought together more than 800 analytics experts from across the company focused on transforming data into actionable insights and customer solutions. Five customer agreements were announced to provide solutions powered by Boeing AnalytX.

The Boeing 737 MAX 9 starred in the daily flying display while the 787-10 Dreamliner, P-8A, V-22, AH-64 Apache and CH-47 Chinook were featured in the static display.

Boeing also announced the launch of the 737 MAX 10 as the newest member of the 737 MAX family at the show. “The 737 MAX 10 will have the lowest seat-mile cost of any single-aisle airplane ever produced. The airliner has gained wide market acceptance with more than 240 orders and commitments secured from more than 10 customers worldwide. The 737 MAX 10 extends the competitive advantage of the 737 MAX family and we’re honoured that so many customers across the world have embraced the outstanding value it will bring to their fleets,” stated Boeing Commercial Airplanes President and CEO Kevin McAllister. “Airlines wanted a larger, better option in the large single-aisle segment with the operating advantages of the 737 MAX family. Adding the 737 MAX 10 gives our customers the most flexibility in the market, providing their fleets the range capability, fuel efficiency and unsurpassed reliability that the 737 MAX family is widely known for,” he added.

Design changes for the 737 MAX 10 include a fuselage stretch of 66 inches compared to the 737 MAX 9 and levered main landing gear. The airplane has the capacity to carry up to 230 passengers. Other changes include a variable exit limit rating mid-exit door, a lighter flat aft pressure bulkhead and a modified wing for low speed drag reduction.

Like Boeing’s other 737 MAX models, the 737 MAX 10 incorporates CFM International LEAP-1B engines, advanced technology winglets, Boeing Sky Interior, large flight deck displays, and other improvements to deliver the highest efficiency, reliability and passenger comfort in the single-aisle market.

## Newest Super Hercules

Lockheed Martin’s LM-100J commercial freighter aircraft made its international debut at the 2017 International Paris Air Show. The LM-100J represents the 17th different mission capability for the C-130J Super Hercules platform and is an updated version of the L-100 cargo aircraft, which Lockheed Martin produced from 1964-1992. The LM-100J made its first flight on 25 May 2017. “The LM-100J has performed remarkably well in flight tests just two weeks after its first flight. Because of this strong performance, we decided to fly the LM-100J to Paris to be on display at the world’s greatest airshow,” said George Shultz, vice president and general manager, Air Mobility & Maritime Missions at Lockheed Martin. “The LM-100J’s presence at the Paris Air Show truly places it on the world’s stage, offering an opportunity to highlight its proven capabilities and unmatched versatility to the global commercial marketplace. We are honoured to introduce the world to the LM-100J!”

Lockheed Martin also introduced the C-130J-SOF, the newest Super Hercules aircraft configured for international military special operations requirements. The C-130J-SOF is the 10th production variant of the Super Hercules. This multi-mission aircraft is specifically intended to meet the unique demands associated with executing operations of strategic importance in support of international Special Operations Forces (SOF).

“The C-130J’s inherent versatility is capable of supporting missions across a broad spectrum of military operations,



*Boeing 737 Max9 at the Paris Air Show 2017*

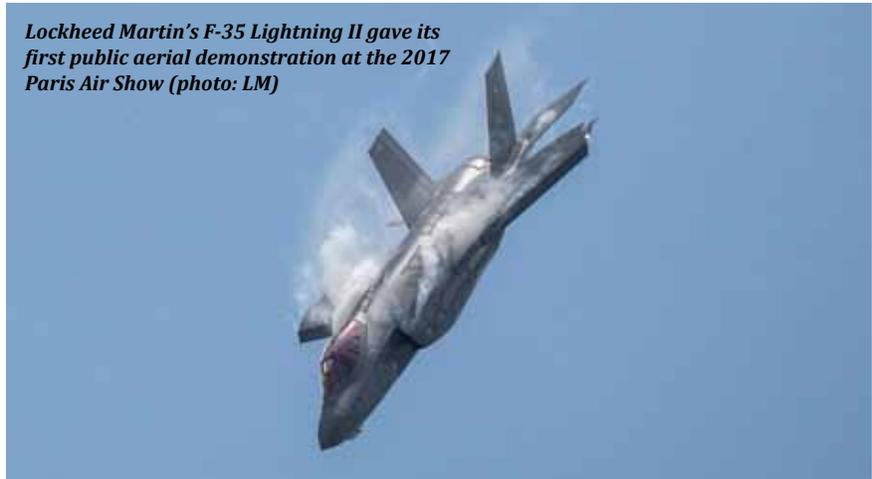
and this is amplified once again with the C-130J-SOF,” stated Orlando Carvalho, executive vice president of Lockheed Martin Aeronautics. “As our global partners face increasing and evolving threats that transcend borders, they want a proven solution. The C-130J-SOF, is in fact, the solution that will ensure security is preserved around the world.”

The C-130J-SOF provides the capability to execute Intelligence, Surveillance and Reconnaissance (ISR) and psychological operations, airdrop resupply, personnel recovery, humanitarian relief, as well as infiltration, exfiltration and re-supply of SOF personnel. With added special mission equipment options, the C-130J-SOF may also be configured for armed over watch that includes a 30mm gun and Hellfire missiles, helicopter/fighter/vertical lift aerial refueling, and Forward Area Refueling Point (FARP) operations.

“Our global partners said they need to support their SOF teams with a solution that is reliable, affordable, effective and integrated. They must support their teams in the sky, on the sea and on the ground,” said George Shultz, vice president and general manager, Air Mobility and Maritime Missions at Lockheed Martin. “International operators want a special missions Super Hercules that’s proven and a true force multiplier. Today, we offer that solution to the world in the form of the C-130J-SOF.”



*Lockheed Martin has introduced the C-130J-SOF, the newest Super Hercules aircraft*



*Lockheed Martin's F-35 Lightning II gave its first public aerial demonstration at the 2017 Paris Air Show (photo: LM)*



*Lockheed Martin's LM-100J commercial freighter aircraft made its international debut at Le Bourget 2017*

## Bombardier Connect

Bombardier Commercial Aircraft concluded a successful week at the Paris Air Show, where it had the “opportunity to connect with customers” from around the world and announced up to US\$2 billion in orders and other commitments. “We are concluding the airshow with solid momentum, and I am very pleased with the level of interest and activity we are seeing in all of our aircraft programmes,” said Fred Cromer, President, Bombardier Commercial Aircraft. “With our unique product portfolio, we are the leader in the market segment below 150 seats, and the orders and commitments, from multiple operators, for over 60 Q400 aircraft announced during the airshow are clear demonstrations that Bombardier already has innovative solutions that meet market requirements for larger and higher-performance turboprops.”

The airshow was also an opportunity for Bombardier to showcase its CS300 aircraft alongside launch operator airBaltic. “As the momentum continues to build up following the successful first year in service of the CSeries aircraft, we are pleased that airlines around the world are demonstrating growing interest as they witness the CSeries performance and hear about the overwhelming positive feedback from passengers and our launch operators,” added Fred Cromer.

## The E-2

Demonstrating the company’s unique position within the commercial, defence, and executive aircraft markets, three Embraer aircraft made their Paris debut. This was Embraer’s largest presence at a major airshow bringing together a static display that showcased the new E195-E2, the largest member of the second generation

## CFM records at Le Bourget

CFM International logged record orders at the 2017 Paris Air Show, receiving orders for 1,658 LEAP and CFM56 engines, in addition to long-term service agreements, at a value of more than \$27.3 billion US at list price. The company left the show with a total 2017 order book of more than 2,850 engines and total LEAP orders on the books for more than 14,000 engines. “This air show has far surpassed all of our expectations,” said Gaël Méheust, President and CEO of CFM International. “It is highly gratifying and humbling to have so many airlines put their faith in CFM to power and support their single-aisle fleets. Now, it is our job to reinforce, every day that they have made the right choice.”

of Embraer’s family of commercial jets, the multi-mission transport and aerial refueling aircraft KC-390 and the state-of-the-art mid-light business jet Legacy 450, “a remarkable union of technology and design aircraft that flies faster and farther than any other jets in its class”. These three full fly-by-wire technology new generation aircraft took part at the airshow’s daily flight display.

Also, according to their latest Market Outlook, Embraer projects a steady market demand for 6,400 new jets in the 70-130+ seat capacity category (2,280 units in the 70-90 seat segment and 4,120 units in the 90-130+ seat segment), worth USD 300 billion by 2036. The 70-130+ seat jet world fleet-in-service will increase from 2,700 aircraft in 2016 to 6,710 by 2036, the fastest growing segment among all aircraft seat capacities. Market growth will drive 63% of total demand and the remaining 37% will be delivered to replace ageing aircraft.

“Whilst region-specific outlooks vary considerably, the underlying drivers to sustain the projected market demand for jets in the 70-130+ seat capacity category remain intact, from feeding complex bank

structures at major hubs to pioneering new markets and complement narrow-body aircraft operation. Fleet optimisation is critical in the vicissitudes of business cycles, and a rationalised fleet does not necessarily signify an optimised one. Right-sized aircraft call for a new smarter approach. Greater control in matching aircraft capacity to market demand prevents the erosion of unit revenues and provides competitive cost structure”, stated Embraer officials.

“The E195-E2, for example, will provide an attractive proposition with much lower trip costs and comparable seat-mile costs to than its large narrow-body counterparts, while combining growth and higher returns with the opportunity to increase unit revenue with a right-sized aircraft.” The airline industry is notoriously known for its boom and bust cycles. Better seat inventory control allows a continuous search for higher profits and efficiency. The ability to shift back towards revenue unit growth, instead of aggressive capacity expansion, is crucial”, stated John Slattery, President & CEO, Embraer Commercial Aviation.

Jets in the 70-130+ seat capacity category are one of the main pillars of business sustainability. The E-Jets E2 is “perfectly positioned to keep Embraer as the market leader in the segment and maximise profitability for both airlines and leasing companies”.

## Enhanced ATRs

ATR is finalising the evaluation for the launch of a version of the ATR 42-600 with enhanced Short Take-Off and Landing (STOL) capabilities. The regional turboprop aircraft manufacturer is ready to offer this new version, the ATR 42-600S, to its current and potential customers. The ATR 42-600S will substantially reduce the minimum length of runway required to take-off and land with full passenger



Embraer's new E195-E2 at Le Bourget

## ATR at Paris



ATR showcased an ATR 72-600 in the colours of its latest customer, Indian carrier IndiGo in the static display at the Paris Air Show. The aircraft is fitted with the latest passenger comfort developments that will be available on the ATR ‘-600 series’. An “innovation corner” inside the aircraft, features two rows of Geven’s new Neo-Classic seats, which are to be standard fitment on all ATR -600s soon.

capacity, down to only 800 metres. By improving these capabilities of the ATR 42-600s, hundreds of airports with runway lengths between 800 and 900 metres will be able to accommodate the aircraft, thus increasing business opportunities for its operators.

As of today, a large and ageing fleet of nearly 2,200 regional aircraft from 30 to 50 seats operate all over the world. Among this fleet, turboprops account for nearly 60% (1,200 aircraft), and provide an essential connectivity to smaller and remote communities. These turboprops serve over

3,100 routes today, with one third of these routes relying exclusively on these aircraft.

“The fleet of inefficient previous generation regional aircraft will need to be replaced in the years to come. The ATR 42 “perfectly addresses this market with a combination of modernity, reliability and the highest standards of passenger comfort. The ATR 42 matches trip costs of 30-seater aircraft while adding seats and driving down unit costs, thus generating potential to stimulate demand”. ATR sees a potential for nearly 600 deliveries of 50-seater turboprops in the 20 years to come.

Commenting on the potential for this new version of the ATR 42-600, Christian Scherer, Chief Executive Officer of ATR, stated: “Facilitating the emergence of future traffic as well as maintaining the connectivity of communities is at the heart of ATR’s role. This is why we have decided to further address the challenges of airfield accessibility, allowing growth in air services for remote areas as well. We are now proposing the ATR 42-600S to our operators and we look forward to positive feedback from the market”.

### And as for the pilots !

CAE released its first *CAE Airline Pilot Demand Outlook*, providing the airline industry with key insights on the future need for professional pilots in commercial aviation. The 10-year view builds on key drivers, variables and trends and addresses airline pilot needs around the world. The report exposes a global requirement for 255,000 new airline pilots over the next 10 years to sustain the growth of the commercial air transport industry and support retirements. It also reports a need

to develop 180,000 first officers into airline captains, a greater number than in any previous decade. The document breaks down the numbers by region and provides a thorough analysis of the training needs of the aviation industry.

“As the leading training organisation in the world, we are very proud to introduce our first-ever *CAE Airline Pilot Demand Outlook* to the market, which will provide airlines with a view on the upcoming needs and development opportunities for professional pilots,” said Marc Parent, CAE’s President and Chief Executive Officer. “It is fair to say that the majority of today’s pilots have been in contact with CAE at some point in their career, whether it be in one of our academies, training centres, as part of a flying assignment or in one of our full-flight simulators. As such, we deeply understand the pilot development process and our experience sourcing and training pilots for airlines from diverse regions gives us a unique position to understand these insights.”

“The airline industry will need 70 new type-rated pilots per day for the next 10 years to meet global demand,” said Nick Leontidis, CAE Group President, Civil Aviation Training Solutions. “This record demand will challenge current pilot recruitment channels and development programmes. New and innovative pilot career pathways and training systems will be required to meet the industry’s pilot needs and ever-evolving safety, competency and efficiency standards. We’re very proud to share this first comprehensive report with the industry and continue to shape the future of pilot training with our aviation partners and colleagues”.

## United Aircraft Corporation showcases broad portfolio

United Aircraft Corporation showed its wide range of civil products, including the Sukhoi Superjet 100 aircraft at Le Bourget. As part of the corporation’s development strategy, the full product line has been formed in all major segments of the civil aviation market: the Il-114-300 regional turboprop, the SSJ100 regional airliner, the MC-21 mainline narrow body and the LRWBA long-haul wide body. In fact, the Sukhoi

Superjet 100 in the livery of the Mexican Interjet airline, was on static display at the show.

The flight simulator for the MC-21 family, which is identical to the real aircraft control panels design, as well as software for flight simulation and operation of the on-board systems, was presented in the pavilion of flight crew training. UAC also presented models of SSJ100, MC-21-300, Il-114-300, Il-112V, MTS, Be-200, Be-103 aircraft and the



MC-21 flight simulator

M-60. Other models included Su-32, Su-35, MiG-29K, MiG-35, Su-30SM, Yak-130 and Yak-152.

# HIGHLIGHTS AT THE PARIS AIR SHOW 2017

## Thales expands range of air-launched laser-guided weapons

Thales, in coordination with the French defence procurement agency (DGA), has developed the capabilities of the BAT-120, a combat proven weapon system already qualified on the Mirage 2000. The laser-guided BAT-120 is a precision strike weapon, reasonably sized that can be carried in large numbers on the aircraft's wing pylons to fight all types of fixed or mobile targets (lightly armoured or unarmoured vehicles, go-fast vessels). Whatever the threat, the ground precision strike helps to reduce operational risk and collateral damages and to protect the armed forces. The laser-guided BAT-120 is a lightweight (35 kg) weapon with low operating costs. This 120 mm precision strike system can be fired at medium and high altitudes. No major modifications to the aircraft are needed because it uses the fire control system of a laser-guided weapon.

## Leonardo introduces new M-40 target drone

Leonardo introduced its new aerial target drone at the Paris Air Show. Based on the company's experience with its successful 'Mirach 100/5' target drone which has earned a place as the "standard threat simulator of international Armed Forces" including France, Italy and the UK, the new 'Mirach 40' (M-40) is designed to provide medium-to-high performance at a price comparable with competitors' entry-level drones.



## Raytheon's Multi-Spectral Targeting System on Show

Raytheon unveiled a smaller, lightweight version of its Multi-Spectral Targeting System, called the Compact MTS which is available for export customers. The new system weighs less than 60 pounds and has a 12" turret. "The Compact MTS delivers capabilities of sensors nearly twice its size at half the weight, making it ideally suited for platforms where space is at premium," said Roy Azevedo, vice president of Intelligence, Surveillance and Reconnaissance Systems at Raytheon's Space and Airborne Systems. We have taken more than 4 million combat flight hours of experience and packed them into a compact turret." Raytheon has delivered more than 3,000 MTS systems that have been fitted on platforms such as the MQ-9 Reaper, MH-60 Seahawk and C-130J Hercules.



## New M-345 trainer aircraft makes its debut

Leonardo chose Le Bourget for the official debut of the new M-345 trainer. The M-345, that has already raised the interest of many air forces, is a training jet aircraft with costs comparable to those of a turboprop aircraft but that delivers superior performances. The first prototype has carried out the first flight on 29 December 2016 while the first flight of the first pre-series aircraft is envisaged by 2018. The Italian Air Force has already ordered a first batch of five aircraft and the first delivery is expected by 2019.



## China's Wing Loong II makes surprise entry

Aviation Industry Corporation of China (AVIC) displayed its next-generation Wing Loong II strike and reconnaissance unmanned aerial vehicle (UAV). The Wing Loong II bears a strong resemblance to the General Atomics Aeronautical Systems' MQ-9 Reaper UAV and like its US-made counterpart, each wing incorporates three under wing hard points for external stores.



## Safran's Ardiden 3G obtains EASA type certification

Safran Helicopter Engines has received EASA engine type certification for its Ardiden 3G engine, which powers Russian Helicopters' Ka-62. The helicopter made its official maiden flight on 25 May 2017. Since its first ground test, the Ardiden 3 maturation and certification campaign has accumulated more than 8500 hours of test. Unveiled in 2010, the Ardiden 3 engine family is the only new-generation 1,700 to 2,000 shaft horse-power engine range designed for the six to nine tonne helicopter. In 2011, the 3G variant was selected by Russian Helicopters to power the Ka-62. Another variant, the 3C/WZ16, has also been selected by Chinese manufacturer Avicopter to power its AC352 which made its first flight in December 2016.

## Rafale F3-R qualification in 2018

The Ministry of Armed Forces has confirmed that the qualification for the new Dassault Rafale F3-R standard will be completed by 2018 and the aircraft will enter operational service the same year. During the first half of 2017, the teams of the DGA, Dassault Aviation, MBDA, Thales and the air and naval testing centres will complete integration of MBDA's Meteor missile and the Thales Talios

designation pod. According to the French DGA, "With the Meteor missile/AESA active antenna radar, the Rafale will still be at the forefront of combat aviation for many years."

The final live-fire test of the Meteor long-range air-to-air missile has also been completed with a successful test being carried out at the Biscarrosse site of DGA Missile Testing. Following the engagement of an aerial target at

long-range by the Meteor missile, a simulated MBDA MICA missile fire against another objective was simultaneously performed. This showcased the new capabilities of the F3-R variant with combination of Meteor missile and RBE2 AESA radar. The 3rd and penultimate round of testing for the new TALIOS pod has also been completed at the DGA Centre test in Istres.



## General Atomics Aeronautical Systems mark 25 years

General Atomics Aeronautical Systems, Inc. (GAASI), a leading manufacturer of Remotely Piloted Aircraft (RPA) systems, radars and electro-optic and related mission systems solutions, is celebrating its 25<sup>th</sup> anniversary. GA-ASI started on 28 April 1992 in the same year that the company won its first contract award for six GNAT-750 Unmanned Aircraft Systems (UAS) by the Turkish government. In 1994, the company won its first major programme award for the Predator RPA from the US Joint Programme Office, which was later transferred to the US Air Force. Predator is arguably the most combat-proven RPA in the world and continues to excel in combat missions, as well as Intelligence, Surveillance and Reconnaissance (ISR) missions. GA-ASI's

long-endurance, mission-capable RPA with integrated sensors and data link systems deliver persistent situational awareness and rapid strike capabilities.

The company's MQ-9B SkyGuardian is designed to be certified for a 40,000-hour service life, operate in all-weather conditions and be the first RPA system of its kind to meet NATO airworthiness requirements. GA-ASI demonstrated its MQ-9B earlier this year before international observers in Palmdale, California. The United Kingdom recently became the first MQ-9B customer under the country's MQ-9B Protector Programme. MQ-9B SkyGuardian recently set a company record for the longest endurance flight of any Predator-series aircraft, flying for 48.2 hours-non-stop!



*Predator C Avenger*

## GA-ASI in Japanese collaboration

General Atomics Aeronautical Systems has executed a research collaboration agreement with a consortium of Japanese industry, government, and academia groups to accelerate operational approval for Medium-altitude Long-endurance (MALE) RPA to fly in non-segregated Japanese civil airspace. The partnership seeks to establish the first civil MALE RPA flight approval in Japan and examine its utility for public

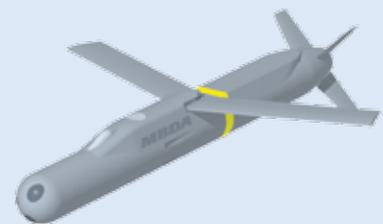
and commercial operations. As a nation surrounded by sea and frequently impacted by natural disasters such as earthquakes, tsunamis, and typhoons, Japan is a country in strong need of resilient situational awareness and communication capabilities. The long-term goal of this collaboration is to fly the GA-ASI-designed Guardian in non-segregated Japanese airspace and to expand the RPA's mission capabilities.

## Safran unveils new-generation Euroflir 410 on Patroller

Safran Electronics & Defence unveiled its new-generation Euroflir 410, a “very-high-performance airborne optronic (electro-optical) system designed for all types of air vehicles, including special-mission aircraft, helicopters, airships and drones”. Very-high-resolution multispectral cameras provide “unequaled” target detection and identification at longer standoff distances, in any environment (smoke, dust, fog, saline), day or night. An optional laser designator guides most precision air-to-ground munitions. The most complete version of the Euroflir 410 will be an integral part of the imaging system on the Patroller, the French army’s upcoming tactical drone system, also designed and built by Safran Electronics & Defence.



MBDA presented the new SmartGlider family of guided weapons, optimised to counter anti-access strategies and other emerging battle space threats. Planned to become available for fighters by 2025, SmartGlider forms a family of all-up-round glider weapons, with folding wings and a range of over 100 km. This new generation of air-to-ground weapons is designed to counter new networked short- and medium-range surface-to-air threats, as well as moving/relocatable targets or hardened fixed targets. The compact family member, SmartGlider Light, is 2 metres long and weighs 120 kg. 12 to 18 SmartGlider Lights can be carried on an aircraft owing to a Hexabomb Smart Launcher (HSL) capable of managing reactive strikes without affecting the pilot’s workload. As such, the SmartGlider Light will allow first-day-entry by saturating and destroying enemy air defences.



# Into the Fifth Decade :

# VAYU at Le Bourget



Once more into the breach ! Few aviation journals can really count back to when they first covered the biennial *Salon International de l'Aeronautique et de l'Espace* at that historical and hallowed airfield, Le Bourget, on the outskirts of Paris. *Vayu* certainly can !

Editors from the journal have been covering the event soon after the journal's very foundation, beginning with the Show in 1975. In its issue of August 1975, *Vayu's* aviation journalist HP Mama made an indepth analytical study of the perceptible trends that emerged at the thirty-first International Air and Space Show (although now no longer with *Vayu*, the irrepresible HP Mama is still writing with passion !).



But back to 1975: At this premier event, the supersonic Concorde airliner continued its triumphant progress towards entry into service and was unabashedly 'Star of the Show', alongside the military (then General Dynamics) F-16. Even as the Concorde has since flown into the pages of history, the F-16 (now part of Lockheed Martin) soldiers on and was subject of an industrial agreement at Paris 2017 with the Tata Group signing their intent to produce this classic (if dated) fighter should the Indian Government select it as their choice of a 'single-engined fighter'.



**Concorde of Air France in spectacular take off**

In 1975, there were 180 types of aircraft then on display at Le Bourget, ranging from the ultra-light Rallye and Robin series to the Concorde and Tu-144 supersonic commercial airliners. In 1975, the Indian Air Force's DPSA requirement was underway and the types under consideration are revisited, as recorded by *Vayu* with two of the three contenders being displayed at Paris that year.



**The first prototype of General Dynamic's F-16 was brilliantly displayed at Paris 1975**

Brilliant flying by professional pilots demonstrated both their skills and the performance of their aircraft. Naturally the most spectacular were the military mounts and it was unanimous opinion that the hit of the Show was General Dynamic's first prototype F-16 (01567) flown by Neil Anderson. The F-16's 300 kt. 7g half-mile diameter turn inside Le Bourget's boundaries and its general fly-by-wire control system manoeuvrability and climb power were very evident of a new generation of fighter technology. The freshly painted Mirage F.1E flown by Guy Mitaux-Maurouard was a smart performer while the third "also-ran" was SAAB's Viggen, with Captain Anders Lefvert in the cockpit. In the event none of these types were to wear IAF colours, the trophy going to the Anglo-French Sepecat Jaguar which was also on static display at Paris 1975. But that is another story.



**Two seat version of the Saab J-37 Viggen at Paris**

Over the next decades, Air Shows have actually become the occasion to announce mega orders, the two fiercely contending Companies being Airbus and Boeing. 40 years on, at the Paris Air Show 2015, for instance, Airbus took the honours although Boeing signed more deals for wide-body airliners. The final tally had both



**Sepecat Jaguar two seater at the Show**

'rivals' notching over \$ 107 billion in orders and commitments, 421 aircraft and 331 aircraft respectively (*the statistics of sales in 2017 are given in the main story of this Issue*).

However, in 1975, there was wider competition with Lockheed's TriStar still very much in the running, with four versions competing again Boeing and Airbus. The former introduced the Jumbo freighter version of its Boeing 747 which lorded over the others at the static display. Smaller airliners were also present, a pleasant surprise being reemergence of the BAC *One-Eleven*, a new version with CFM 56 high by-pass ratio turbofans. There was of course much talk about the "decade of the derivatives" indicated by Boeing and McDonnell Douglas displaying their Boeing 7x7 and DC-x-200 respectively, the target being replacement of the 707/DC-8s, in a market estimated at 1500 numbers.



**Dassault Mirage F.1 displayed with armament at Le Bourget**

Down the scale and selling at a steady, if unspectacular rate, was the Fokker-VFW F.28 Fellowship which at one time was considered by Indian Airlines to replace its HS 748s and F.27s. The competition (not taken much seriously), was the Yakovlev Yak-42 trijet whose arrival at Le Bourget was bit of a surprise. This type too was offered to India but not taken forward as was the Canadian entry in form of the de Havilland Canada Dash 7, with four-turboprop engines. But this too was not destined to operate in India!

In rounding up, the 1975 Paris Air Show revealed the growing Israeli innovative genius bringing their Westwind 1124 light jet as also the remarkable little Arava light logistic transport aircraft. In this category was the BN Islander (which was already in service with the Indian Navy then but was an early casualty when the Indian Government launched its light transport aircraft – LTA – requirement and the honours went to Dornier of Germany).

That really changed the scenario in India and has been reviewed in various Issues of the *Vayu* for several decades thereafter.

# Visit to Thales in France



*At Bretigny: live demonstration of the mini-drone Spy 'Ranger' was witnessed*

## Drones, C-UAV, radars and airport security systems on display

**O**n 29 May 2017, some 30 media persons from around the world gathered at Bretigny in France for a 3-day detailed session on Thales and their activities which included factory visits and live demonstrations of some of their innovative products.

Thales is a global technology leader in the aerospace, transport, defence and security markets. With 64,000 employees in 56 countries, Thales has recorded sales turnover of €14.9 billion in 2016. With over 25,000 engineers and researchers on their rolls, Thales designs and deploys equipment, systems and services to meet security requirements worldwide.

After arrivals throughout the day in Paris and then being shifted to Bretigny on 29 May, a welcome dinner was organised for the international media gathered there. It was a good opportunity to get to know the Thales officials as well as fellow journalists in

a calm and beautiful setting. Next morning, 30 May, we left our hotel to Thales' hangar in the North Zone for a presentation of 'Thales in the field of drones' given by Thibault Trancart - Vice President Marketing and Intelligence, Surveillance and Reconnaissance Strategic project,

Thales. This was followed by a presentation of the Nouvelle Aquitaine and Ile-de-France Clusters to highlight this sector of excellence in the field of drones. These very interesting talks and presentations were delivered by Jean-Marc Grolleau - AETOS cluster Director, Thales and Jean-Philippe



*Jean-Marc Grolleau - AETOS Cluster Director, Thales*



*Thematic workshops in the hangar*

## The Spy'Ranger mini-UAS

**S**py'Ranger is a latest-generation mini-UAS with the “only EO/IR imaging system in the world” capable of transmitting high-definition electro-optical and infrared imagery in real time. The system draws on a decade of experience of micro- and mini-UAV systems with the French armed forces and offers particularly high levels of endurance. It is deployed with the Spy'C automatic command-and-control software already adopted by the French land forces. Designed to operate in extreme, non-permissive environments, this new-generation system gathers and transmits accurate, operational beyond-line-of-sight image intelligence for joint battlegroup and brigade-level units. It is interoperable with France's multi-sensor image interpretation and dissemination system (MINDS/SAIM) to generate imagery that can be used directly in operational C4I systems for frontline mission planning and multi-sensor manoeuvres by forward units. The Spy'Ranger system is transportable in a tactical backpack and offers a range of different deployment options. The air vehicle was purpose-designed with a specialised French firm to withstand the wide range of climatic conditions encountered in different theatres of operations and to provide outstanding performance in the critical take-off and landing phases.



*Installation, presentation and then walk around before the launch of the Spy'Ranger*

Spy'Ranger deploys a high-performance EO/IR imaging system. The airframe is made of a special, patented composite material for robustness and resilience. The design was fully proven through an iterative process of in-flight testing. Based on operational feedback from customers, the system provides an optimal combination of endurance, imaging performance, robustness, resilience, security and life-cycle costs.

Thales is planning to participate for an Indian requirement for upto 200 UAS systems. The company is already in talks with, “a couple of companies in India, checking what we can do with them,” Thibault Trancart, Vice President Marketing and ISR Strategic Projects, stated.

Thales will deliver the first batch of Spy'Ranger UAS to France next year. The 14.5kg aircraft has a range of 30km and an endurance of two and a half hours.

Bonhomme - Drones Paris Region Cluster Director, Thales. A very interesting session followed, on Thales' Counter-UAV system by Michel Dechanet - Air Defence Business development Director, Thales.

We then moved on to the South Zone for a live demonstration of the mini drone Spy'Ranger, which included the installation from scratch to launch, all within a short duration. The Spy'Ranger is on offer to the Indian Armed Forces for which there is a requirement for 200 of the type.

The afternoon session involved ‘Thematic workshops’ inside the hangar. Styled like a mini-trade show where one could talk individually to each company and visit each stand, the themes included ‘Unmanned Warrior with WKP and Halcyon’, ‘Innovation with Stratobus and AUSS’, ‘Unmanned Traffic Management (UTM)’, ‘Communication for UAVs’, ‘Counter-UAV’ and ‘Spy'Ranger’. Two SME clusters showed their prowess: the SMEs Ile-de-France cluster and SME AETOS Cluster.

Of particular interest was the SME's AETOS Cluster with Jean-Marc Grolleau - AETOS cluster Director, Thales as the lead man, very enthusiastic and passionate about his responsibility, much information garnered on his subjects. Some highlights were the DRONISOS (firefighter, tool for the SNCF etc), Drone Protect System / Skeyetech (smart surveillance system drone), Helipse manufacturer for helicopter drones (with a new model HE220E), Reflet du Monde (long distance drone including a satellite communication solution), Nethis (Capteur Terahertz to see through materials) and the Helper Drone which is used to save lives (beach surveillance and so on).

Ever since the AETOS cluster was set up in 2010 as a joint initiative by Thales and the Aquitaine regional authorities, the Group has been actively involved in developing unmanned air systems and services industry in this region of South-West France. Led by Jean-Marc Grolleau of Thales, the cluster has attracted some 60 companies from

every part of the UAS value chain. Some of these are technology providers, NeTHIS for example, developing terahertz imaging systems that can “see through” matter while others design complete unmanned systems. Fly-n-Sense, for instance, was the first company ever authorised by the air traffic control authorities to deploy a civil UAS in French airspace. The cluster also includes service providers offering flight time by the hour or developing turnkey solutions for customers, as well as training schools for UAS operators and the CESA test centre, which provides facilities for flight testing unmanned air systems at several sites in the Aquitaine region.

“Thales has a long and extensive experience in military unmanned air systems, and as a co-founder of the AETOS cluster we want to support the major ecosystem that is now emerging around unmanned systems and services. The cluster has attracted other large companies, including Airbus, Safran and Dassault, as well as numerous SMEs and start-ups serving different parts of the aerospace market,” stated Jean-Marc Grolleau.

One of Thales’s specific objectives is to promote collaborative developments and innovative products by working hand-in-hand with some of the SMEs and research institutes taking part in the UAS cluster initiative. The CARUS project (Cooperative Autonomous Reconfigurable UAV Swarm), for example, is a collaborative venture with several SMEs and the LaBRI research lab (*Laboratoire Bordelais de Recherche Informatique*) aiming to prove the feasibility of a swarm of UAVs conducting a mission autonomously. In other words, making their own decisions without being controlled from the ground at every step.

In addition to these futuristic projects, cluster members have developed a number of fully operational unmanned air systems, some of which are already commercially available. Several projects conducted at the AETOS cluster have demonstrated the operational and economic benefits of unmanned air systems in various applications and are now being developed into products and solutions for customers. Several SMEs have already moved into the production phase. Fly-n-Sense, as mentioned before, is offering an unmanned air system that can fly over a wildfire front and transmit real-time images to a command centre, helping the authorities to

## Thales Q1 2017 order intake and sales

Thales has announced its order intake and sales for Q1 2017. As per Patrice Caine, Chairman and Chief Executive Officer, “The start of 2017 has confirmed the solid momentum of all of our businesses, with organic sales growth ahead of the full year target, driven by both mature and emerging markets. Order intake for the first quarter of 2017 is in line with our expectations. We remain focused on implementing all the initiatives undertaken as part of our *Ambition 10* strategy and we confirm our 2017 sales growth and profitability objectives.”

In Q1 2017, order intake amounted to €2,281 million, down 1% compared to Q1 2016 (down 2% at constant scope and currency). Order intake for the Aerospace segment fell 9% to €938 million, compared to €1,030 million in Q1 2016. Order intake for the space and commercial avionics activities increased compared to the previous year, unlike the In-Flight Entertainment (IFE) and Training & Simulation businesses which did not see any significant contracts during the period, in contrast with Q1 2016. Order intake for the Defence & Security segment rose 8% to €1,112 million, from €1,030 million in Q1 2016.

Sales for Q1 2017 stood at €3,058 million, compared to €2,732 million in Q1 2016, up 11.9% on a reported basis, and up 11.0% at constant scope and currency (“organic” change). Sales in the Aerospace segment totalled €1,252 million, a sharp 17.3% increase compared to Q1 2016 (up 16.2% at constant scope and currency), reflecting a favourable basis of comparison in In-Flight Entertainment, which had recorded a temporarily low level of activity in Q1 2016, and robust sales growth in the Space segment, driven primarily by the observation, exploration and navigation businesses, which brought in several large orders in 2015 and 2016.

Sales in the Defence & Security segment represented €1,511 million, up 9.0% compared to Q1 2016 (up 8.0% at constant scope and currency). “This segment continues to enjoy a broad based momentum, driven notably by the major contract wins of 2015 and 2016, military telecommunications networks and cybersecurity activities.”



Thales and India’s Bharat Dynamics Limited have signed an MoU to assess the opportunity for transfer of technology of the STARSTREAK missile. (Photo taken at Aero India 2017 at the Thales stand.)

make critical decisions about the resources needed on the ground. The system is being proposed to fire-fighters in France and has already been selected in Canada.

Thales’s involvement in the cluster goes well beyond promoting innovative R&D

projects. A number of Thales employees are taking part in the dedicated training modules offered by Bordeaux University and various engineering schools to help tomorrow’s specialists understand the science and culture of unmanned air systems.

And so, after an intense but most interesting day, we boarded a bus to our next destination which was Rouen.

On 31 May, at the Thales Rouen site, there were presentations on activities with a radar activity focus. Talking to us on these topics were Marc Fiolin, Director of Rouen Thales site and Thierry Le Joncour, Director for surface civil radar activities, Thales. More details were given on new generation radars by Gaston Marcantoni, Director for surface multi-functions radar activities, Thales.

Later we were introduced to Thales' *Factory of the Future* and the Company Group vision as well with focus on the Factory 4.0 with the Sea Fire 500 radar at Rouen. Presentations by Philippe Chamoret, Vice President Industry, Thales, Marc Fiolin, Director of Rouen Thales site and Philippe Eudeline, Innovation Director for surface radar activities, Thales were informative indeed!

We walked around the site to see at first-hand operations of the new Trac NG radar and its systems as well as three production centres. Philippe Juge, Product line manager for Air Traffic Management radars, Thales walked us through the details.

As for the military part, we were provided information on the RBE2 AESA radar which is on order for the Indian Rafales. We also had the opportunity to "discover" two new RBE2 innovations. A presentation on this radar for the international market was provided by Bruno Gilon, Product line manager for combat aircraft, Thales. Hands-on activities included simulation activities for airborne systems and 3D immersive training.

The Rouen tour continued with a presentation given by Thibault Trancart, Marketing director for Intelligence, Surveillance and Reconnaissance activities on the Searchmaster radar (and its new developments) and Coast Watcher 100 (CW100).

Another hectic day over, we left for the train station for departure to Paris.

On 1 June, at Thales' Gennevilliers site, we were introduced to Thales' solutions in the security market. This included airport security solutions from anti-terrorism to new video technology tools. Details on Thales' radar and airport security solutions will be covered in *Vayu's* next issue (Sep/Oct 2017).

All in all an excellent visit to Thales. *Vayu* thanks the entire team at Thales in France who managed to put together such an extensive plan and discussing such a wide variety of topics/products (in such an efficient manner). And of course, a special "Thank you" to Anne-Sophie Malot, Dorothée Bonneil and Cedric Leuerquin who escorted and put up with all our demands throughout the tour!

In the next Issue, we will cover Thales' radar & airport security systems.



*International media and Thales officials in this group photograph in glorious weather!*

# Thales in India



*Catherine Thermal Imagers on Indian Army T-90 tanks*

Present in India since 1953, Thales has over 300 employees working with its wholly-owned Indian subsidiary, Thales India Pvt. Ltd. Headquartered in New Delhi, Thales has various operational offices and sites that are spread across Hyderabad, Bengaluru, Chennai and Mumbai, among others. Thales strategy of developing its industrial footprint in India is in line with the Indian government's policy of 'Make in India' and for developing the defence base of the country. With this as the backdrop, Thales has formed various co-operative partnerships with public and private sector industries. It has been closely associated with HAL for over 50 years and has formed JVs with Samtel, BEL and L&T Technology Services.

**Hindustan Aeronautics Limited (HAL):** Thales has been working closely with HAL for over 50 years. Thales has been providing high-end avionics to equip various platforms that HAL is designing.

**Bharat Electronics Limited (BEL):** The JV Company was incorporated in August 2014 as BEL-Thales Systems Limited (BTSL). Thales holds 26% equity in the joint venture, while Bharat Electronics holds 74 % of the stake. The JV is dedicated to the design, development, marketing, supply and support of civilian and select military ground based radars for India and the global markets. In March 2016, Thales and BTSL signed a partnership agreement for joint development of the Pharos fire control radar for gun and missile systems.

**Samtel:** Thales signed a JV agreement with Samtel in 2008 to locally develop and produce helmet mounted sights and displays, military avionic and airborne sensor systems for the defence market. Samtel Avionics Limited holds 74% of the stake and Thales 26%. The JV is fully operational and the facility is based in Noida. The production of displays for the Mirage 2000 upgrade programme by this JV will pave the way for future opportunities to serve local and export markets.

**L&T Technology Services:** In June 2014, Thales and L&T Technology Services formed a JV with a view to develop software engineering activities in India, particularly in the avionics domain.

**BDL:** At Aero India 2017, Thales and Bharat Dynamics Limited (BDL), a Government of India enterprise, signed a Memorandum of Understanding to assess opportunities for the transfer of technology of STARStreak missile capability to India with the support of the Government of the United Kingdom (UK).

On the defence front, on 23 September 2016, the Indian Government contracted for 36 Rafale omnireole combat aircraft. Rafale's new export success "demonstrates Thales' ability, alongside Dassault Aviation and its partners, to constantly meet the customer's highest expectations through innovation, mastery of advanced technology and industrial excellence".

Thales provides a number of state-of-the-art equipment and systems on board the Rafale. These include the provision of RBE2 AESA radar, the Spectra electronic warfare system, optronics, the communication navigation and identification system (CNI), the majority of the cockpit display systems, power generation systems and a logistics support component.

In July 2011, Thales and Dassault Aviation had signed a contract for the upgrade of the Indian Air Force's Mirage 2000 fleet, the upgrade to enhance technical-operational capabilities of the Indian Air Force's Mirage 2000. As a result, the IAF will have a coherent platform-system combination for the next 20 years. The IAF's air potential will be further enhanced by the integration of new capabilities. Four upgraded Mirage 2000 aircraft have been delivered to the Indian Air Force, the rest of the fleet being upgraded under the responsibility of HAL with the support of Dassault Aviation and Thales teams, as per the contract.

In addition, Thales has also signed other major contracts with the Indian Ministry of Defence. For the IAF, there are radars and systems (GS100), avionics & INGPS (Inertial Navigation and Global Positioning System) for military aircraft such as the Mirage 2000, MiG-21 and-27, Su-30MKI, reconnaissance pods Vicon 91, IFF (Identification friend or foe) and INGPS for the MiG-29s.

For the Indian Navy, there are electronic warfare (EW) systems, anti-submarine warfare sonar systems and mine-hunting solutions as well as long-range surveillance radar LW08 and DA04.

For the Indian Army, Thales optronics include Hand Held Thermal Imagers (HHTI) and Catherine Thermal Imagers on T-90 tanks. As for air defence radars, there is the Flycatcher Mk1 in operation.



*Thales' RBE2 AESA radar: soon for the IAF Rafales*



# The Baltic Connection

*Vayu's Angad Singh visited a number of Russian shipyards on the Baltic Sea, reporting on several key programmes relevant both to India and the broader Russian shipbuilding industry.*

Goa is a popular tourist destination in India, particularly among Russian travellers, so it was not surprising to hear that Yantar Shipyard's General Director, Eduard Efimov, was enthused at the possibility of co-operating with Goa Shipyard Limited (GSL) on production of frigates for the Indian Navy. In an exclusive interaction with *Vayu* at Yantar, in the strategic Russian exclave of Kaliningrad, he spoke at length about the work his shipyard has already done with the Indian Navy, and shared details about the proposed deal for four new warships.

"Discussions are being held," said Efimov, "and we do hope that by the end of this year we have some clarity [on this order]."

Yantar has built the second batch of three *Talwar*-class frigates for the Indian Navy : *INS Teg*, *Tarkash* and *Trikand*, distinguished by their primary armament of BrahMos cruise missiles in place of 3M54

Klub missiles on the first three ships, and AK630 close-in weapon systems instead of the larger Kashtan CIWS. These vessels are significantly modified variants of the venerable Soviet-era *Krivak*-class frigates, and the Russian MoD was sufficiently convinced of their utility to order a six-ship run of frigates based on the *Talwar*-class.

Produced under Project 11356R/M (Russian/Modernised), the class is named for the lead ship, *Admiral Grigorovich*, differing only slightly from the Indian boats with two 12-cell vertical launchers for its 3S90 Shtil surface-to-air missiles instead of the older single-arm trainable launcher that is incapable of rapid firing. Crucially, the Russian frigates have retained the same gas turbine powerplant, supplied by Ukraine's Zorya Mashproekt. The first vessel was laid down in December 2010 at Yantar, and by the time the Ukrainian crisis had boiled over into the annexation of Crimea by Russia, construction of five of the six boats

was in full swing. However, only three sets of engines had been delivered by that time, and Ukraine's embargo then left Yantar and the Russian MoD with three frigates under construction without any realistic hope of getting powerplants.

While an ambitious import substitution programme was put in place across all sectors of Russian industry, it became rapidly clear that it would be quite some time before Russia's turbine manufacturers would be able to duplicate the Zorya powerplant for the *Grigorovich*-class vessels. The Russian government elected to find a buyer for these vessels, one that Ukraine would be amenable to doing business with. India was the natural first choice as an existing operator of the type, and on the sidelines of the BRICS summit at Goa in October 2016, the two nations announced an agreement on four *Grigorovich*-class frigates in addition to a multitude of other procurements (see *Vayu VII/2016*).



*A hydraulic press at one of Yantar's production workshops*



*One of Yantar's Waldrich Siegen shaft-machining lathes, dating back to 1941!*

Since then, talks on the frigates have rapidly progressed, with Efimov leading a Russian team to evaluate the facilities at state-owned GSL in March 2017, and receiving a GSL team for a familiarisation visit in June.

"I personally believe GSL is able to handle contracts for warships of this class," stated Efimov. "If I am not mistaken, they plan to erect a new workshop for hull assembly, and the technological base appears broadly sufficient, but there may be a need to create specialised 'branches' of the company, and employ certain specialists for equipment installation and integration. The hull and propulsion is no problem at GSL."

"Existing bilateral protocols already enable training of such specialists," he continued. "[Indian Navy flagship INS] *Vikramaditya* was an example, in terms of crew training but also shipbuilding specialists. Should India place the order, a similar programme for training could certainly be implemented with Yantar."

With two frigates to be completed at Yantar and two built from scratch at GSL, Efimov was confident the programme could be run smoothly. "After the contract is signed, the first ship will be completed within three years. After that it will take six months for the second ship to be built," he stated. This tracks with the build rate of the first six *Talwar*-class ships, accounting

for the fact that the vessels will not need to be built from the keel up.

On the other hand, given that construction at GSL would entail all the pitfalls of building a 'first-of-class' vessel at that yard, Efimov estimated that "from keel-laying to delivery, GSL should be able to deliver their first ship in five to seven years." With the two sets of frigates being built essentially in parallel, this translates to only a slightly staggered rate of delivery for all four. "At this time we are negotiating, so nothing is firm," cautioned Efimov, before offering a solution to further shorten the delivery period. "We could deliver parts [to GSL] and are ready to do so. It could, in theory, reduce the construction time at Goa."

Yantar is a 73-year old yard, with a history stretching back to the turn of the 20<sup>th</sup> century. Indeed, there is functional machinery being used for present-day projects dating back to the early 1900s! Apart from regular warship repair contracts, key projects at the yard include frigates, large landing ships (Project 11711 *Ivan Gren*-class), ocean exploration vessels, and large fishing trawlers. The yard has delivered nearly 700 ships in its history, with over 160 of these being naval warships for domestic and export customers. Efimov is confident in the work of his organisation, and expressed a willingness to accommodate customer-specified equipment on the Indian frigate order, to produce ships to the Indian Navy's specifications, which he said "would not impact the build rate."



*Vayu had unprecedented access to a number of yards*



*Under the bow of the fourth 11356R/M frigate under construction at Yantar*

### From combat to rescue

Fresh from standing under the bows of 4000-tonne frigates in Kaliningrad, we moved further up the Baltic Coast to Saint

Petersburg, this historic shipbuilding city and its yards now familiar to *Vayu* and its readers (see *Vayu IV/2015*).

Admiralty Shipyards has produced the vast bulk of India's sub-surface fleet, from the first *Kalvari*-class (Project I641, NATO reporting name: *Foxtrot*) to the modern *Sindbugosh*-class (Project 677EKM, NATO reporting name: *Kilo*). Alexander Buzakov, Director General of Admiralty Shipyards, noted that "India is the nation with which Admiralty has had the longest relationship."

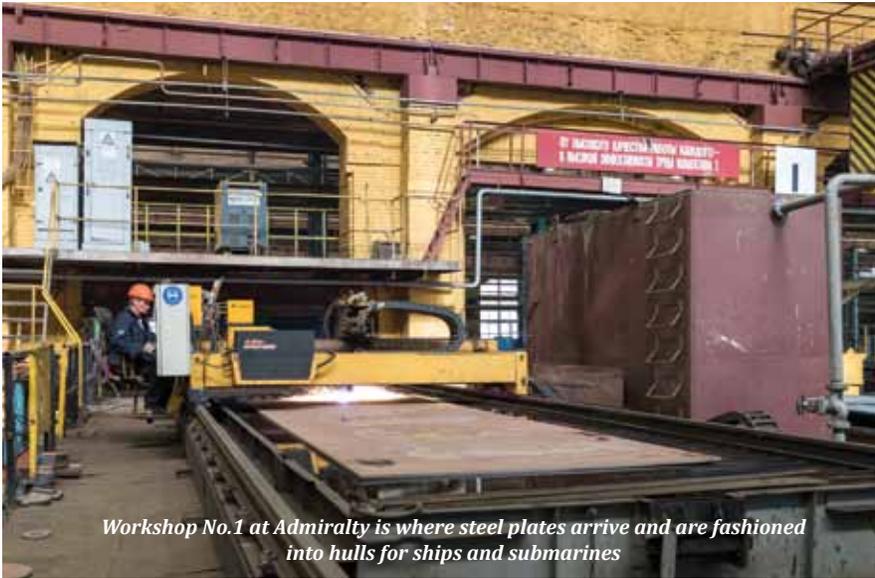
From fifty years of submarine co-operation, the Russian firm is now in talks with Indian Navy for an advanced rescue vessel to aid submarines in distress. "Project 21300 from the Almaz design bureau has a special diving complex to enable divers to go down to 400m. It also comes equipped with a *Bester* submersible to enable rescue operations down to 700m, and can carry unmanned submersibles that can operate as far as 1000m below the surface," said Buzakov. The first ship of this class, *Igor Belousov*, is already in service with the Russian Pacific Fleet, and even stopped by at Visakhapatnam during its long transit from the Baltic to Russia's Far East (see *Vayu V/2016*).

The Indian Navy's need for a submarine rescue capability has taken on urgent dimensions now that it employs multiple nuclear submarines, which will operate in deep waters far from home shores. In fact, during dive testing of the indigenous nuclear-powered ballistic missile submarine *Arihant*, the Indian Navy had to turn to the Russian Navy in order to have a rescue ship available, the vessel in question being RFS *Epron*, an older *Prut*-class boat (see *Vayu III/2016*).

Regarding the Russian offer itself, Buzakov revealed that there had initially been "some technical issues" to iron out with the IN, but that "they have been overcome and now we are discussing pricing." Designed for operations in virtually all conditions and up to sea state 7, Buzakov stated that the issue was not to do with the rescue ship itself, but rather its rescue equipment, specifically the submersible carried on board. The Navy has already ordered two British-made James Fisher Defence LR5 manned submersibles for its deepwater rescue needs, and only needs a ship to carry them. "The Indian side wanted to know if additional [third party] rescue equipment could be added



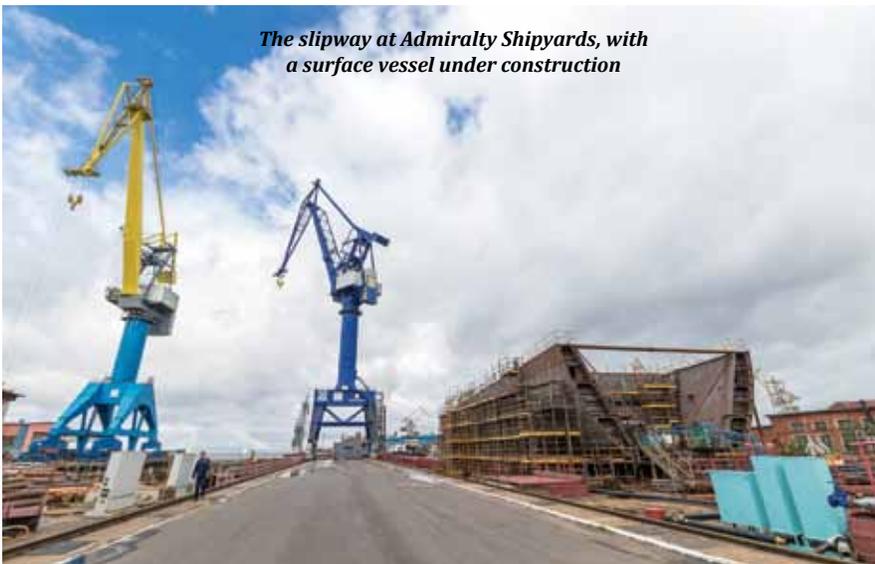
*Workshop No.12 at Admiralty Shipyards is solely equipped for machining, cutting, treating and bending tubes and pipes*



*Workshop No.1 at Admiralty is where steel plates arrive and are fashioned into hulls for ships and submarines*



*A plasma cutter in action at Admiralty's Workshop No.1*



*The slipway at Admiralty Shipyards, with a surface vessel under construction*

to the ship. We have now confirmed that the British submersible vessel can be integrated,” said Buzakov.

Even as the Indian contract is being negotiated, Buzakov also anticipates additional orders for the class from the Russian Navy. “*Igor Belousov* has gone to Pacific Fleet, and we plan to have one such ship with each operational fleet [these are the Northern, Baltic and Black Sea fleets]. The orders are not yet placed because the new state armament programme [for 2018-2025] is being prepared. Meanwhile, *Igor Belousov* is being extensively tested in the Pacific Fleet to ensure it meets the standards required by the Navy, after which additional orders are more likely.”

On the subject of the shipyard’s traditional area of expertise – submarines – Buzakov was more circumspect, given the unclear nature of the Indian Navy’s Project 75 (India) and the MoD’s recently-notified policy on private sector strategic partnerships (SPs). He noted that the Navy’s experience with Project 75 (*Kalvarii/Scorpène*-class) should lead to a more gradual local construction programme, with greater OEM involvement in the physical build process, but that the final decision would rest with the MoD. On the possible requirement to integrate the indigenous DRDO AIP as customer-specified equipment, Buzakov highlighted his yard’s close working relationship with the Rubin design bureau: “If Rubin does the integration – we can build it!” he said with a smile, before pointing out that Admiralty has built a wide variety of submarines, from nuclear to conventional.

### **Rubin and the Amur-1650(I)**

As the lead design agency for the Russian effort for P-75(I), the Rubin design bureau was able to offer extensive briefings on technology readiness and the rough contours of Russia’s proposal for the project, particularly in the context of the new Strategic Partnership policy.

*Vayu* spoke with Rubin’s Deputy Director for Foreign Affairs, Andrey Baranov and Chief Designer Igor Molchanov at the International Maritime Defence Show (IMDS) at Saint Petersburg, where Baranov revealed that after “two years for almost no communication from the [Indian] Navy on P-75(I), we resumed contact in May this year.”



*A Kilo-class submarine moored at the Admiralty Shipyards*

Baranov visited NHQ as part of a Russian delegation invited by the Navy, and discussed the technology transfer elements of the Russian offer for P-75(I). “At that time, SP was in the final stages of approval and we were informed that the technical requirements of P-75(I) had been finalised and were only awaiting the notification of the chapter.”

During the Saint Petersburg International Economic Forum in June 2017, Baranov met with Indian delegates and was informed that the SP chapter had been approved, and that L&T and Reliance Defence were among the private sector firms under consideration to build submarines. “Now we are waiting for certain steps and actions to be taken in India because we understand [from the SP chapter] that these firms will have to meet certain requirements and this process might take several months,” said Baranov. “We hope the issues will be finalised by end-2017 or early next year, so the tender process for P-75(I) can begin.”

Although the RFP has yet to be issued, Baranov indicated that there might still be some flexibility on the AIP, with the

Navy preferring a proven module over the DRDO AIP currently under development. He revealed that Rubin has already opened dialogue with the DRDO, with Rubin specialists visiting the Naval Materials Research Lab (NMRL) in Mumbai earlier in the year.

“All shore trials [of the Rubin AIP] are complete. We have met all the requirements of the Russian Navy for this AIP plant, and are now preparing for the next stage of trials for our Navy,” stated Baranov. “To reach the status of a plant that is considered ‘proven’ by the IN, we have to complete this next stage, and we have no doubt we can achieve this in the shortest time and that the Russian Navy will accept the plant.”

Baranov also revealed that DRDO head Dr S Christopher had visited Rubin’s AIP test stand in March 2017 and observed the plant in operation. “He was satisfied with what he saw and we made a plan for certain areas of cooperation, with the aim of bringing the Indian AIP to a state where it can be installed on board a submarine,” he said. “Right now we have extensive interactions between Rubin and DRDO,

and I can say that we are hoping to sign some contracts on cooperation before the end of this year.”

Rubin has also been engaging with private sector firms vying for the submarine strategic partnership – from legacy issues such as *Kilo*-class refits to focused discussions on Project 75 (India). “All these discussions were more or less informal because of the nebulous nature of the programmes at the time. Of course, we plan on meeting with these companies again,” said Baranov.

By his assessment, “L&T already have certain submarine construction capacities, particularly a very good hull construction capability in Hazira and a world-class shipyard in Katupalli. So they need less investment to start submarine building. But this is not for us to decide – we await a decision from the IN and MoD. If they decide to work with another SP, we are ready to work with them.”

On the possibility of a DPSU yard being nominated, Baranov said, “We understand that MDL is best prepared for submarine building in India. In principle we are ready to cooperate with them, but if we look at



Shaft sets for a number of Indian warships have been delivered by the Baltic Shipyard, with a P-15B (Visakhapatnam-class) shaft seen under production in this image

the situation realistically, MDL is fully equipped and ‘oriented’ toward French submarine technology. DCNS (now Naval Group) is also actively participating in the P-75(I), and it is difficult to imagine how we can cooperate with MDL, as they are not likely to establish a separate Russian line – they don’t have space and it would be very expensive.”

Perhaps most crucially, Chief Designer Igor Molchanov indicated that the Indian Navy’s technical requirements for P-75(I) would require Rubin to design a new submarine, with the *Amur-1650* serving as a ‘proof of concept’ prototype for the programme. Depending on the extent of customisation required for the Indian order, design work alone could take up to four years, with construction of the lead submarine overlapping with the final year of the design process and taking a further two-to-three years. Subsequent boats would be built at intervals of no more than a year.

Baranov stated that Rubin was absolutely open to the involvement of the Directorate of Naval Design’s Submarine Design Group (DND SDG) in the design process, and that this would indeed be “logical,” but also admitted that the programme RFP would decide the organisations involved in transfer of design and build know-how and the extent of transfer required. The design for India would leverage lessons from not only the *Lada*- and *Amur*-classes, but also from the in-development *Kalina*-class, to be Russia’s next generation of conventional submarines. The new type would receive a variant letter ‘I’ (for India), and be designated *Amur-1650(I)* at Rubin.

“If India buys the *Amur-1650* as-is, it can be delivered in four years,” said Baranov. “But with requirements for ‘Make in India,’ transfer of design authority, and so on, the design and build time will be stretched out and a quick result cannot be expected. A decade would be optimistic!”

Why then is Rubin still keen to participate in the programme? It all hinges on the AIP and the technology used therein, according to Baranov. The new trend in AIP technology is fuel-reforming to generate hydrogen, thereby obviating the need to store the gas on board, significantly improving safety as well as alleviating space constraints. Baranov believes that the Indian Navy will insist on fuel-reformation based AIP technology, because if not, “they would have completed P-75(I) with Germany long ago! Their hydrogen fuel cell AIP is proven in service across multiple platforms.” On the other hand, he believes Russia has a clear lead in fuel-reforming AIP technology, noting that while most other countries, including Germany with their proven fuel cell AIP, have begun working on diesel-reforming AIP, none are as far into development as Rubin’s product.

In a later interaction, Rubin CEO Igor Vilnit was similarly sanguine about P-75(I), despite the challenges. “Our foreign competitors will participate in this tender, and I respect their technical capabilities; they are strong competitors. They force us to provide more advanced

proposals, and as a result of past discussions, I view our chances positively. If I thought differently, we wouldn’t bid at all,” he stated!

“Technical parameters of conventional submarines worldwide are broadly similar, and we have a good understanding of these. Nevertheless, there are differences and I am positive about this tender because our offer is based on the latest-generation *Lada*-class submarine, the first of which has passed all trials,” explained Vilnit. “As of today, this boat is the latest design. Other countries’ offers are based on submarines developed much earlier, while we are offering a future Indian submarine based on the latest technologies, so this is very important.”

“The principle of operation [of Rubin’s AIP] is acknowledged worldwide as the most promising, because both the French and Germans are now moving in this direction. We started work much earlier than them, however, so I believe we hold the advantage. This advantage will be put into action with P-75(I), alongside Indian systems,” he concluded.

Elaborating on the details of Rubin’s offer and the possibility of using Indian-nominated systems, Vilnit expressed his openness to working with the DRDO. “We consider this part of the project as a ‘Make in India’ element,” he said. “I am sure that India would like to have its own AIP on these submarines and the Indian Government would be justified in insisting that that [the DRDO AIP] plant is to be installed. We envisage assisting India in integration of their AIP into our platform or in helping complete development and integration of the AIP module itself. Given the similarities between our systems, we are also open to transferring technology to improve the plant or accelerate development and integration.”



Part of IMDS involves an excursion to the nearby Rzhevka firing range for a demonstration of naval guns

## State of the Union

USC President Alexey Rakhmanov also spoke to *Vayu* at IMDS 2017, providing some insight into the Russian shipbuilding industry as well as programmes involving India.

He revealed that the Russian engine manufacturer NPO Saturn “is working on a complete substitution” of the COGAG M7N power plant built by Ukraine’s Zorya Mashproekt, with the intention of delivered “a more efficient and reliable plant overall. The first complete prototype will be tested before the end of 2017 and the first production power plant will be ready by 2018,” he said. This first set of gas turbines would be tested on a *Gorshkov*-class (Project 22350) frigate at the Severnaya (Northern) Shipyard. Future turbine-powered ship classes would all incorporate Saturn engines, making Russia self-reliant in this field.

In the meantime, said Rakhmanov, USC was committed to working toward a contract that would allow its stalled Project 11356 frigates to enter service with the Indian Navy. The goal, he said, was to sign a contract in the fourth quarter of 2017 so as to commence work as soon as possible. Indian requirements for domestic weapons and equipment are key sticking points in the negotiations, and are adding to the engineering costs and extending timelines.

Another issue is the completion and testing of the vessels. Final delivery of all four ships is likely to be done from Indian shores, owing to the pre-delivery testing and training requirements, which will require Indian ranges, telemetry and crews. Discussions are underway regarding the best way to deliver the two Yantar-built frigates – whether to transport nearly-complete hulls by barge to Goa or to complete the vessels entirely in Russia and sail under their own power to India for delivery trials and commissioning.

Rakhmanov also highlighted an interesting characteristic of USC that he believes could help with P-75(I). Describing the programme itself as “still a mystery” in terms of process, he pointed out that the USC structure of separated design bureaus and shipyards would allow closer parallel cooperation on both the development and construction sides of the programme.

“We are the oldest friends of India,” said Rakhmanov, sharing a Russian saying: “one old friend is better than two new ones !”

*(All photos by the author unless noted otherwise)*

## Flying the Flag ! BrahMos at IMDS 2017

The sole Indian representation among the few foreign participants at IMDS 2017 was BrahMos. Although a bilateral joint venture, the Indian flag and models of Indian combat assets took centre stage at the company’s stand, buttressed by the ever-energetic presence of Praveen Pathak, General Manager (Market Promotion and Export).

He reported a great deal of interest from export customers, and indeed one witnessed several uniformed officers from a range of Asian navies at the BrahMos stand over the course of the week, particularly awed by the ship-launched variant of the missile. Although BrahMos has been tested for underwater vertical launch (from a submerged pontoon), the missile is not expected to be among the requirements for P-75(I), as it is about twenty centimetres too wide to be fired from 533mm torpedo tubes. Rubin’s Andrey Baranov expressed his bureau’s willingness to integrate the missile in the VLS configuration, but stressed that the final decision would be taken by the Indian Navy, and that they were not keen on a VLS system aboard a conventional submarine. In addition to the diameter being too large for torpedo tubes, the nearly nine-metre length of the missile makes it far too large to fit aboard any conventional submarine, the hulls of which are usually no taller than 7-8 metres. “We are ready to integrate it,” said Baranov, “but if the requirements are frozen, it is useless to offer something the Navy does not want. If their opinion changes, we are ready to do this work.”

On the other hand, there was good news on the air-launched front, with six out of six airborne separation trials now successfully completed, paving the way for a live firing of the missile from a Su-30MKI. The first firing test is anticipated in the July-August time frame, and will involve a fully-guided live launch against a ship target, as opposed to the more common practice of conducted a number of unguided ‘ballistic’ firing tests before graduating to guided firing. The missile will be cued by GPS data, with the seeker taking over in the terminal phase.

BrahMos Aerospace is also separately working on two range extension programmes for the missile. The first, which involves minimal modifications and no external dimensional changes, will increase the range of the base missile to 450 km (up from the original MTCR-limited 300-km range). The second is a programme to further develop the missile to endow it with an 800-km range.

More distant is a proposal to miniaturise the missile, expanding the number of combat aircraft types that will be able to carry the weapon, and also enabling tube-launch from submarines.



# “New Kid on the Block”



## Irkut MC-21's Maiden Flight

On 28 May 2017, the first MC-21-300 airliner made its maiden flight at the Irkutsk Aviation Plant in south-eastern Siberia. The flight lasted 30 minutes, with a maximum altitude of 1,000 metres and speed of 300 km/h, and included validation of in-flight stability and controllability, and also a range of engine response tests. The flight culminated with a planned go-around before landing, a technique typical for maiden flights of new aircraft types.

The aircraft was commanded by test pilot Oleg Kononenko with Roman Taskayev, as his co-pilot, both holding the title of ‘Hero of the Russian Federation,’ their country’s highest honour. Kononenko reported that the flight “was normal” and that there were “no obstacles” that should preclude further flight testing of the MC-21. Taskayev noted that “the characteristics of the power plant are confirmed, and all aircraft systems operated without glitches.”

As Irkut Corporation President Oleg Demchenko stated, “today is a historic day for our personnel and the whole team that worked on the MC-21. We incorporated

the most advanced technologies in our aircraft to provide enhanced comfort for passengers and improved efficiency for operators. I am happy to declare the maiden flight of the MC-21 aircraft has been successfully accomplished. I congratulate all project participants!”

As Yury Slyusar, the President of United Aircraft Corporation (UAC) then stressed, “the MC-21 is created through broad cooperation, where together with Irkut,

other enterprises of the United Aircraft Corporation are active participants, namely Aerocomposit, Ulyanovsk and Voronezh aircraft plants, and the UAC Integration Centre in Moscow. This is an important stage in the formation of a new industrial model at UAC. According to our estimates, the global demand in the MC-21 segment will be about 15,000 new aircraft in the next 20 years, and I am sure airlines will appreciate our new aircraft.”



*The 'A' Team after MC-21's maiden flight*

## Overview of the MC-21

The MC-21-300, with a capacity of 163 to 211 passengers, targets the largest segment of the civil aviation market. The aircraft provides passengers with “a new level of comfort,” with the largest fuselage diameter among all narrow-body aircraft, significantly increasing space available to each passenger, ensuring free passage of passenger and service trollies in the aisle, and shortening airport turnaround time. Natural lighting of the passenger cabin is enhanced with larger windows, and more comfortable cabin pressurisation is maintained compared to legacy narrow-bodies. Demand for improved comfort and efficiency resulted in “implementation of advanced technical solutions in aerodynamics, propulsion, and avionics.” The MC-21 also features an innovative ergonomic flight deck, and incorporates both Russian and Western avionics and hardware.

The major contributor to the aircraft’s performance is its all-composite structure, the first such developed for narrow-body aircraft. The MC-21 utilises composites in over 30 per cent of its design, making it unique among single-aisle aircraft.

Importantly, and for the first time in the history of Russian aircraft manufacturing, the airliner is offered with two engine options : the Pratt & Whitney PW1400G geared turbofan (GTF) or the Russian United Engine Corporation PD-14. The former is integrated and powered the aircraft on its first flight, while the latter is still under development and is expected to be offered later in the product’s life.



Coming into land

## Vital statistics of the MC-21-300

<b>Two-class layout</b>	163 seats (16 business + 147 economy)
<b>Dense layout capacity</b>	211 seats
<b>Maximum takeoff weight</b>	79,250 kg
<b>Maximum payload</b>	22,600 kg
<b>Maximum flight range</b>	6,000 km
<b>Length</b>	42.2 m
<b>Wing span</b>	35.9 m
<b>Height</b>	11.5 m



Both new engines, however, feature improved fuel consumption, low noise and improved emissions, allowing the MC-21 to meet a range of proposed environmental requirements.

The manufacturer estimates a reduction of direct operational costs at 12-15 per cent lower than for competitors and the initial backlog of 175 firm orders for the type provides for adequate utilisation of production capacity in the near future.

## Irkut's 2016 results

On 24 April 2017, Irkut Corporation issued consolidated financial statements for the year 2016, reporting a 17 per cent increase in revenue, reaching almost \$1.624 billion, against \$ 1.386 bn in 2015. The growth was achieved mainly through a 62 per cent increase in export sales, and a gross margin in 2016 of 28 per cent compared to 16 per cent in 2015. The profit from operating activities in 2016 exceeded \$121 million, which completely covered the Corporation’s borrowing costs. Net profit for the year amounted to \$18.219 million.

The Irkut Corporation is currently engaged in series production of Su-30SM and Su-30MK multirole fighters, developing and producing the Yak-130 lead-in fighter trainer, and developing the new Yak-152 primary trainer. Irkut Corporation are also the prime contractor for development and production of the MC-21 family of commercial narrow-body airliners.

## Rostec to invest \$385 million in MC-21 engines

United Engine Corporation, part of Rostec State Corporation, plan to upgrade its production facilities in 2017-2025 at a cost of \$385 million (21.9 billion Rubles) to prepare for series production of the PD-14 turbofan engine. One of the upgrade programme directions is defined as re-equipment of production with modern machinery: universal machining centres intended for manufacturing complex parts. Another focus area is

creation of an after-sales service system: establishment of repair facilities, training centre, spare parts distribution network and maintenance and repair centres.

A production line designed to produce at least 50 sets per year will be established for PD-14 assembly, and UEC expects to complete upgrades to its engine test stand this year. The new stand is planned to be launched in the third quarter of 2017.



## PD-14 in successful tests

The United Engine Corporation (a subsidiary of Rostec State Corporation) have successfully completed the second stage of flight tests of the new PD-14 turbofan engine.

PD-14 No. 100-07 (021) is a two-shaft turbofan, created within a framework of cooperation for the MC-21 airliner, utilising the latest technologies and materials, including a high degree of composites. It is the first engine for commercial airliners successfully designed and developed in modern Russia. The PD-14 flight tests were conducted on an Il-76 flying testbed at the MM Gromov Flight Research Institute in Zhukovsky, outside Moscow (see picture).

“Successful testing of the PD-14 engine is a significant stage in the implementation of the programme aimed at increasing the share of domestic components in our civil aircraft,” said Anatoly Serdyukov, Industrial Director of the aviation cluster at Rostec State Corporation. “The creation of this type of engine will equip them with one of the most important developments in the history of domestic aircraft construction – the medium-range MC-21 aircraft.”

The major aim of the trials was to confirm the working efficiency of the engine at different altitude and speed conditions, representative of operations on an MC-21 airliner, and to assess the level of its operational

performance. The engine is now being re-assembled to resume its tests on ground stands.

The successful development of the PD-14 engine “is an important milestone in the implementation of a new strategy of Rostec’s aviation cluster, according to which the revenues of the cluster should increase by around 12% per year, and exceed 1.5 trillion Rubles by 2025.” This growth rates will be achieved through a substantial increase in civilian production (30-40%), increase in exports (by 50%) and improvements in operational efficiency. In addition, a world-class after-sales service for helicopters and aircraft is planned, “which should increase revenue by more than 2.5 times owing to the creation of a ‘single window’ for customers and the transition to managing the life cycle of cluster products.”



## Sino-Pak JF-17s for Myanmar



A JF-17 ‘Thunder’ in Myanmar Air Force markings has been observed undergoing flight tests at Chengdu in China, this image on the Chinese internet showing the aircraft, designated JF-17M, in two-tone blue camouflage. As first reported by *Vayu*, Myanmar signed for 16 JF-17 Block 2 worth approximately \$560 million in July 2015. Deliveries are expected to start from second half of 2017 and could replace the venerable Nanchang Q-5 and Chengdu J-7 fighters that China previously supplied to Myanmar.

Compared with standard-production JF-17s for the Pakistan Air Force, the JF-17M features a different UHF/VHF antenna beneath the nose and LED landing lights on the front undercarriage. Block 2 aircraft possess in-flight refueling capabilities as well as improved avionics and electronics systems. Earlier, the twin-seat JF-17B variant made its first flight from Chengdu on 27 April 2017, CAC claiming that the twin-seater retains the combat capabilities of the single-seater. Despite additional space in the fuselage for the stretched cockpit, endurance remains largely unchanged owing to the installation of a fuel tank in a dorsal spine.

## First Japanese-built F-35A

The first Japanese-assembled F-35A has been unveiled at the Mitsubishi Heavy Industries (MHI) Komaki South F-35 Final Assembly and Check Out (FACO) facility, operated by MHI with technical assistance from Lockheed Martin and oversight from the US Government. The first four of 42 JASDF F-35As on order have earlier been delivered from the Fort Worth, Texas, production facility.



## Maiden flight of Gripen E



On 15 June, the first Gripen E next generation, multi-role fighter made its maiden flight from Saab’s airfield in Linköping, Sweden and flew over eastern parts of Östergötland for 40 minutes, with the aircraft carrying out a number of actions to demonstrate various test criteria including retracting and extending of the landing gear. “Today we have flown this world-class fighter aircraft for the first time. We achieved it with the fully qualified software for the revolutionary avionics system. This is about giving our customers a smart fighter system with the future designed-in from the start. The flight test activities will continue to build on this achievement with the programme on track to achieve the 2019 delivery schedule to our Swedish and Brazilian customers,” stated Jonas Hjelm, Senior Vice President and Head of Saab Business Area Aeronautics.

## UK reconsidering F-35B numbers



According to reports, the UK government is considering a reduction in numbers of the VTOL version of the F-35 for the Royal Navy’s future aircraft carriers, but accepting more land-based variants. The Ministry of Defence has committed to buying 138 F-35Bs, which operate from aircraft carriers, but there reportedly has been a recent review to consider taking fewer F-35Bs and instead freeing funds for conventional F-35As. These moves would reduce the number of F-35Bs to 48-60 and switch the rest for acquisition of F-35As.

A Royal Navy source said the RAF had “no interest in tying up its future with two new aircraft carriers due to become operational in the next few years, and wanted to ensure that some F-35 squadrons

could operate from land air bases”. An RAF source dismissed this, saying that a “blend” of the two aircraft made more sense because the F-35A was cheaper than the F-35B, had a longer range and could carry more weapons because it did not have to carry extra fuel and engine power for short takeoffs and vertical landings on an aircraft carrier. However, there is still some uncertainty on the affordability of 138 aircraft of either variant. The British MoD has not cleared a timeline for the order, merely committing to acquiring the first 48 by 2026.

### Production of the Tu-160 M2

According to Russian sources, series production of the improved Tu-160M2 strategic bomber for the Russian Aerospace Forces (VKS) will begin in 2020. Two or three Tu-160M2s will



be produced annually by the Gorbunov Aircraft Plant in Kazan under a contract signed by the United Aircraft Corporation and the Russian Defence Ministry, with first flight of the bomber expected next year. Deputy Defence Minister Yuri Borisov had said the VKS had a requirement for 50 Tu-160M2s.

The Tu-160M2 incorporates the same basic airframe as the existing Tu-160 Blackjack, but includes new avionics, electronics, cockpit, communications and control systems, as well as new weapon systems. Advanced engines of increased thrust are also to be incorporated.

### Boeing F-15s for Saudi – and Qatar

Another batch of Boeing F-15A Advanced Eagles has been delivered to the Royal Saudi Air Force, deliveries beginning in December 2016, which curiously co-incided with Qatar Minister



of State for Defence Affairs, Dr Khalid Mohammed Al Attiyah visiting Seymour Johnson Air Force Base, North Carolina to gain insight on the US Air Force’s F-15Es. Qatar is now poised to buy “over 30” F-15QA aircraft, the US State Department having approved a possible Foreign Military Sale (FMS) to the Qatar Emiri Air Force (QEAF) for up to 72 F-15QA aircraft at an estimated cost of \$21.1bn. This would include weapons and related support, equipment and training. However, sources have suggested the numbers are actually for 36 aircraft and will include the provision of continental United States-based lead-in-fighter-training.

### US arms worth \$1.42 bn for Taiwan

The United States plans to sell Taiwan \$1.42 billion in arms, the first such sale under the administration of Donald Trump and a move sure to antagonise China, whose assistance has been sought “to rein in North Korea”. The State Department said the package included technical support for early warning radar, high speed anti-radiation missiles, torpedoes and missile components, so supporting Taiwan’s ability to maintain a sufficient self-defence capability.

A State Department official said the latest package primarily represented “upgrades to existing defence capabilities aimed at converting current legacy systems from analog to digital.” In a strong sign of congressional support, the Republican chairman of the House Foreign Affairs Committee welcomed what he called the “long-overdue” arms sale. “Sales of defensive weapons, based on Taiwan’s needs, are a key provision of our commitments as laid out by the Taiwan Relations Act and the Six Assurances,” said Rep. Ed Royce, referring to legislation and informal guidelines that steer US relations with Taiwan.

### Bulgaria opts for the Gripen



The Bulgarian Government has confirmed that the Saab JAS 39C Gripen is “the country’s new combat aircraft”. Bulgaria had issued a request for proposals (RFP) for eight multi-role fighters to be delivered by 2020. A selection board conducted detailed reviews of three submitted offers which comprised used F-16MLUs supplied by the United States and Portugal, with a full logistic and weapons

package supplied by the US; new Saab JAS 39C Gripens; and used Tranche 1 Eurofighter Typhoons supplied by Italy, all through government-to-government agreements.

Bulgaria's Defence Minister Stephan Yanev has said that the Swedish proposal for the JAS 39C Gripen has been ranked in the first place followed by the combined US-Portuguese F-16 proposal with the Italian Eurofighter in third place. Furthermore, the Swedish proposal provides for rapid deliveries to be completed within 18 months, and supported by a deferred payment scheme.

## Croatian interest in Gripen

According to reports from Croatia, official presentations of the Gripen have been made to the *Hrvatsko Ratno Zrakoplovstvo i Protuzračna Obrana* (HRZ I PZO, Croatian Air Force) and to various high-ranking Croatian officials, including the defence minister and president. Demonstrated at Zagreb was a JAS 39C from the Hungarian Air Force's 59<sup>th</sup> Tactical Fighter Wing, which is home base of the single fighter unit of the HRZ I PZO, the *Eskadrila Borbenih Aviona* (EBA, Combat Aircraft Squadron), operating 12 modernised MiG-21s. The Croatian Ministry of Defence began a selection process to replace its ageing MiG-21s in mid-2015, when requests for information were sent to various manufacturers. Reportedly, the most serious contenders are the Gripen, offered by the Saab Group and the F-16, the latter offered by Israel in the form of its recently retired F-16A/B Netz aircraft. A month before the Gripen presentation, an HRZ I PZO team went to Israel to inspect the aircraft being offered and also visited Romania, a NATO nation that is currently switching from MiG-21s to F-16s. After the presentation, the HRZ I PZO planned to make official visits to the Czech Republic and Hungary, both former MiG-21 users which now operate the Gripen.

## Swiss re-start fighter evaluation

The Swiss Ministry of Defence has outlined four options as it restarts its plans to select a new fighter. According to reports, four options have been identified, the most ambitious being the purchase of 55-70 fighters as part of an integrated air defence system. Two 'mid-range' options envisage buying 30 fighters and a complete ground-based air defence system, or 40 fighters and a more modest air defence system. The lowest-cost option would be to acquire 20 fighters and the more modest air defence system. As is recollected, the Swiss had earlier selected Saab's Gripen to meet its requirement for replacement of its F-5s but the programme was shelved after a national referendum on various issues.

## Finland's new fighter weaponry

The Finnish Defence Forces' Logistics Command has issued a Request for Information (RFI) relating to weapons and other equipment as part of its HX project to replace the country's present F/A-18C/D Hornet fleet. The preliminary RFI sent to governments in France, Germany, Israel, Sweden, the United Kingdom and the

United States aims to identify suitable weapons and other external equipment for the new multi-role fighter. According to the Finnish Defence Ministry, "The goal of the RFI is to establish the true weapons and equipment options offered by the candidates for the HX project (F/A-18E/F, Rafale, Typhoon, F-35 and the Gripen)."

## MiG-35 close to first Russian order

RAC MiG is continuing with flight testing of the MiG-35 fighter, and expects the programme to be completed by the end of 2017. Following this, it is expected that the Russian Government will sign an order for the type, possibly for 37 numbers while in the longer term, the MiG-35 is likely to replace Moscow's inventory of 258 MiG-29 fighters. RAC MiG also believes the type has strong export potential, with representatives from 30 countries having attended the type's rollout in February 2017.



## Argentina interest in MiG-29s, L-159s

Russian sources report that Argentina has shown renewed interest in the MiG-29, the type having been formally presented to the government along with terms of a possible contract for 15 aircraft to supplant the obsolescent Mirages and Skyhawks still in service. Meanwhile, Aero Vodochody have offered the L-159 Advanced Light Combat Aircraft (ALCA) to Argentina that would see the *Fabrica Argentina de Aviones* (FAdeA) collaborate in production, with the potential to establish a local assembly line if the order is "large enough". Aero Vodochody recently re-launched production of the L-159 after 13 years and has also introduced an upgraded trainer version, the L-159T1+.

In unrelated news, there are unconfirmed reports that Malaysia is offering some of its MiG-29s being phased-out, in a reciprocal deal for acquiring HAL-built components for the RMAF's Su-30MKM fighters.

## KT-1Ps for Peru

The Peruvian Ministry of Defence has now taken delivery of all 20 KT-1P *Torito* turboprop primary trainers. The final aircraft was one of 16 manufactured by SEMAN Perú, the Maintenance



Service of the FAP, in conjunction with Korea Aerospace Industries (KAI). A \$209m co-production contract for 20 aircraft was signed between Peru and the Republic of Korea in November 2012, and included technology transfer, a parts manufacturing facility and a flight simulator. The first four aircraft were built at KAI facilities in South Korea, while the remaining 16 were co-produced by KAI and SEMAN.

### More P-8s ordered by Australia, UK, USA and New Zealand



Boeing has received a \$42.2bn contract to produce additional P-8A multi-mission maritime aircraft for Australia, the United Kingdom and the United States. The latest deal covers at least 17 P-8 Poseidon aircraft under Lot 8 full-rate production, including four for the Royal Australian Air Force (RAAF), 11 for the US Navy and the first two for the UK's Royal Air Force. The agreement also includes options for 32 additional aircraft, as well as funds for long-lead parts for future orders. After exercising all options, the total contract value will be US\$6.8bn.

In addition, the US Defence Security and Co-operation Agency (DSCA) have announced approval for the potential sale of four P-8A Poseidons to New Zealand, valued at US\$1.46 bn. New Zealand's

Defence Capability Plan (DCP) have recommended retirement of the Royal New Zealand Air Force's P-3K2 Orions in the mid-2020s. Besides the P-8A, the Kawasaki P-1 and the Saab Swordfish are also under consideration.

### Boeing P-8s ordered by Norway



Norway has ordered five Boeing P-8A maritime patrol aircraft (MPA), to be delivered in 2022 and 2023, which will cost around US\$1.47 billion, via the Foreign Military Sales programme. The Poseidons will replace six P-3 Orions and three Falcon 20s currently in use. Norway has decided to renew its MPA capability under its Defence Long-Term Plan, issued in 2016. The US State Department had earlier cleared the sale of five P-8s to Norway at an estimated value of US\$1.75bn.

### Indonesia negotiates for A400M



Airbus Defence and Space are in negotiation with Indonesia for the supply of A400M heavy lift tactical transport aircraft. The negotiations will include terms of potential industrial collaboration and technology transfer for the number of aircraft being procured for the Indonesian Air Force. In late March 2017, PT Pelita Air, as responsible for an Indonesian industrial consortium, signed a letter of intent with Airbus for an "undisclosed number" of A400Ms, previously reported as five aircraft.

## Massive Saudi Arabian orders



During President Trump's state visit to Saudi Arabia in May 2017, the Kingdom and the United States signed a massive \$110 bn arms contract that will include 48 CH-47F Chinooks and additional S-70 helicopters. This was personally signed between President Donald Trump and King Salman bin Abd al-Aziz Al Saud. Saudi Arabia has also revealed its intent to order P-8 maritime patrol aircraft. Also, the Lockheed Martin and Taqnia joint venture will support final assembly and completion of an estimated 150 S-70 Black Hawk utility helicopters for Saudi Arabia.

Meanwhile, Boeing has completed a radar upgrade for the Royal Saudi Air Force's (RSAF's) E-3A Airborne Warning and Control System (AWACS) fleet. The Northrop Grumman Radar System Improvement Programme (RSIP) comprises a new radar computer, a radar control maintenance panel and electrical and mechanical software and hardware.

## First Typhoons for Oman



On 21 June 2017, the Royal Air Force of Oman took delivery of its first Eurofighter Typhoon fighter, part of a batch of 12 scheduled to be delivered to the Sultanate of Oman. This ceremony was held in presence of Air Vice-Marshal Mattar bin Ali bin Mattar Al Obaidani, at Adam Air Base in Oman. The Sultanate of Oman had announced its decision to purchase 12 Eurofighter Typhoons and eight Hawks in December 2012.

## LM Sniper Pods for Kuwait

Lockheed Martin will provide Sniper Advanced Targeting Pods (ATP) to the Kuwait Air Force for its F/A-18C/D Hornet aircraft. The order was added under Lockheed Martin's existing



foreign military sales indefinite delivery/indefinite quantity contract and includes 14 Sniper ATPs, spares, support equipment and integration. Lockheed Martin had first announced efforts to integrate Sniper ATP on the Kuwait Air Force's Typhoon aircraft in 2016. Sniper ATP is also used on Canada's CF-18 and on multinational F-15, F-16, A-10, B-1, B-52 and F-2 aircraft. Additionally, Lockheed Martin is conducting Sniper ATP flight tests on the US Navy's Super Hornet.

## Development of the PAK-DA



Maiden flight of the PAK-DA new-generation strategic bomber (Project 640) for the Russian Air and Space Force (RuASF) is projected for the 2025-26 timeframe, followed by series production in 2029. Developed by Tupolev, the PAK-DA strategic bomber is expected to feature an aerodynamic flying wing layout and supersonic speed. The low-observable bomber will be armed with long-range cruise missiles fitted with either conventional or nuclear warheads.

## Another PAK FA prototype



The latest prototype of Sukhoi's PAK FA fifth-generation fighter project, T-50-9, reportedly made its first flight at Komsomolsk-on-Amur on 24 April. Aircraft '509' differs from its predecessors in having a 'pixelated' camouflage scheme, the aircraft also undergoing trials with new underwing drop tanks.

## Iran's new AJT

Full-scale prototype of Iran's new advanced jet trainer, the Kowsar-88 was unveiled at a ceremony at Teheran's Mehrabad Airport on 15 April. In December 2007, Iranian Aircraft



Manufacturing Industries (IAMI) had been contracted by the Islamic Republic of Iran Air Force (IRIAF) to begin design and development for a new jet trainer. The Kowsar-88 prototype is equipped with Zvezda K-36DM ejection seats, two General Electric J85-GE-13 turbojets and some F-5B components including (locally produced) landing gear and avionics with minor upgrades. In the summer of 2016, an RF-5A was used as a source of parts to manufacture the Kowsar-88 prototype. Delays have reportedly been caused by the lack of finance and unavailability of parts. The first prototype will temporarily be equipped with analogue F-5B instruments before receiving three multifunction displays in each cockpit and a head-up display in the front cockpit. It is also planned to add four underwing hardpoints for carrying air-to-ground weapons.

## Poland seeks MRTTs

The Polish Government are to issue an RFI for multi-role tanker-transport (MRTT) aircraft, capable of delivering strategic air transport, medical evacuation (including intensive care facilities) and aerial refueling. Six companies have reportedly responded to the Armament Inspectorate being Airbus Defence and Space; Boeing Defence, Space & Security; Elbit Systems Electro-Optics Elop; Embraer Defence & Security; Wingstore Zofia Kiebal and a consortium of Wojskowe Zakłady Lotnicze Nr 2 and the Israel Aerospace Industries (IAI) Bedek Aviation Group.

## Turkey orders Super Mushshaks



As earlier reported in *Vayu*, Turkey has formalised a contract with the Pakistan Aeronautical Complex (PAC) for 52 Super Mushshak basic trainers. This order is PAC's biggest single order for Super Mushshaks to date. Last year it received orders for eight and ten aircraft for the Qatar Emiri Air Force and Nigerian Air Force respectively. The *Türk Hava Kuvvetleri* (THK, Turkish Air Force) will use the Super Mushshak to replace basic training aircraft including the Cessna T-41 and SF 260.

## Flypast on Pakistan Day 2017



The armed forces of Pakistan held a Joint Services Parade on 23 March to mark Pakistan Day at Shakarparian Parade Ground in Islamabad, which included 66 aircraft of 17 different types from

all three branches of the armed forces, with 17 formation flights and some solo displays. Qasim Army Aviation Base (AAB) at Dhamial Rawalpindi, home to 101 Army Aviation Group, hosted bulk of the helicopters including assets from the Pakistan Navy. Air Chief Marshal Sohail Aman, the CAS, led the flypast in an F-16 Block 52, while other PAF fighters of different types followed in diamond formations, F-16As and F-16Bs followed by JF-17s, F-7PG Skybolts and F-7Ps. ROSE Mirages represented strike element of the PAF and also marked 50 years of their service. Also participating was a ZDK-03 Karakoram Eagle airborne early warning and control (AEW&C) aircraft flanked by two Saab 2000 Erieyes. Making its debut was an Il-78 tanker flanked by two C-130s.

A pair of P-3Cs represented PN Aviation while unmanned aerial vehicles (UAVs) were shown on flatbed military trucks. Examples included the Burraq, as well as the Scout, Huma and Uqab. The indigenous Ra'ad air-launched cruise missile was also displayed on a flatbed carrier. The second half involved 19 helicopters from the Pakistan Army and PN Aviation. The majority of these were from 101 Army Aviation Group, while a group of AH-1s were from the 404 Army Aviation Group based at Multan. The helicopters were led by three AH-1s, followed by three AS550C3 Fennecs, Bell 412EPS, IAR-330SM Pumas, Mi-17s and PN Aviation Z-9ECs from 222 Squadron.

These were followed by two formations of jet trainers from the PAF Academy, now named after *Air Marshal Asghar Khan*. The first was from the Academy's Aerobatics Team '*The Sherdils*' with four T-37s, followed by nine K-8s. A lone JF-17 performed an aerobatics display, the Thunder being followed by an F-16 from PAF Base Mushaf at Sargodha.

## More Erieyes for Pakistan



The Pakistan Air Force is to receive three new Saab 2000 Erieye airborne early warning and control (AEW&C) aircraft, the first to be delivered in December 2017. These will boost the PAF's AEW&C fleet, which currently comprises three Erieyes serving with No.3 Squadron and four ZDK-03s with No.4 Squadron.

## Kazakhstan orders more C295s



Airbus Defence and Space have announced that Kazakhstan will acquire two more C295 transport aircraft. The contract between Kazakhstan and Airbus covers the final two aircraft included in a memorandum of understanding signed in 2012. The latest deal also includes a spares and support package. Both aircraft will be delivered in the second half of 2017 and will take the Kazakhstan Air Defence Force's fleet of the Type to eight.

## Stellwagen orders C295

Aviation financier and lessor Stellwagen, a 100% subsidiary of Acasta Enterprises Inc., a Canadian public company (AEF), has signed a firm order for 12 Airbus C295 medium transport aircraft, in the first sale to a leasing company achieved by Airbus Defence and Space, which includes options for a further 12 aircraft. These will enable Stellwagen to address civil markets to serve the humanitarian sector, freight operators in austere environments, and government agencies such as search and rescue services. The C295 is a nine tonne capacity, ramp-equipped, medium transport and mission aircraft in-service with 28 operators in 25 countries.

## Fourth Airbus A400M for Malaysia

The Malaysian Defence Minister, Dato' Seri Hishammuddin Tun Hussein, has accepted delivery of the fourth Airbus



A400M military transport aircraft for the Royal Malaysian Air Force (RMAF). Malaysia is the A400M's first export customer outside of the original European launch nations. "With this delivery, the RMAF now has a fleet of four aircraft, and can start to fully benefit from the A400M's unique capabilities. We look forward to seeing the aircraft in operation in the region, and will provide our full support as the RMAF expands its use of the A400M," stated Fernando Alonso.

## Milestone B award for Boeing Chinook Block 2



According to Boeing, "the US Army has awarded Milestone B approval for the Block 2 version of the CH-47F/MH-47G Chinook, making it a formal programme of record, meaning that the Chinook Block 2 has moved from the 'Technology Maturation and Risk Reduction (TD)' phase to 'Engineering and Manufacturing Development' (EMD). Milestone B for Block 2 was approved in April, paving the way for signature of the EMD contract, which will be followed by a Milestone C decision on low-rate initial production in 2021. The US Army is scheduled to receive deliveries of the first aircraft, which incorporate Boeing's Advanced Chinook Rotor Blade (ACRB) as well as improved engines, in 2023.

## Mi-35Ms for Nigeria

The first two Mi-35M attack helicopters ordered by the Nigerian Air Force (NAF) have been delivered to the service and officially inducted during celebrations marking 53<sup>rd</sup> anniversary of the NAF at



Makurdi Air Base on 21 April. The balance 10 are due to be delivered this year. As well as procurement of the Mi-35Ms, the NAF will overhaul its two former Russian Air force Mi-35Ps.

Meanwhile, the US government plans to sell up to 12 Sierra Nevada Corporation A-29 Super Tucano aircraft to Nigeria for use against Boko Haram Islamic extremists. Nigeria has been seeking the purchase of Super Tucanos since 2015, but previous plans were frustrated after reports of the Nigerian Air Force (NAF) allegedly "bombing civilians".

## Iran to build Ka-226s



Following India's earlier decision, Russian Helicopters have now signed a memorandum of understanding (MoU) with Iran's Industrial Development & Renovation Organisation (DRO) for launching licence production of the Ka-226 utility helicopter in Iran. As reported earlier, an Indo-Russian joint venture is to produce Ka-226 utility helicopters to replace Cheetah and Chetak helicopters of the Indian armed forces. Hindustan Aeronautics Limited (HAL), Russian Helicopters and Rosoboronexport will set up the joint venture under a \$1bn deal that was agreed last October. A total of 60 Ka-226T helicopters will be supplied to India in 'flyaway' condition, while 140 more are to be manufactured in India.

## Airbus Helicopters' helicopter assembly in China



Construction is underway for Airbus Helicopters' H135 Final Assembly Line (FAL), the first of its kind in China. The FAL will be located in Qingdao, Shandong Province in eastern China, with construction expected to be completed by 2018. A framework agreement signed in June 2016 calls for 100 H135s to be assembled over the next 10 years, with the first aircraft roll-out from Qingdao planned for mid-2019. The FAL will have a total annual capacity of 18 H135 helicopters, which could be extended for future growth.

### Upgrade of Singapore Apaches



The Republic of Singapore Air Force has embarked on an upgrade programme for its AH-64D Apache fleet. The attack helicopters have been equipped with “new mission systems to enhance the helicopter’s survivability and improve its mission capability.” The upgrade includes integrating the Helicopter Integrated Electronic Warfare System (HIEWS) and SATCOM and the programme is expected to be completed “over the next few years.”

### Panthers for Indonesia

According to Airbus Helicopters, first two of 11 ‘green’ AS565MBe Panthers have been delivered to *PT Dirgantara Indonesia* (PTDI), which will be adapted for maritime missions and



delivered to the Indonesian Navy. PTDI will equip the AS565MBe Panthers with an anti-submarine warfare suite, including dipping sonar and torpedoes. Airbus Helicopters and PTDI also delivered one H215M and two H225M helicopters to the Indonesian Air Force in mid-March, plus two Fennec armed scout helicopters to the Indonesian Army in January. The two H225Ms are the third and fourth of a batch of six units under contract.

Meanwhile, Boeing has begun flight testing of first of the eight AH-64Es ordered by the *Tentara Nasional Indonesia-Angkatan Darat* (TNI-AD-Indonesian Army). The helicopters will be flown by *Skadron Udara Angkatan Darat 13 Serbu* at Achmand Yani Airport, Semarang in Java.

### Egyptian Ka-52s



The first Ka-52 combat helicopter for Egypt has made its first flight and further Ka-52s are at various stages of assembly. Egypt’s Ka-52s features different systems to those in service with the Russian Air Force, including the OES-52 electro-optical targeting system. According to reports, the OES-52 has been developed by Moscow-based NPK SPP using the French Safran STRIX gyro-stabilised targeting turret. Other new systems include two new jamming modules installed at the sides of the lower part of fuselage, being prismatic in shape and bear no resemblance to any known systems.

### British Apaches to be upgraded



Boeing are to upgrade the British Army's Apache attack helicopters to the AH-64E standard. A US Department of Defence statement on 11 May provided details of the \$488m modification to a Foreign Military Sales contract, which covers remanufacture of 38 Apaches, as well as procurement of three Longbow crew trainers and associated spares. Work will be performed in Mesa, Arizona, with estimated completion in May 2024. A total of 50 helicopters will eventually be manufactured. The British Army will be relocating the Attack Helicopter Force from Wattisham Flying Station in Suffolk, to a new base closer to the Salisbury Plain training area. Among possible bases in southwest of the country are Middle Wallop, Hampshire, Royal Naval Air Station Yeovilton, Somerset, or Boscombe Down, Wiltshire.

Meanwhile, the Apache Conversion Unit (653 Squadron/3 Regiment Army Air Corps), based at RAF Wattisham in Suffolk took part in Exercise *Lightning Force*, designed to give personnel converting to the Apache experience in operational flying over challenging terrain and in a contested air environment.

## CH-47Ds for Greece

The US State Department has approved sale of CH-47D helicopters to Greece with the Defence Security Co-operation Agency notifying Congress of the proposed package. The sale includes five CH-47Ds, seven Common Missile Warning Systems (CMWS) and 12 T55-GA-714A engines. Also included are mission equipment, communications and navigation equipment, ground support equipment, special tools and test equipment, spares and publications.

Meanwhile, the Pentagon has announced a contract to supply the Royal Netherlands Air Force (RNLAf) with another 15 CH-47F helicopters to be supplied as both 'cargo renew' and new-build helicopters as part of a \$541m modification to an existing Foreign Military Sales contract.

## Black Hawks for Afghanistan

The United States will deliver up to 159 refurbished UH-60A Black Hawks to Afghanistan to replace the present inventory of Mi-17 transport helicopters even as the country aims to double the size of its 17,000-strong Special Forces Wing. The US is providing \$814m to bolster the Afghan Air Force, including funding for 53 Black Hawks. A first delivery is expected within two years and the helicopters could be delivered at a rate of up to 30 annually.



## Airbus Helicopters reveal 'Racer'



Airbus Helicopters has unveiled the aerodynamic configuration of the high speed demonstrator it is developing as part of the Clean Sky 2 European research programme. Called the *Racer*, for 'Rapid And Cost-Effective Rotorcraft', this demonstrator will incorporate a host of innovative features and will be optimised for a cruise speed of more than 400 km/h, achieving the best trade-off between speed, cost-efficiency, sustainability and mission performance. Final assembly of the demonstrator is expected to start in 2019, with its first flight the next year.

## Airbus in Automatic Air-to-Air Refuelling contacts



Airbus Defence and Space have demonstrated automatic air-to-air refuelling (AAR) contacts with a fighter aircraft from a tanker's refuelling boom the first time that this has been done. The Airbus' A310 MRTT development aircraft performed six automatic contacts with a F-16 of the Portuguese Air Force in a demonstration of a technique which the company believes holds great promise for enhancing in-service AAR operations.

## UAE Global 6000 for special missions

Two Bombardier BD700-1A10 Global 6000 business jets are being extensively modified as special mission aircraft for the United Arab Emirates Air Force and Air Defence by Marshall Aerospace and Defence Group in the UK. Work on modifying



the two aircraft for electronic intelligence and signals intelligence roles has reportedly been ongoing at Cambridge since their arrival there in April 2017.

### Korean A330 MRTTs

The first of four Airbus Defence and Space A330-200 for the Republic of Korea Air Force (RoKAF) to be converted to Multi-Role Tanker Transport (MRTT) standard, arrived at Getafe from Toulouse in mid-May. Deliveries of all four aircraft to RoKAF are expected to be completed by 2019.

### Airbus completes 1,500th target drone

Airbus has completed the 1,500th target drone (Do-DT direct target) at its Friedrichshafen site in southern Germany, which will soon enter service with the German Armed Forces. Since 2002, around 40 employees from the Target Systems and Services department have manufactured and operated target drones for training and the evaluation of weapon systems and related units.

### 20 737 MAX 9s for Primera Air

Boeing and Primera Air have announced an order for eight 737 MAX 9 aircraft, plus purchase rights for four additional 737 MAX 9s and a lease agreement for eight more aircraft from the Air Lease Corporation. The 737 MAX 9 will form backbone of the low-cost airline's future as it seeks to commence flights between Europe and North America. Primera Air plans to use the MAX 9's auxiliary fuel tanks to lower trip costs and maximise the range for connecting Europe to the east coast of USA.



### China Southern order A350s



China South Airlines have ordered 20 Airbus A350-900s in a deal valued at some US\$6 billion. China Southern is one of the largest operators of Airbus, currently operating over 300 of its aircraft, having also announced an ambitious plan to expand its fleet to 1,000 aircraft by 2020, up from the current level of 700. Other Asian operators include South Korea's Asiana Airlines, which is the latest A350 operator. It's first A350-900 is in a 311-seat three-class configuration, one of 30 A350s the airline ordered in 2008. A further three A350-900s will be delivered to Asiana this year.

### Iran Air orders ATR 72s



Iran Air has ordered 20 ATR 72-600 twin-turboprop airliners with another 20 on option. The ATR 72-600s will upgrade Iran's air transport capability, which was impacted by many years of international sanctions. Four ATR 72-600s, already built, were painted in Iran Air livery in 2016, followed by the other three. The sales agreement had called for the delivery of these aircraft within three weeks of the order. A further nine will be delivered by the end of 2017 and the remainder in 2018.

### China, Russia in wide-body airliner programme

On 22 May, China and Russia launched an ambitious project to jointly develop a wide-bodied airliner "to challenge Boeing and Airbus", some weeks after successful test flight of the C919.

Chinese manufacturer Commercial Aircraft Corporation of China (COMAC) and Russia's United Aircraft Corporation (UAC) have formally established this previously announced joint venture in Shanghai.

Plans for new airliner (C929) were first unveiled last June when visiting Russian President Vladimir Putin met China's Xi Jinping in Beijing, while Chinese state media have previously quoted officials saying the project could be worth between \$13 billion and \$20 billion. "The establishment of the joint-venture company symbolises the important progress made in the China-Russia long-range wide-body passenger aircraft project," COMAC chairman Jin Zhuanglong stated.

## Philippine Airlines orders Q400



Philippine Airlines (PAL) signed an agreement with Bombardier at the Paris Air Show converting the earlier seven options into firm orders. Configured in a new dual class 86-passenger, the purchase "which validates Bombardier's faith in demand for turboprops with capacities of up to 90 passengers". Jaime Bautista, president and COO of PAL, stated that the new Q400s will enable the carrier to set a new standard in flying turboprops in the Philippines.

The Q400s will be outfitted in dual class, economy and premium economy configurations. The first of the now-firm orders, intended to replace aging Q400s in its current fleet, will be delivered in July, with one per month following through to November, Deliveries of the converted option orders commence next March and will total five in 2018, with the remaining two coming in the latter part of 2019.

## Delta orders 30 additional A321s



Delta Air Lines has placed an incremental order for 30 A321neo aircraft following three previous Delta orders for the *Current Engine Option* version of this largest Airbus A320 Family member. The airline took delivery of its first A321 in March 2016. Delta now has ordered a total of 112 A321s, each powered by CFM56 engines from CFM International. All of Delta's A321s will feature fuel-saving Sharklets, which are lightweight composite wingtip devices that offer up to 4 percent fuel-burn savings, this environmental benefit giving airlines the option of extending their range up to 100 nautical miles/185 kilometres or increasing payload capacity by some 1000 pounds/450 kilograms.

## Cebu Pacific orders more A321s

Cebu Pacific of the Philippines has placed another order with Airbus for seven A321neo "to meet ongoing strong growth on its domestic and regional network." The latest contract is in addition



to an existing order for 32 A321neo. The aircraft will start joining the carrier's fleet in 2018. Manila-based Cebu Pacific is one of Asia's leading low cost carriers, operating domestic, regional and long haul services, the carrier flying to over 60 destinations in Asia, Australia, the Middle East and the USA. The carrier's in-service Airbus fleet currently comprises 36 A320s and four A319s flying on domestic and regional services, plus eight widebody A330-300s operating on high capacity regional and long haul routes.

## Airbus Helicopters' 700th H130



On 16 May 2017, Airbus Helicopters rolled out the 700th H130 light single-engine helicopter, which will be operated by a private customer. The H130 fleet has so far accumulated more than 1.8 million flight hours with 340 operators worldwide. Since entry into service of the first EC130 in 2001, this light single engine helicopter has continued to evolve in response to customers' expectations, with the latest H130 variant being certified in 2012.

### Airbus Corporate Jets launches ACJ330neo



Airbus Corporate Jets has launched a private jet version of its new A330neo, which combines new-generation engines and aerodynamic and other improvements to deliver “even more comfort, efficiency and true non-stop to the world” range. The ACJ330neo will fly 25 passengers 9,400 nm/17,400 km or 20 hours, for non-stop air services from Europe to Australia.

### Fishtail Air's H125s of Nepal



Airbus Helicopters have signed its first HCare Smart contract in Nepal under which two H125 helicopters operated by Fishtail Air will be covered by Airbus' HCare programme for a period of five years, covering both scheduled and un-scheduled events providing all necessary support to the operator to carry out its operations safely, efficiently and cost-effectively.

### 89 ATR aircraft ordered in 2017

ATR has received commitments for the purchase of 89 aircraft and options for 20 additional ones since the beginning of 2017. At the Paris Airshow, ATR announced new deals for both ATR 42-600s and ATR 72-600s “to develop new markets, in China and Africa in particular”. Earlier this year, ATR signed a deal for 50 ATR 72-600s with the Indian carrier IndiGo, along with orders for 20 ATR 72-600s and 20 options with Iran's national flag carrier, Iran Air.

### A350-1000 'Early Long Flight'



On 12 May 2017, the A350-1000 completed its unique 'Early Long Flight' with 310 passengers on board, including 10 Airbus Flight Test crew members and 13 Virgin Atlantic cabin crew. Test aircraft MSN065 took off from and landed in Toulouse after a 12-hour flight. Although not part of the technical certification programme, the Early Long Flight allows Airbus to assess cabin environment and systems in-flight and optimise cabin procedures to ensure full maturity at Entry Into Service for its customers.

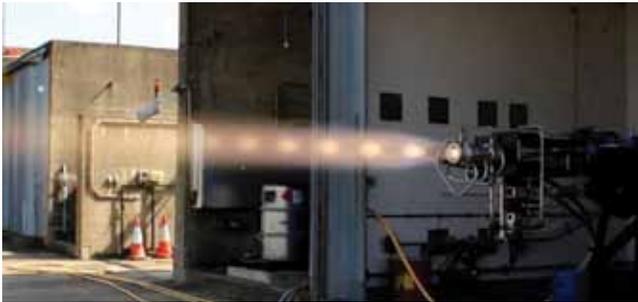
### Sino-Russian agreement on AHL

An agreement between China and Russia on development of a new heavy helicopter is “virtually confirmed”. In May 2015, the Aviation Industry Corporation of China (AVIC) and the Russian Helicopters Corporation signed a framework co-



operation agreement on common development of a new-generation Advanced Heavy-Lift (AHL) helicopter, to be powered by two engines with a maximum take-off weight of 38,200kg (84,216lb) including a 10,000 kg (22,046lb) payload carried inside the cabin or 15,000kg (33,069lb) slung externally. Design requirements include a maximum speed of 163 kts (300km/h) and a service ceiling of 18,700 ft (5,700m) and a range of 340nm (630km). Russia is expected to complete the preliminary design and develop critical systems including rotors and transmissions, China, in turn, will undertake detailed design, testing, certification and series production of the helicopter. The Ukrainian company Ivchenko Progress is proposing development of the AI-8000V engine rated at 7,600hp (5,590kW) for the AHL helicopter.

## Nammo acquires Moog's European In-Space Propulsion



Nammo will acquire Moog Inc's In-Space Propulsion businesses in UK and Ireland. Nammo's CEO Morten Brandtzæg stated that "The deal will strengthen Nammo's position as one of the world's leading providers of compact thrusters and rocket engines for space launchers and satellites. Space is an area where we see a lot of potential for Nammo's products and technologies. Our experience from the defence market means we are very good at making small, powerful and reliable rockets and propulsion systems for use in extreme conditions. When we combine this experience with our existing capabilities in space, and the skills and technologies we have acquired today, I believe we are well on our way to becoming one of the key players within this particular market segment."

## Textron Systems tests its Fury



## Nammo establishes US distribution centre

In addition to being one of the leading providers of military ammunition and rocket engines, Nammo also provides some of the world's most respected and popular brands of ammunition and powders for hunters and sports shooters, including Lapua, Vihtavuori, Sk and Berger. Nammo will be establishing a distribution centre in Pettis County, Missouri, to strengthen its market presence in the United States. Known as Capstone Precision Group, the centre will act as the central distribution hub for retailers of premium civilian ammunition for all four brands. "Nammo is excited about the creation of the Capstone Precision Group logistic centre in Missouri. This move to Missouri is a well thought through strategy where all the benefits for all counterparts are optimised. The local authorities have been very easy to work with to help develop this project. We look forward to years of growth through this facility" stated Raimo Helasmäki, Nammo's Executive Vice President of Commercial Ammunition.

Textron Systems Weapon & Sensor Systems, a business of Textron Inc has tested the Fury lightweight precision guided glide munition against moving targets at Yuma Proving Grounds in Arizona, marking completion of the Fury weapon's development. The Weapon & Sensor Systems team conducted 13 test flights for the Fury weapon, which has accumulated a total of 23.8 flight hours between captive carriage, survey flights and 10 weapon releases from unmanned aircraft systems (UAS). Two tests were conducted from Textron Systems' own Shadow Tactical UAS at an altitude of 8,000 feet and a 1.5 kilometre standoff against a moving target. Both munitions successfully impacted the target.

## GE9X certification testing

Trials of the first full engine to test (FETT) GE9X engine commenced in March 2016 at Ohio, generating critical data on the full engine system and aerodynamic performance, mechanical verification, and aero thermal system validation. Testing of the



FETT engine concluded earlier this year with a series of preliminary natural-icing tests at PTO, where the GE9X ran more than 50 test points, accumulating 168 hours and 162 cycles for certification testing. The GE9X will power Boeing's new 777X aircraft.

## Modernised TACMS missile

Lockheed Martin's modernised Tactical Missile System (TACMS) missile made a long-range mission in its sixth consecutive successful flight at White Sands Missile Range, New Mexico, being launched from a High Mobility Artillery Rocket System (HIMARS) launcher, which was 'hot-conditioned' (the launcher was held in an environmental chamber until just prior to launch to simulate hot launch conditions). It flew approximately 240 kilometres and successfully engaged the target.



## Raytheon radar upgrade



Raytheon Company's newest integrated air and missile defence radar, the gallium nitride-powered Active Electronically Scanned Array proposed upgrade to the Patriot Air and Missile Defence, has surpassed more than 1,000 hours of operation in just over a year, or half the time of a typical testing programme. The Patriot radar prototype uses two key technologies: active electronically scanned array, which changes the manner the radar searches the sky; and gallium nitride circuitry, which uses energy efficiently to amplify the radar's high-power radio frequencies. Raytheon's GaN-based AESA prototype radar routinely demonstrated 360-degree capability by working together with a second GaN-based AESA antenna aimed in a different direction.

## USAF awards JASSM-ER production



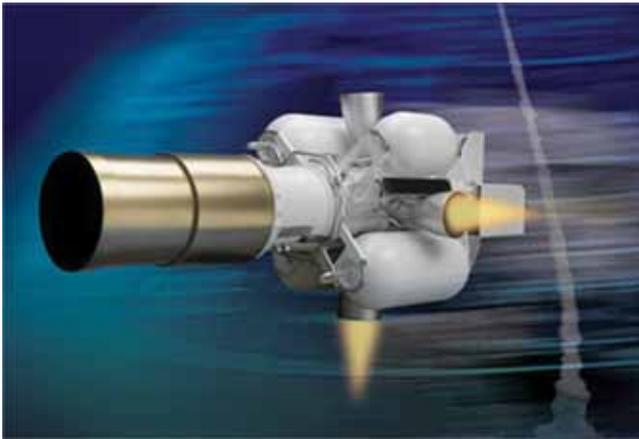
The US Air Force has contracted Lockheed Martin for Lot 15 production of the Joint Air-to-Surface Standoff Missile (JASSM)-Extended Range (ER) version, including 360 JASSM-ER missiles, data, tooling and test equipment. These 360 missiles bring JASSM-ER missiles under contract to 910, and to more than 3,000 missiles for JASSM and JASSM-ER combined. Effective against high-value, well-fortified, fixed and relocatable targets, JASSM is integrated on the US Air Force's B-1B, B-2, B-52, F-16 and F-15E. Additionally, JASSM is carried on F/A-18A/B and the F-18C/D Hornets.

## Pratt & Whitney F135 engine upgradation

Pratt & Whitney has completed performance testing of its Fuel Burn Reduction Demonstrator Engine and the company can now offer a Growth Option 1.0 upgrade configuration for the F135 engine, which powers the fifth generation F-35 Lightning II fighters. The engine testing, conducted at Pratt & Whitney's West Palm Beach, FL, facility, verified this upgrade can provide a 5 to 6 percent fuel burn improvement and a 6 to 10 percent thrust increase across the F-35 flight envelope. While the current production F135 engine meets current performance requirements, an F135 propulsion upgrade would enable future capability improvements associated with the F-35 weapon system's block upgrade programme.

## Raytheon EKV intercept of ICBM

Raytheon upgraded Exoatmospheric Kill Vehicle, or EKV, a kinetic-force weapon that slams into its targets, destroyed an intercontinental ballistic missile for the first time during a Missile Defence Agency test of the Ground-based Midcourse Defence system. It was the tenth intercept for the GMD programme, which is



### APG-83 SABR for F-16 AESA radar

The US Air Force has selected Northrop Grumman Corporation's APG-83 Scalable Agile Beam Radar (SABR) as the active electronically scanned array (AESA) for its F-16 radar upgrade. Northrop Grumman will upgrade 72 US Air National Guard F-16s to meet a US Northern Command Joint Emergent Operational Need for homeland defence, the radar upgrade extending the operational viability and reliability of the F-16 and providing 5th generation fighter radar capabilities to counter and defeat increasingly sophisticated threats.

designed to protect the US against long-range ballistic missile attacks by destroying incoming threats while they are still in space, well outside the Earth's atmosphere. A world leader in kill vehicle design and production, Raytheon is simultaneously managing four kill vehicle programmes: the EKV, Standard Missile-3 kinetic vehicle, Redesigned Kill Vehicle and Multi-Object Kill Vehicle. The Raytheon Kill Vehicle family has now achieved more than 40 successful space intercepts.

### P&W PurePower GTFs for IAG's A320neo Aircraft

International Consolidated Airlines Group SA (IAG) has signed a memorandum of understanding with Pratt & Whitney for the PurePower Geared Turbofan (GTF) engine to power 47 firm Airbus A320neo family aircraft. "The PurePower GTF engine is a game-changing, break-through technology with more than 200,000 hours of passenger service. There are 67 aircraft with 13 operators flying 250 flights per day to over 100 destinations on four continents."

### Leonardo 'BriteEye' defensive aids suite



Leonardo has recently exhibited its latest electronic warfare (EW) survivability product, the 'BriteEye' which combines sensing and countermeasures into a single integrated product, can detect radar-guided "radio frequency" (RF) threats to aircraft and launch appropriate countermeasures. BriteEye uses proven technology from Leonardo's SEER radar warning receiver to detect RF threats and can then automatically cue countermeasures from an integrated countermeasure dispensing system (CMDS) including flares and Leonardo's BriteCloud expendable radar-jamming decoy.

Designed to fit in compact space, BriteEye is suited for light fighters, small intelligence, surveillance and reconnaissance (ISR) aircraft and Remotely-Piloted Air Systems (RPAS).

### Dassault Systèmes and AVIC establish Joint Innovation Centre

Dassault Systèmes and the Aviation Industry Corporation of China (AVIC) have established a Sino-French Industry Joint Innovation Centre that will operate across the complex system lifecycle specific to the aviation industry and its entire industrial chain. The centre will be an important part of the 'Made in China 2025' and 'Industrie du Futur' cooperation framework. The Sino-French Industry Joint Innovation Centre will be located in the China Aviation Industry Science and Technology Park of Zhongguancun, Beijing.

### Saab's self-protection systems for the Caracal

Saab has been contracted by Airbus Helicopters for the IDAS Integrated electronic warfare self-protection systems for the H225M Caracal multirole utility helicopter. Saab's Integrated Defensive Aids Suite (IDAS) "protects the crew by enhancing platform survivability in sophisticated, diverse and dense threat environments, the system providing timely warning against radar, laser and infrared (IR) guided threats and automatically deploys the appropriate countermeasures". The system has proven capability on many airborne platforms such as the Saab 2000, AgustaWestland A109, Super Lynx 300, Boeing CH-47 Chinook, Denel Rooivalk and Oryx, Eurocopter Cougar, Puma and Super Puma, NH Industries NH90, C-130 and L100 Hercules, Sukhoi Su-30MKM. Deliveries are ongoing for the HAL Dhruv Advanced Light Helicopter.

### PLAN's aircraft carrier plans

China launched its new aircraft carrier on 26 April at Dalian, being the yet unnamed Type 001A. Presently, the People's Liberation Army Navy (PLAN) has one carrier in service, which is the *Kuznetsov*-class *Liaoning* (Type 001), essentially for training of naval aviation operations. The similar Type 001A, that was unveiled to much fanfare, incorporates a number of

improvements, but most importantly is indigenously designed and built. From construction to launch, the Type 001A required just over two years, a notable contrast to the US Navy's new carrier USS *Gerald R Ford*, of which construction began in late 2009 with the vessel only now going to sea. The new Chinese carrier is a much less advanced vessel, but reports suggest the PLAN's next-generation carrier, the Type 002, will be "a far more capable asset, launching its aircraft by catapult rather than a ski-jump".



### Pakistan Navy Sea King refurbishment

Vector Aerospace Corporation, a global independent provider of aviation maintenance, repair and overhaul (MRO) services, has contracted with the Pakistan Navy for the return to service of three Leonardo Helicopters (ex-Westland) Sea Kings at its Fleetlands facility in Gosport, in the UK. Work on the contract is performed by Vector's UK-based Aviation Services team, previously responsible for depth maintenance of the UK Ministry of Defence's Sea King helicopter fleet. A total of seven former UK MoD Sea King aircraft have been acquired by the Pakistan Navy under a separate contract signed last year. The ceremony for formal handover of the aircraft from UK MoD's Disposal Services Authority (DSA) to the Pakistan Navy was held at Fleetlands on 24 May.



# 5 Centuries of Maritime Prowess



## Naval Group (DCNS) as shipbuilder and integrator

The DCNS of today can trace its roots back to 1631, when France's Louis XIII ordered the construction of new naval shipyards. More than just an administrative decision, this move was a radical change in naval shipbuilding. It aimed to bring together under one organisation the best experts and infrastructure that France had to offer in terms of naval architecture, construction, systems integration and maintenance.

Fast forward by nearly five centuries, with a tour of DCNS's unique end-to-end industrial model, which has been exported with success around the world.

Since then and till now, DCNS and its industry partners have designed and constructed a wide range of frontline warships (frigates, corvettes, landing platform deck (LPD), aircraft carriers) and submarines (nuclear and conventional). But not only platforms, a core know-how of DCNS is in the state of the art seamless

integration. Seamless integration is at the heart of today's most advanced warships. Designing these requires the integration of multiple systems to create one floating system capable of executing multiple missions. No individual system can be disconnected from another. This integration of systems makes the modern warship one of the most complex human-made systems extant, far more complex than about any other vehicle. Being also a system designer and builder, DCNS naturally imbibes the capabilities of such integration in complex platforms and make them adapted to any mission for the French Navy or other international navies of the world.

### Tactical ships and submarines

DCNS is one of the few companies in the world to have design competencies in both nuclear and conventional submarines, having delivered 37 submarines, ranging from 2,000 tonnes to 14,000 tonnes, over

the past 50 years. DCNS currently designs, builds and/or maintains *Scorpène 2000*-class submarines for foreign countries such as Malaysia, Brazil and India (building of 6 submarines for the Indian Navy under the P75 project). DCNS is designing and building the new *Barracuda* SSN attack submarine for the French Navy, the first of which will enter service in 2017. It will offer a high SRS (Silent Running Speed) combined with excellent manoeuvrability. Its advanced ability to communicate discreetly is particularly useful during crisis management missions. *Barracuda* can launch a large range of weapons and countermeasures, including fire-and-forget anti-ship and land-attack missiles as well as wire-guided torpedoes. To improve its overall efficiency, *Barracuda* offers higher at-sea availability. Last but not least, DCNS won in 2016 a strategic and sustainable partnership with the Commonwealth of Australia for the Australia's Future

Submarine Programme for 50 years. “DCNS is committed to ensuring that Australia has a regionally superior submarine constructed in 12 units in Adelaide and develops a sovereign naval industry.”

### The Digital Frigate

DCNS latest tactical warship is christened *Belh@rra*, the new 4,000-ton digital frigate proposed to meet needs of the French Navy and meet a growing international demand for first-rate, heavy armed frigates with a displacement of 4,000 tons. These intermediate-size frigates, of which the first unit will be delivered in 2023, are designed to replace the *La Fayette*-class frigates that entered service with the French Navy between 1996 and 2001. They will incorporate many innovations such as a new architecture based upon a data centre, an advanced cyber-defence capability, a modern Command Information centre, a new, extremely powerful radar, etc. *Belh@rra* is a good example of DCNS investments to ensure security of operations and ship’s digitalisation, which are key to maintain competitiveness and retain our customer confidence.

### Future platforms in India

Mazagon Dock Shipbuilders Limited (MDL) is a natural partner for DCNS, having developed a successful cooperation for construction of the modern and advanced *Kalvari*-class submarines. In

## DCNS changes its name to



DCNS is now ‘Naval Group’ and this “new identity is a natural step in the group’s history, aimed at supporting our ambitions to guarantee our exposure and credibility in international markets”. Naval Group CEO Hervé Guillou said: “The creation of a strong, unifying brand, that embodies both our heritage and our expertise will enable us to meet two major objectives: continue to attract and retain the best and brightest talent for our workforce to ensure we have the critical skills required to maintain our clients’ sovereignty, and increase our international reach and win new markets in an extremely competitive landscape”.

India, DCNS is also involved in the project of 4 LPDs for which DCNS has partnered with Pipavav (now Reliance Defence and Engineering Limited RDEL). DCNS has proposed to Pipavav/ RDEL a modified version of the *Mistral* type LHD to meet the Indian Navy’s specific requirements.

In addition, DCNS is in constructive discussion with Indian Navy for future advanced naval platforms like aircraft carriers, latest generation cyber-secured frigates-and more. “The French shipbuilder is available to provide key technologies and design to ensure indigenous building of any advanced tactical ships at Indian

shipyard through transfer of technology.” The indigenous shipbuilding of platforms like an aircraft carrier will enable DCNS to incorporate and work together with Indian design engineers and industrial houses from the early stage of conception and thus enhancing local expertise and indigenous content for future advanced naval platforms.

### Future submarines

AIP being a strong requirement of the Indian Navy and in line with the objective to continuously increase the high indigenous content of the P75 submarines (already achieved,) DCNS have been supportive of



the indigenous DRDO AIP being developed at NMRL. “We indeed are keen to have the DRDO AIP integrated in the P75 submarines sooner or later and are advising NMRL on the safety requirement so that they can adapt their technology and general arrangement of the various subsystems accordingly.”

DCNS, under patronage of the French Navy has developed the latest generation, safest and modern torpedo F-21 for SSN *Barracuda*-class submarines. Integration of such heavy weight torpedo in any submarine is a complex and costly task, but DCNS being an integrator and developer of advanced combat management systems the F-21 torpedo can seamlessly be integrated with the Subtics CMS family of the *Scorpène* submarines. This can of course be done in coordination with sound defence industrial ecosystem in India for the increased indigenous content.

### Stand alone systems

Having delivered eight indigenously-made stealth raft mounted gearboxes for four anti-submarine corvettes (P28 project), built at Garden Reach Shipbuilder and Engineers (GRSE), DCNS wants now to cooperate with Indian companies on new generation DCNS Versatile Gearbox (DVG) for future naval warships and platforms.

DCNS is also proposing advanced simulators for submarine applications

to the Indian Navy. Such simulators are being proposed with high indigenous content and in partnership with Goa Shipyard Limited (GSL) which is not only a key shipbuilder but also centre of excellence for simulators.

“In addition, DCNS (and its subsidiaries like Sirehna) propose to Indian Navy and Indian shipyards advanced tactical systems and equipment like latest generation, PLC-based IPMS, latest generation helicopter landing grids, Dynamic Positioning Systems (DPS) and much more. With support of Indian subsidiary DCNS India and its sound industrial ecosystem powered by qualified MSMEs, DCNS is also in position to offer considerable indigenous content while proposing our systems and equipment, in complete sync with Government of India’s ‘Make in India’ policy.”

### F21 torpedo in final development phase

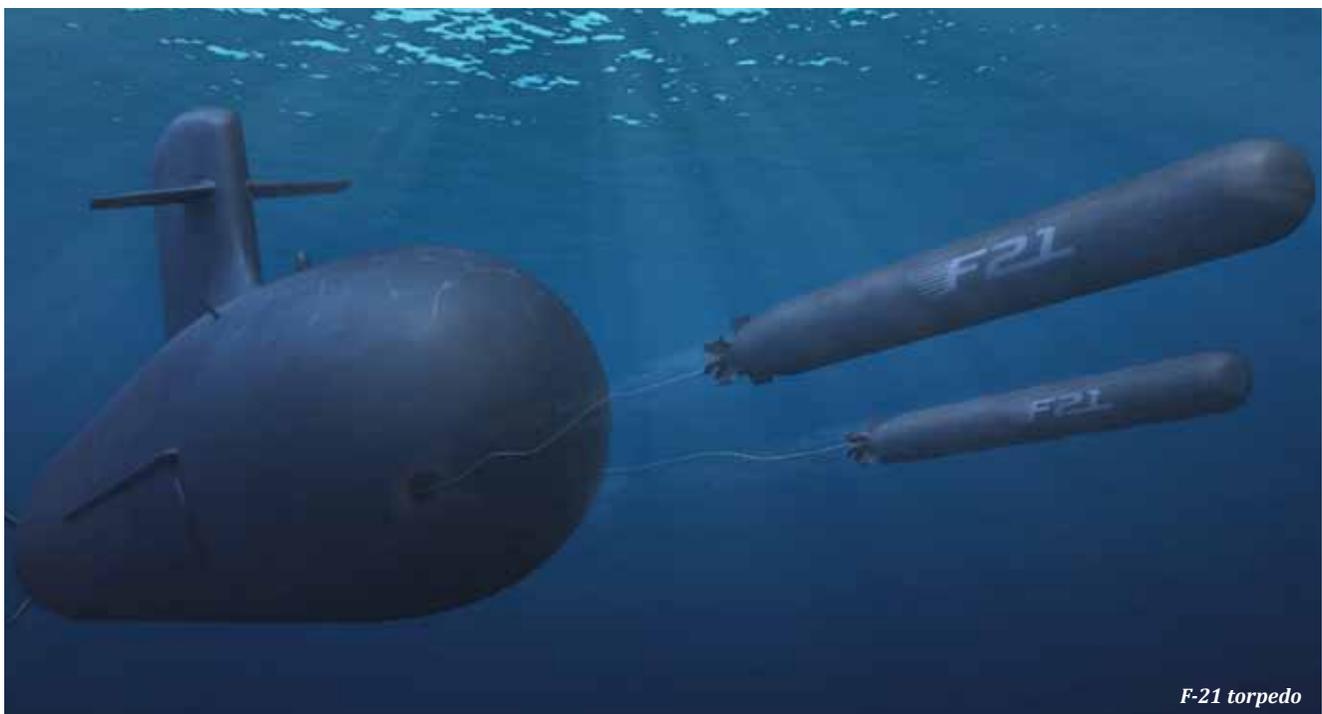
DCNS has performed a qualification firing of the F21 torpedo as part of the Artémis programme led by the DGA (*Direction Générale de l’Armement*). Artémis aims to equip all French Navy nuclear submarines with this heavy weight torpedo, the highest performing one of its generation. This qualification firing was performed under the authority of the DGA in a secured maritime area. It was preceded by about twenty industrial sea trials on prototypes

from DCNS’s test vessel *Pégase* and COMEX’s vessel *JANUS*, as well as from submarines. This qualification firing, which was conducted off the Mediterranean coast, builds in particular on firings since the end of 2016. With the completion of these milestones, the Artémis programme has now entered its final development phase.

The F21 heavyweight torpedo was designed to neutralise enemy vessels and submarines. With a range in excess of 50km and a speed greater than 50 knots, the F21 is foreseen for operation not only in deep waters but above all in coastal areas with high levels of noise and dense shipping. Thanks to its significant computing power that allows for ‘exceptional’ real-time processing capacities, the F21 torpedo benefits from an advanced mission system and extended autonomy. These technical characteristics considerably widen its possibilities for tactical use with an ‘unequaled’ target discrimination capacity, including in very challenging environments.

This will gradually equip all French submarines, starting in 2018. The contract includes the development and delivery of about one hundred F21 torpedoes and their integration into French submarines. The Brazilian Navy has also selected the F21 to equip its submarines.

*Courtesy: DCNS Naval Group*



F-21 torpedo

# “Act with Awareness”



## INIOHOS 2017

The Hellenic Air Force Air Tactics Centre (*Kentro Aeropirikis Taktikis* - KEAT) was formed in the 1980s and is located at Andravida in northwestern part of the Peloponnesian Peninsula. KEAT has been hosting exercise *INIOHOS* at Andravida since 2013. Initially participating aircraft were deployed to 110 Combat Wing in Larisa, but in later years each aircraft operated from its home base. In 2005, *INIOHOS* was transformed into becoming a medium-scale exercise, involving all three branches of the Hellenic Armed Forces. On November 2013, a ‘Single Base Concept’ was adopted for *INIOHOS* and the selected host for the exercise was the 117 Combat Wing at Andravida, home of the Hellenic

Air Force F-4E Phantom fleet. It was also decided that *INIOHOS* would become an ‘invitex,’ meaning other nations could be invited to participate in the exercise.

The 2017 edition marks the third time *INIOHOS* has featured international participation, with the US, Israeli, Italian and United Arab Emirates (UAE) Air Forces in attendance, both Italy and UAE being new participants at the exercise. The UAE contingent comprised the most advanced ‘Block 60’ F-16E/F variant of the Lockheed Martin F-16, while Italy sent the AMX ground attack aircraft.

US Air Force participation consisted of twelve F-16C Fighting Falcons from the 482nd Fighter Wing, Homestead Air

Reserve Base, Florida. “This experience gives us the feel for a red deployment,” said Staff Sgt. Jordan Anthony, 482nd Maintenance Squadron crew chief. “It gives us a chance to improve flexibility with things we may or may not have and the opportunity to work in an environment we’re not used to,” enhancing the interoperability capabilities and skills amongst allied air forces in the accomplishment of joint operations and air defences to maintain joint readiness and reassure our regional allies. “We can deploy to a mission like this, almost like a bare base, and execute effective missions day-in and day-out,” observed Capt. Paul Deveaux, 482nd Maintenance Operations Group maintenance operations officer.



from the AEW&C aircraft is designed to confuse pilots who already have much to contend with when engaging their opponents.

Finally, the 2017 edition of the exercise saw a wide variety of aircraft from various units within the host Air Force participating, with over twenty F-16s, Mirage 2000s and F-4Es deploying from Andravida.

While *INIOHOS* dates back to the late 1980s, when it was established as a small scale air warfare exercise exclusive to the Hellenic Air Force, in 2013 the focus of the exercise changed to a more international character based on experiences from the Tactical Leadership Programme (TLP) and the Red Flag exercises in the USA.

KEAT oversees the Tactical Weapons School (*Scholio Oplon Taktikis*) which normally runs annual ten-week courses for HAF pilots. Decades of such training courses (updated and improved over time) have resulted in accumulation of a vast pool of experience that now provides high quality training during this multi-national invitational exercise. KEAT worked with the Hellenic Army and Navy to design each scenario to include time sensitive targeting (TST) strikes on land and sea. Each target such as a bridge, airfield or on naval vessels has an array of air defences from surface-to-air missile batteries to defending aircraft.

The Hellenic Army used their attack and utility helicopters such as the AH-64D while the Navy had surface vessels with S-70 Seahawk helicopters conducting Exercise *Astrapi* parallel to *INIOHOS*.

The multinational exercise “enhances the interoperability capabilities and skills amongst allied air forces in the accomplishment of joint operations and air defences to maintain joint readiness and reassure regional allies.”

Each day different missions in a different warfare scenario were conducted. On average, some 120 sorties were flown in multiple missions per day through the exercise, encompassing counter air operations, fighter sweep, anti-surface force air operations, Combat Search and Rescue (CSAR), interdiction of air defences and air strikes against high value targets. . “The goal is to develop the exercise to the most demanding and realistic multinational LIVEX in Greece,” according to Lt Col Dimitrios Varsamis.

During the Media Day on 29 March, the Chief of the Hellenic Air Force General Staff, Lieutenant General Christos Vaitis clearly stated that “the goal is for *INIOHOS* to become the largest multinational exercise in the European theatre” — and this is well on the way to becoming reality.

“After it is all done, we can redeploy home with the same effectiveness it took to get us here. “This exercise gives us the chance to strengthen our bonds with other countries like Italy, Israel, Greece, our allies, with a different type of air superiority.”

In addition to twelve F-16Is, Israel provided another aircraft type – the Gulfstream G550 ‘Eitam’ Conformal Airborne Early Warning (CAEW), acting as an ‘eye in the sky.’ The CAEW is fitted with an IAI Elta EL/W-2085 multi-band phased array radar providing 360-degree coverage combined with advanced electronic support measures, electronic intelligence and communications intelligence capabilities. False or ‘spoofing’ information broadcast

## Overview of participants and sorties on 29 March 2017

Country	Unit(s)	Type	Total sorties on 29 March 2017
Greece	Various	Mirage 2000-5, F-16C/D, (R)F-4E, UAV ‘Pegasus’	50
USA	482nd Fighter Wing, 93rd Fighter Squadron	F-16C/D	12
Israel	101 Squadron, 105 Squadron	F-16 I, G550	32
Italy	51 Stormo, 132 Gruppo	AMX	4
United Arab Emirates	Shaheen 2 Squadron	F-16E/F	6
NATO	NAEWF	E-3A	1
			105



*Eitam CAEW coming in to land at Andravida*



*Hellenic Air Force F-4E moments before touchdown*



*A Hellenic Air force Mirage 2000-5 with training missile landing at Andravida*



*The ubiquitous F-16 at INIOHOS ! From top: UAE Block 60, Israeli F-16I, USAF 93rd Fighter Squadron Block 30, and HAF Block 50*

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

# FAMEX 2017



## Down Mexico way !

From 26 to 29 April 2017 the second edition of the *Feria Aeroespacial México* (FAMEX) was held at Base Aérea Militar No. 1 Santa Lucía to the north of Mexico City. With over 550 exhibitors, the event has almost doubled in size compared to the first edition in 2015. The official inauguration of the event was on 26 April 2017, with President Enrique Peña Nieto, President of the Republic of Mexico, confirming importance of the show for the Mexican Government. As Rodolfo Rodríguez Quezada, President of the FAMEX stated: “The goal of the event is to bring together the most important

aerospace companies to promote and support Mexico’s aerospace industry. FAMEX aims to become a business centre for the exchange of technology and services and become a platform to support Mexico’s penetration into the sector.” The Mexican Air Force (FAM) participated majorly in the event to support these goals.

### Static display

The static display consisted mainly of modern types active within the different branches of the Defence Forces: The Air Force, Navy and *Policía Federal*. Besides that, the Air Force museum provided some

static assets while Aero México showed both their oldest as well as their latest aircraft. The only foreign military participant was an A400M from the Spanish Air Force.

Unfortunately, there were no fighter displays at FAMEX 2017, whereas the 2015 edition had included some F-5 formation flying. Contrary to recent reports that the type was withdrawn from service in September 2016, the F-5 still soldiers on in Mexican service. Of eight F-5s with Escuadrón Aéreo 401 at Santa Lucía Air Base, four are still operational while the other four are awaiting refurbished engines from RUAG, the Swiss company. No



FAMEX in large numbers, with more than 25 aircraft performing fly pasts in different configurations. Since 2012, the training capabilities of the Mexican Air Force have been given a boost by the T-6C+ which have gradually replaced the PC-7 in the process.

Despite having modern training aircraft, the FAM still relies on proven types for basic flying training. The syllabus of the Colegio del Aire (Air College) starts with training on the Cessna 182S and even PT-13 and PT-17 Stearmans are being used (6 remain in service). The SIAI-Marchetti F260EU is being replaced by the Grob G120TP-A, of which more than 70 are scheduled to be

delivered. Only two examples were seen during the show, owing to the distance from their home base to Santa Lucía.

A large part of both the static and aerial display was performed by helicopters of the FAM. Main attraction of the show was a large helicopter fly-by and on-site landing of several types in service, including the recently acquired UH-60Ms, MD530MG, Bell 412EP and Mi-17s. The FAM currently has two units operating the UH-60M; Escuadrón Aéreo 108 based at Monterrey and Escuadrón Aéreo 101 at Santa Lucía. Besides these, both the Mexican Navy (*Marina*) and *Policía Federal* use the type, both being present at FAMEX.



*Bell 412 and UH-60 at the Show*

decision has been taken on the replacement of the fighters although Russia has been pushing the MiG-35 as an option. Still, no fighters other than the locally based F-5s were to be found in the static display at FAMEX.

Of the recently delivered T-6C+ aircraft (deliveries started in 2012), many airframes were with hard-point wings, Head-Up Display and integrated glass display, enabling fighter pilot training to a certain extent.

With over 50 T-6C+ delivered to the Mexican Air Force and Navy, it was no surprise that this type was present at



*The Fuerza Aerea Mexicana at present has just a handful of F-5E/Fs*



*The FAM now has only two ex-RAF C-130Ks in service*

Also present were several Mi-17s of Escuadrón Aéreo 303, which has become the backbone of the transport helicopter force. Out of the 24 originally delivered to the FAM, nineteen have been upgraded and another fourteen Mi-171s are currently on order.

An interesting type on the static display was a Bell 407GX of Escuadrón Aéreo 111 carrying a Simplex Aerospace Model 208 Spray System used for “anti-narcotic operations,” the helicopters flown on a daily basis from Forward Operating Bases (FOBs) all over the country.

For the near future, the FAM intends to buy another 46 helicopters for training, liaison and SAR to replace the aging fleet of Bell 206s. The types currently under consideration are the Airbus H125 and the Bell 407GX.

The flying display at FAMEX had participation of some new types in transport

fleet of the Mexican Air Force, with mixed formations of the C295s and C-27. The FAM uses two versions of the C295; the C295M and the updated C295W. The latter was shown during FAMEX in the static display. Of the C-27s delivered to the FAM, one was on the static display. Out of the large fleet of C-130 Hercules aircraft once active (including C-130A, C-130E and C-130K subtypes) only two former RAF C-130K remain operational. The FAM tried to buy two new C-130J-30 airlifters but the Air Force is now looking for another long-range transport aircraft. Airbus sent a new A400M to FAMEX, the aircraft considered as one of the highlights in the static display. At the FAMEX inauguration ceremony, Mexican President Enrique Peña Nieto visited the cabin together with the Spanish ambassador to Mexico, Luis Fernandez-Cid, and head of the logistic support command (MALOG),

Lt Gen Jose Maria Orea Malo.

With the recent (February 2017) retirement of the Boeing 727s, VIP-transport duties are performed by three B737-800s.

The *Coordinacion General de Transportes Aereos Presidenciales* (CGTAP) or Presidential Flight also showed off some of its aircraft on the opening day, when the President and many high-ranking officials were flown in from Mexico City for the inauguration.

The Mexican Air Force obviously took great pains to make FAMEX 2017 a success, and with more exhibitors and visitors, this seems to have worked. Flying displays were mainly conducted by the FAM, with no demonstrations from major aerospace companies which was somewhat surprising; perhaps they will at the next Show in 2019 ?

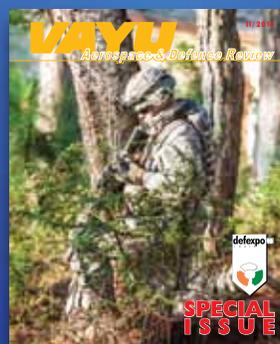
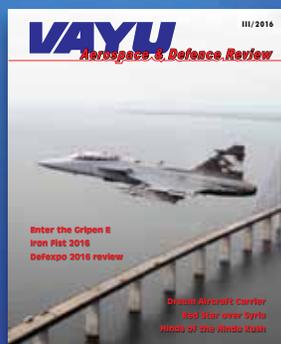
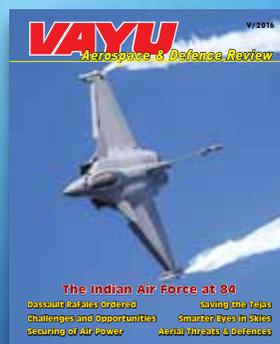
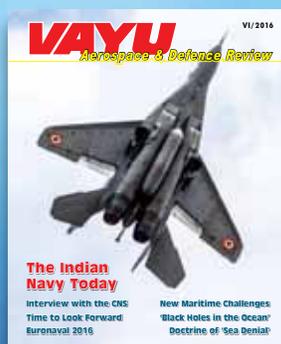
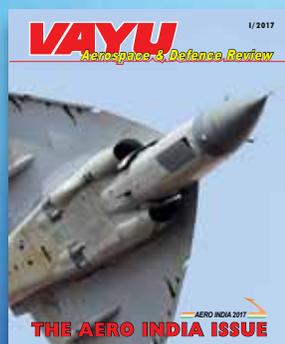
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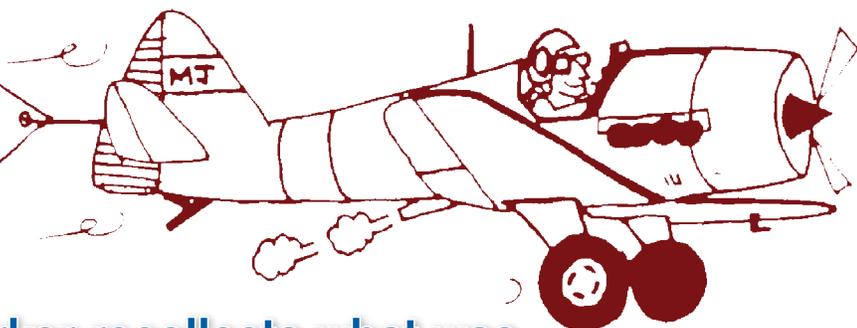


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## Ancient Aviator Anecdotes



Air Vice Marshal Cecil Parker recollects what was

# Lost and Found

The flight cadets of No 58 Pilots Course (1951-1952) did their flying training on the Tiger Moth (Basic) and the Harvard (Advanced) in Ambala and Begumpet. As we neared the end of our 18-month training period around mid-1952, in the solo pilot–navigation phase strict standards (a 40% attrition rate) had reduced our numbers to 30. On 2 May 1952, after the first sortie of the day had landed, one Harvard aircraft was missing and was soon declared ‘overdue’. There was no radio contact with the pilot, Flight Cadet Bhatt. Search aircraft overflew his planned flight path but found no trace of aircraft or pilot. Communication technology was still in its infancy and we were all deeply concerned about our coursemate. After several hours a message was received on the police net to say that a *hawai jahaz* had landed near town of Banswada (110 km away) and, much to our collective relief, the *kaptaan* had walked to a nearby village. Along with another cadet, I was detailed to accompany the rescue party led by our CTO (Chief Technical Officer).

Four hours later, near sunset, we observed a crowd on the side of the road and then spotted a Harvard that had done a ‘wheels-up’ landing in a field. Apart from bent propellers and a scraped under-surface, it appeared relatively undamaged. The local police constable escorted us to a nearby village where we found Saligram Bhatt, draped in a white shawl, seated regally in the *choupal* and treated like royalty! It transpired that a visit from a ‘high-up’ official had been expected, hence our hero’s unorthodox arrival did not come as too much of a surprise! We thanked the *tehsildar* and local inhabitants for looking after him so well and left our IAF police to safeguard the aircraft.

On the night drive back to Begumpet, we learned from Saligram that cloud build-

up along his flight path had obscured his ground vision and, being unable to read his map, he was soon thoroughly lost. He had no radio contact with anyone, had been airborne for over two hours and was running low on fuel. He (wisely) decided to put the aircraft down while he still had engine power. He recced a field, made two trial approaches and then belly-landed without damage to property or persons. After the *tehsildar* gave him the name of the town, he discovered he was well off his planned flight path and was understandably apprehensive of the consequences. In the event, the air force authorities attributed his navigational error, which led to the accident, to inexperience and we were happy that he received his wings and commission with the rest of us a few weeks later. Post-commission he did his twin-engine conversion on Dakotas and was then posted to a multi-engine squadron equipped with Liberator bombers. I would like to imagine that our Saligram was much relieved to find that the crew of the Liberator included a full time navigator!

Unfortunately, Fg Offr Bhatt developed medical problems which became serious enough to cut short his flying career and for him to be medically boarded out of

service. His separation, though a loss to the air force, was a gain for civil aviation and its legal fraternity. Today, Professor Saligram Bhatt is the JNU Professor of Aerospace Law, Visiting Professor at NALSAR (Air University), and a retired Deputy Director General of Civil Aviation, having spent ten years as an ATC Officer in the air traffic control centres in Delhi and Mumbai.

He might have got lost 65 years ago but certainly found his true vocation in life. Way to go Saligram – *shabash!*

(Prof S Bhatt can be reached at [bhattsaligram@yahoo.co.in](mailto:bhattsaligram@yahoo.co.in))



Prof S Bhatt (R) with the author at Secunderabad, April 2017



Harvards such as this served as advanced trainers in the 1950s (photo: Angad Singh)

# 25 Years Back

## From Vayu Aerospace Review Issue IV/1992

### LCA ('Last Chance Aircraft')

Variously labelled as the *Last Chance Aircraft*, the *Low Credibility Aircraft*, or even, *Last Chance for Arunachalam*, as often quipped by Dr Arunachalam himself, the project has still managed to keep going. It will be unfair to prophesy its ultimate fate but one hopes that this time at least the amended design, the new milestones and re-worked cost estimates will hold and that the IAF will finally have an aircraft by 2002-05 for its MiG-21 replacement. In fact, the LCA could even become a 'Eurofighter Light', with export to Western countries a reality should the German offer be taken forward.

### Building confidence with China

Much significance is being attached to the 5-day visit of Indian Defence Minister Sharad Pawar to China in late July 1992, the first ever visit of an Indian Defence Minister to China, which ironically, comes almost thirty years after the brief, but intense, border war between the two countries in the Himalayas. Mr Pawar was accompanied by senior officers from the three services, Lt General BC Joshi, GOC-in-C Southern Command, Air Marshal BD Jayal, AOC-in-C South-Western Air Command, and Vice Admiral KASZ Raju, FOC-in-C Southern Naval Command.

### Indo-Russian arms ties

Despite the brave statements and still cocky attitudes of the recent past, Indian foreign policy spokesmen are finding it hard to keep up their confidence on future Indo-Russian ties especially on sensitive issues such as help on India's space programme, assistance in development of rocket technologies and supplies of new defence hardware. Russia's ambassador to India had recently stated that his country had offered to shift some of their arms production units to India and also consider joint production of aircraft, armoured fighting vehicles and warships. However, Russia is under tremendous pressure from the United States to desist from fanning any armed race in South Asia.

### Surplus MiG-29s for sale

The Russian Government, under pressure from the nation's defence industry, is considering methods by which enterprises would be cleared to market their products and defence hardware independently. As a start, the Supreme Council of the Russian Federation has issued a draft directive that permits the Dementiev Moscow Aircraft Production Enterprise to market the MiG-29, being one of the two production facilities that built this Mikoyan-

developed fighter in factories in the Moscow area. Dementiev has reportedly ceased production of the MiG-29 for the Russian air force but has some 50 undelivered MiG-29s because of drastic cuts in the Russian defence budget. Malaysia and India are mentioned as possible customers for these "surplus" MiG-29s.

### ALH roll out

The first prototype of HAL's Advanced Light Helicopter (ALH) had its formal 'roll-out' ceremony at Bangalore on 29 June 1992, marking a major milestone in the development of India's first helicopter design and development effort. The prototype's first flight is now scheduled for September and HAL is confident in meeting the new timetable.

### INSAT-IIA in orbit

India's indigenously built multi-utility satellite INSAT-11A was launched by an AR 44L Ariane space launch vehicle on 10 July from Kourou, in French Guyana. The Indian Space Research Organisation (ISRO) said that the satellite was 'nudged' to near geo-synchronous orbit when scientists carried out the second apogee firing (AMF-II) on 13 July, commanded by scientists from the Master Control Facility (MCF) at Hassan. The final orbit-trimming manoeuvres and deployment of solar panels, antennae, solar sails, booms and other operations were carried out subsequently.

### Air-India's Boeing 747-400s

Air India has signed a credit agreement for US\$600.039 million with Exim Bank, USA, for financing the acquisition of four Boeing 747-400 passenger-version aircraft. These will be delivered to Air India in August, November and December 1993 and June 1994. The acquisition of these aircraft will enable the national airline to replace a portion of its ageing fleet.

### Indian, French Defence Ministers meet

During his visit to Paris in end-June 1992, Indian Defence Minister Sharad Pawar met with his French counterpart Pierre Joxe on a number of occasions when, reportedly, bilateral cooperation in the area of defence-equipment production was discussed. India is keen that such links be intensified between the two countries providing "a more comprehensive view India's requirements of indigenous production as well as of exports." For France, talks with India on further Mirage 2000 sales are to be a tight-rope walk, with Pakistan also considering the procurement of some 40 such fighters, apart from other weaponry, including helicopters.

# Tale Spin

## Curry versus Chopsuey !



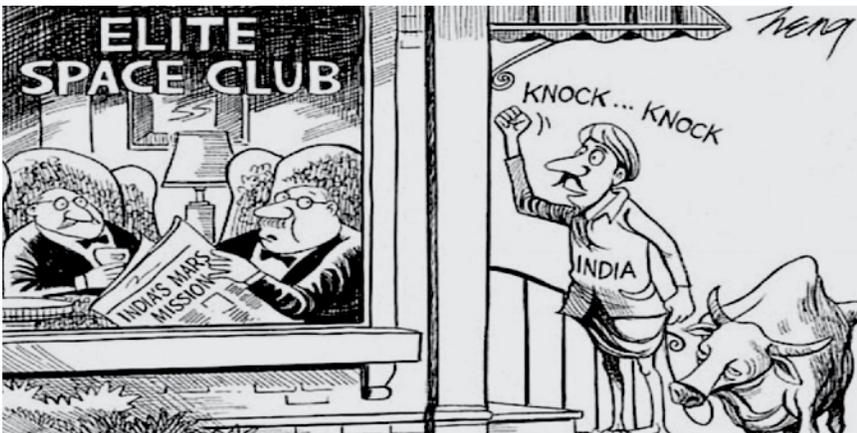
The current standoff between Indian and Chinese forces in a remote tri-junction in Bhutan is hardly to be taken lightly but what is somewhat amusing is that China has issued an advisory for its citizens travelling to India, asking them to take necessary precautions for their personal safety.

However, according to tourism statistics, there are multiple times more visitors from China to India than the other way around although this is being gradually balanced if statistics are to be believed. In any case, more Indians relish Chinese food (even if there are dishes like Manchurian veggies in *Chingjabi*) than otherwise. It is amusing to see Chinese visitors struggling through *Chettinad* food at Indian restaurants.

*Our Secret Weapon ?*

## Apple to the Stars

India's success in space needs no reiteration, what with ISRO launching satellites with aplomb. But how many remember that 35



*Now open that door !*

years ago, when the first Ariane Passenger Payload Experiment (Apple) was launched, the satellite had been transported to the site on a bullock cart, captured for posterity in an unforgettable photograph, with a rash of cartoons that followed ....

## Co-passengers any one ?



In the Hollywood movie *Passengers*, the gorgeous Jennifer Lawrence and Chris Pratt are lone passengers in a space shuttle (see the film for more ....) but nearer home, we have an 8-foot long Indian rock python hitching a ride in an IAF transport aircraft.



*Do we have a choice ?!*

## Vegetarian meals-but choice wines on AI

As if the ban on eating beef in the country was not enough to ruin moods and appetites, in its latest policy, Air India,



hopes to save some Rs 8-10 crore every year by only serving vegetarian fare in their economy class section sectors. Chicken feed! (pardon the pun!). But there is a twist. Not only did 'Bibi' (Israeli PM Benjamin Netanyahu) contemplate turning vegetarian ('like my friend PM Modi') during the latter's State visit to Israel, but we now have it that Air India will re-train its chefs and bring in a Sommelier to help select wines from Italy, Switzerland and France as also offer mocktails instead of orange juice for non-drinkers.

*Happy days are here again !*

## Window seat for me?

On an American Airlines flight from Houston to Seattle, a flier Cory Patterson reported that when approaching Seattle the captain keyed in, 'Ladies and gentlemen if you look to the right you'll see a fantastic view of Mt Ranier.'

"We looked but Mt Ranier was nowhere to be seen, so everyone was confused.

"Then the Captain came on saying, 'I'm sorry folks, I meant to the left.'

"Then he chimed in again saying, 'So the passengers on the right side aren't disappointed, if you look to your left you'll notice the happy faces of the left passengers enjoying the view!'"

*Left or right, window seat is best !*



**Afterburner**



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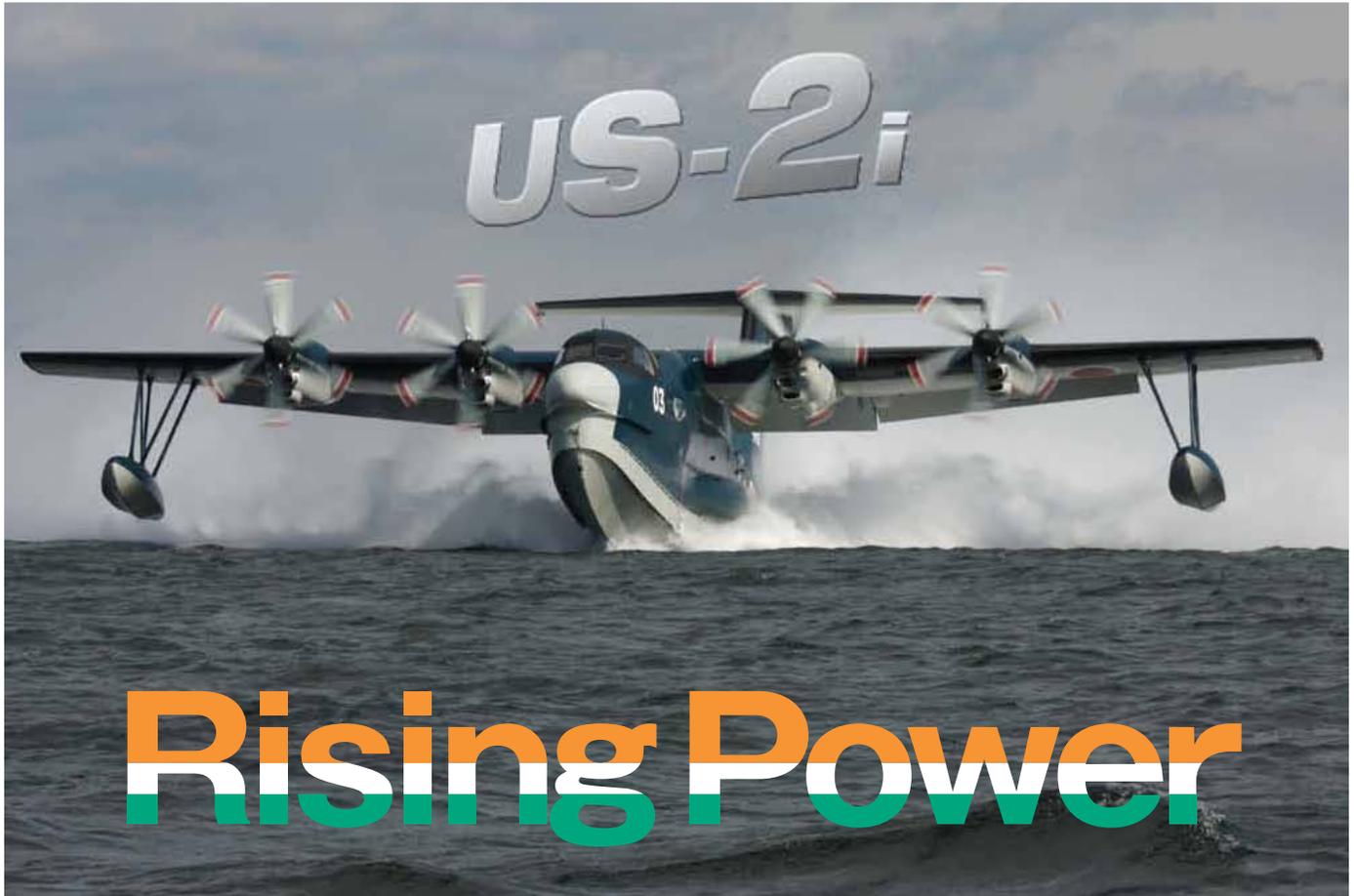


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